ANNEX

Annex -1 Preliminary Data Collection Survey for Expressway Development Final Report September 2013

Annex -2 Leaflet (prepared in the Preliminary Data Collection Survey)

Annex-1

Preliminary Data Collection Survey for Expressway Development In The Kingdom of Cambodia

Final Report

September 2013

Japan International Cooperation Agency

Prepared by:
Shunji Hata (Highway Engineer)
NEXCO Central Japan
And
Tatsyuki Sakurai (Institutional Design Specialist)
Katahira & Engineers International

Table of Contents

APPENDICES

ANNEX

List of Tables

List of Figures

CHAPTER 1 INTRODUCTION

1.1 Background

The national road network of Cambodia was severely deteriorated during the civil war and there were many impassable sections. Many road rehabilitation projects were implemented in 1990s to early 2000s with financial assistance by Japan, USA, Australia, the Asian Development Bank, the World Bank and other development partners. As the result, urgent rehabilitation the existing roads has been completed, and the main focus of road network development is now shifting to strengthening of the functions of existing road network to support the rapid economic growth of Cambodia, as well as to promote the regional cooperation among ASEAN and GMS countries.

The road network of Cambodia needs to be strengthened in three fields:

(1) Widening and improvement of pavement into asphalt concrete to cope with the increase in traffic demand and increase in vehicle weight.

(2) Improvement of local roads in order to disseminate the benefits of improvement of national roads to the local communities.

(3) Construction of expressways which are needed for modern industry /economy.

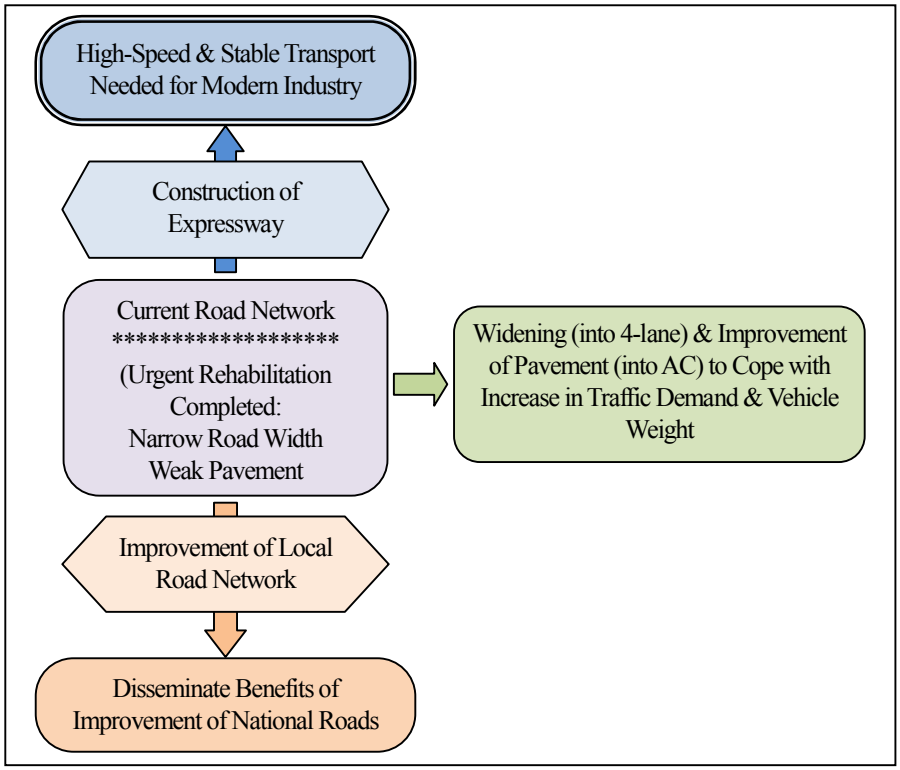


Figure 1.1-1 Three Fields for Strengthening of Road Network of Cambodia

While improvement of the existing national roads, both single-digit and double-digit, are being implemented, it is necessary for Cambodia to start planning of expressway network development.

There may be argument on the third item, construction of expressways. In many developing countries where the network of ordinary roads remain poor, many road policy makers think that it is too early or they cannot afford to construct expressway. However, expressway network is one of the vital infrastructures for the modern industry/economy, and thus, essential for further economic development. Actually, to enable stable periodic parts supply and reliable transportation of products are two of the main keys for such industries as automobile and electric appliances. Delay in construction (opening to traffic) of expressways often causes problems in such logistics and hamper development of modern industries.

Knowing this fact, many Asian countries, including Vietnam and Thailand, have formulated their national expressway network plan and is constructing expressway network. Table 1 summarizes the timing of planning of expressway and opening of the first expressway with regard to GDP per capita in Asian countries.

Table 1.1-1 Timing of Expressway Construction and Economic Level in Asian Countries

Country	Network Plan		Plan of 1st Section		Opening 1st Section	
	Year	GDP/Cpt	Year	GDP/Cpt	Year	GDP/C
Vietnam	2008		2003 (Kunming – Haiphon)	480	2009	1,136
Thailand	1992 (JICA)	1,945			1984 (Urban)	719
Indonesia					1978 (JKT – Bogor)	596 (1981)
Malaysia			1980's	1,818 (1981)		
China					1984 (Part of Shenyang-Dalien)	298
Korea					1968 (Pat of Pusan-Yinchong)	? (1,800 in 1981)
Japan	1967 (National Network Plan)	1,290 ($1.0= Y360)	1956 (Nagoya- Kobe)	300 ($1.0= Y360)	1963 (Amagasaki - Ritto)	760 ($1.0= Y360)

As can be seen in the table above, many Asian countries had started construction of expressway network before economic growth started when GDP/capita was less than US$1,000. In view of the fact that the current GDP/capita of Cambodia is approaching US$ 1,000 and the rapidly developing regional cooperation among GMS and ASEAN countries, it is now the time for Cambodia to formulate its expressway master plan.

1.2 Objective

As explained above, it is appropriate time for Cambodia to start preparation for expressway network development. Formulation of an expressway master plan needs studies on various aspects and substantial time period. It also needs understanding, cooperation and participation of various stakeholders. Therefore, the study on expressway master plan needs diligent preparation, including discussion with the stakeholders.

JICA is ready to implement the full study on expressway master plan if Cambodian government requests. Thus, this Survey was also to study the scope of the Survey for Expressway Master Plan and discuss with the Cambodian side such subjects as the necessity of expressway master plan, the items to be studied in the Master Plan Study, and implementation schedule of expressway network development.

Note: *Although the initial intension of this Survey was to discuss the outline of the further detailed study for preparation of an expressway master plan of Cambodia, the Survey Team was informed that another study for preparing an expressway master plan had already been started with an assistance of Chinese government.*

1.3 Survey Area

The area for the Survey is whole country of the Kingdom of Cambodia. However, main focus was targeted at the areas with high traffic demand, namely the area along National Roads No.1, No. 3 and No.4, No. 5, and No.6. This does not mean little attention was paid to other area.

1.4 Methodology

The method of the Survey is as outlined below:

Two experts with different expertise were employed by JICA; Shunji HATA, Highway Engineer and Mr. Tatsuyuki SAKURAI, Institutional Design Specialist. Both of them have practical experience of planning, design, construction supervision and maintenance of expressway network of Japan as the staff of former Japan Highway Public Corporation and current Central Japan National Expressway Company (NEXCO Central).

The two experts worked in close collaboration with MPWT and Mr. Takshi SHMADA, Transport Policy Advisor, MPWT as well as JICA Cambodia Office.

Main tasks were; (i) collection and review of relevant information / data, (ii) study of possible routes of expressways on map and with site condition survey for limited area, (iv) visit to Vietnam and Thailand to survey the plan and current condition of expressway in these countries, (v) proposal for fundamental aspects of expressway master plan, and (vi) proposal of further study for preparation of expressway master plan. Details of the outcome of these tasks are described in the later chapters.

CHAPTER 2 NATIONAL ROADS IN CAMBODIA

2.1 National Development Plan

In order to ensure the efficiency and sustainability of socio-economic development and reduction of poverty, the Royal Government of Cambodia (RGC) has worked hard to formulate and implement key national policy frameworks, which focus on the governance action plan and the improvement of the quality of people life. The Government has prepared two (2) national development policies consisting of:

- Mid-term Review 2008 on National Strategic Development Plan, 2006 - 2010
- Rectangular Strategy, Phase 2 (RS-II)

The Rectangular Strategy, Phase 2 prepared in September 2008 is as follows:

- The Rectangular Strategy Phase 2 states that "Overriding goal of the Royal Government of Cambodia (RGC) is to firmly and steadily build Cambodian society which enjoys peace, political stability, security social order and sustainable and equitable development, with strict adherence to the principal of liberal multi-party democracy and respect for human rights and dignity; the social fabric will be strengthened to ensure that the Cambodian people are well-educated, culturally advanced, engaged in dignified livelihoods and living in harmony within both the family and society". The RS-II declares that RGC is strongly committed to achieve its prioritized goals ensuring:

(1) Sustainability, peace, politically stability, security and social order to promote rule of law and protect human rights and dignity and multi-party democracy

(2) Sustainable long-term economic growth at a rate of 7% per annum on a broader basis and more competitive capacity in the context of one-digit inflation

(3) Poverty reduction at a rate of over 1% per annum and improvement of main social indicators, especially in education, health and gender equity.

(4) Increased outreach, effectiveness, quality and credibility of public services

2.2 Road Development Objectives, Policies and Strategies

(1) Road Development Objectives

The road sector's strategy is described in "Rehabilitation and Construction of Physical Infrastructure". Transportation network and transport infrastructure are defined as arteries that transform the country into an integrated economy and are vitally critical for distributed economic growth. They play an essential role in contributing to poverty reduction, which is the government's highest target, by facilitating trade, movement of goods and services, by promoting tourism and rural development, and by fostering integration of domestic markets as well as enabling integration with the region and the world. Therefore the plan insists that the objective in this sector is to create a convenient, comprehensive, safe, effective, cost effective transport network to achieve above-mentioned purpose.

(2) Road Development Policies

- The road network plays a role as a prime mover of economic growth' and as arteries linking all parts of Cambodia to be a cohesive economic body and to integrate the Cambodian economy into the region and the world.
- The Government will continue to give high priority to the rehabilitation and reconstruction of road network connecting to all parts of the country and with neighboring countries.
- The Government will continue to accord high priority to the maintenance of national roads and the reconstruction of provincial and rural roads.
- The Government will seek increasing the participation of private sector and road users in road infrastructure development.
- The Government will speed up the adoption of the Law on Roads as well as support legal and regulatory framework for efficient management of transport infrastructure.
- The Government will place emphasis on traffic safety and take strict measures against transport offences including overloaded carriers.

(3) Road Development Strategies

Main items of the road development strategies are as follows:

- Enhancement of multi-growth pole development
- National Integration
- Development of international corridors for Cambodian regional integration
- Enhancement of rural socio-economic development mainly agriculture development for poverty reduction
- Strengthening of economic growth corridor development
- Promotion of tourism development

(4) Objectives and Targets of Each Development Strategy

Strategy 1: Enhancement of Multi-Growth Pole Development

Objectives: To contribute to multi-core national development instead of that of sole initiative by Phnom Penh.

Target: Expansion to 4-lane roads on 1-digit national roads connecting to Phnom Penh, introduction of ring road and bypass construction at major growth poles.

Strategy 2: Promotion of national integration

Objectives: To contribute to a national integrity and administration with remote areas where road access is very limited.

Target: Improvement of roads to turn them into all-weather roads so as to facilitate connection to Phnom Penh even in the rainy season.

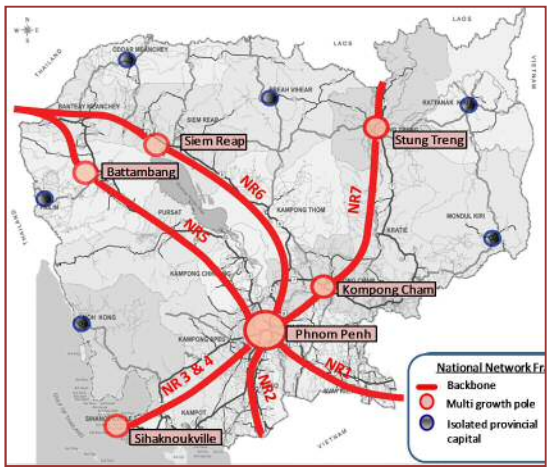


Figure 2.2-1 Strategy: 1 Enhancement of Multi-growth pole Development

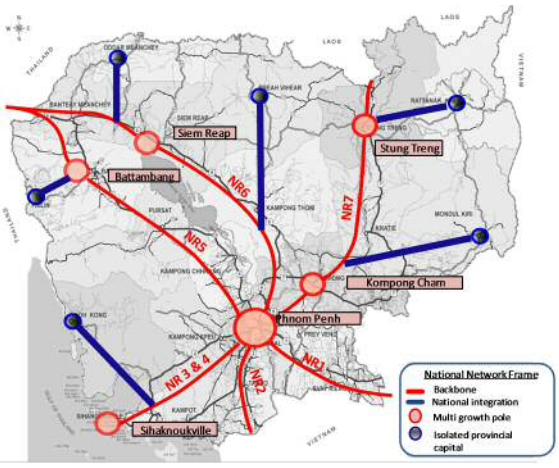


Figure 2.2-2 Strategy: 2 Promotion of National

Source: Follow up Study on the Road Network Development Master Plan, 2009

Strategy 3: Development of International Corridors for Cambodian Integration Development

Objectives: To contribute to an expansion of trade and commodity flows to and from neighboring countries

Target: Functional strengthening of 1-digit roads and improvement of 2-digit roads that have been designated as GMS (Asian) Highways

Strategy 4: Enhancement of Rural Economic Development for Poverty Reduction

Objectives: To contribute to a promotion of rural industries, an expansion of investment, increase in employment opportunities and strengthening national security.

Target: Reinforcement of road access, especially by 2 and 3-digit roads to high potential agriculture, manufacturing and tourism areas

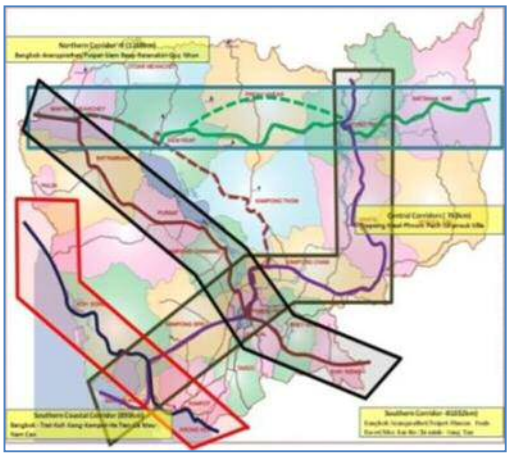


Figure 2.2-3 Strategy: 3 Promotion of International Corridor

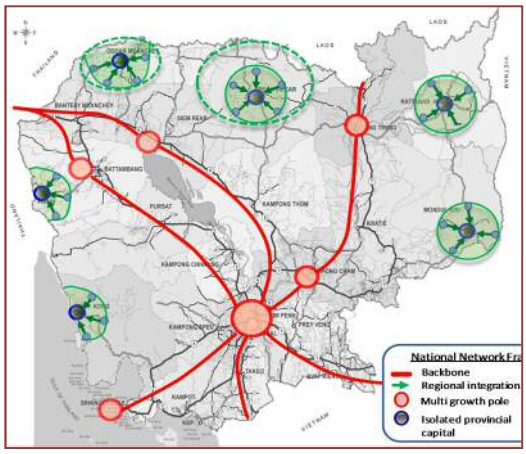


Figure 2.2-4 Strategy: 4 Enhancement of Rural Development for Poverty Reduction

Source: Follow up Study on the Road Network Development Master Plan, 2009

Strategy 5: Strengthening of Economic Growth Corridor Development

Objectives: To contribute to industrial development and to alleviate traffic congestion and conflict

Target: Expansion of 4-lane roads on Phnom Penh - Sihanoukville and construction of 2nd Mekong Bridge in Phnom Penh - Bavet Corridor

Strategy 6: Promotion of Tourism Development

Objectives: To contribute to tourism development, which has many potentials to attract tourists from the world.

Target: Improvement of roads in tourism areas in order to provide comfort and convenient environments to tourists and to create more employment opportunities

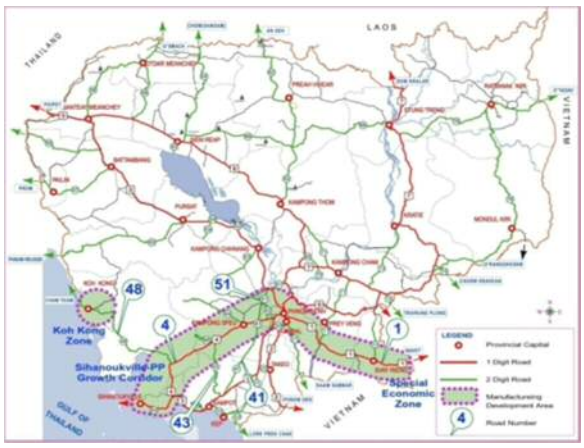


Figure 2.2-5 Strategy: 5 Strengthening of Economic Growth Corridor Development

Figure 2.2-6 Strategy: 6 Promotion of Tourism Development

Source: Road Development Strategy in Cambodia presented by H.E. Ken Borey in 2013

2.3 Progress of Road Improvement and Planning

The Progress of Road Improvement and Planning for the future is summarized in Table 2.3-1.

Table 2.3-1 Progress of Road Improvement and Planning for the future

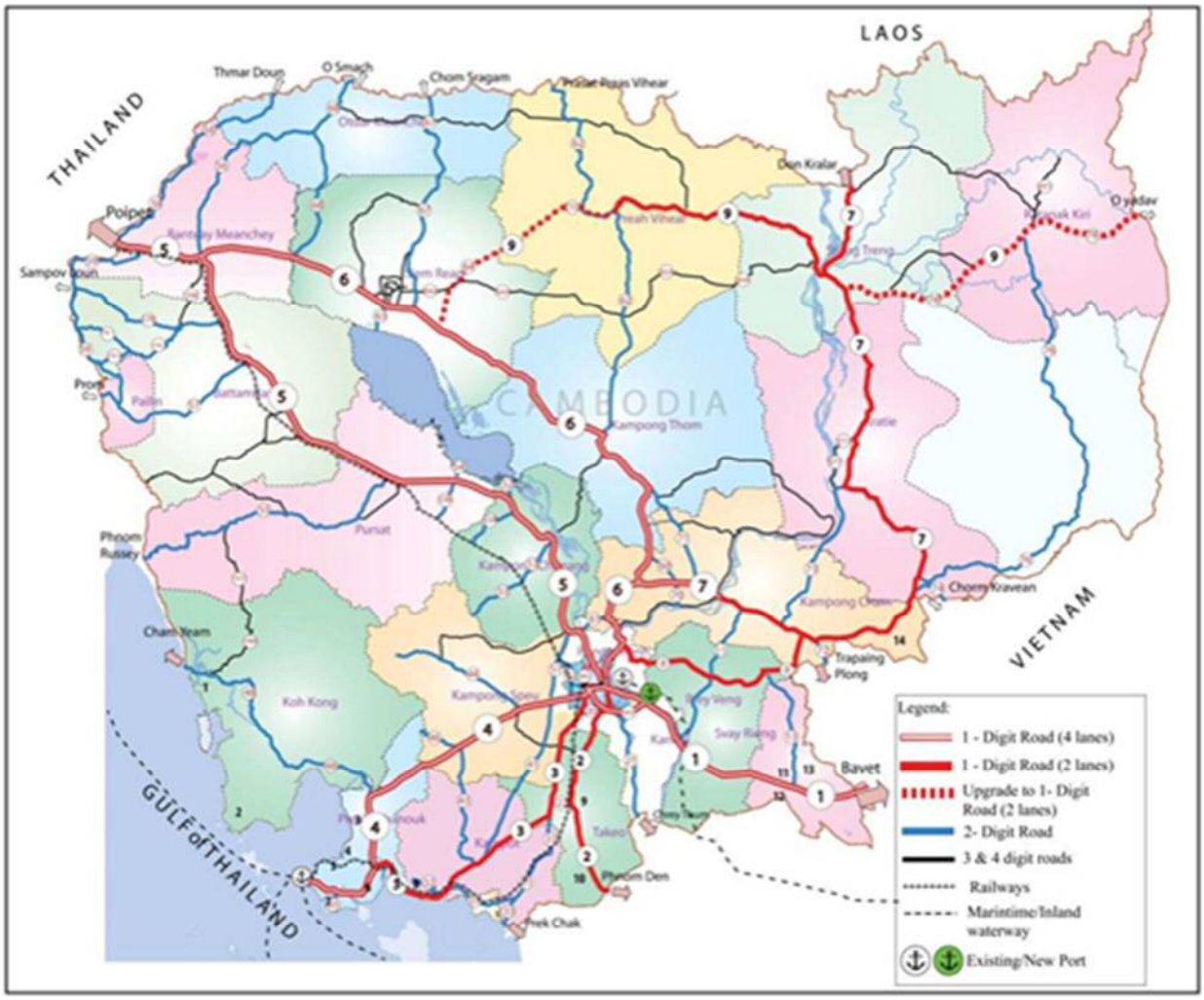
Existing Road Condition						Remark
Road Section	**Location**	**Length (km)**	**Current road condition**	**Road Width (m)**	**Road Pavement**	
NR 1	**Phnom Penh - Vietnam Border**	**167**				
1-1	Wat Phnom - Monivong Bridge	5	(2 lanes + bike) x 2	20-24	AC	Good condition
1-2	Monivong Bridge - 5 km from Br.	4	1-lane x 2	-	AC	2 lanes x 2 to be financed by Japan in 2014 - 2016
1-3	5 km from Br - Neak Loeung	50	(1-lane + bike) x 2	17-18	AC	Completed by Japan in 2011
1-4	Neak Loeung Bridge	-	-	-	-	On-going (by Japan) in 2011 - 2015
1-5	Neak Loeung - Bavet	107	1-lane x 2	10-11	DBST	Repairing (by ADB, 2012) Improve to AC in 2015 - 2017 is under consideration by Japan
NR 2	**Monivong Bridge - Phnom Den**	**120**				
2-1	Wat Phnom - Takhmau Roundabout	6	(2 lanes + bike) x 2	20-24	AC	Completed in 2010 ?
2-2	Takhmau Roudabout - Takeo	64	1-lane x 2	8.0-10.0	DBST	Developed by ADB, 2001; F/S to upgrade into AC by Korea
2-3	Takeo - Phnom Den	50	1-lane x 2	10.0-11.0	AC	Completed (by Japan, 2007)
NR 3	**Phnom Penh - Veal Rinh**	**201**				
3-1	Wat Phnom - Chaom Chao	12	(2 lanes + bike) x 2	20-24	AC	Good condition
3-2	Chaom Chao - Kampot	137	1-lane x 2	12-13	DBST	Completed (by Korea, 2011)
3-3	Kampot - Trapang Ropaou	33	1-lane x 2	12-13	DBST	Completed (by Korea, 2007)
3-4	Trapang Ropaou - Veal Rinh	19	1-lane x 2	12-13	DBST	Completed (by WB, 2006)
NR 4	**Phnom Penh - Sihanoukville**	**214**				
4-1	Chaom Chao - Kampon Speu (KP 45)	33	(2-lane x 2); (2-lane x 1, 1-lane x 1)	17-20	AC/DBST	Completed (by USA, 1996) Maintained by AZI
4-2	Kampong Speu - Sihanoukville	181	1-lane x 2	10-13	AC	Completed (by USA, 1996) Maintained by AZI
NR 5	**Phnom Penh - Poipet**	**407**				

Existing Road Condition						Remark
Road Section	**Location**	**Length (km)**	**Current road condition**	**Road Width (m)**	**Road Pavement**	
5-1	Wat Phnom - Prek Kdam	30	1-lane x 2	11.0-12.0	AC/DBST	2-lane x 2 being widened by China with AC, from 2012
5-2	PrekKdam - ThleaM'am	139	1-lane x 2	10-10.5	DBST	2-lane x 2 financing by JICA is under discussion (2016 - 2018)
5-3	ThleaM'am - Battambong	123	1-lane x 2	10-10.5	DBST	2-lane x 2 financing by JICA is under discussion (2017 - 2019)
5-4	Battambang - Sri Sophorn	68	1-lane x 2	10.0-11.0	DBST	2-lane x 2 financing by JICA is under discussion (2015 - 2017)
5-5	Sri Sophorn - Poipet	47	1-lane x 2	10.0-11.0	AC	Completed (by ADB, 2008) 2-lane x 2 financing by JICA is under discussion (2018 - 2020)
NR 6	**Phnom Penh - Sri Sophorn**	**415**				
6-1	Wat Phnom - Skun (PK 75)	75	1-lane x 2	9.0-10.0	AC	On-going (upgraded to 4 lanes, China, from 2012)
6-2	Skun - Siem Reap	240	1-lane x 2	10.0-11.0	DBST	Bakong temple to Siem Reap (15 km) by Japan 2001, Committed (upgraded to AC 2 lanes, China, 2012)
6-3	Siem Reap - Sri Sophorn	100	1-lane x 2	10.0-11.0	AC	Completed (by ADB, 2008)
NR 7	**Skun - Trapaing Kreil**	**446**				
7-1	Skun - NR 11	61	1-lane x 2	9.0-10.0	AC	55 km by Japan in 1999 / 2003
7-2	NR 11 - Kratie	187	1-lane x 2	11.0-12.0	DBST	-
7-3	Kratie - Stoeung Treng	142	1-lane x 2	11.0	TBST	Completed (by China, 2007)
7-4	Stoeung Treng - Trapaing Kreil	56	1-lane x 2	11.0	TBST	Completed (by China, 2007)
NR 8	**PreakTameak - Krek**	**128**				
8-1	Preak Tameak - NR 11	64	1-lane x 2	10	AC	Completed (by China, 2012)
8-2	NR 11 - Vietnam Border	44	1-lane x 2	10	AC	Completed (by China, 2012)
8-3	Vietnam Border - Krek	20	1-lane x 2	12	AC	Completed (by China, 2012)

Source: Data collection survey in 2013, JICA, edited by the Survey Team

2.4 Revised Road Master Plan

To achieve the target mentioned on the above, proposed projects have been selected according to the each strategy. Revised Road Network Master Plan in Cambodia is shown in Figure 2.4-1.



Source: Data collection survey in 2013, JICA

Figure 2.4-1 Revised Road Network Master Plan in Cambodia

2.5 Summary of Projects for National Road Improvement Proposed by Japan

Summary of Projects for National Road Improvement proposed by Japan is shown in Table 2.5-1, and their implementation schedule is shown in Figure 2.5-1.

Table 2.5-1 Summary of Projects for National Road Improvement Proposed by Japan

Existing Road Condition				Project Cost	Remark
Road Section	Location	Length (km)	Current road Condition		
NR 1	**Phnom Penh - Vietnam Border**	**167**		USD mil	
1-1	Wat Phnom - Monivong Bridge	5	(2 lanes + bike) x 2		Good condition
1-2	Monivong Bridge - 5 km from Br.	5	1-lane x 2	12	2 lanes x 2 to be financed by Japan in 2014 - 2015
1-3	5 km from Br - Neak Loeung	50	(1-lane + bike) x 2		Completed by Japan in 2011
1-4	Neak Loeung Bridge	-	-	100	On-going (by Japan) in 2012 - 2016
1-5	Neak Loeung - Bavet	107	1-lane x 2	50	Repairing (by ADB, 2012) Improve to AC in 2015 - 2017 is under consideration by Japan
NR 5	**Phnom Penh - Poipet**	**407**			
5-1	Wat Phnom - Prek Kdam	30	1-lane x 2	30	2-lane x 2 being widened by China with AC, from 2012
5-2	PrekKdam - ThleaM'am	139	1-lane x 2	139	2-lane x 2 financing by JICA is under discussion (2016 - 2018)
5-3	ThleaM'am - Battambong	123	1-lane x 2	123	2-lane x 2 financing by JICA is under discussion (2017 - 2019)
5-4	Battambang - Sri Sophorn	68	1-lane x 2	68	2-lane x 2 financing by JICA is under discussion (2015 - 2017)
5-5	Sri Sophorn - Poipet	47	1-lane x 2	47	Completed (by ADB, 2008) 2-lane x 2 financing by JICA is under discussion (2018 - 2020)

Source: Data collection survey in 2013, JICA, edited by Survey Team

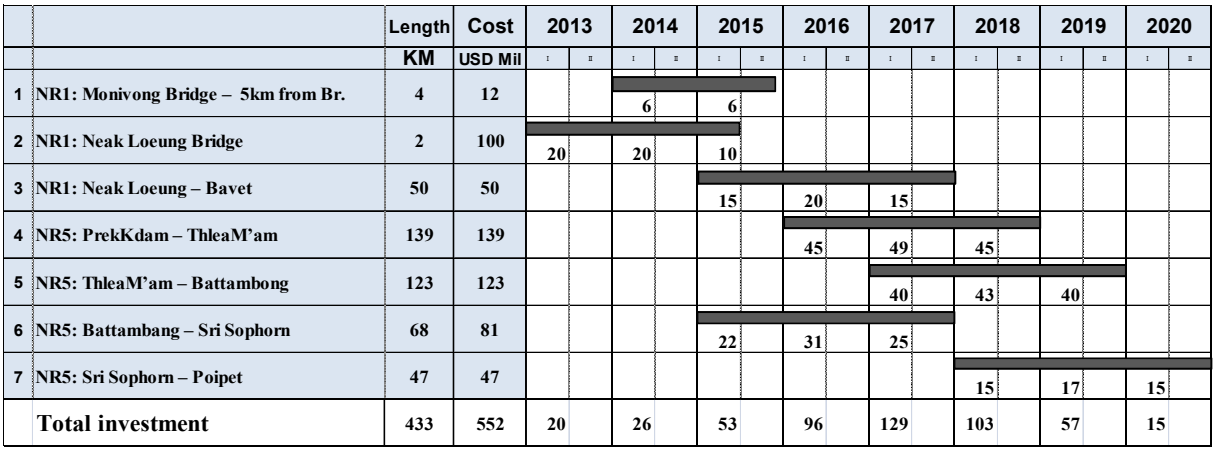


Figure 2.5-1 Implementation Schedule of Proposed Projects

CHAPTER 3 RING ROAD

3.1 Role of Ring Roads

Roles of Ring Roads are as follows:

- The 1st role of ring roads is to reduce traffic jam of city center due to decrease of unnecessary inflow traffic to the city.
- The 2nd is to reduce the travel time of inlow traffic to the city due to the best choice of alternative routes.
- The 3rd is to facilitate direct exchange and cooperation among satellite cities due to efficient and effective transportation by eliminating unnecessary inflow traffic to the city center.

As a whole, ring roads will facilitate the development of the whole city by ensuring the smooth flow of traffic. Therefore, ring road development plan is key issue to efficient and effective development of city. And the timing of construction is important because Ring Road construction will face difficulty after the expansion of city.

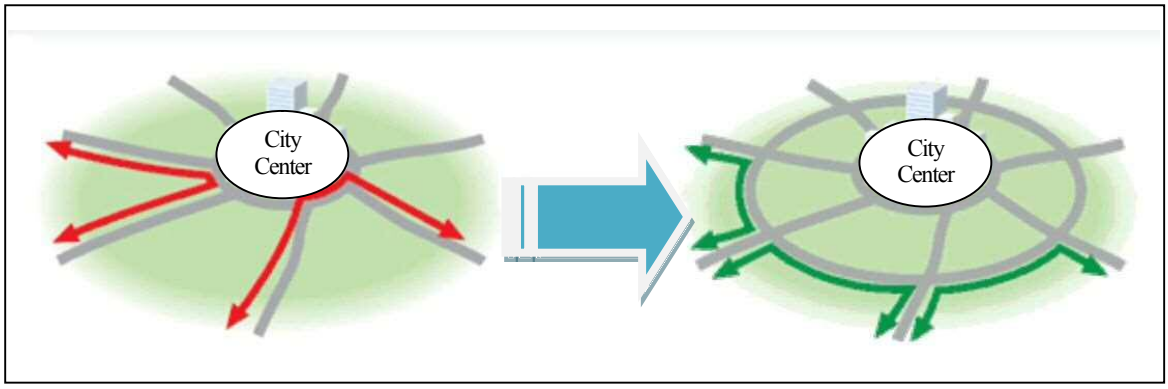


Figure 3.1-1 The 1st Role of Ring Roads: To reduce traffic jam of city center due to decrease of unnecessary inflow traffic to the city

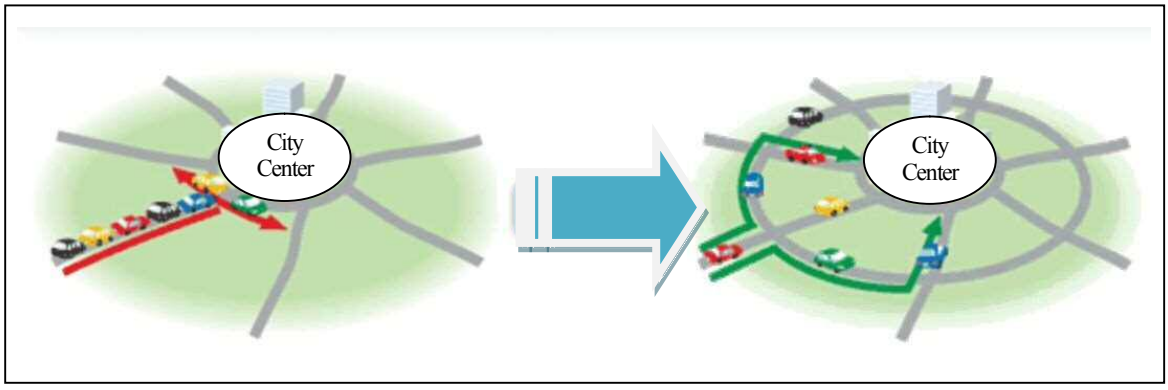


Figure 3.1-2 The 2nd Role of Ring Roads: To reduce the travel time of inlow traffic to the city due to the best choice of alternative routes

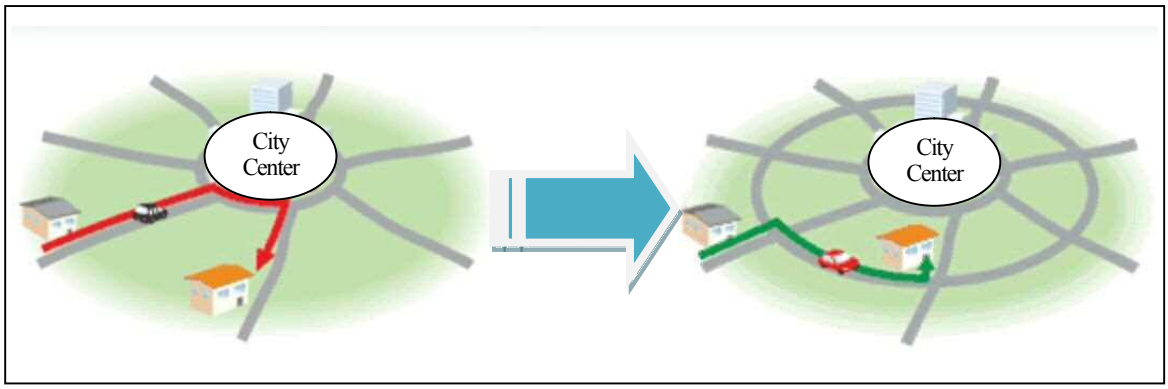


Figure 3.1-3 The 3rd Role of Ring Roads: To facilitate direct exchange and cooperation among satellite cities due to efficient and effective transportation by eliminating unnecessary inflow traffic to the city center

3.2 Ring Roads in Phnom Penh

In Phnom Penh, there are 4 planned ring roads as shown in Figure 3.2-1. Ring Road 2 (RR 2) is financed by China. Ta Khmau Bridge of RR 2 over Bassac River is under construction. West part of Rind Road 3 (RR 3) from NR 5 to NR 21 will be financed by South Korea with the BOT / PPP scheme. The remaining part of RR 3 from NR 21 to NR 1 is opened to the other donor. This section will be considered as a candidate for Japanese ODA. The need for Ring Road 4 (RR 4) has also being recognized.

(1) Existing west part of Ring Road 3 (RR 3)

The north section of the existing RR 3 from NR 1 to NR 5 is used by many heavy vehicles such as container trucks and there are many factories along RR 3. Thus, new industrial development can be expected. RR 3 crosses two railways. Slope of RR 3 embankment in the north section of wet land is protected by cement concrete seal. This method would be used in other section or expressway to be built in flood area. Section of 4 km north of NR 4 intersection is under widening. Cross section consists of [2 car lanes (3.5 m) + shoulder (2.75 m) + pedestrian (5.00 m)] x 2 directions.

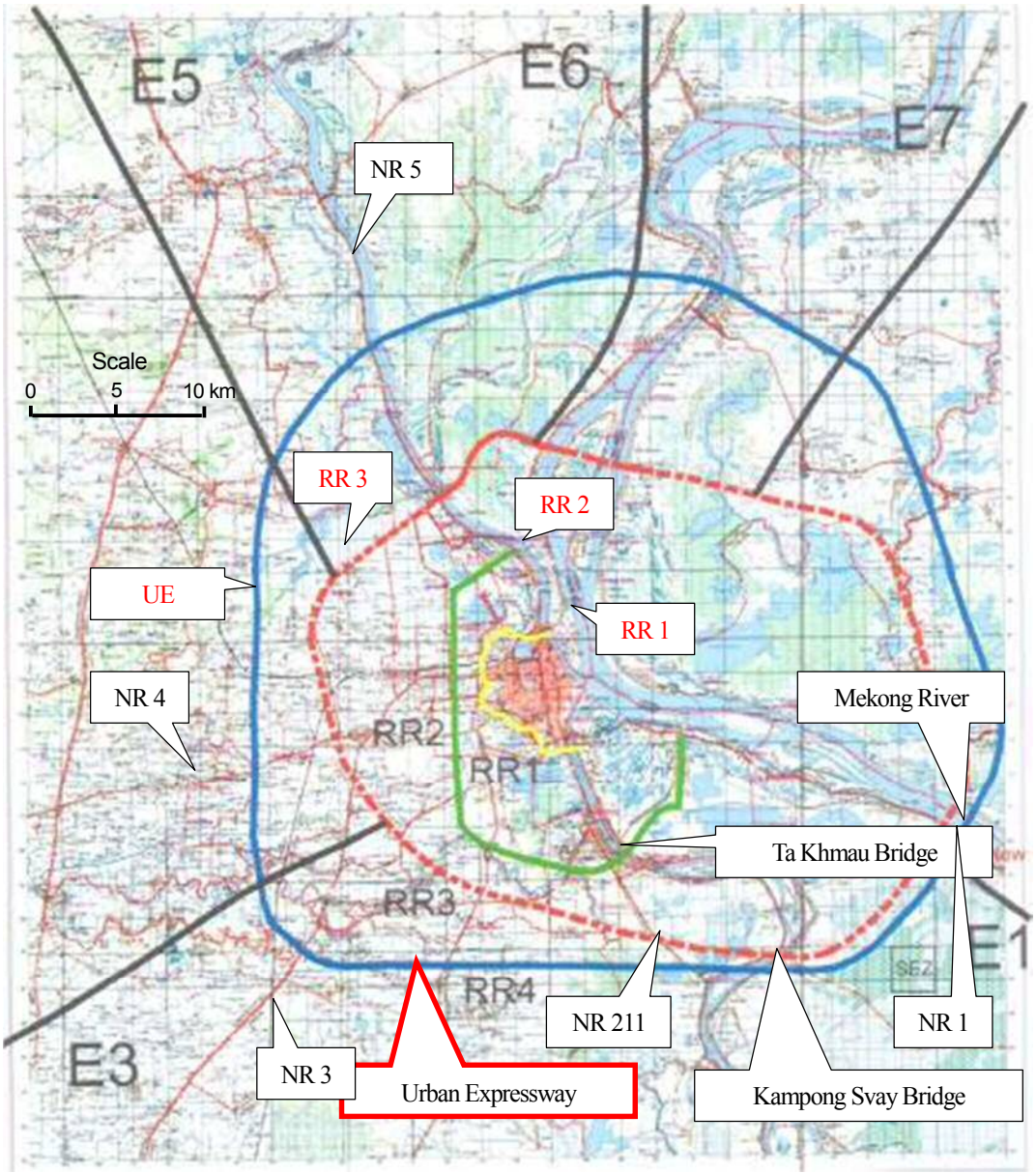


Figure 3.2-1 Ring Roads in Phnom Penh

Figure 3.2-2 RR 3 is used by many trucks carrying containers

Figure 3.2-3 Many factories are located along RR 3

(2) Plan of Ring Road 3 proposed by Korea

(a) Brief history of the study by Korea

RR 3 has been studied by Korea as a form of BOT / PPP since 2009. They made three project presentations to Cambodian Government including MPWT and MOEF in 2013. They almost finalized the proposal judging from the 3rd presentation materials. Brief history of the study is shown in the Table 3.2-1.

Table 3.2-1 Brief history of Project Proposed by Korea

Date	Item
May. 2009	Request of Korean ODA (EDCF) at ASEAN-Korea Summit Meeting
Sep. 2009	Submission of Pre-Feasibility Study
May.2010	Prime Minister's Approval on Project Scheme (PPP) and Alignment
Aug. 2012	Launching Feasibility Study
Jan. 2013	1st Project Presentation to Cambodian Government including MPWT and MOEF
Apr. 2013	2nd Project Presentation to Cambodian Government including MPWT and MOEF
June. 2013	3rd Project Presentation to Cambodian Government including MPWT and MOEF

Source: Presentation by Korea on June 2013: summarized by survey team

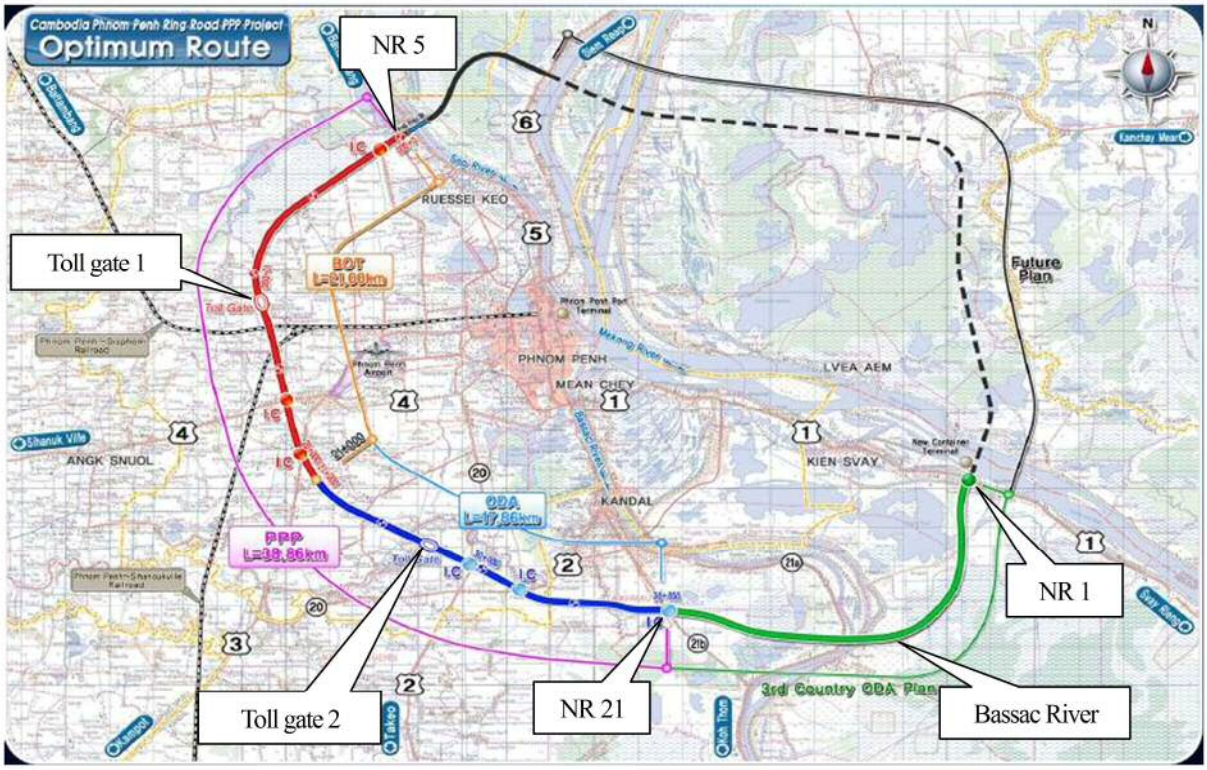
(b) Summary of Project proposed by Korea

The length of PPP project is 39 km, which is from NR 5 to NR 21 and the cost is USD 90 mil. The project of 1st phase consists of 21.0 km of private fund (USD 41 mil) and 17.9 km of Korean ODA of EDCF (USD 49 mil) Unit cost of RR 3 proposed by Korea is USD 2.3 million/km (90 mil/ 38.9 km). Concession period of the project is 30 years. The Summary of Project proposed by Korea, Route Map of RR 3, Future Traffic Volume and Cross section are shown in Table 3.2-2 and 3.2-3, Figures 3.2-4 to 3.2-6.

Table 3.2-2 Summary of Project Proposed by Korea

Project Name	Phnom Penh Ring Road PPP Project
Location	Phnom Penh Prek Phnov - Kandal Tuol Krasang
Plan Length and Cost	Total 60.3 km (3 Phase Construction) Phase 1) 38.9 km 2 lanes USD 90 mil Phase 2) 38.9 km 2 ⇒4 lanes USD 51 mil NR 21- NR 1) 21.4 km ODA project from other nation
Project Type	Build Operation Transfer (BOT) Phase 1 consists of 21.0 km of private fund (USD 41 mil) and 17.9 km of Korean ODA of EDCF (USD 49 mil)
Period (Phase 1)	Construction 3 years (2015 - 2017), Operation 30 years (2018 - 2047)
Summary of construction	Width:2 lanes (15.5 m) 2.5 m + 0.5 m + 3.5 m + 2.5 m + 3.5 m + 0.5 m + 2.5 m Interchanges : 6 units Toll gate: 2 units Pavement: Cement Concrete (main lane), Asphalt Concrete (shoulder)
Design	60-80 km/hr
Toll fee level	Similar to NR 4: Sedan USD 0.7 /toll gate (around 20 km) Heavy truck USD 3.00 /toll gate

Source: Presentation by Korea on June 2013: summarized by survey team



Source: Presentation by Korea on June 2013

Figure 3.2-4 Route Map of RR 3 proposed by Korea

Table 3.2-3 Future Traffic Volume estimated by Korea

Section		Toll gate 1			Toll gate 2		
Year		2018	2027	2037	2018	2027	2037
MC		14,840	24,420	41,069	11,845	15,896	29,460
LV		4,738	7,798	13,116	3,782	5,077	9,409
HV		1,205	1,984	3,336	962	1,291	2,391
Total	IN MC	20,783	34,202	57,521	16,589	22,264	41,260
		5,943	9,782	16,452	4,744	6,368	11,800

Source: Presentation by Korea on June 2013

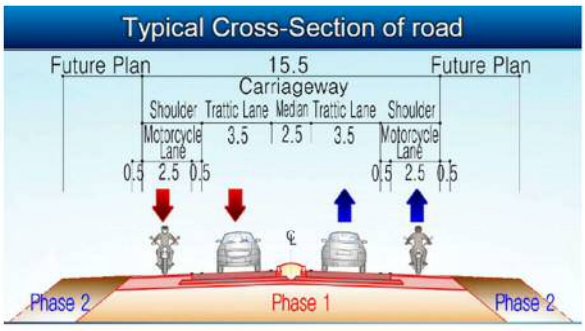


Figure 3.2-5 Typical Cross Section of Embankment of RR 3

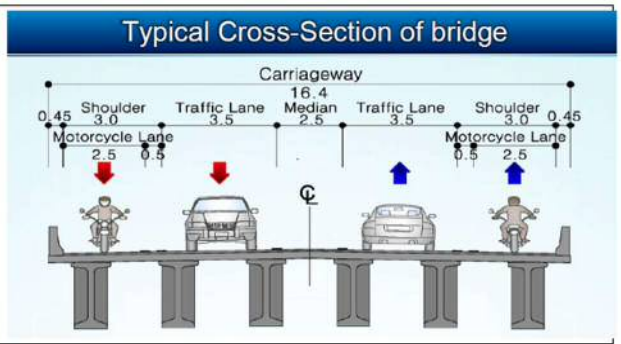


Figure 3.2-6 Typical Cross Section of Bridge of RR 3

Source: Presentation by Korea on June 2013

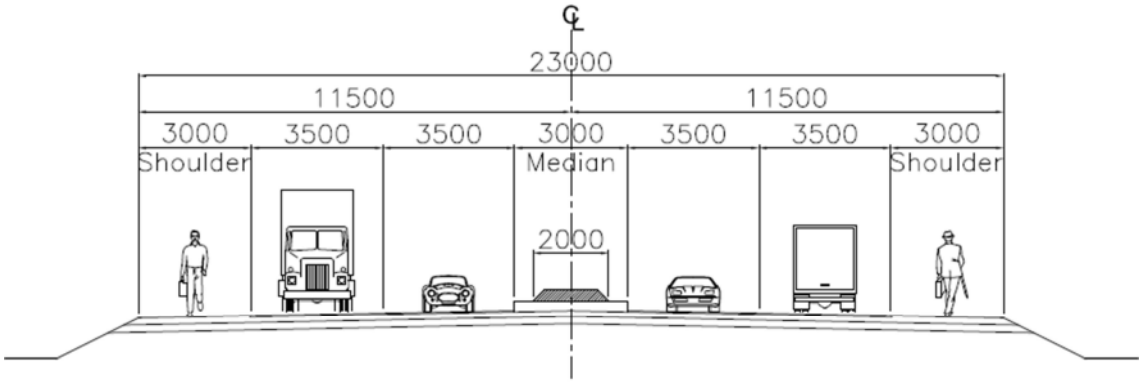
(3) Ring Road 3 from NR 21 to NR 1 (Proposed Project)

(a) General Plan proposed by the Survey Team

The section of Ring Road 3 from NR 21 to Mekong River would be considered as a candidate project for Japanese ODA. Total length is 22 km including bridge on RR 3 over Bassac River.

(b) Cross section

Considering a rapid modal shift from motor bike to car in many countries and small increase of cost of 0.5 m from bike lane to car lane, study team proposes 3.5 m x 4 car lanes. And the 3.0 m pedestrian walkway on both sides is proposed due to importance of economic activity and safety of pedestrian traffic. The typical cross section of embankment is based on the section of design standard.



Typical Cross Section of Embankment (Ring Road 3)

Figure 3.2-7 Typical Cross Section of Embankment for the Section from NR 21 to NR 1

(c) Plan of bridge over Bassac River (Kampong Svay Bridge)

Ta Khmau Bridge is under construction by China and located 15 km upstream to Kampong Svay Bridge of RR 3 over Bassac River. Profile of Ta Khmau Bridge is shown in Table 3.2-4. The Typical cross section of Bridge is based on the section of design standard and unit cost is based on the section of cost analysis. Profile of Kampong Svay Bridge of RR 3 over Bassac River is planned as shown in Table 3.2-5 by the Survey Team based on Profile of Ta Khmau Bridge. The location of new Bridge over Bassac River is shown in Figure 3.2-10.

Table 3.2-4 Profile of Ta Khmau Bridge

	Item	
1	Bridge Type	Composite PC (Box girder - T girder - Hollow slab)
2	Length	850 meters
3	Span length	Hollow 20 m x 7 spans + T 40 m x 3 spans + 75 m + 135 m + 75 m + T 40 m x 3 spans + Hollow 20 m x 9 spans
4	Navigation clearance	8 m x 90 m (H x W) at height water level
5	Type of Foundation	cast-in-situ Pile (D = 1.2 m to 2.0 m, L= 40-50 m)
6	Cross section	(3.5 m lanes + 3.0 bike lanes) x 2 = 13 m

Figure 3.2-8 Ta Khmau Bridge over Bassac River under Construction by Chinese Assistance

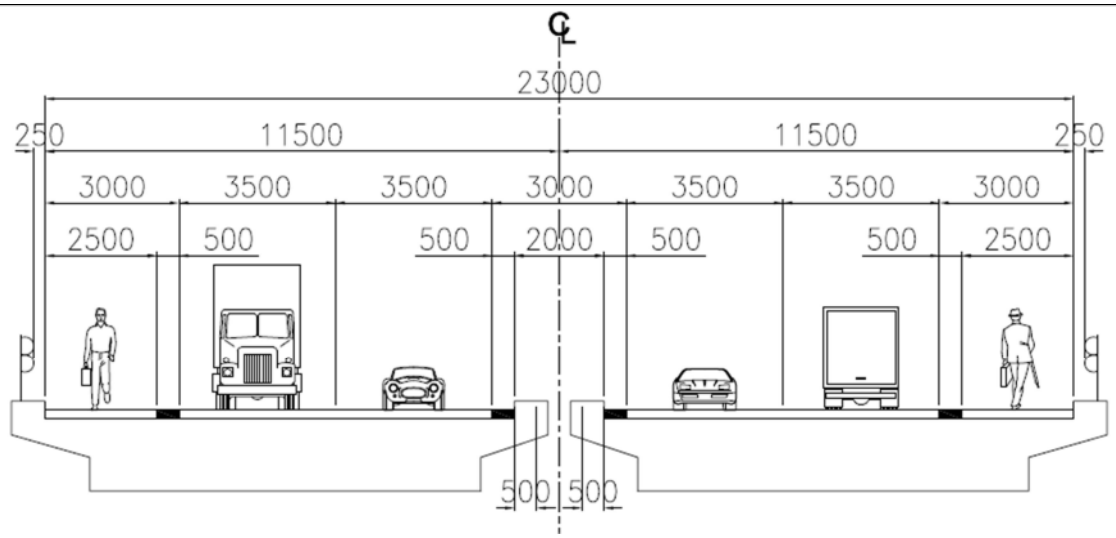
Figure 3.2-9 Ta Khmau Bridge over Bassac River under Construction by Chinese Assistance

Table 3.2-5 Profile of Kampong Svay Bridge of RR 3 over Bassac River

	Item	
1	Bridge Type	Composite PC (Box girder + PC girder)
2	Length	1,020 meters
3	Span length	40 m x 8 spans + 80 m + 140 m + 80 m + 40 m x 10 spans
4	Navigation clearance	8 m x 90 m (H x W) at height water level
5	Type of Foundation	cast-in-situ Pile L= 40-50 m
6	Cross section	(3.5 m x 2 lanes + 3.0 m pedestrian) x 2 + 3.0 median = 23.0 m
7	Cost	USD 28 million = 23 m x 1,020 m x USD 1,200 /m^2

Figure 3.2-10 Location of new Bridge as RR 3 over Bassac River

Figure 3.2-11 Local market near the location of new bridge



Typical Cross Section of Bridge (Ring Road 3)

Figure 3.2-12 Typical Cross Section of bridge for the Section from NR 21 to NR 1

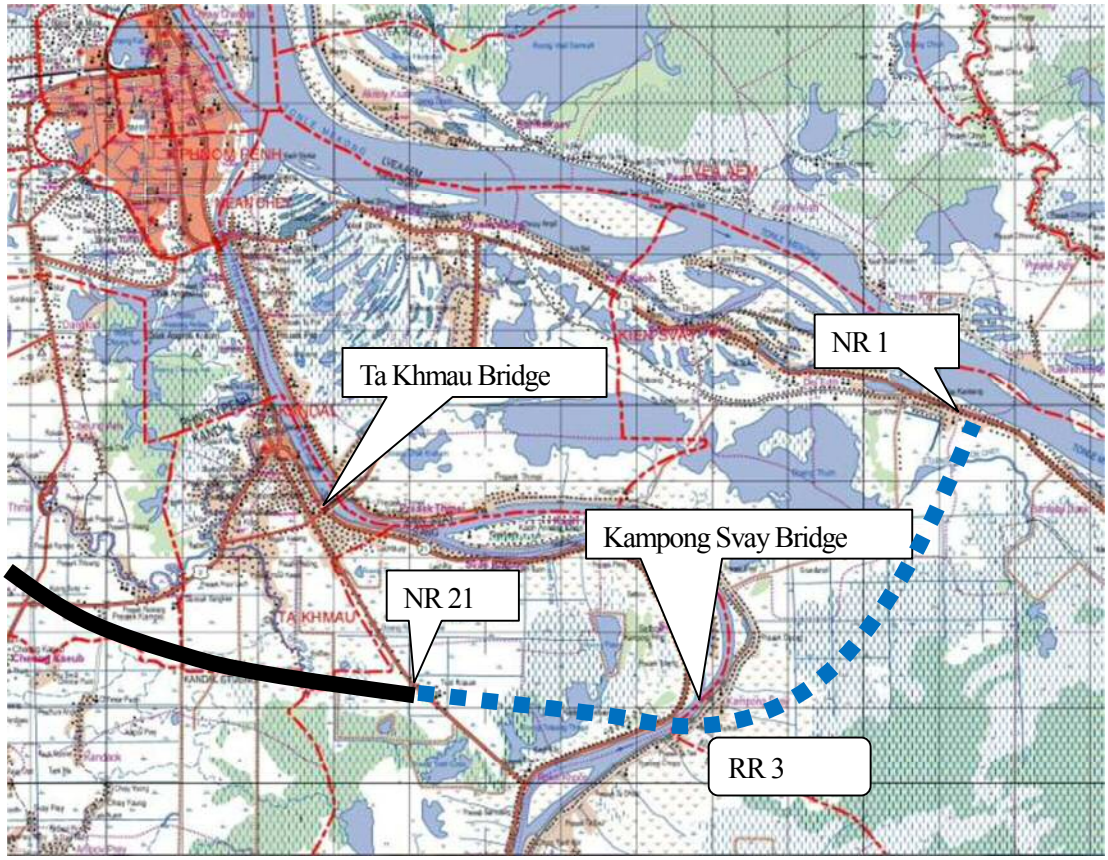


Figure 3.2-13 Route Map of RR 3 for the Section from NR 21 to NR 1 Proposed by the Survey Team

(d) Project Cost of Ring Road 3 for the section from NR 21 to NR 1

Project Cost of Ring Road 3 for the section from NR 21 to NR 1 is shown in Table 3.2-6.

Table 3.2-6 Total cost of Ring Road 3 from NR 21 to NR 1

	Section		Remarks
1	Embankment	USD 63 mil	21 km x USD 3 mil/km
2	Kampong Svay Bridge	USD 28 mil	1 km (23 m x 1,020 m x USD 1,200 /m^2)
	Total	USD 91 mil	

(4) UE (Proposed Urban Expressway)

(a) International comparison of Ring Roads of Expressways

Comparing radius of ring roads of expressways in major cities such as Tokyo, Paris, Beijing, Seoul, Hanoi and HCM, every city has Ring Road of Expressway with the radius ranging from 10 km to 20 km as shown in Table 3.2-7. In case of Phnom Penh, RR 3, with relatively high standard, has been planned and being constructed 10 - 20 km from the city center. The area inside of RR 3 is already urbanized and it is difficult to acquire the land for construction of urban expressway ring road. Thus it is proposed to construct an urban expressway ring road The RR plan proposed with 25 km radius. The proposed route of Urban Expressway Ring Road is shown in Figure 3.2-19.

In most countries, city plan and transportation plan would be done in parallel. Urgent development of the city plan for Phnom Penh is crucial because there is no consolidated city plan for the city.

Table 3.2-7 International Comparison of Ring Roads of Expressways

Radius of RR	R = 5 km	R = 10 km	R = 15 km	R = 20 km	R = 30 km	R = 40 km
Tokyo		Chuo Kanjo	Gaikann			Ken-O
Paris			A86	A104		
Beijign			RR 4	RR 5		
Seoul		RR		RR		
Hanoi		RR 3		RR 4		
HCM		RR 3		RR 4		
Phnom Penh						

Figure 3.2-14 Ring Road in Tokyo

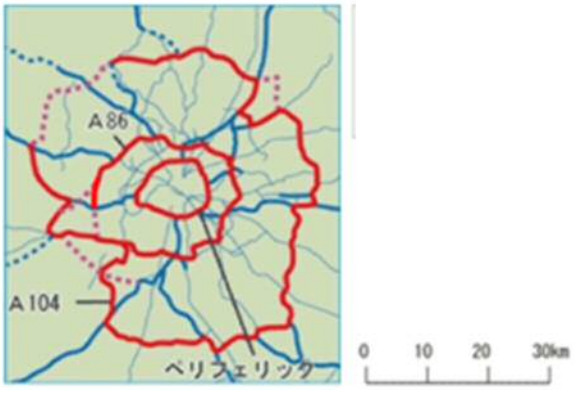


Figure 3.2-15 Ring Road in Paris

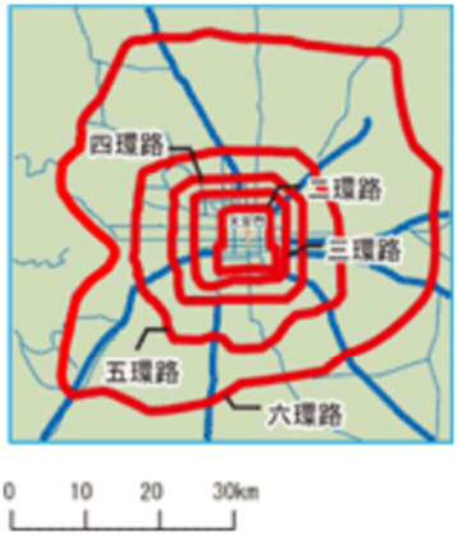


Figure 3.2-16 Ring Road in Beijing

Figure 3.2-17 Ring Road in Seoul

Figure 3.2-18 Ring Road in HCM City, Vietnam

Source: HP of MLIT

(b) Outline of Urban Expressway (UE) (Proposed Project)

Considering the above, Survey team proposes a rough idea of UE in Phnom Penh. The length of project is 80 km, which connects E1, E3, E5, E6 and E7 as shown in Figure 3.2-19. Cost of UE is USD 1,550 million as shown in Table 3.2-8. Typical Cross Sections of embankment and bridge of UE are shown in Figures 3.2-20 and 3.2-21, respectively.

Table 3.2-8 Summary of UE

Project Name	Urban Expressway (UE)
Location	Phnom Penh (Radius = 25 km)
Length	Total 155 km
Cost	USD 1,550 million (10 mil /km x 155 km)

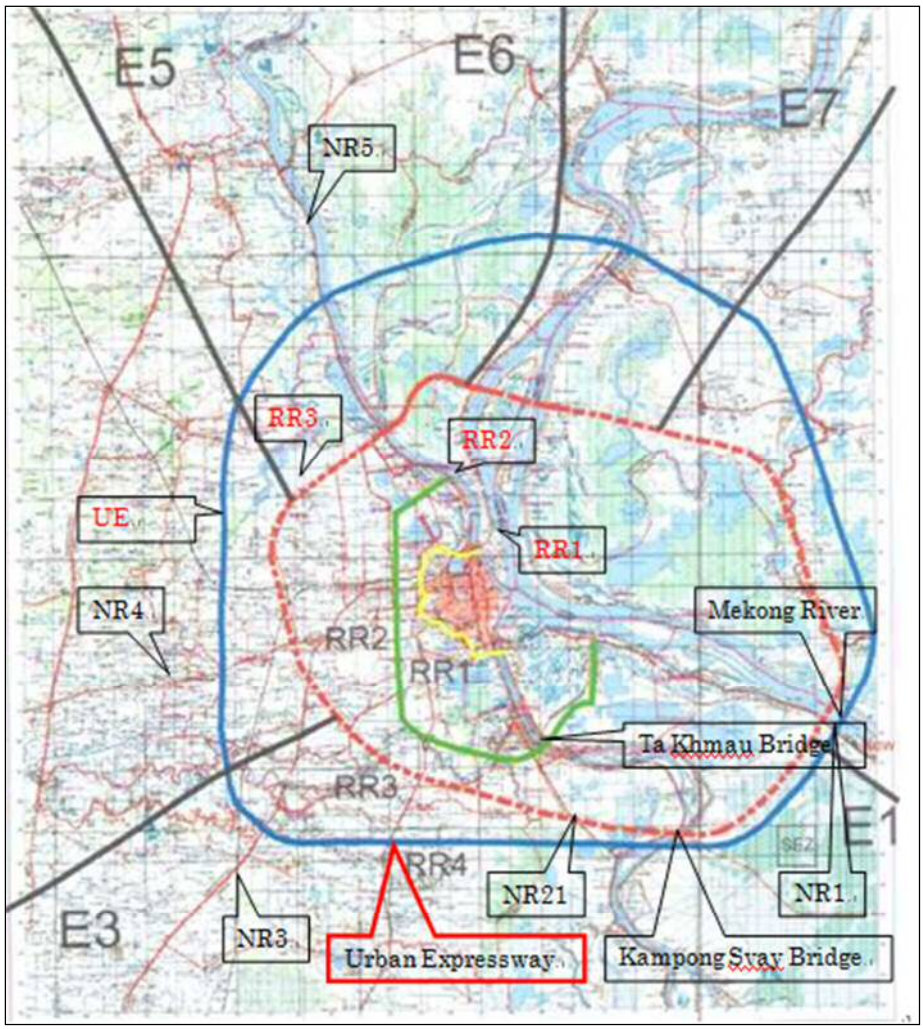


Figure 3.2-19 Ring Roads in Phnom Penh Proposed by the Survey Team

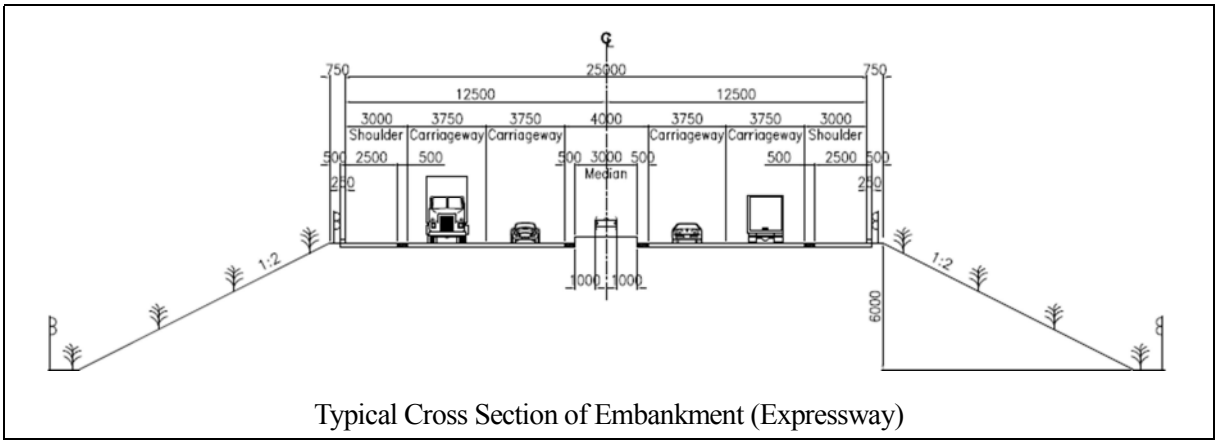
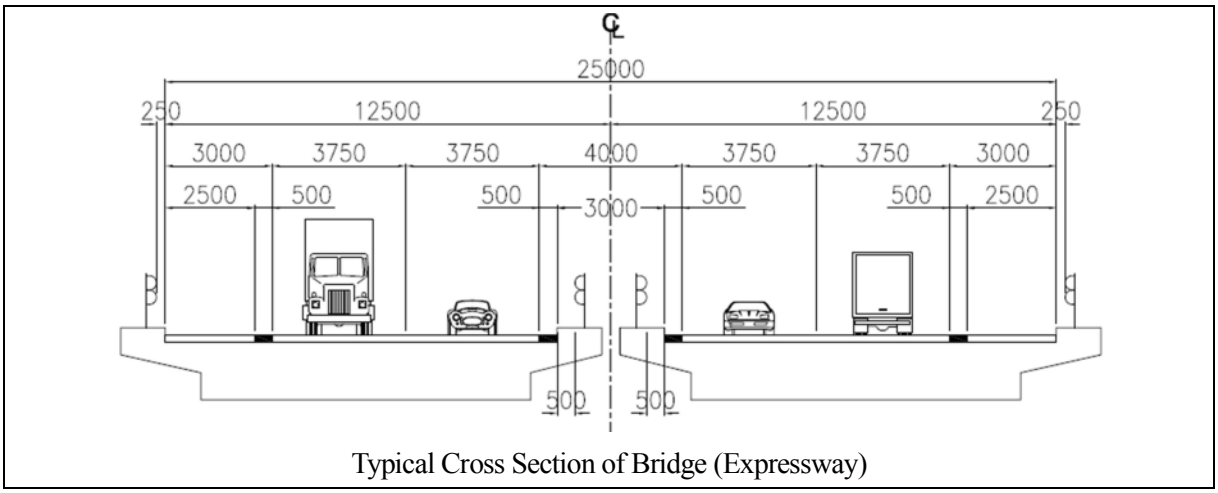


Figure 3.2-20 Typical Cross Section of Embankment of UE



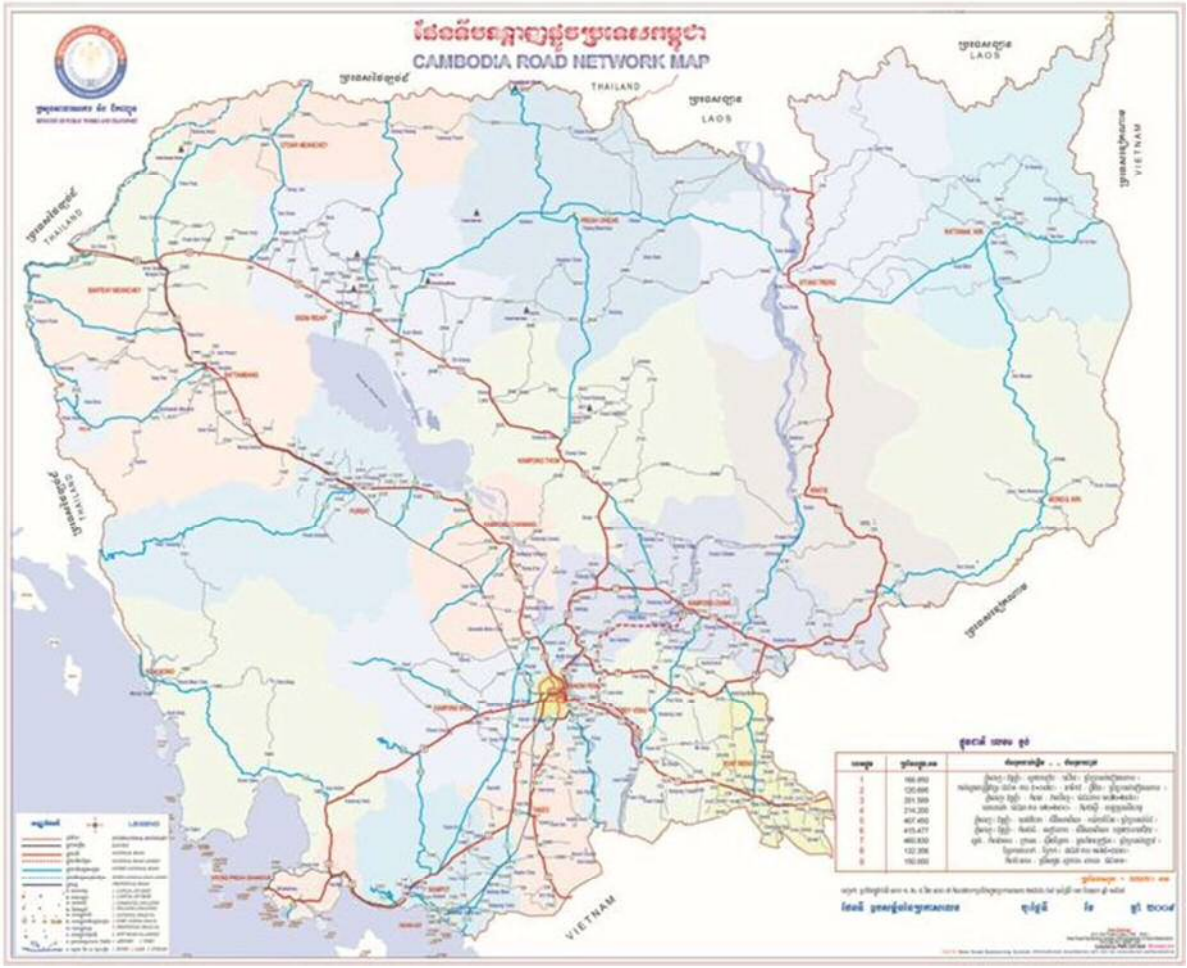
Typical Cross Section of Bridge (Expressway)

Figure 3.2-21 Typical Cross Section of Bridge of UE

CHAPTER 4 TOLL ROADS IN CAMBODIA

4.1 Toll Roads in Cambodia

There are / were 9 toll road projects in Cambodia, of which 6 projects are on-going and 3 projects failed, as shown in Figure 4.1-1, Table 4.1-1 and 4.1-2.



Source: Presentation in March 2013 by H.E. KEM BOREY, DG of Public Works, MPWT

Figure 4.1-1 Location Map of Toll Roads in Cambodia

Table 4.1-1 List of Toll Road (1 - 5)

Project No.	1	2	3	4	5
Description	To Sihanouk Ville	Koh Kong Bridge	To Kos Ker Temple	To Bousra Waterfall	From Airport
Route	NR 4	NR 48 crossing river	NR 64	PR 3764	Street No. 2004
Situation	On going	On going	Failed	Failed	On going
Length	214 km	2 km	105 km	36 km	4 km
Lane	2	2	2	2	2
Pavement	AC	RC	DBST	DBST	AC
Design Speed	80 km/hr	80 km/hr	80 km/hr	80 km/hr	80 km/hr
Investment Cost	USD 44 mil	USD 7 mil	USD 22 mil	USD 6 mil	USD 2 mil
Year of Investment	2001	2002	2003	2004	2004
Concession Period	35 years	30 years + Extension of 20 years	30 years	30 years	30 years
Investor	AZ Investment	LYP Group	KSM Investment	Sorla Investment	Sorla Investment

Source: Presentation in March 2013 by H.E. KEM BOREY, DG of Public Works, MPWT

Table 4.1-2 List of Toll Road (6 - 9)

Project No.	6	7	8	9
Description	City Road No. 598	Airport Veng Sreng Street	Prek Pnov Bridge	KOulen Moutain
Route	Street No. 598	Veng Sreng Street NR 4	Crossing Tonle Sap River	NR 67 - Koulen Moutain
Situation	Failed	On going	On going	On going
Length	9 km	8 km	9 .km	31 km
Lane	2	2	2	2
Pavement	AC	AC	PCC	DBST & PCC
Design Speed	80 km/hr	80 km/hr	80 km/hr	40-60 Km/hr
Investment Cost	USD 5 mil	USD 5 mil	USD 45 mil	USD 8 mil
Year of Investment	2005	2005	2010	2012
Concession Period	30 years	30 years	30 years	30 years
Investor	Phnom Penh Highway	Phnom Penh Highway	LYP group	Nokor Kokthlok

Source: Presentation in March 2013 by H.E. KEM BOREY, DG of Public Works, MPWT

4.2 Details of Each Project

(1) Project 1: Toll road of NR 4

Toll road of NR 4 is 214 km long in total which starts from NR 4 from Chaom Chao to Preah Sihanouk Ville as shown in Figure 4.2-1. Toll fee is shown in Figure 4.2-2.

Source: Presentation in March 2013 by H.E. KEM BOREY, DG of Public Works, MPWT

Figure 4.2-1 Route Map of Toll Road of NR 4

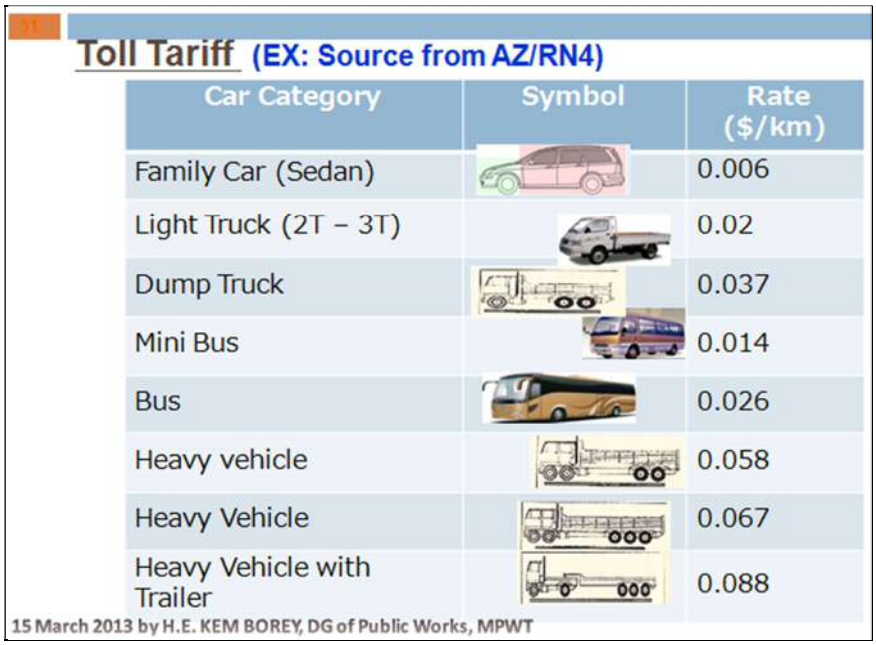


Figure 4.2-2 Toll Fee of Toll Road of NR 4

Figure 4.2-3 Toll Gate of NR 4 (1st Toll Gate)

(2) Project 5: Toll road of street No. 2004

Toll road of street No. 2004 is 4 km long in total which is from Street No. 271 to Air Port of Publi - Russian Confederation Blvd as shown in Figure 4.2-4. This toll road was newly constructed in 2004. Many buildings are located along the toll road. Main users are the cars which have origin or destination in the toll road. Toll fee is shown in Table 4.2-1.

Figure 4.2-4 Route Map of Toll Road of Street No. 2004

Table 4.2-1 Toll Fee of Toll Road of Street No.2004

No	Category	Toll fee (USD)	Toll fee (R)
1	Passenger car	0.25	1,100 (pass 2 gates)

Figure 4.2-5 Toll Road of Street No. 2004 (1st toll gate)

Figure 4.2-6 Toll Road of Street No. 2004 (pay for ticket)

Figure 4.2-7 Toll Road of Street No. 2004; 2-lane x 2 direction

Figure 4.2-8 Toll Road of Street No. 2004 (2nd toll gate)

(3) Project 7: Toll road of Veng Sreng Street near the Phnom Penh Airport

Toll road of Veng Sreng Stree is 8 km long in total which is from the junction of NR 3 and NR 4 to the city center of Phnom Penh. The route map is shown in Figure 4.2-8. Heavy trucks are not allowed to use the road in front of the international airport and enter the city center of Phnom Penh in order to prevent traffic congestion. Therefore, heavy trucks have to use this toll road. Small Passenger car is free. The toll road is very crowded in heavy trucks. The causes of traffic jam are considered as a shortage of toll booths and open markets along the road. The toll fee is shown in Table 4.2-2.

Figure 4.2-9 Project No. 7: Tall road of Veng Sreng Street

Table 4.2-2 Toll fee of Toll Road of Veng Sreng Sterrt

	Category	Toll fee (USD)	Toll fee (R)
1	Small bus		1,200
2	Small truck		2,200
3	Big bus/ Medium truck		4,400
4	Heavy trucks		6,000

Figure 4.2-10 Toll Road of Veng Sreng Street (toll gate)

Figure 4.2-11 Toll Road of Veng Sreng Street (open market)

(4) Project 8 : Toll road of Prek Pnov Bridge (RR 3)

Toll road is 9 km long in total which is from NR 5 to NR 6. Toll road is located at 10 km north of the city center of Phnom Penh as shown in Figure 4.2-12. This toll road has the function of Ring Road 3. The toll road is classified to two sections which are bridge section over Tonle Sap River and low embankment section in wetland as shown in Table 4.2-3. Toll fee is shown in Table 4.2-4.

Figure 4.2-12 Project No.8 Toll Road of Prek Pnov Bridge

Table 4.2-3 Outline of Toll Road of Prek Pnov Bridge

	Section	Length	Road width	
1	Bridge	1 km	(1-lane + bike) x 2	
2	Wet land	8 km	2 lanes x 2	Embankment is 1 m high with cement concrete pavement

Table 4.2-4 Toll Fee of Toll Road of Prek Pnov Bridge

No	Category	Toll fee (USD)	Toll fee (R)
1	Tourist Car (Mini-car)	1.35	5,700
2	Pick up car	1.61	6,800
3	Small Bus (12-15) seat /Truck with 3 Axles	3.00	12,700
4	Bus (24-45) seat	4.00	17,000
5	Truck with 5 Axles	4.30	18,000
6	Heavy Truck (More 5 Axles)	8.00	34,000

Figure 4.2-13 Toll Gate of Prek Pnov Bridge

Figure 4.2-14 Bridge Over Tonle Sap River

Figure 4.2-15 Section of Embankment in Wetland

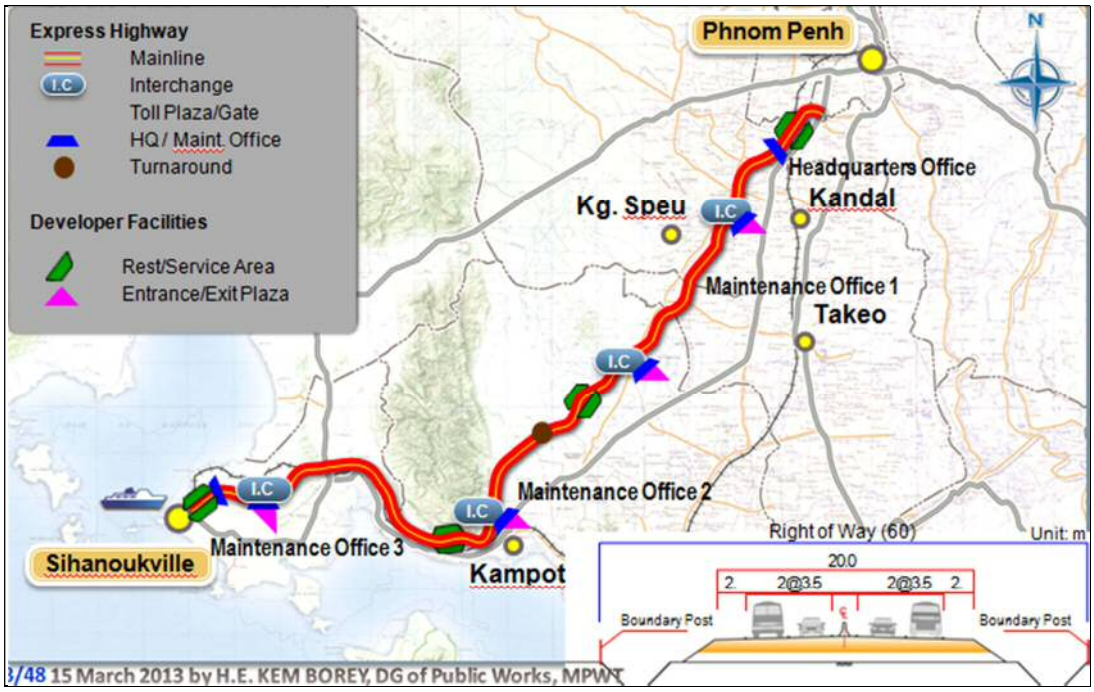
Figure 4.2-16 Toll Booth and Fee Table

4.3 Planned Toll Road Projects

Table 4.3-1 Planned Toll Road Projects

	1	2
Description	Ring Road 3	Expressway
Route	Ring Road 3 in PP	Along NR 3
Length	39 km (phase 1) 2-lane of USD 90 mil 39 km (phase 2) 2 ⇒4 lanes 21 km (ODA by other donor)	207 km
No. of Lane	2 lanes	4 lanes
Pavement	CC and AC	AC
Design Speed	60-80 km/hr	100 km/hr
Investment Cost USD	Build Operation Transfer (BOT) Phase 1 consists of 21.0 km of private fund (USD 41 mil) and 17.9 km of Korean ODA (USD 49 mil of EDCF)	1,000S mil
Investment scheme	BOT	BOT/ BOO
Year of Investment	2015 - 2017	
Concession Period	30 years	50 years
Investor	Korean company +bank	Korea
Status	Seeking preliminary approval	pending

Source: Presentation in March 2013 by H.E. KEM BOREY, DG of Public Works, MPWT



Source: Presentation in March 2013 by H.E. KEM BOREY, DG of Public Works, MPWT

Figure 4.3-1 Expressway along NR 3

CHAPTER 5 EXPRESSWAY NETWORK IN VIETNAM

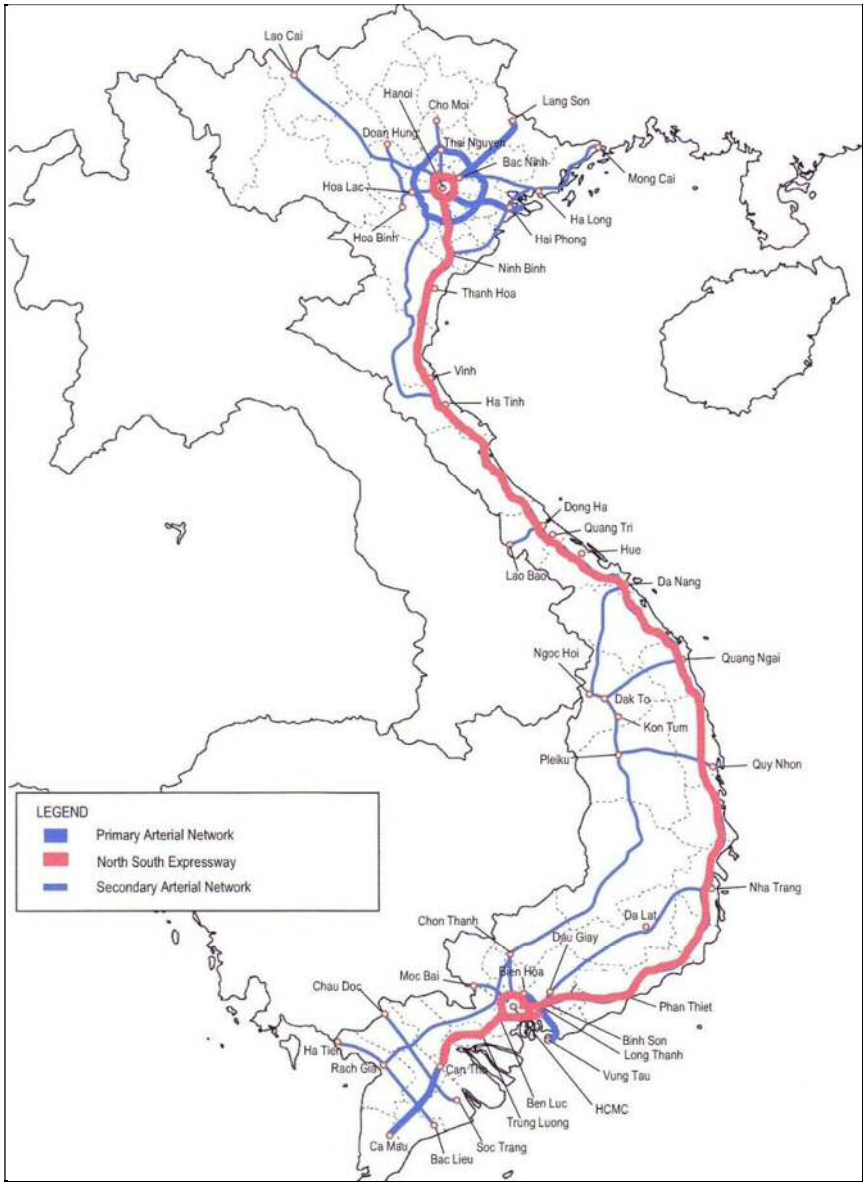
5.1 Plan and Progress of Expressway Development in Vietnam

(1) Master plan of expressway

Master plan was approved by the Prime Ministe's Decision No. 1734 / QD-TTg dated October 2008, which defines 5,873 km expressway network in Vietnam as shown in Figure 5.1-1. The total investment for the construction of expressway network (5,753 km) is about VND 766,220 million (about USD 50 billion), in which:

・Up to 2020: total construction of 2,639 km / VND 394,730 million (about USD 26 billion)

After 2020: total construction of 3,114 km / VND 371,490 million (about USD 24 billion)

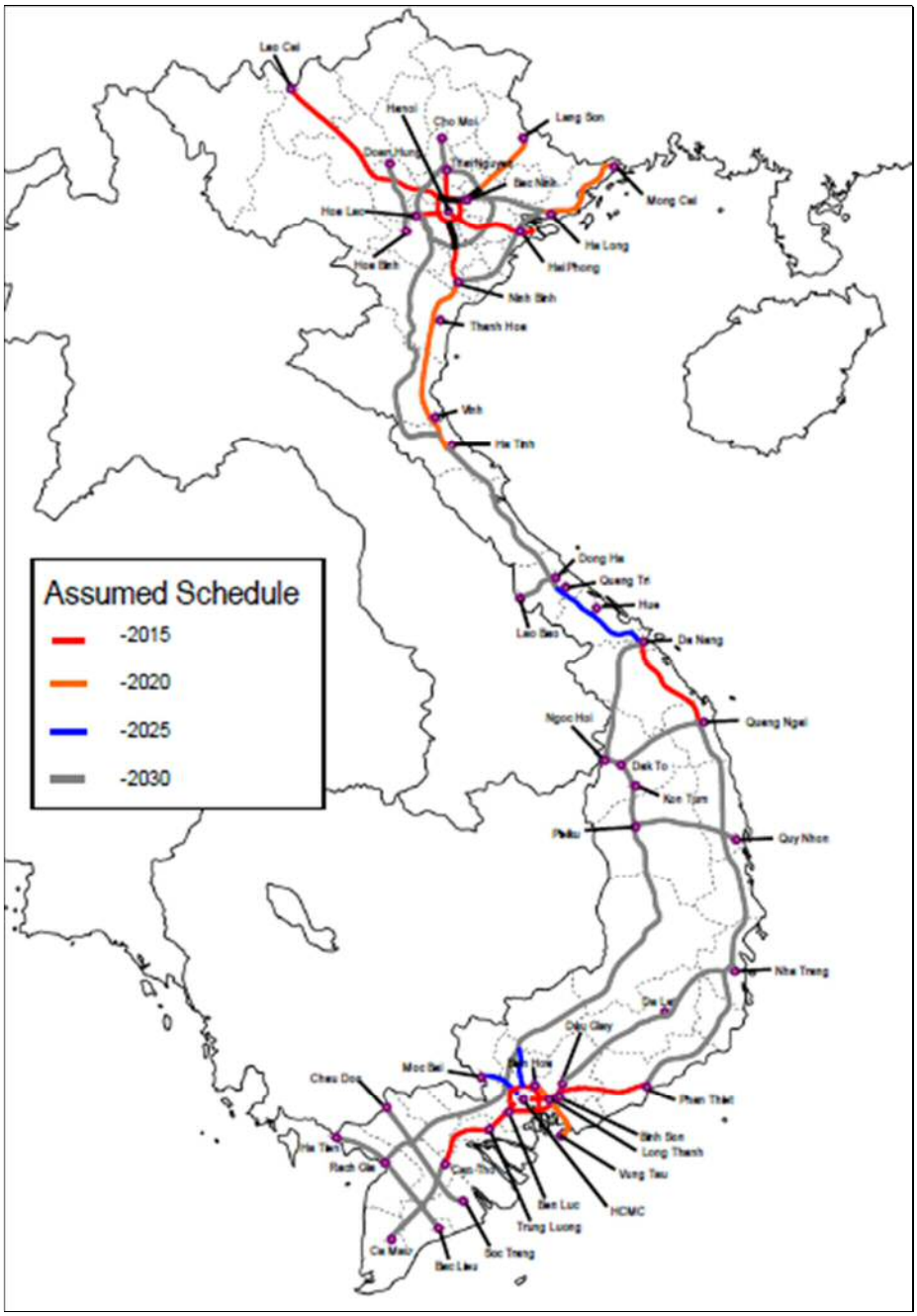


Source: VITRANSS 2 Study

Figure 5.1-1 Expressway Plan in Vietnam (Master Plan of Expressway)

(2) Overall policy for expressway development in Vietnam

The first priority was given to the north, central and south sections of the North - South Expressway and the area around Hanoi and HCM as shown in Figure 5.1-2.



Source: VITRANSS 2 in 2010

Figure 5.1-2 Implementation Schedule

(3) Progress of expressway network development in Vietnam

The first expressway constructed in Vietnam is the HCM - Trung Luong Expressway, which was opened to traffic in February, 2010. In total, the 168 km length of expressway has been completed up to now as shown in Table 5.1-1. The unit cost of the HCM - Trung Luong expressway was USD 15 million/km

(USD 582 mil/ 40 km). The unit cost of Lan - Hoa Lac expressway was USD 15 million/km (USD 441 mil/ 30 km).

Table 5.1-1 Completed Expressways (168 km)

		Length (km)	Number of Lane	Investment (VND Bil.)	Investment (USD Mil.)
1	HCM - Trung Luong	40	4	9,900	582
2	Lan - Hoa Lac	30	6	7,500	441
3	Lien Khuong - Da Lat	19	4	1,000	59
4	Ring Road 3 in Hanoi	28	4		830
5	Cau Gie - Ninh Binh	50	4		461
	Total	168			2,373
Source: MOT presentation June 2013 and revised by Survey team Exchange rate: USD 1 = VND 17,000 in 2010					

(4) 2008 Expressway Master plan review in 2013

The 2008 Master Plan on expressway was reviewed in 2013. According to Decision No. 356 /QD-TTg dated February 25, 2013, the Vietnam expressway network shall be developed to provide 2,020 km of expressway by 2020, which consists of the completed 168 km section shown in Table 5.1-1 and another 1,852 km shown in Table 5.1-2. The unit cost of the expressway in future is estimated to be USD 9 million/km (USD 17,000 mil/ 1,852 km).

The cost for expressway development for the period from 2013 to 2015 is estimated to be USD 7 billion. The 50% of the cost will be financed by ODA, and the rest would be covered by BOT / PPP scheme. The cost for the period from 2016 to 2020 is estimated to be USD 10 billion. The 30% of the cost will be financed by ODA and the rest will be covered by BOT / PPP scheme as shown in Table 5.1-3.

Table 5.1-2 Master Plan Toward 2020 (1,852 km) Reviewed in 2013

		Length (km)	Number of Lane	Investment (mil VND)	Investment (mil USD)
1	North - South Expressway	776	4-8	9,900	4,950
2	North Expressway Network	705	4-6	7,500	3,750
3	South Expressway Network	76	6		
4	Other Expressway	200			
5	Ring Road of Hanoi and HCM	95			
	Total	1,852			17,000
Source: MOT presentation document on June 2013 Exchange rate: USD 1 = VND 20,000 in 2013					

Table 5.1-3 Fund Arrangement for Expressway Development

Period	Amount of fund	ODA	BOT / PPP / Government
2013 - 2015	USD 7 billion	50%	50%
2016 - 2020	USD 10 billion	30%	70%
Source: Meeting with MOT			

5.2 Implementing Organization Expressway Development

The Ministry of Transport (MOT) is responsible for the development of the expressway network. The following four types of organizations are in charge of construction, operation and maintenance of the expressways under MOT, Project Management Unit (PMU), which is directly under MOT, Vietnam Expressway Management Office (VEMO) of DRVN, Vietnam Expressway Company (VEC) and BOT / PPP companies.

MOT tried to establish an expressway authority as a sole organization to develop expressway network across Vietnam, but the organization plan was not accepted by the Prime Minister. This shows that expressway develop in Vietnam is not well-organized in terms of organization.

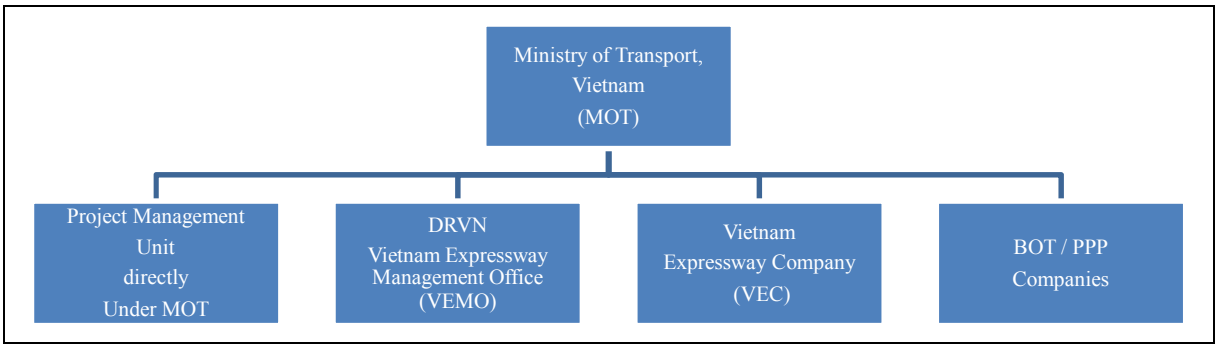


Figure 5.2-1 Organization in Charge of Expressway Development

5.3 Project Scheme of Expressway in Vietnam

Project scheme of expressway in Vietnam is categorized in three types which are VN Government, BOT and PPP as shown in Table 5.3-1. VN Government means that Implementation Agencies of government, such as MOT, DRVN and VEC, carry out fund arrangement, construction and operation and maintenance by themselves. BOT means that MOT makes BOT contract with BOT Company based on BOT law in Vietnam and BOT companies carry out fund arrangement, construction and operation and maintenance for concession period. PPP means that MOT makes PPP contract with PPP Company based on PPP law in Vietnam as well as MOT providing PPP project with financial gap, and PPP companies carry out fund arrangement, construction and operation and maintenance for concession period. However, PPP is under negotiation and not realized yet.

Table 5.3-1 Project Scheme of Each Project in Vietnam

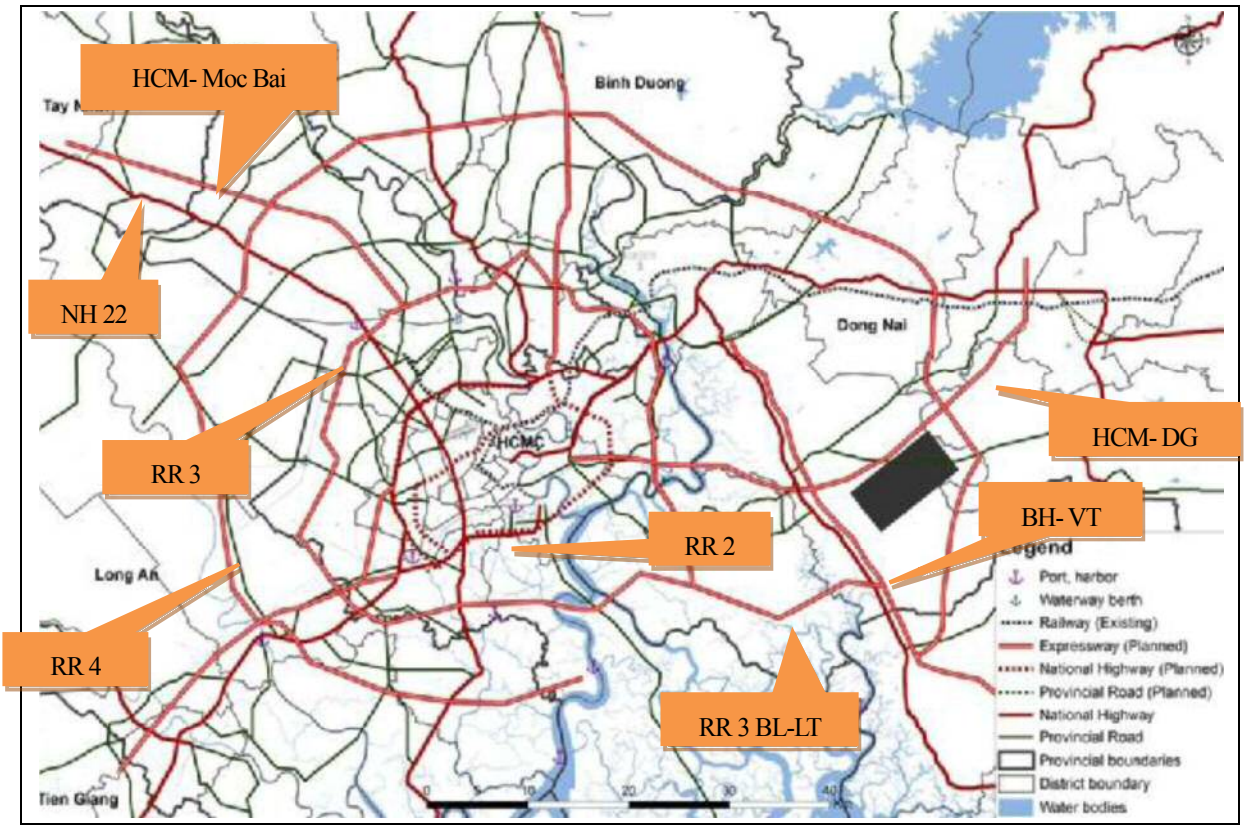
No	Section	Length (km)	Implementat - ion Agency	Fund Source	Project Scheme	Present Status
1	Ha Noi - Hai Phong	105	(MOT) VIDIFI	VIDIFI	BOT	Construction
2	Hanoi - Lao Cai	264	VEC	ADB	VN Government	Construction
3	Ha Noi - Thai Nguyen	62	DRVN	JBIC (JICA)	VN Government	Construction
4	Lang - Hoa Lac	30	MOT PMU TL	VN	BT & Government	Completed
5	Phap Van - Cau Gie	30	(MOT)	Private	BOT	Negotiation

No	Section	Length (km)	Implementat - ion Agency	Fund Source	Project Scheme	Present Status
			NEXCO-C	JICA		
6	Cau Gie - Ninh Binh	50	VEC	VN	VN Government	Completed
7	Da Nang - Quang Ngai	131	VEC	JICA WB	VN Government	Detail Design
8	Phan Thiet - Dau Giay	100	(MOT) BITEXCO	Private IBRD	PPP	Finding additional fund
9	HCMC - Dau Giay	55	VEC	JICA ADB	VN Government	Construction
10	Long Thanh - Ben Luc	45	VEC	JICA ADB	VN Government	Detail Design
11	HCMC - Trung Luong	40	MOT CUU Long	VN	VN Government	Completed
12	Bien Hoa - Vung Tau	76	(MOT) BVEC	Private	BOT	Finding additional fund

(1) HCM - Moc Bai expressway

The MOT of Vietnam said that the route of the HCM - Moc Bai Expressway has not been decided yet. But survey team thinks that the route is under the process of official approval judging from a newspaper article, an ADB study map, a HCM map available at a shop and a MOT presentation slide, which clearly show the route connecting to RR 3 in HCM at a different from the existing National Highway 22 as shown in Figures 5.3-1 to 5.3-3.

The Vietnam side said that the implementation of the project will be after 2020. MOT explained that the MPWT of Cambodia and the MOT of Vietnam had decided the route respectively and will make an adjustment for the route around the national border through discussion between the two parties.



Source: ADB Technical Assistance on Ho Chi Minh Outer Ring Roads

Figure 5.3-1 Transportation Network

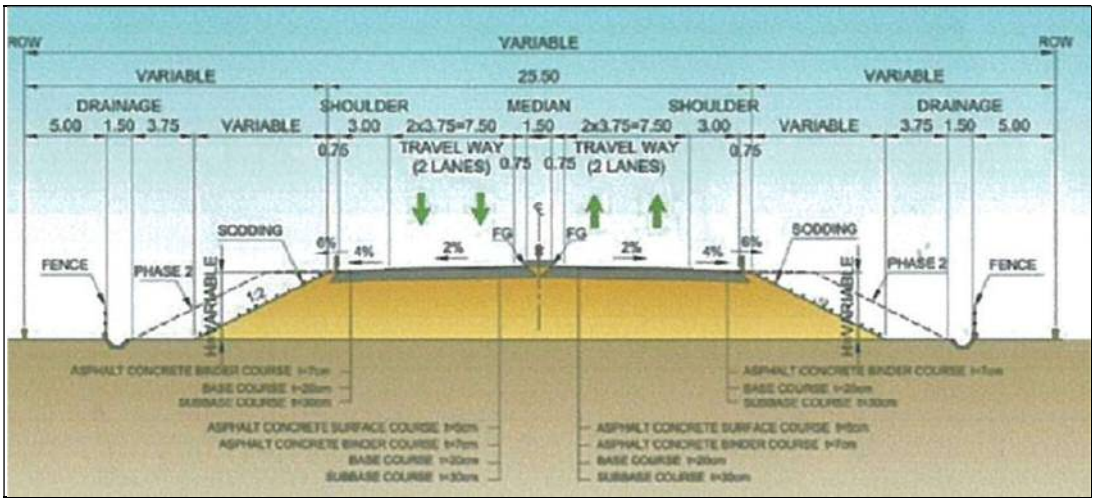
Source: Map available at a shop

Figure 5.3-2 Route of HCM Moc Bai Expressway

Source: Material at meeting with MOT

Figure 5.3-3 5-Route of HCM Moc Bai Expressway

Figure 5.3-4 shows a typical cross section of Expressway in Vietnam is a 2 way, 2-lane road.

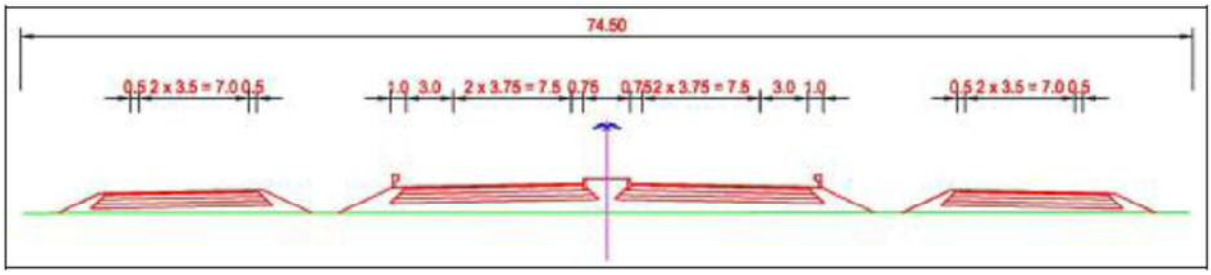


Source: MOT, Vietnam

Figure 5.3-4 Typical Cross Section of Expressway in Vietnam

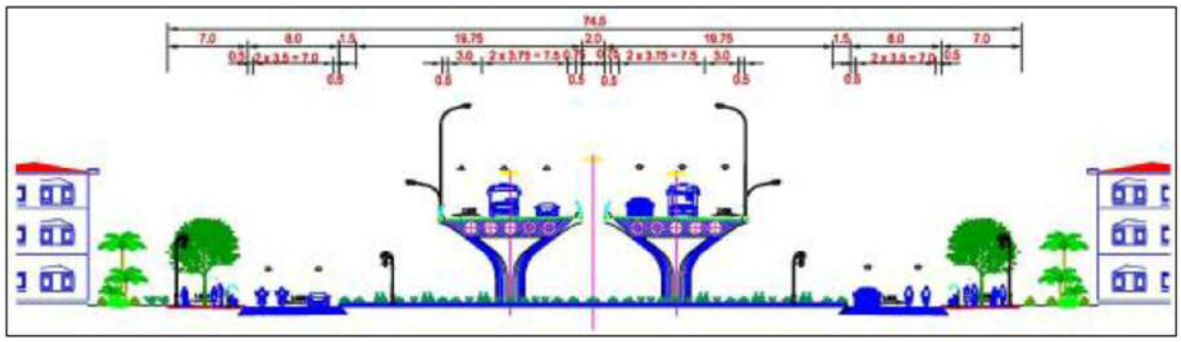
(2) RR 3 in HCM

The typical cross-sections of embankment and flyovers (viaducts) for the 1st stage of the design consist of 4-lane expressway with 2-lane service roads on each side as shown in Figure 5.3-5 and 5.3-6 respectively. The typical cross-section of embankment for the ultimate stage consists of 8-lane expressway with 2-lane service roads on each side as shown in the Figure 5.3-7. Generally, the limit of land acquisition is the construction limit plus 3 m on both sides. Unit cost of 1 km is estimated to be USD 19 to 29 million/km with bridge ratio of 9 to 33% as shown in Table 5.3-2.



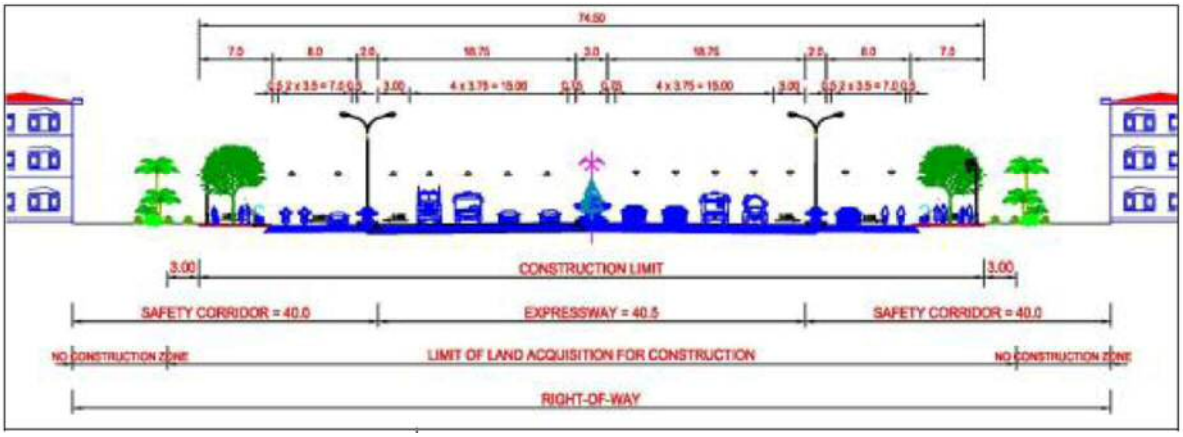
Source: ADB Technical Assistance on Ho Chi Minh Outer Ring Roads

Figure 5.3-5 Typical Cross Section of Embankments for RR 3 in Phase 1



Source: ADB Technical Assistance on Ho Chi Minh Outer Ring Roads

Figure 5.3-6 Typical Cross Section of Flyovers on RR 3 in Phase 1



Source: ADB Technical Assistance on Ho Chi Minh Outer Ring Roads

Figure 5.3-7 Typical Cross Section of Embankments for RR 3 in Final Phase

Table 5.3-2 Cost of RR 3 in HMC

1st stage	Total Length	Cost	Cost/km	Length of Bridge
Section 1	26.4 km	USD 761 M	USD 29 M/km	8.4 km (32%)
Section 3	17.9 km	USD 451 M	USD 25 M/km	5.9 km (33%)
Section 4	28.3 km	USD 550 M	USD 19 M/km	2.5 km (9%)

Source: ADB Technical Assistance on Ho Chi Minh Outer Ring Roads

5.4 Toll Fee

For 15 km section from HCM to Ben Luc, toll fee for passenger car is VND 15,000. Unit toll fee of Ho Chi Minh - Trung Luong expressway for passenger car is 1,000 VND/km (0.05 USD/km) as shown in Table 5.4-1. Unit toll fee of Cau Gie - Ninh Binh expressway for passenger car is 1,500 VND/km (0.075 USD/km) as shown in Table 5.4-1. The unit toll fee for trucks of a tonnage of 18 tons or over and 40 ft-container Lorries is 6,000 VND/km (0.3 USD/km) in both expressways.

Table 5.4-1 Ho Chi Minh - Trung Luong Expressway

No	Category	Toll fee (VND/km)	Toll fee (USD/km)
1	Cars of under 12 seats, trucks of a tonnage of under 2 tons and mass transit buses	1,000	0.05
2	Cars of between 12 and 30 seats, trucks of a tonnage of between 2 tons and under 4 tons	1,500	0.075
3	Cars of between 12 and 30 seats, trucks of a tonnage of between 2 tons and under 4 tons	2,200	0.011
4	Trucks of a tonnage of between 10 and under 18 tons and 20 ft-container lorries	4,000	0.20
5	Trucks of a tonnage of 18 tons or over and 40 ft-container lorries	6,000	0.30

Source: Survey team

Table 5.4-2 Cau Gie - Ninh Binh Expressway

No	Category	Toll fee (VND/km)	Toll fee (USD/km)
1	Cars of under 12 seats, trucks of a tonnage of under 2 tons and mass transit buses	1,500	0.075
2	Cars of between 12 and 30 seats, trucks of a tonnage of between 2 tons and under 4 tons	2,000	0.10
3	Cars of between 12 and 30 seats, trucks of a tonnage of between 2 tons and under 4 tons	3,000	0.15
4	Trucks of a tonnage of between 10 and under 18 tons and 20 ft-container lorries	3,500	0.175
5	Trucks of a tonnage of 18 tons or over and 40 ft-container lorries	6,000	0.30

Source: Survey team

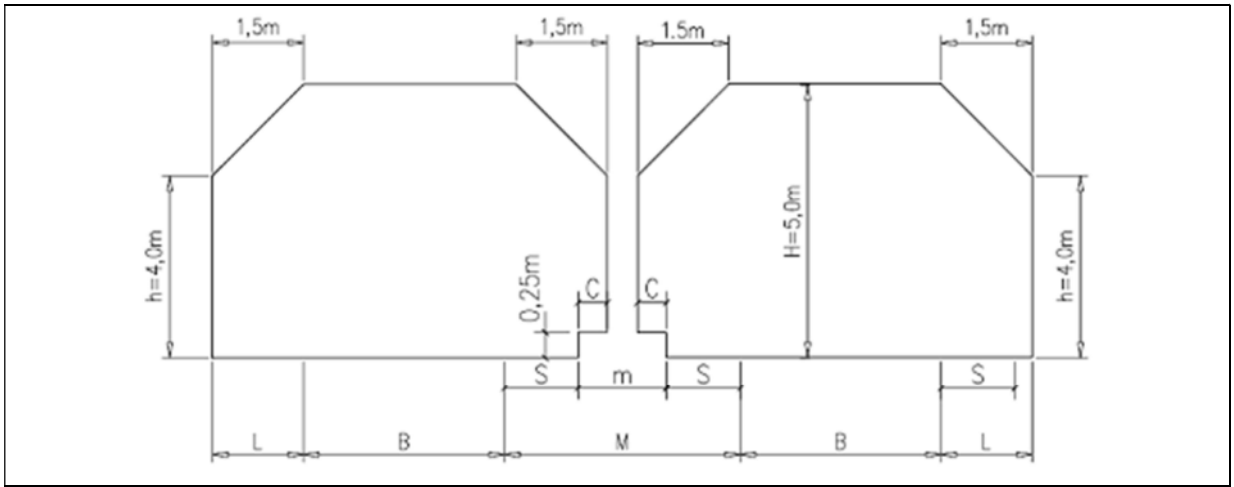
5.5 Technical Standard

TCVN 5729 Expressway standard of design is specified in 2007 as shown in Table 5.5-1. Expressways are divided into 4 grades. Figure 5.5-1 shows navigation clearance. Figure 5.5-2 and Table 5.5-2 show design standard of cross section.

Table 5.5-1 Expressway Grades and Design Speed

	Category	Design speed
1	Grade 60	60 km/h
2	Grade 80	80 km/h
3	Grade 100	100 km /h
4	Grade 120	120 km/h

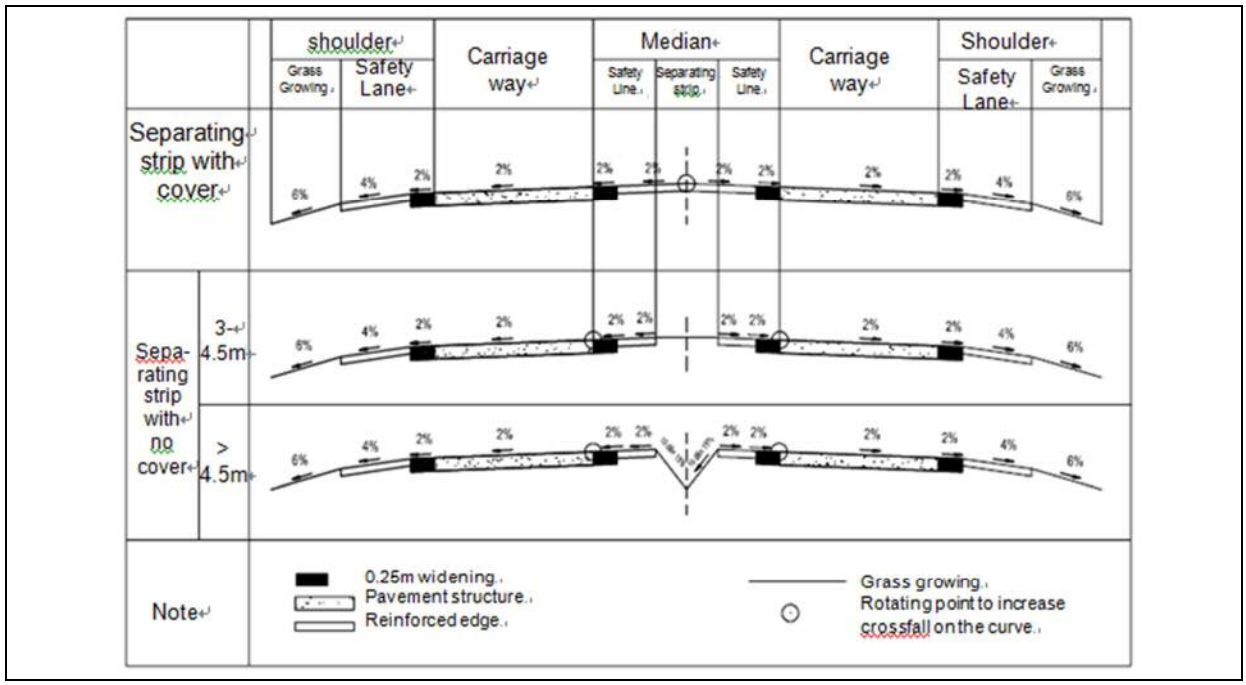
Source: TCVN 5729 Expressway standard of design in 2007, Vietnam



m: Width of separating strip
B: Width of the carriageway (road surface), measured in meter
M: Width of median strip
L: Width of hard shoulder (excluding the grass shoulder)
S: Wdth of the emergency strip

Source: TCVN 5729 Expressway standard of design in 2007, Vietnam

Figure 5.5-1 Navigation Clearance on Expressway



Source: TCVN 5729 Expressway standard of design in 2007, Vietnam

Figure 5.5-2 Cross Sectional Arrangement

Table 5.5-2 Design Standard of Cross Section

Structure of separating strip	Express-way grades	Shoulder		Carriage-way	Median			Carriage-way	Shoulder		Road width
		Grass-growing	Safety Lane (reinforced shoulder)		Safety lane	Separating strip	Safety lane		Safety lane	Grass-growing	
1. with cover without column (Lighting pole)	60	0.75	2.5	7.0	0.50	0.5	0.50	7.0	2.5	0.75	22.0
	80	0.75	2.5	7.5	0.50	0.5	0.50	7.5	2,5	0.75	23.0
	100	035	3.0	7.5	0.75	0.5	0.75	7.5	3.0	0.75	24.5
	120	1.00	3 0	7.5	0.75	1.0	0.75	7.5	3.0	1.00	25.5
2. with cover and column (Lighting pole)	60	0.75	2 5	7.0	0.50	1.5	0.50	7.0	2.5	0.75	23.0
	80	0.75	2.5	7.5	0.50	1.5	0.50	7.5	2.5	0.75	24.0
	100	0,75	3.0	7.5	075	1.5	0.75	7.5	3.0	0.75	25.5
	120	1.00	3.0	7.5	0.75	1.5	0.75	7.5	3.0	1.00	26.0
3. without cover	60	0.75	2.5	7.0	0.50	3.0	0.50	7.0	2.5	0.75	24.5
	80	0.75	2.5	7.5	0.50	3.0	0.50	7.5	2.5	0.75	25.5
	100	0.75.	3.0	7.5.	0.75	3.0	0,75	7.5	3.0	0.75	27.0
	120	1.00	3.0	7.5	0.75	3.0	0.75	7.5	3.0	1.00	27.5

Source: TCVN 5729 Expressway standard of design in 2007, Vietnam

CHAPTER 6 EXPRESSWAY NETWORK IN THAILAND

6.1 Classification of Expressways in Thailand

Expressways in Thailand are classified into two categories:

- Expressways usually mean urban expressways which are constructed and operated by Expressway Authority of Thailand (EXAT).
- Motorways mean inter-urban motorways which are constructed and operated by Department of Highway (DOH) of Ministry of Transport and Communication

As a summary, motorway refers to inter-urban expressway/motorway while expressway refers to urban expressway / motorway.

6.2 Existing Expressways

(1) Inter-Urban Motorway

Currently only two routes (Srinakarin – Chonburi (Bangphra); 80 km and Bang Pa In – Wat Salut; 75 km) are open to traffic. As described later, Thai government has not pay much attention to inter-urban motorways.

(2) Urban Expressway

Currently, ten sections with total length of 207.9 km are open to traffic, as shown in Figure 6.2-1.

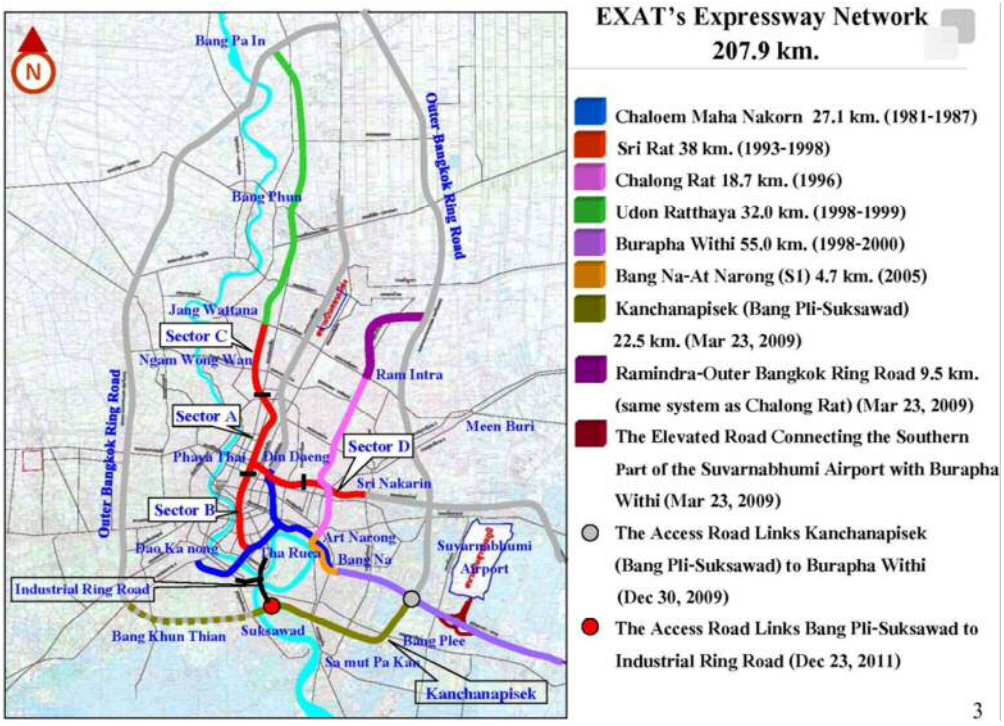


Figure 6.2-1 Urban Expressways Open to Traffic

6.3 Expressway Network Plan

(1) National Motorway Network

Construction and operation of interurban motorway network is the responsibility of DOH. A master plan for national motorway network with a total length of approximately 4,150 km was prepared in 1991 with a technical assistance of JICA. However, very little of this network master plan has been actually implemented by now. DOH explains the reason for not implementing the motorway master plan prepared by JICA as follows:

- Most of the routes motorways were planned to be parallel to the ordinary national highways, and it was anticipated that motorways and ordinary national highways compete with each other.
- Thai government focused on the improvement of ordinary national highways (widening into separated 4-lane or wider) and there has been little necessity of motorways.

DOH also explained that improvement of ordinary national highway network is now approaching its completion and Thai government is considering commencing construction of national motorway network and is reviewing the network plan.

(2) Unban Expressway Network

Four projects are either being studied or under construction in and around Bangkok Metropolitan area. Figures 6.3-1 to 6.3-5 show these projects. In addition to these, 4 projects which extends towards outside of Bangkok area are being studied. Figures 6.3-6 to 6.3-9 show these projects. Further, regional urban expressways are being studied around three major cities (Chiang Mai, Phuket and Koh Kaen), as shown in Figure 6.3-10.

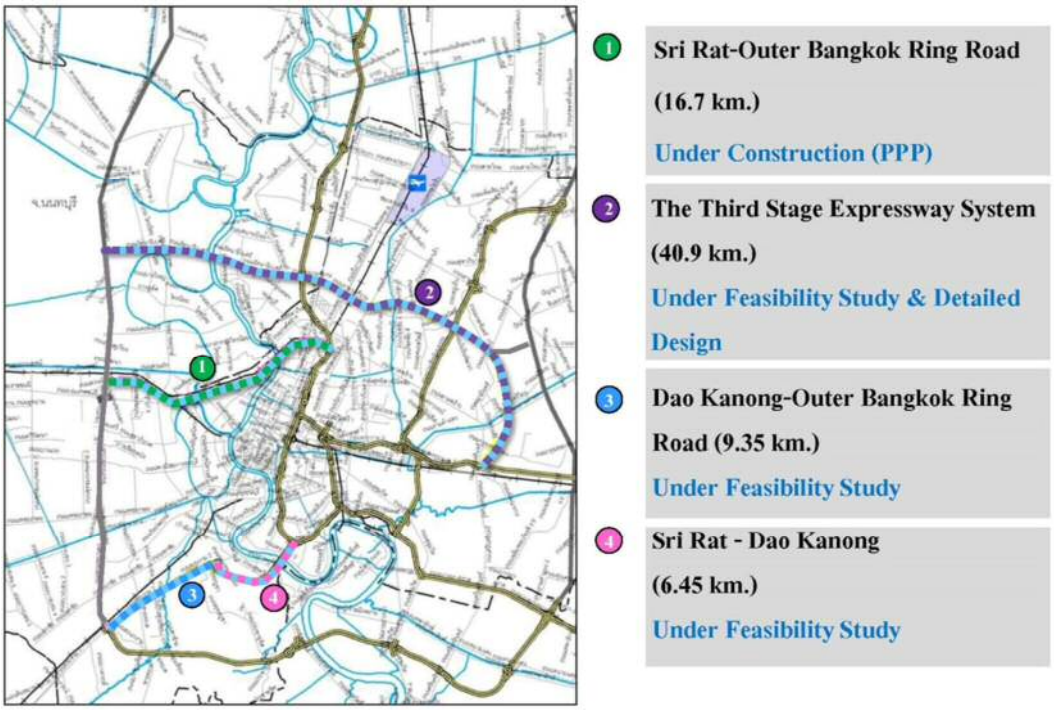


Figure 6.3-1 Urban Expressways under Construction and Plan Around Bangkok

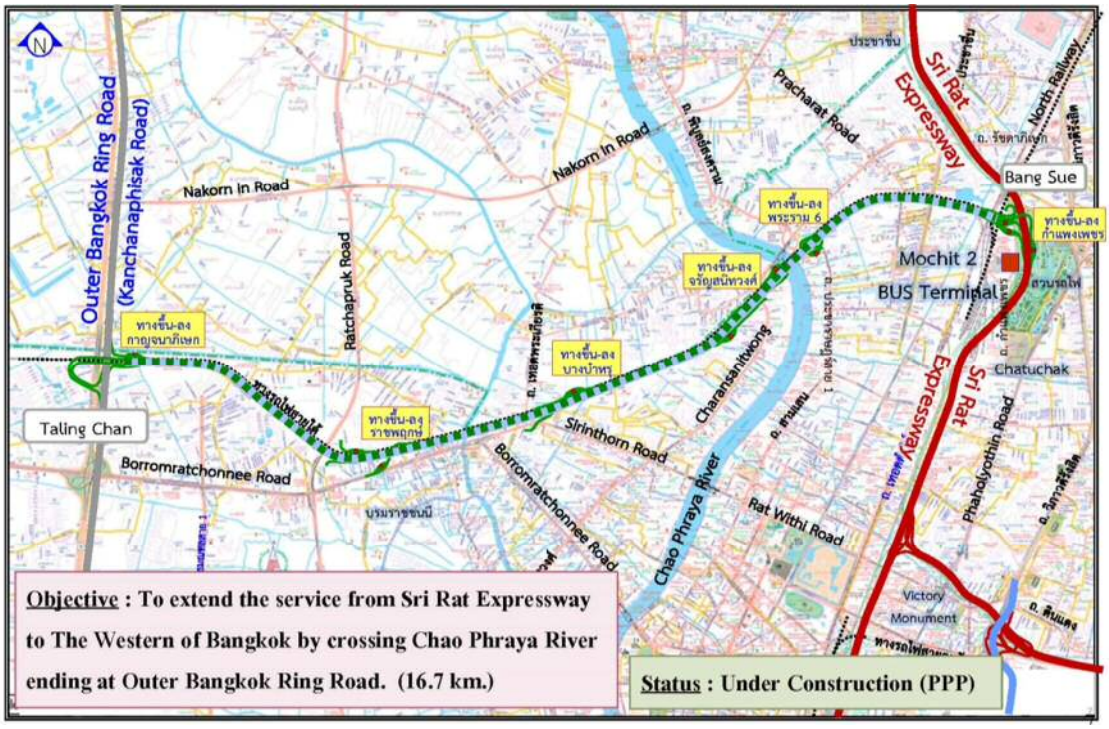


Figure 6.3-2 Sri Rat - Outer Bangkok Ring Road Expressway

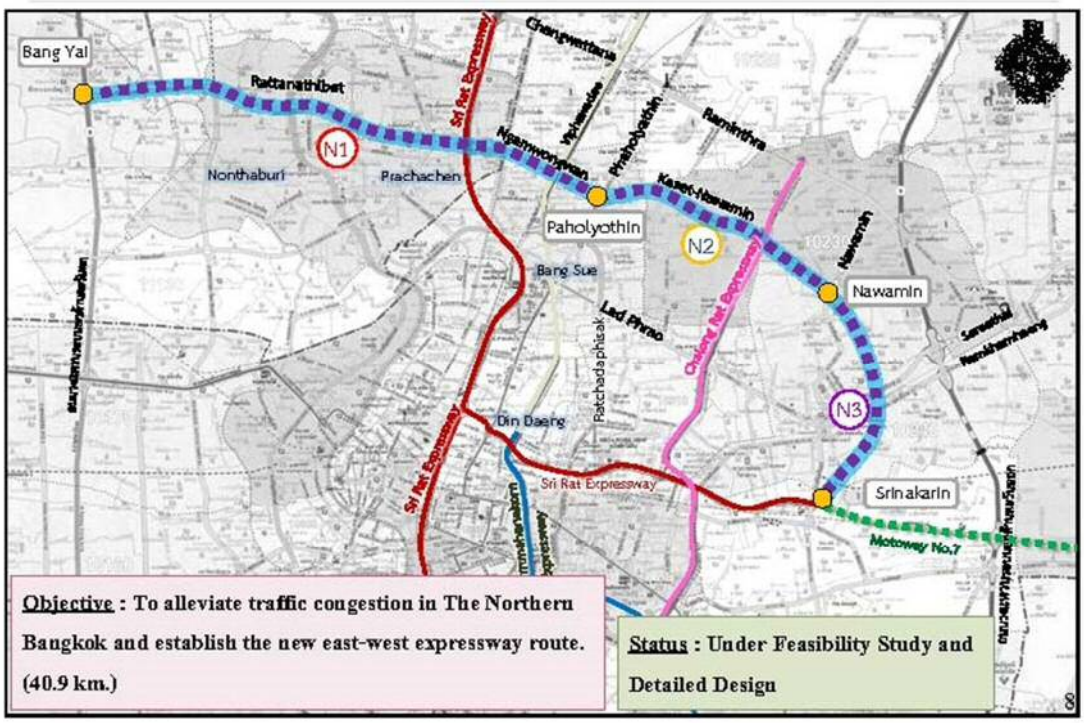


Figure 6.3-3 Third Stage Expressway

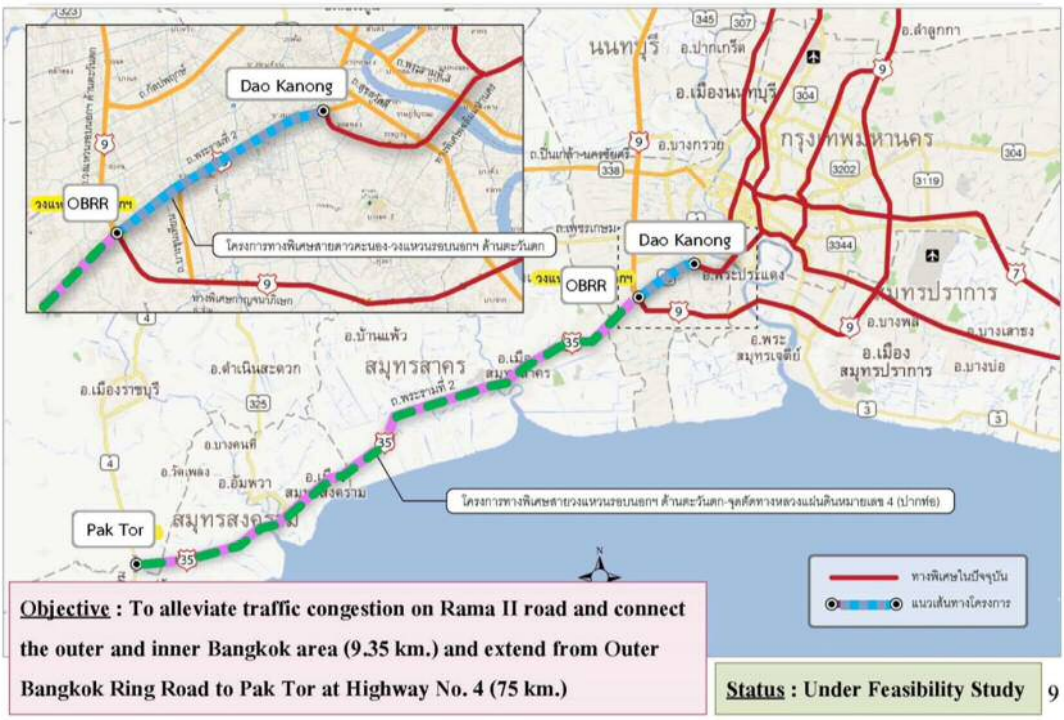


Figure 6.3-4 Dao Kanong - Outer Bangkok Ring Road Expressway

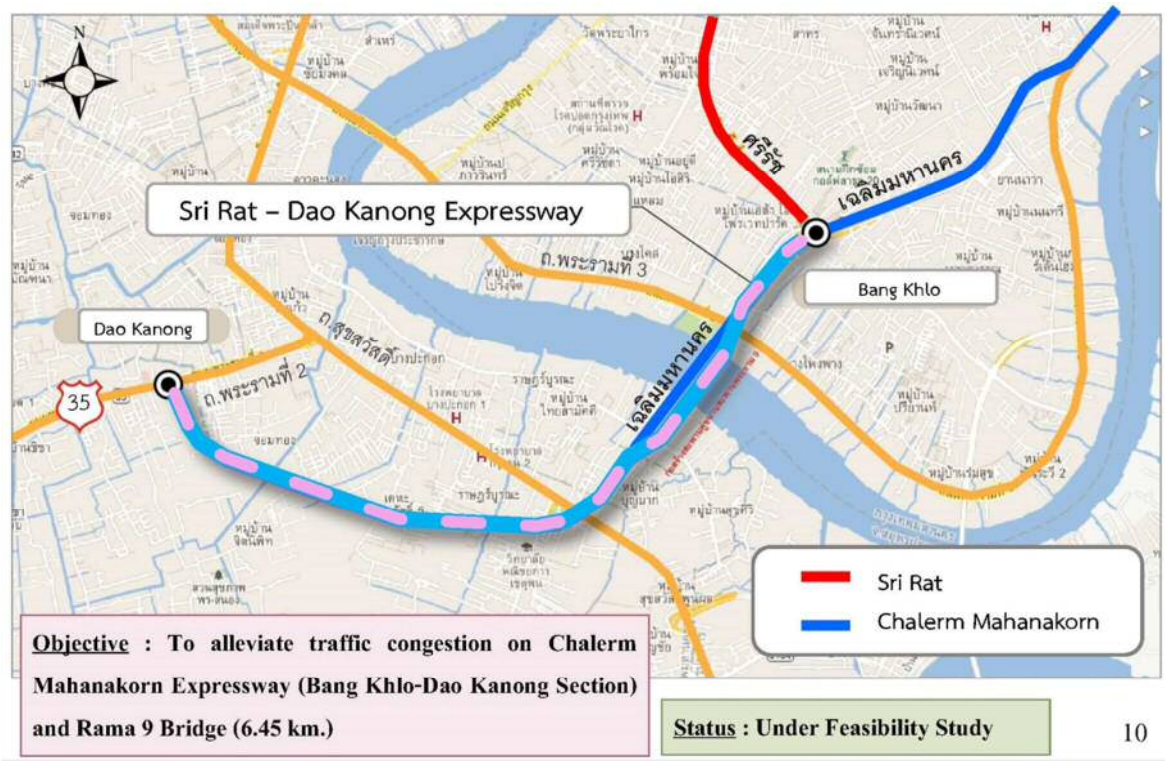
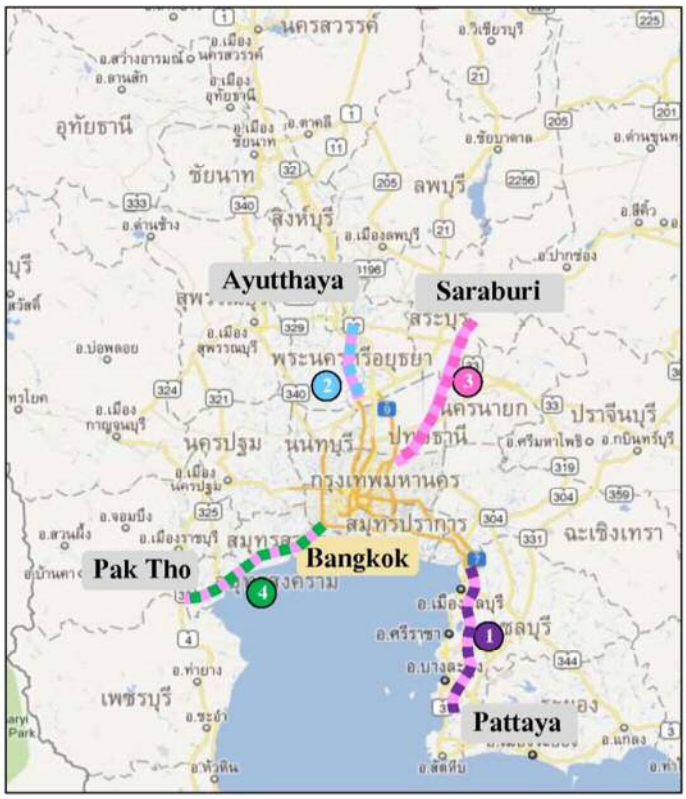


Figure 6.3-5 Sri Rat - Dao Kanong Expressway



1 **Burapha Withi-Pattaya**
(57 km.)
Under Feasibility Study

2 **Udon Ratthaya-Ayutthaya**
(23 km.)
Under Feasibility Study

3 **Chalong Rat-Saraburi**
(63 km.)
Under Feasibility Study

4 **Bangkok Outer Ring Road-Pak Tho**
(75 km.)
Under Pre-Feasibility Study

11

Figure 6.3-6 Inter - City Expressway Projects

Burapha Withi-Pattaya Expressway

Objective : Extending expressway network to Eastern Part of Thailand. It's also transportation route to Laem Cha Bang Industrial district and Laem Cha Bang Port as well.

Route : The six-lane elevated expressway connects Burapha Withi Expressway at Chonburi Toll Plaza. The route goes along the Southern Corridor of Highway No.3 till the end of South Pattaya.

Distance : 57 km.

Status : Under the feasibility study

12

Figure 6.3-7 Burpha Withi - Pattaya Expressway

Udon Rattaya-Ayutthaya Expressway

Objective : Extending expressway network to the Central and Northern Part of Thailand

Route : The six-lane elevated expressway connects from Udon Ratthaya Expressway at Bang Pa In. The route goes along the Highway No.347 and ending at Highway No.32 in Bang Pa Hun District (Ayutthaya).

Distance : 35 km.

Status : Under selecting the consultants for the feasibility study

13

Figure 6.3-8 Udon Rattaya - Ayutthaya Expressway

Chalong Rat-Saraburi Expressway

Objective : Extending expressway network to the Northeastern Part of Thailand

Route : The six-lane elevated expressway links from Chalong Rat Expressway at Chatuchot Toll Plaza and head towards to Northeastern across Highway No.305 (Rangsit-Nakhon Nayok) and No.33. The route is ending at Saraburi Province.

Distance : 63 km.

Status : Under preparing the TOR

14

Figure 6.3-9 Chalong Rat - Saraburi Expressway

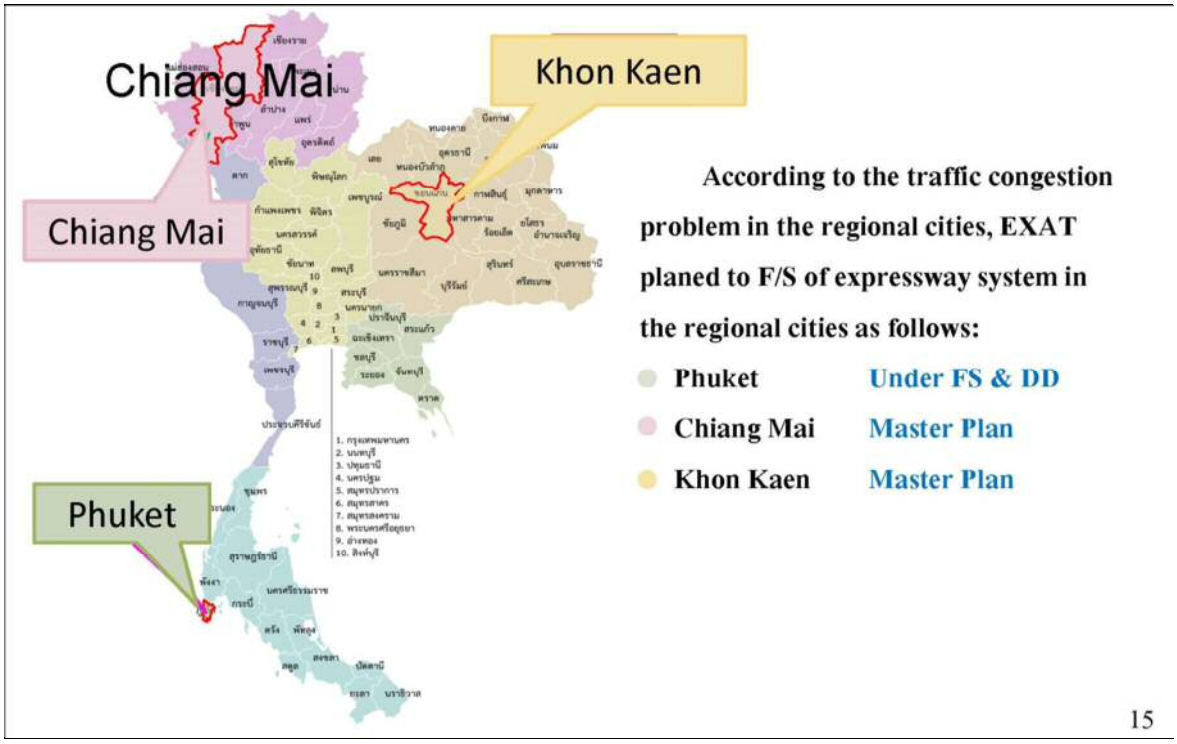


Figure 6.3-10 Regional Expressway Project

(3) International Connectivity

Although relatively little attention has been paid to construction of national motorway network, DOH considers that the existing condition of ordinary national highway network with mostly separated 4-lane or more is sufficient to cater international logistic.

According to DOH, the first priority route of motorway for international logistics is the route connecting to Myanmar (Bang Yai - Kanchanaburi). Priority of connection to Cambodia is currently low and there is no concrete plan for constructing motorway towards Poipet.

Cross-border point with Cambodia has been agreed with Cambodian government to be moved to a new location near the existing one and the existing check point will be used for passengers only in the future.

In the opinion of EXAT, connection to Malaysia is the first priority, followed by connection of Myanmar - Laos - China.

6.4 Design Standard

Main points of design standards for inter-urban motor ways are as summarized below:

- Design speed: 120 km/hr for flat terrain
- Lane width: 3.6 m (may vary depending on the road class)
- Shoulder width: 3.0 m (left shoulder) 1.0 m (right shoulder)

- Max. grade: 3% (flat terrain) - 5% (mountainous terrain)
- Pavement: 25 cm - thick cement concrete or 10 cm - thick AC; AC is adopted more frequently than cement concrete pavement for lower initial cost.

6.5 Fund

Fund source for inter-urban motorways constructed by DOH is the government's general account (tax). PPP was announced for the motorway between Bangkok and Kanchanaburi about 10 years ago, but there was no offer of private investment.

Fund source for urban expressways constructed by EXAT are varied. Japanese Yen loan and other ODA loans have been widely used. Up to year 2000, such ODA loans were regarded as the main fund source. Recently, PPP is being looked as the new funding scheme. When a project for PPP is not attractive to the investors and yet the expressway needs to be constructed as scheduled, some incentive is given to make the project financially attractive. (BOT was adopted in the so-called Bangkok Second Stage Expressway (a part of Chaleon Maha Nakorm Expressway). The A Japanese contractor constructed this expressway and the Thai government bought is after it was completed. Thus, it was not operated by the private investor who constructed it.

Foreign loans became serious financial burden to EXAT as the exchange rate between Thai Baht and international currency, such as US Dollar, become unfavorable after the Asian Financial Crisis of 1997. Thus, EXAT recommends use of domestic fund to the maximum extent.

6.6 Toll Rate

Toll rate of inter-urban motorways is 1.0 Baht/km (USD 0.03 /km). This low toll rate is due to (i) no VAT is applied and (ii) the toll is set to cover maintenance and operation cost only (construction cost is covered by tax). On the other hand, toll rate of EXAT expressways are set at the level to cover construction cost and include VAT. In general, toll level of EXAT expressways is 4 ~ 5 Baht/km.

6.7 Organization

EXAT has about 5,000 staff including field crew (toll collector etc.). Figure 6.7-1 shows the organizational structure of EXAT.

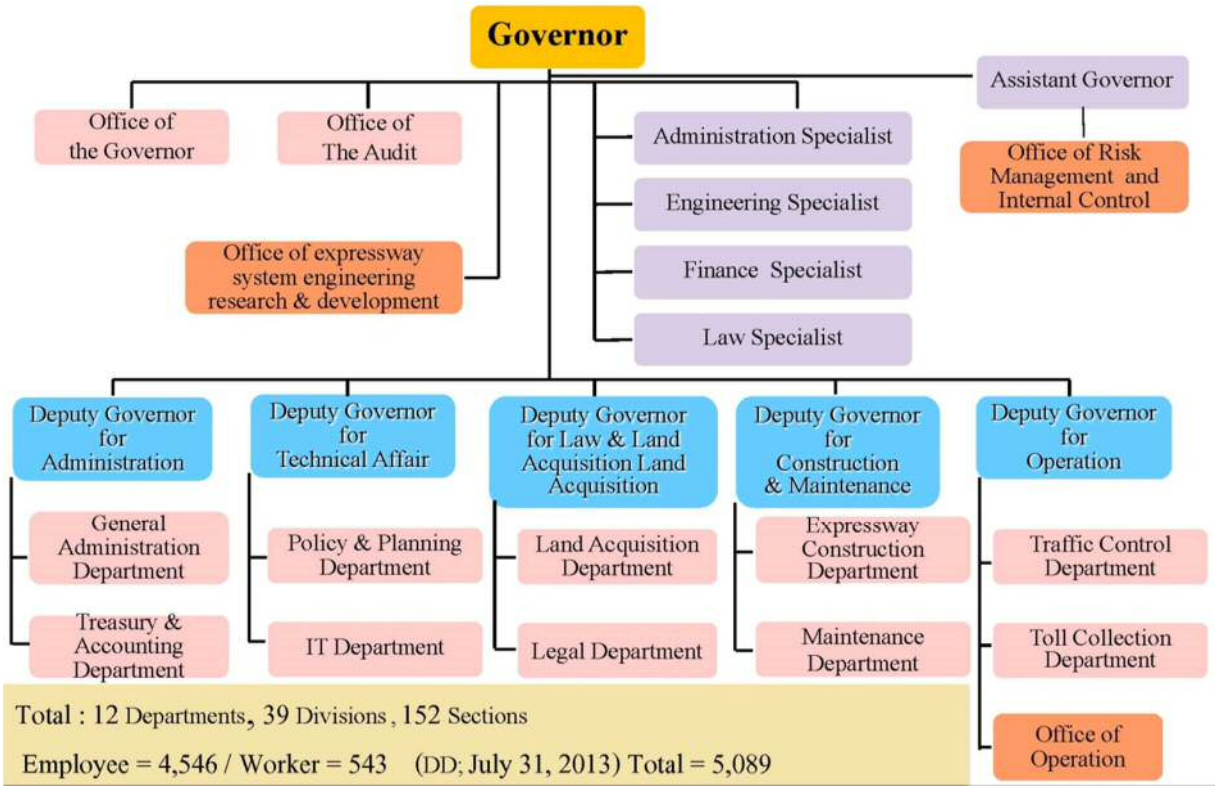


Figure 6.7-1 Organizational Structure of EXAT

CHAPTER 7 RECOMMENDATION ON EXPRESSWAY IN CAMBODIA

Based on the discussions stated above, the followings are recommended on the development of the expressway network in Cambodia. Please note that these recommendations are made based on the results of the Survey conducted in a relatively short time period, and thus, are subject to adjustment after more detailed survey will be conducted.

7.1 Traffic Demand Forecast of Expressway

As the very basic of discussion on the expressway network, traffic demand forecast on the expressways is stated here. The most important feature of traffic demand forecast is so-called 'diversion rate'. This refers to the ratio of traffic demand on expressway to the total traffic demand along the corridor including national and provincial roads. Road users evaluate the value of benefits obtained through use of expressway (toll road) and compares with the toll charge. Only though who find the benefit is larger than the toll fee would divert to the expressway. In this Survey, however, the available information / data are insufficient to estimate the diversion rate. Thus, approximate estimation is adopted.

(1) Methodology of Traffic Demand Forecast

Methodology of Traffic Demand Forecast in this survey consists of three steps as shown in Table 7.1-1, which were generated utilizing the existing traffic survey data and traffic demand analysis results from the past survey.

(a) Step 1

The 1st step is calculation of ratio of Light Vehicle (LV) and Heavy Vehicle (HV) to the total traffic volume (denoted as NR). Motorcycles are not allowed to enter expressways. The ratio of Light Vehicle (LV) and Heavy Vehicle (HV) to the total traffic volume on each National Road is calculated based on the data shown in the report of "Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor", JICA, 2013 (hereinafter referred to as 'JICA Data Collection Survey').

The ratio of (LV/HV) /NR is calculated based on the traffic volumes on the existing national roads as shown in Table 7.1-1.

(b) Step 2

The 2nd step is calculation of ratio; R (Exp) of Expressway traffic to both National Road (NR) and Expressway traffic. Detail data such as toll fee, length of access road to expressway, difference of travel time between Expressways and National highways are not specified at this moment. Survey team used the ratio of 52% as R (Exp) by analyzing traffic data of the neighbor country. Traffic data of the Ho Chi Minh - Trung Luong Expressway and National highway 1 was used for calculation of R (Exp).

(c) Step 3

The 3rd step is calculation of traffic volume on expressway in future. Future Traffic volumes on National Roads were calculate through by JICA Data Collection Survey. The road network on the survey does not include Expressway network. Therefore, this Future Traffic Volume; T (NR) on National Roads is considered to include traffic volume of expressways as well as that of National Roads. The traffic volume of expressway is considered to be included in T (NR). Future traffic volume at each location of each expressway; T (Exp) shall be calculated by multiplying T (NR), R (NR) (LV/HV), and R (Exp).

Table 7.1-1 Methodology of Traffic Demand Forecast

	Description	Remarks
Step 1	Calculation of ratio of Light Vehicle (LV) and Heavy Vehicle (HV) to the total traffic volume	R (NR) (LV/HV) NR= Traffic Volume on National Road
Step 2	Calculation of ratio of Expressway traffic to both National Road and Expressway traffic.	R (Exp)
Step 3	Calculation of Expressway traffic volume	T (Exp) =T (NR) x R (NR) (LV/HV) x R (Exp)

Source: Study team

(2) Existing Traffic Volume

(a) Vehicle Classification

Vehicles are classified as shown in Table 7.1-2.

Table 7.1-2 Vehicle Classification for Traffic Count

Group		Classification	
I	Motor Cycle (MC)	1	Motorbike and Motodop
		2	Tuk - tuk
		3	Motorumo
II	Light Vehicle (LV)	4	Sedan, Wagon, Van
		5	Taxi
		6	Mini Bus
		7	Light Truck / Pick Up
		8	Truck (2 axles)
III	Heavy Vehicle (HV)	9	Medium and Large Bus
		10	Truck (More than 3 axles)
		11	Semi & Full Trailer (with Container or Load)
		12	Semi & Full Trailer (without Container or non-load)
		13	Tank lorry

Source: Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor

(b) Passenger Car Unit

In the traffic assignment, traffic volume is expressed in the form 'Passenger Car Unit' (PCU). The PCU equivalents used in this survey are shown in Table 7.1-3.

Table 7.1-3 PCU Factor

Categories	MC	LV	HV
PCU Equivalents	0.30	1.25	3.00

Source: Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor

Usually, PCU of sedan and pick-up truck is set at 1.0. In this survey, PCU of Light Vehicle (LV) is set at 1.25 considering that this category includes light truck, pick-up truck and 2 axle truck whose speeds are slower than passenger cars because of the cargo and, as a consequence, their contribution to traffic congestion is larger than ordinary passenger car.

(c) Existing Traffic Volume

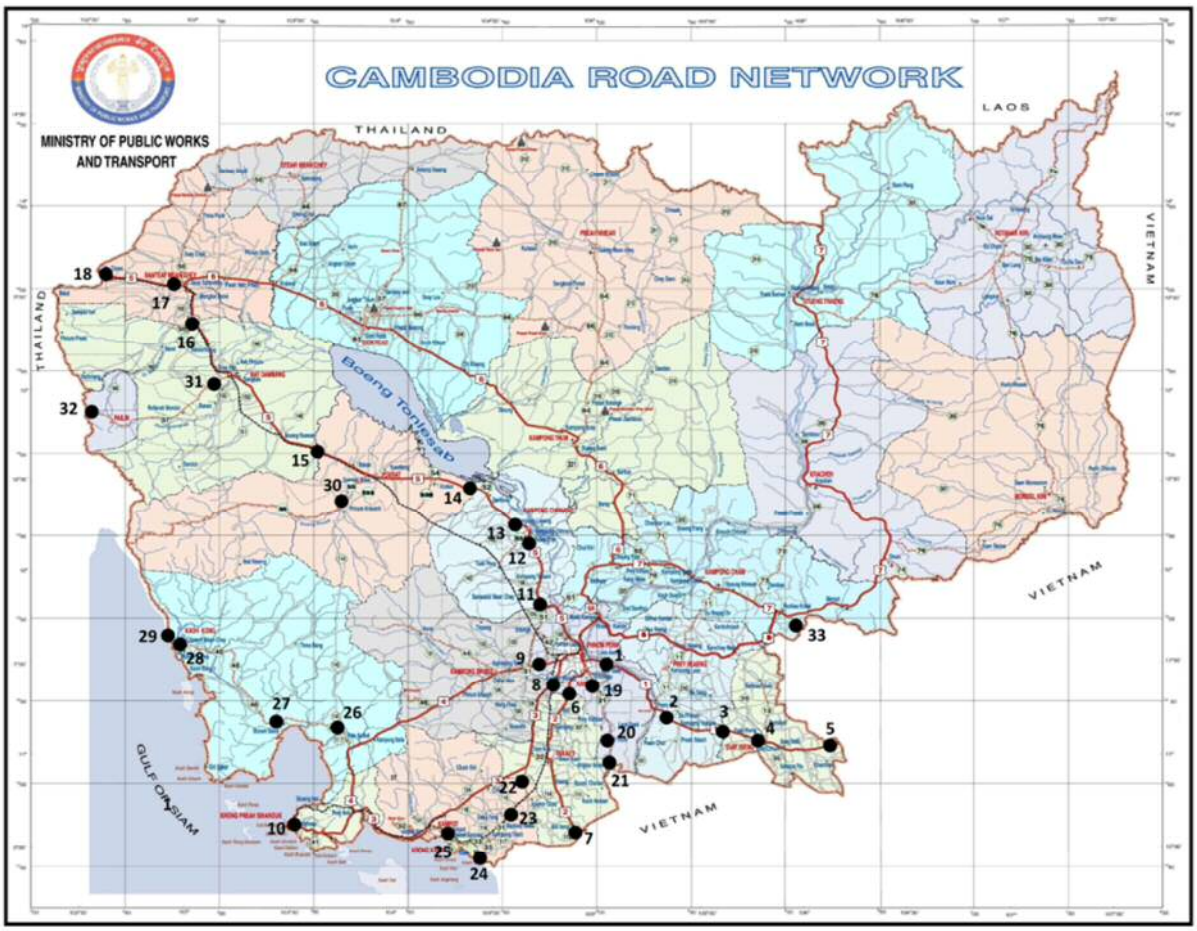
Existing Traffic Volume and location of traffic survey are shown in Table 7.1-4 and Figure 7.1-1 respectively.

Table 7.1-4 Existing Traffic Volume in Cambodia

Unit: PCU

Location No.	National Road No.	MC	LV	HV	Total	Year	Remarks
1	1	4,482	5,745	1,689	11,916	2012	PP boundary
2	1	2,573	4,220	1,239	8,032	2011	PK 64+200
3	1	786	2,179	1,416	4,381	2013	Provincial Boundary
4	1	2,305	2,636	726	5,667	2011	PK 123+500
5	1	1,719	2,447	1,176	5,342	2013	Bavet
6	2	2,733	4,319	894	7,946	2012	PP boundary
7	2	1,251	782	1,050	3,083	2013	Vietnam Border
8	3	2,638	6,433	2,703	11,774	2012	PP boundary
9	4	4,751	9,888	4,299	18,938	2013	PP boundary
10	4	1,716	3,675	3,987	9,378	2013	Sihanoukville
11	5	1,718	4,735	3,855	10,308	2012	Provincial Boundary
12	5	1,691	3,705	3,288	8,684	2012	Kampong Chhnang
13	5	991	2,654	2,829	6,474	2012	Kampong Chhnang
14	5	260	2,173	2,730	5,163	2012	Provincial Boundary
15	5	475	2,075	3,567	6,117	2012	Provincial Boundary
16	5	1,169	2,853	2,328	6,350	2012	Provincial Boundary
17	5	1,070	4,591	2,436	8,097	2011	Jct NR 5 and NR 6
18	5	1,144	5,207	2,289	8,640	2013	Poipet

Source: Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor



Source: Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor

Figure 7.1-1 Location of Traffic Volume Survey

(3) Future Traffic Volume on National Roads on Data collection survey in 2013, JICA

(a) Data collection survey in 2013, JICA

Forecast of the future traffic demand is calculated based on existing traffic volume and depends on road improvement planning and economic analysis. Methodology and data used in the traffic demand forecast on "JICA Data Collection Survey" are described hereafter, together with the result of the forecast. In the estimation of future traffic demand, target years are set at 2020 (medium-term plan) and 2030 (long-term plan). Preconditions of traffic volume estimated in "JICA data collection survey" are as follows.

(i) Socio-economic data

The OD table prepared by "Preparatory Survey for National Road 5 (South Section) Rehabilitation Project in 2012" was modified and traffic demand forecasting was computed. In computing transport demand forecasting, the following future economic indicators were used. Future Populations are shown in Table 7.1-5. The future GDP growth rates are shown in Table 7.1-6.

Table 7.1-5 Future Population in Cambodia

Unit :Person

Year	2013	2020	2030
Population	14,962,591	16,505,444	18,390,683

Source: "General Population Census of Cambodia 2008, Population Projections of Cambodia", National Institute of Statistics, Ministry of Planning

Table 7.1-6 GDP growth

Year	2013 - 2020	2020 - 2030
GDP growth	6.3%	5.6%

Source: Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor

(ii) Freight Traffic Demand

The southern Railway Line (SL) is operating between Phnom Penh and Shihanoukville, where National Road 4 (NR 4) runs along. The rehabilitation work of SL with the assistance of ADB was completed in December 2012, and SL operates experimentally now. In the briefing sheet by ADB which took effect on ADB in November, 2012, it is assumed that a railway takes 40% of carriage of goods between Phnom Penh and Shihanoukville after the start of service of the SL. When the network of railway was developed in Japan, railway share for transportation of 1,000 km or more is assumed 6%, and that for transportation of 100 km to 300 km is 1%. It is therefore considered that ADB indication of 40% seems relatively too high. In this forecasting, it was assumed that 20% of heavy vehicle is converted into a railway.

(iii) Future Network Scenario

The road network was set as future road network including on-going projects, road rehabilitation, Neak Leung Bridge, and road widening in the Southern Economic Corridor (SEC), Phnom Penh ring road and other relative proposed road. In order to consider the evaluation of the road project, the survey team made a scenario of the future road network, which is shown in Table 7.1-7.

Table 7.1-7 Scenario of the Road Network

Road Section	Future Project
NR 1	PK 30 - Neak Leung 4 lanes
	1st Neak Leung Br.
	2nd Neak Leung Br.
Ring Road	Ring Road 2
	Ring Road 3 (NR 1 to NR 2) 4 lanes (NR 2 to NR 5) 4 lanes
NR 4	Whole Section 4 lanes
NR 5	Whole Section 4 lanes
	With Kampong Chhnang Bypass, Battambang Bypass and Sri Soporn Bypass
NR 6	Whole Section 4 lanes

Source: Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor

(iv) Future Traffic Volume on National Roads

Traffic volume by national road section in the future was estimated by "JICA Data Collection Survey" using traffic assignment program of JICA STRADA. JICA STRADA adopts 'the minimum paths method' in which the vehicles are assumed to take the path with the minimum cost (sum of travel time cost) among the road links of the network connecting the pair of OD zones. The traffic assignment results for the project case for 2020 and 2030 are shown in Table 7.1- 8.

Table 7.1-8 Future Traffic Volume on National Roads

Unit: PCU

Road	Section	Location	2020	2030
NR 1	1-1	Wat Phnom - Monivong Bridge	25,601	59,501
	1-2	Monibong Bridge - PK 9	29,868	44,696
	1-3	PK 9 - PK 30	25,958	39,552
	1-4	PK 30- Neak Loeung	14,762	43,890
	1-5	1st Neak Loeung Bridge	9,074	24,494
	1-6	2nd Neak Loeung Bridge	6,725	22,744
	1-7	Neak Loeung- Bavet	8,014	18,507
Phnom Penh Ring Road 3	RR 3-1	NR 1 KP 30 - NR 2	19,275	34,786
	RR 3-2	NR 2 - NR 5 PK 12	16,020	26,306
NR 2	2-1	Wat Phnom - Takhmau Roundabout	26,358	48,893
	2-2	TakhmauRoudabout- Takeo	12,667	15,070
	2-3	Takeo - PhnomDen	2,876	3,940
NR 3	3-1	Wat Phnom -Chaom Chao	39,727	57,416
	3-2	Chaom Chao - Kampot	12,979	16,858
	3-3	Kampot- Veal Rinh	3,299	5,321
NR 4	4-1	PK 12 - PK 18	27,939	55,851
	4-2	PK 18 - Kampon Speu (PK 48)	26,748	50,878
	4-3	Kampong Speu- PK 78	19,273	41,134
	4-4	PK 78 - PK 144	13,199	31,693
	4-5	PK 144 - Sihanoukville	12,248	23,514
NR 5	5-1	Wat Phnom - PrekKdam	36,925	51,744
	5-2	PrekKdam - ThleaM'am	18,121	36,864
	5-3	ThleaM'am - Battambong	14,368	30,344
	5-4	Battambang - Sri Sophorn	11,772	21,490
	5-5	Sri Sophorn - Poipet	13,951	21,703

Source: Data Collection Survey on the Trunk Road Network Planning for Strengthening of Connectivity through the Southern Economic Corridor

(4) Traffic Demand Forecast for Expressway

(a) Step 1: calculation of ratio of Light Vehicle (LV) and Heavy Vehicle (HV) to the Total Traffic.

Ratios of LV and HV on National highways are calculated in Table 7.1-9.

Table 7.1-9 Ratio of LV and HV

Unit: PCU

Road No.	Location	Motor Cycle	Light Vehicle	Heavy Vehicle	Total
		PCU	PCU	PCU	PCU
NR 1	1	4,482	5,745	1,689	11,916
	2	2,573	4,220	1,239	8,032
	3	786	2,179	1,416	4,381
	4	2,305	2,636	726	5,667
	5	1,719	2,447	1,176	5,342
	sub total	11,865	17,227	6,246	35,338
	Ratio (%)	**33%**	**49%**	**18%**	
NR 2	6	2,733	4,319	894	7,946
	7	1,251	782	1,050	3,083
	sub total	3,984	5,101	1,944	11,029
	Ratio (%)	**36%**	**46%**	**18%**	
NR 3	8	2,638	6,433	2,703	11,774
	Ratio (%)	**22%**	**55%**	**23%**	
NR 4	9	4,751	9,888	4,299	18,938
	10	1,716	3,675	3,987	9,378
	sub total	6,467	13,563	8,286	28,316
	Ratio (%)	**22%**	**49%**	**29%**	
NR 5	11	1,718	4,735	3,855	10,308
	12	1,691	3,705	3,288	8,684
	13	991	2,654	2,829	6,474
	14	260	2,173	2,730	5,163
	15	475	2,075	3,567	6,117
	16	1,169	2,853	2,328	6,350
	17	1,070	4,591	2,436	8,097
	18	1,144	5,207	2,289	8,640
	sub total	8,518	27,993	23,322	59,833
	Ratio (%)	**14%**	**47%**	**39%**	

Step 2: Calculation of ratio: R (Exp) of Expressway traffic to both National Road (NR) and Expressway traffic. R (Exp) is calculated based on traffic volume of National Highway 1 and Ho Chi Minh - Trung Luong Expressway. R (Exp) is 52% as shown in Table 7.1-10.

Table 7.1-10 Calculation of R (Exp)

	National Road	Expressway
Name of Roads	NH 1 in Vietnam	HCM - Trung Luong
Traffic volume Cars / day excluding motorbikes	18,656	20,106
Allocation	48%	52% R (Exp)

Source: Ministry of Transport of Vietnam and Survey Team

(b) Step 3: Calculation of Expressway traffic volume

Traffic Demand of Expressways (CPU) is calculated as shown inn Table 7.1-11. Traffic Demand of Expressways (vehicle) is calculated as shown in Table 7.1-12.

Table 7.1-11 Traffic Demand of Expressways

Road	Section	Location	2020 (PCU)	2030 (PCU)	2020			2030		
					LV	HV	Total	LV	HV	Total
	1-1	Wat Phnom - Monivong Br	25,601	59,501	6,523	2,396	8,919	15,161	5,569	20,730
	1-2	Monibong Bridge - PK 9	29,868	44,696	7,610	2,796	10,406	11,389	4,184	15,572
	1-3	PK 9 - PK 30	25,958	39,552	6,614	2,430	9,044	10,078	3,702	13,780
	1-4	PK 30 - Neak Loeung	14,762	43,890	3,761	1,382	5,143	11,183	4,108	15,291
	1-5	1st Neak Loeung Bridge	9,074	24,494	2,312	849	3,161	6,241	2,293	8,534
	1-6	2nd Neak Loeung Bridge	6,725	22,744	1,714	629	2,343	5,795	2,129	7,924
	1-7	Neak Loeung- Bavet	8,014	18,507	2,042	750	2,792	4,716	1,732	6,448
Ring Road 3	RR 3-1	NR 1 KP 30 - NR 2	19,275	34,786						
	RR 3-2	NR 2 - NR 5 PK 12	16,020	26,306						
NR 2	2-1	Wat Phnom - Takhmau	26,358	48,893	6,305	2,467	8,772	11,695	4,576	16,272
	2-2	Takhmau - Takeo	12,667	15,070	3,030	1,186	4,216	3,605	1,411	5,015
	2-3	Takeo - PhnomDen	2,876	3,940	688	269	957	942	369	1,311
NR 3	3-1	Wat Phnom - Chaom Chao	39,727	57,416	11,362	4,751	16,113	16,421	6,867	23,288
	3-2	Chaom Chao - Kampot	12,979	16,858	3,712	1,552	5,264	4,821	2,016	6,838
	3-3	Kampot - Veal Rinh	3,299	5,321	944	395	1,338	1,522	636	2,158
NR 4	4-1	PK 12 - PK 18	27,939	55,851	7,119	4,213	11,332	14,231	8,422	22,653
	4-2	PK 18 - Kampon Speu	26,748	50,878	6,815	4,034	10,849	12,964	7,672	20,636
	4-3	Kampong Speu- PK 78	19,273	41,134	4,911	2,906	7,817	10,481	6,203	16,684
	4-4	PK 78 - PK 144	13,199	31,693	3,363	1,990	5,354	8,075	4,779	12,855
	4-5	PK 144 - Sihanoukville	12,248	23,514	3,121	1,847	4,968	5,991	3,546	9,537
NR 5	5-1	Wat Phnom - PrekKdam	36,925	51,744	9,024	7,488	16,513	12,646	10,494	23,140
	5-2	PrekKdam - ThleaM'am	18,121	36,864	4,429	3,675	8,104	9,010	7,476	16,486
	5-3	ThleaM'am - Battambong	14,368	30,344	3,512	2,914	6,425	7,416	6,154	13,570
	5-4	Battambang - Sri Sophorn	11,772	21,490	2,877	2,387	5,264	5,252	4,358	9,610
	5-5	Sri Sophorn - Poipet	13,951	21,703	3,410	2,829	6,239	5,304	4,401	9,706

Table 7.1-12 Traffic Demand of Expressways (vehicle)

Road	Section	Location	2020 (PCU)	2030 (PCU)	2020 (vehicle)			2030 (vehicle)		
					LV	HV	Total	LV	HV	Total
	1-1	Wat Phnom - Monivong Br	25,601	59,501	5,219	799	6,017	12,129	1,856	13,985
	1-2	Monibong Bridge - PK 9	29,868	44,696	6,088	932	7,020	9,111	1,395	10,505
	1-3	PK 9 - PK 30	25,958	39,552	5,291	810	6,101	8,062	1,234	9,296
	1-4	PK 30 - Neak Loeung	14,762	43,890	3,009	461	3,470	8,947	1,369	10,316
	1-5	1st Neak Loeung Bridge	9,074	24,494	1,850	283	2,133	4,993	764	5,757
	1-6	2nd Neak Loeung Bridge	6,725	22,744	1,371	210	1,581	4,636	710	5,346
	1-7	Neak Loeung- Bavet	8,014	18,507	1,634	250	1,884	3,772	577	4,350
Ring Road 3	RR 3-1	NR 1 KP 30 - NR 2	19,275	34,786						
	RR 3-2	NR 2 - NR 5 PK 12	16,020	26,306						
NR 2	2-1	Wat Phnom - Takhmau	26,358	48,893	5,044	822	5,866	9,356	1,525	10,882
	2-2	Takhmau- Takeo	12,667	15,070	2,424	395	2,819	2,884	470	3,354
	2-3	Takeo - PhnomDen	2,876	3,940	550	90	640	754	123	877
NR 3	3-1	Wat Phnom - Chaom Chao	39,727	57,416	9,090	1,584	10,673	13,137	2,289	15,426
	3-2	Chaom Chao - Kampot	12,979	16,858	2,970	517	3,487	3,857	672	4,529
	3-3	Kampot - Veal Rinh	3,299	5,321	755	132	886	1,217	212	1,430
NR 4	4-1	PK 12 - PK 18	27,939	55,851	5,695	1,404	7,099	11,385	2,807	14,192
	4-2	PK 18 - Kampon Speu	26,748	50,878	5,452	1,345	6,797	10,371	2,557	12,928
	4-3	Kampong Speu - PK 78	19,273	41,134	3,929	969	4,897	8,385	2,068	10,452
	4-4	PK 78 - PK 144	13,199	31,693	2,690	663	3,354	6,460	1,593	8,053
	4-5	PK 144 - Sihanoukville	12,248	23,514	2,497	616	3,112	4,793	1,182	5,975
NR 5	5-1	Wat Phnom - PrekKdam	36,925	51,744	7,220	2,496	9,716	10,117	3,498	13,615
	5-2	PrekKdam - ThleaM'am	18,121	36,864	3,543	1,225	4,768	7,208	2,492	9,700
	5-3	ThleaM'am - Battambong	14,368	30,344	2,809	971	3,781	5,933	2,051	7,984
	5-4	Battambang - Sri Sophorn	11,772	21,490	2,302	796	3,097	4,202	1,453	5,654
	5-5	Sri Sophorn - Poipet	13,951	21,703	2,728	943	3,671	4,243	1,467	5,710

7.2 Expressway Network in Cambodia

(1) Role of Expressway in Cambodia

(a) Segregates long distance traffic from local traffic

・Urbanization in Cambodia is expected to further progress. It is also expected that industrial development will intensify and be more extensive along main roads. While existing national roads require improvement, the development of expressways for segregating long distance traffic from local traffic is considered necessary to respond to the changing contexts.

(b) Facilitates the provision of competitive transportation services to ensure efficiency, safety, and amenity

・Cambodia is and will be a trade-oriented economy that requires efficient and effective transportation service. Expressways can offer a practical and realistic solution that reduce transportation costs and travel time along main corridors.

(c) Serves as strategic means to achieve regional development

・In expressway development planning, a route should be carefully selected in a way that expressway development can contribute to the development of the local communities. Expressway development should be integrated with urban development, industrial development, tourism and other area of development. Appropriate measures should be taken to promote economic development of the local communities through expressway development.

(d) Serves as core transportation corridor that works in conjunction with other key transportation modes

・High quality and efficient transportation services should be provided in Cambodia. For this reason, the expressway network plan needs to take the following points into account.

(i) Guarantee of connectivity among major cities, province capitals, and growth centers including major industrial zones, gateway ports and airports.

(ii) Realization of effective network configuration with national and major provincial roads, as well as urban roads.

(iii) Provision of the desired quality of passenger and freight transportation services by strengthening intermodal facilities, logistics, and road user service facilities.

(2) Design Standards for Route Selection in Cambodia

Route selection shall be carried out taking account of the major design controls as shown in Table 7.2-1. Alternative routes should be considered and discussed with local municipalities and all stakeholders so that an optimum route can be selected on the basis of consensus.

Table 7.2-1 Design Standards Route Selection in Cambodia

No	Category	Control points	Remarks
1	Natural	Large river, Lake, wetland, steep terrain, beach and preservation area, etc.	Keep appropriate distance to avoid unnecessary structure and earthwork
2	Social	City, Town village, etc.	Keep appropriate distance to support regional socio-economic development
3	Cultural	Cultural heritage, cemetery, temple / pagoda / church, etc.	Keep appropriate distance to avoid adverse effect to cultural activities
4	Industrial	Railways, port, airport, industrial zone, high voltage power line, etc.	Keep appropriate distance to avoid adverse effect to those facilities, consider appropriate connections to enable smooth transfer of people and goods
5	Agricultural	Paddy field, etc.	Minimize adverse effect to agricultural activities

(3) General Plan of Expressway Network in Cambodia

Based on the role of expressway and design standards for route selection in Cambodia as discussed above, Survey Team collected and studied the data as shown in Table 7.2-2.

Table 7.2-2 Data Collected and Studied by Survey Team

	Category	Remarks
1	National Roads development plan, Ring Roads development plan,	Expressway information in Vietnam and Thailand. Strategy of ASEAN / ASIAN / GMS
2	Sea and River Port, Railway, Airport development plan	
3	Demographic and economic data,	Population, Poverty level
4	Natural data	Landscape, Flood area
5	Industrial data	SEZ, Number of establishment
6	Protected area	

Considering the above, survey team proposes a rough idea of expressway network in Cambodia as an output of preliminary data collection survey before carrying out the study on Expressway Master Plan. Proposed expressway network is shown in Table 7.2-3 and Figure 7.2-1.

Table 7.2-3 Proposed expressway network in Cambodia

No.	Route	Related NRs	Length	Cost (USD mil)
E1	PP - Bavet	NR 1	135 km	1,350
E3	PP - Sihanoukville	NR 3 / 4	210 km	2,100
E5	PP - Poipet	NR 5	355 km	3,550
E6	PP- Sri Sophon	NR 6	400 km	4,000
E7	PP - Laos border	NR 7	335 km	3,350
E9	Siem Reap - Vietnam border	NR 66 + NR 78	390 km	3,900
E10	Krong Kep - Koh Kong	NR 33 + NR 48	220 km	2,200
UE	Phnom Penh Ring Road		155 km	1,550
	Total length		2,200 km	22,000

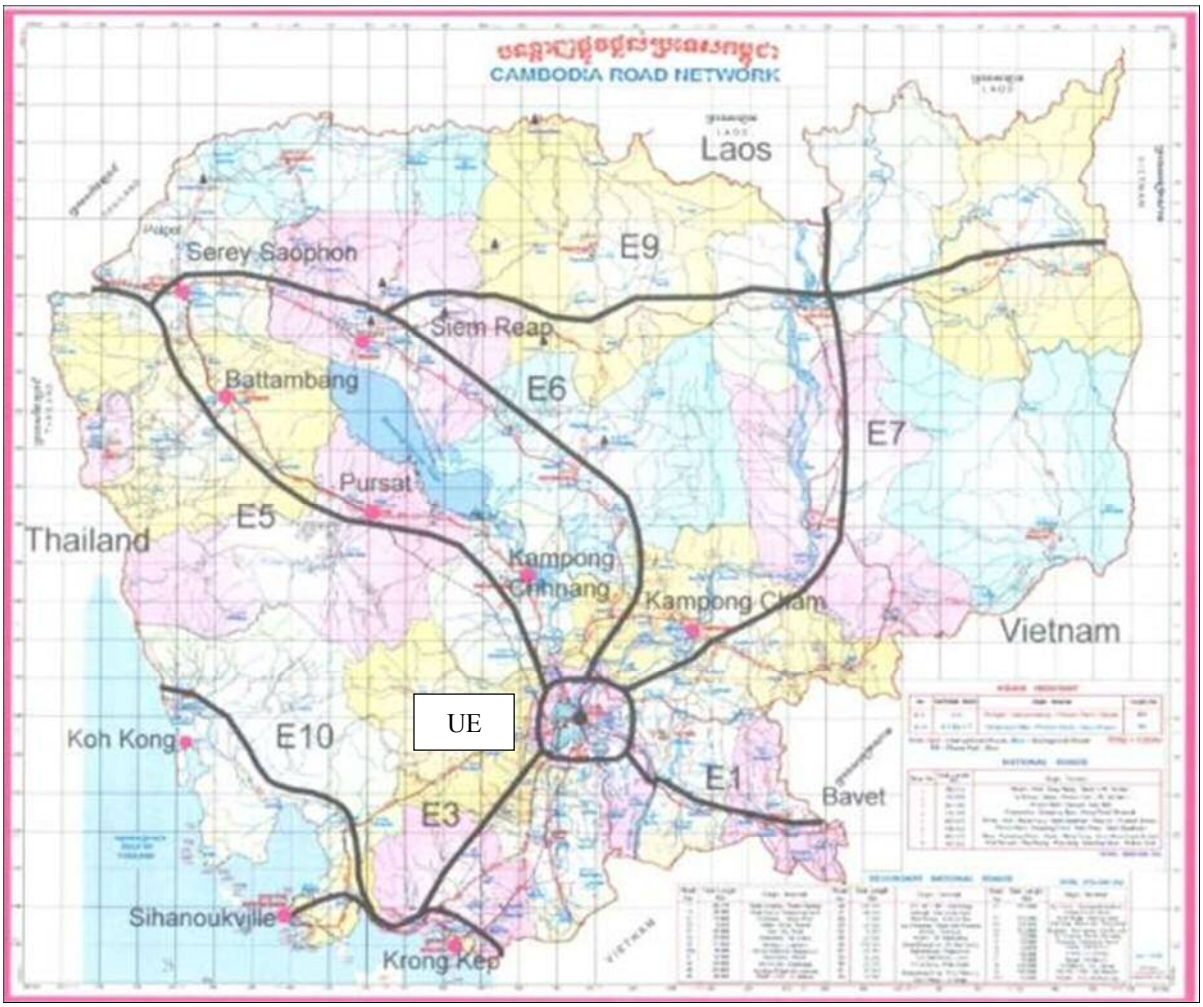


Figure 7.2-1 Proposed Expressway Network in Cambodia

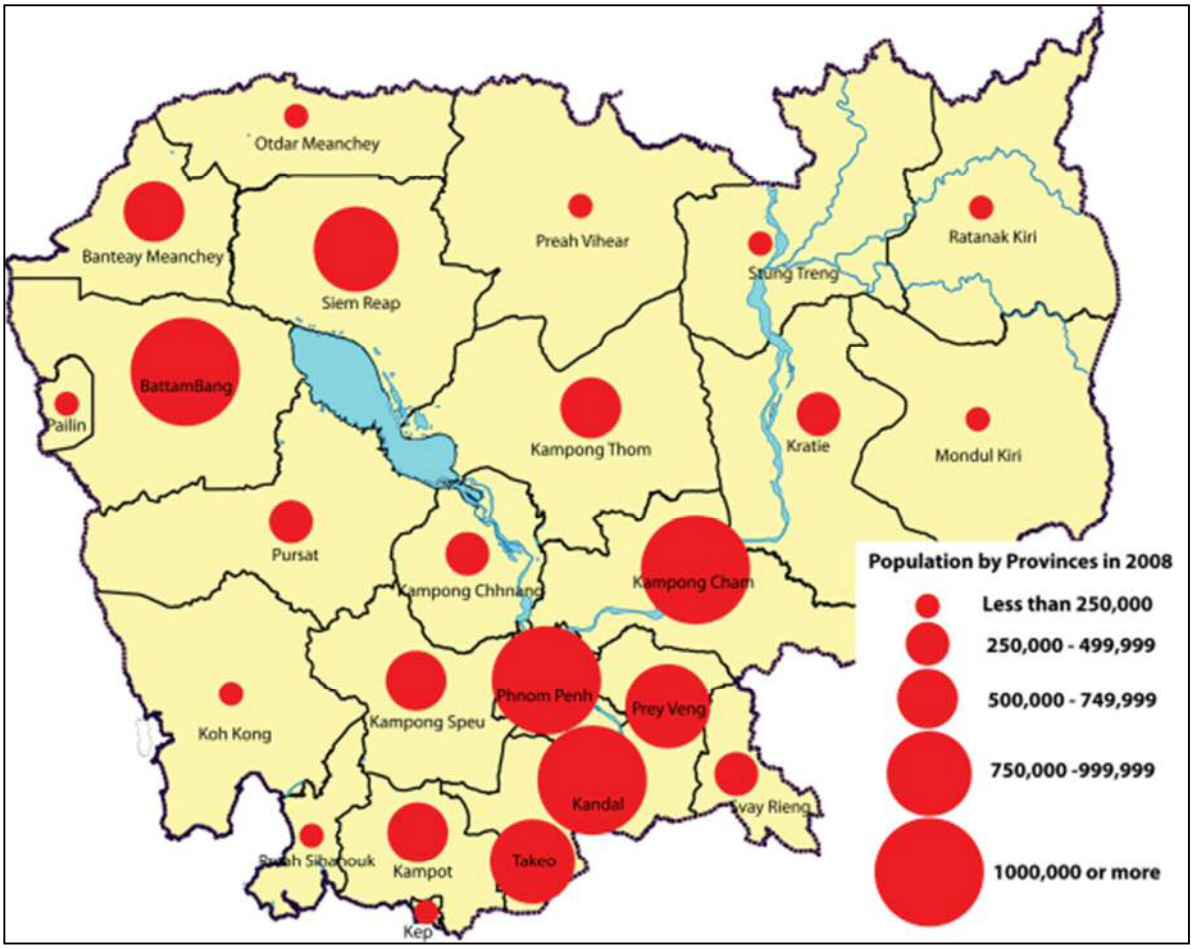
(4) Evaluation of the Projects

(a) Evaluation Methodology

The expressway network plan was formulated and presented in the previous section. This section describes the method used for evaluation of the expressway, which focuses on priority of each expressway. Evaluation criteria and factors should be considered from many aspects such as urgency and necessity, as well as traffic, social, economic and international aspects. Survey Team selected the following criteria as factors of project evaluation.

(i) Population

Figure 7.2-2 shows population distribution by province in 2008. The number of population along the route does not provide an accurate evaluation, the longer the route, the larger the population along the route, and thus the route is given a mistakenly high priority. The number of population per 100 km was selected since it is less likely to be affected by the length of the route as shown in Table 7.2-4.



Source: Statistical Yearbook of Cambodia in 2011, NIS

Figure 7.2-2 Population Distributions in 2008

Table 7.2-4 Population along Expressway Routes

No.	Provinces	Population of Province (2008)	Population along Expressway (1,000)	Length of Expressway (km)	Population per 100 km (million)
E1	Kandal	1,265	2,695	135	2.0
	Prey Veng	947			
	Svay Reing	483			
E3	Kandal	1,265	3,611	210	1.7
	Kampong Speu	717			
	Takeo	844			
	Kampot	585			
	Shinanoukville	200			
E5	Kandal	1,265	4,554	355	1.3
	Kompong speu	717			
	Kompong Chhnang	472			
	Pursat	397			
	Battambang	1,025			
	Banteay Meanchey	678			
E6	Banteay Meanchey	678	5,151	400	1.3

No.	Provinces	Population of Province (2008)	Population along Expressway (1,000)	Length of Expressway (km)	Population per 100 km (million)
	Siem Reap	896			
	Kampong Thom	631			
	Kampong Cham	1,681			
	Kandal	1,265			
E7	Prey Veng	947	3,059	335	0.9
	Kampong Cham	1,681			
	Kratie	319			
	Steung Treng	112			
UE	Kandal	1,265	2,929++	155	2.0++
	Prey Veng	947			
	Kampong Speu	717			
E9	Siem Reap	896	1,329	390	0.3
	Preah Vihea	171			
	Steung Treng	112			
	Ratanakiri	150			
E10	Kampot	585	925	220	0.4
	Shinanoukville	200			
	Koh Kong	140			
Total:			24,253	2,200	

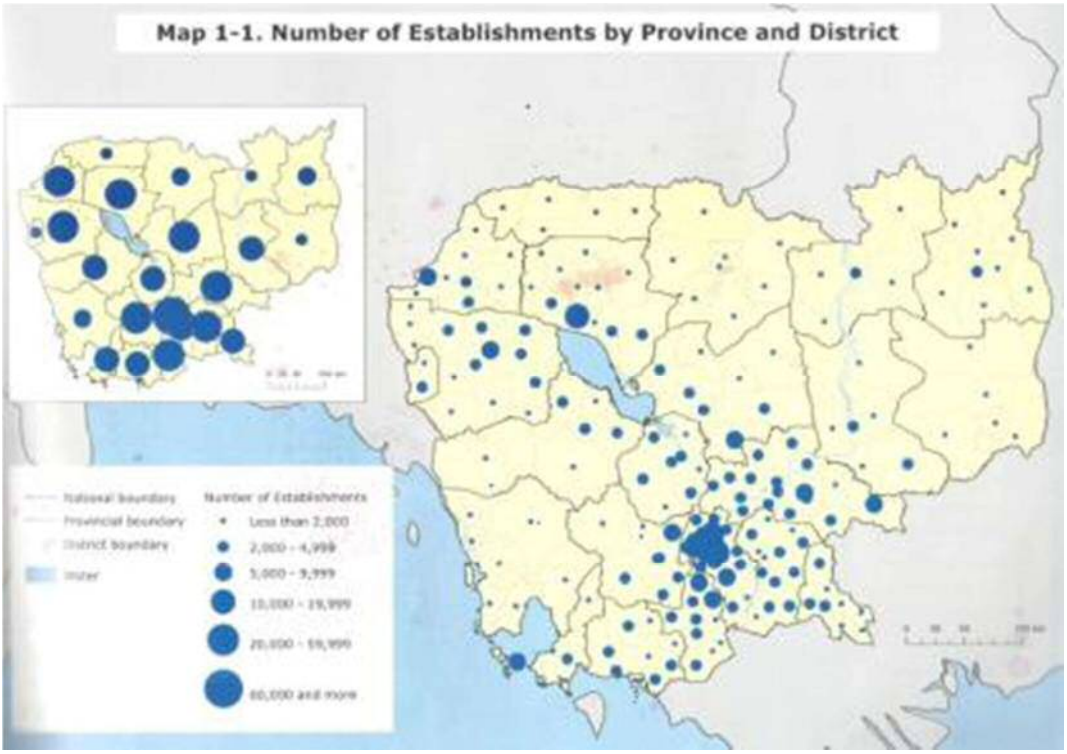
(ii) Traffic volume

For estimation details of traffic volume of each expressway, refer to Section " ". The estimated 2030 traffic volume was used as an evaluation factor.

(iii) Economy (Establishment)

The number of establishment along the route was selected as a factor of evaluation because it is easy to be counted and is considered to be the indicator of economic activity as shown in Figure 7.2-3.

The establishment refers to a unit of place where economic activities are performed and fulfill the following conditions in principle: An establishment is a unit of place which occupies a certain space and in which economic activities are performed under a single management. An establishment has (a) person (s) engaged and equipment, and produces and / or sells good, or provides services on a continuous basis.

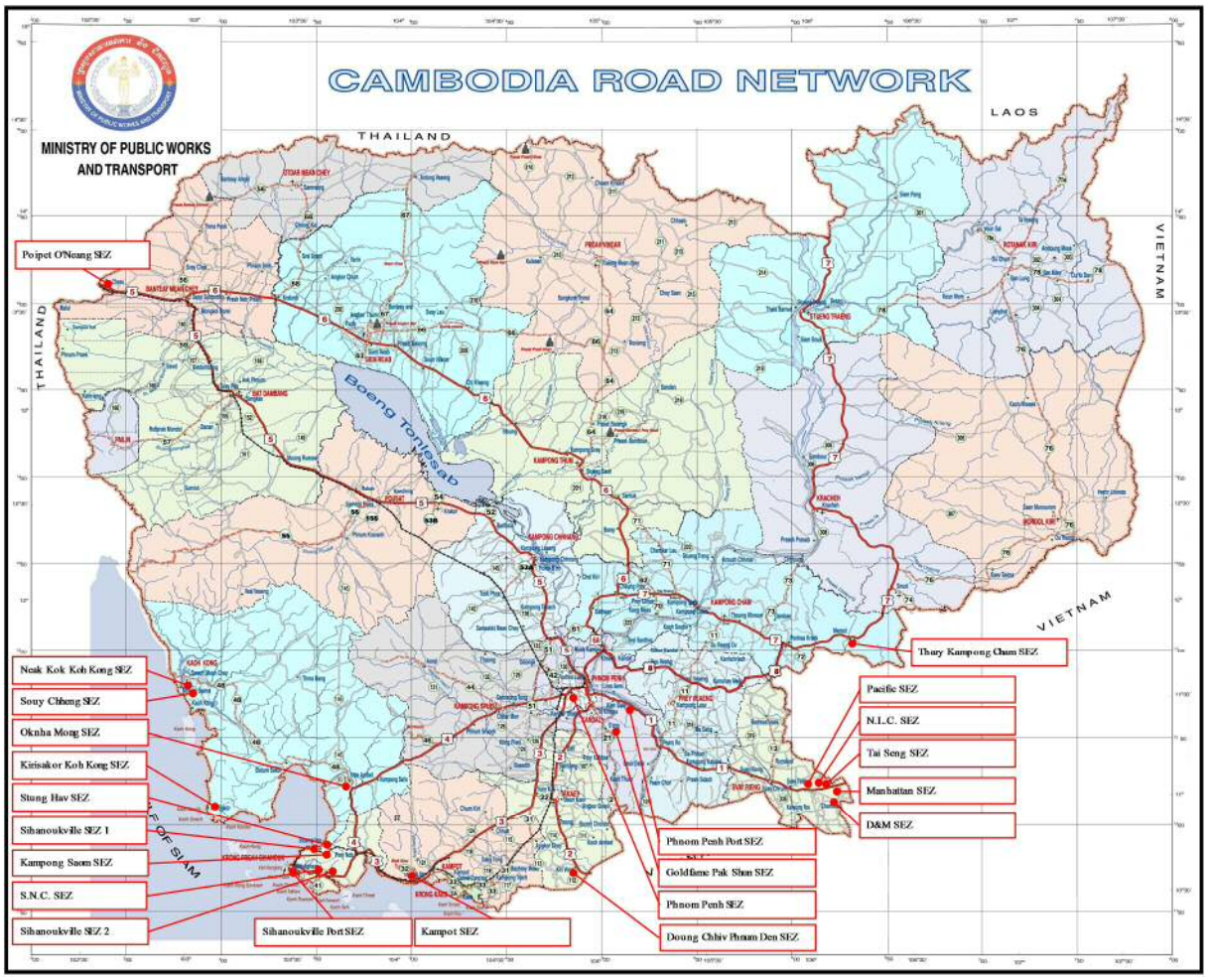


Source: Economic Census of Cambodia 2011, Census Atlas, NIS

Figure 7.2-3 Number of Establishment

(iv) Direct investment (SEZ)

The development of Special Economic Zone (SEZ) in Cambodia encourages private sector investment and ensures the provision of world class infrastructure and services. The Council for the Development of Cambodia (CDC) has approved 22 SEZs across the country with total investment capital in excess of USD 740 million. Figure 7.2-4 shows location of SEZ in Cambodia. Among these SEZs, 10 of them are operational and others are at various stages of development. The SEZs are designed to ease challenges to setting up business with government officials stationed on site to provide administration services, such as clearances and permits.

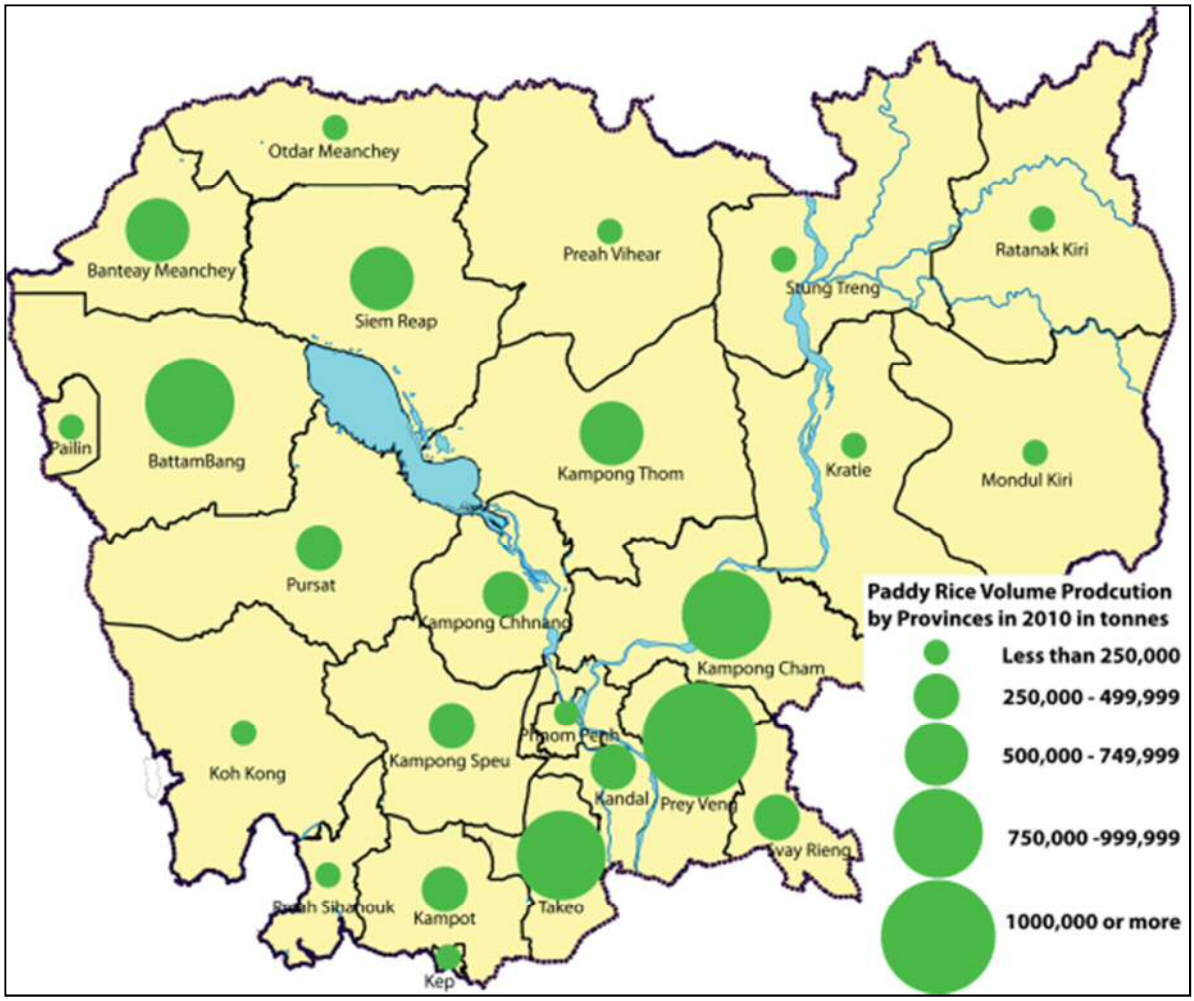


Source: Data Collection Survey JICA in 2013

Figure 7.2-4 Location of SEZ

(v) Agriculture

Since 2000, Cambodia has made great efforts to produce agricultural products. The growth rate of paddy rice production during the period from 2000 to 2011 was about 4.9% per year. Figure 7.2-5 shows the volume of paddy rice production by province in 2010.



Source: Statistical Yearbook of Cambodia in 2011, NIS

Figure 7.2-5 Paddy Rice Production by Provinces in 2010

(vi) Tourism

Tourism is one of the important factors for evaluating the priority of the expressways.

(vii) GMS Corridors

Economic growth in the Southern Economic Corridor (SEC) of Cambodia, Thailand and Vietnam have been expanding rapidly mainly in manufacturing exports, thus the faster-growing economies in the world. In order to accelerate the economic growth in the Greater Mekong Sub-region (GMS), nine (9) economic corridors in the sub-region was identified by Asian Development Bank (ADB) as shown in Figure 7.2-6. Among the nine (9) economic corridors, the following three (3) economic corridors are related to Cambodia and they are important corridors: Southern Economic Corridor, Central Economic Corridors, and Southern Coastal Corridor. More details of those corridors in Cambodia are shown in the Table 7.2-5.

Source: Transport and Trade Facilities in General Mekong Subregion, ADB

Figure 7.2-6 Major Economic Development Corridors in GMS Region

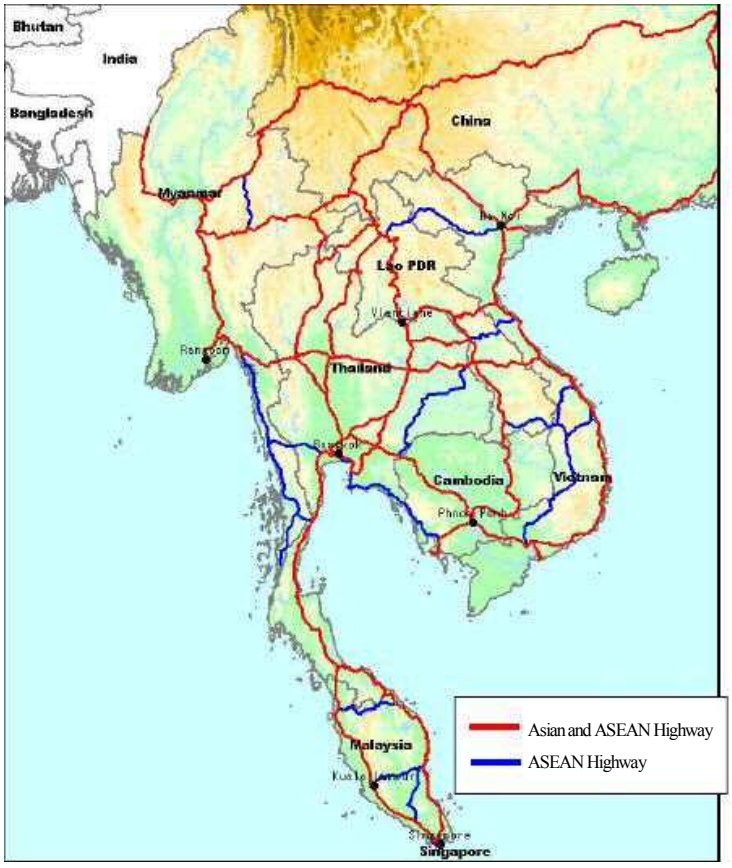
Table 7.2-5 Economic Corridor in Cambodia

No.	Economic Corridor	Length (km)	Detailed Route
1	Southern Corridor I	1,032	Bangkok- Aranyaprathet/Poipet - Phnom Penh- Bavet/Moc Bai - Ho Chi Minh - Vung Tau
2	Southern Corridor II	1,168	Bangkok- Aranyaprathet/Poipet - Siem Reap - Stung Treng - Ratanakiri/O Yadov - Pleiku - Quy Nhon
3	Central Corridor	893	Sihanoukville - Phnom Penh - Kratie =Stung Treng - Dong Kralor - Veun Kham - Pakse -Savannakhet
4	Southern Coastal Corridor	763	Bangkok - Hat Lei/Cham Yeam - Kampot - Ha Tienn - Ca Mau - Nam Can

Source: Transport Infrastructure Survey in Cambodia in 2010, JICA

(viii) International Highway (Asian Highway / ASEAN Highway)

Regarding the international highway / road network, there are two major transport networks: one is Asian / ASEAN highway network. Since the establishment of the highway network, great efforts for improvement of the highway network have been made by various agencies and countries.



Source: Transport Infrastructure Survey in Cambodia 2010, JICA

Figure 7.2-7 Asian/ASEAN Highway Plan (GMS Region)

(ix) Scoring Factors

Scoring of factors used in the overall evaluation is shown in Table 7.2-6, and calculation of score of each expressway is shown in Table 7.2-7. E1 and E3 are given high priorities, followed by E5 and UE. E6 and E7 are in given a mid-level priority, while E9 and E10 are given the lowest priorities.

Table 7.2-6 Scoring of Factors Used in the Overall Evaluation

			Weight	Score
1	Population / 100 km	1. P > 2,000,000	2	5
		2. 2,000,000 > P > 1,500,000		4
		3. 1,500,000 > P > 1,000,000		3
		4. 1,000,000 > P > 500,000		2
		5. P < 500,000		1
2	Traffic Volume ADT (pcu/day)	1. ADT > 40,000	2	5
		2. 40,000 > ADT > 20,000		4
		3. 20,000 > ADT > 10,000		3
		4. 10,000 > ADT > 5,000		2
		5. ADT < 5,000		1
3	Economy (Number of Establishment)	1. Large amount of Industrial and Agriculture Output	1	5
		2. Medium amount of Industrial and Agriculture Output		3
		3. Small amount of Industrial and Agriculture Output		1
4	Direct investment	1. More than 5 SEZ	1	5
		2. SEZ = 4		4
		3. SEZ = 3		3
		4. SEZ = 1 - 2		2
		5. SEZ =0		1
5	Agriculture	1. Large amount of paddy rice production	1	5
		2. Medium amount of paddy rice production		3
		3. Small amount of paddy rice production		1
6	Tourism	1. Big amount of Tourism Output	1	5
		2. Medium amount of Tourism Output		3
		3. Small amount of Tourism Output		1
7	GMS Corridor	Greater Mekong Sub-region (GMS)	1	5
		Other		0
8	Asian / ASEAN Highway	Asian Highway and ASEAN Highway	1	5
		Asian Highway or ASEAN Highway		3
		Other		0

Table 7.2-7 Calculation of Score of Each Expressway

	Items for Evaluation	W	E1	E3	E5	E6	E7	E9	E10	UE
1	Population	2	5 x 2	4 x 2	3 x 2	3 x 2	2 x 2	1 x 2	1 x 2	5 x 2
2	Traffic Volume	2	3 x 2	3 x 2	3 x 2	2 x 2	1 x 2	1 x 2	1 x 2	4 x 2
3	Economy	1	5	5	5	5	3	1	1	5
4	Direct investment	1	5	5	2	1	1	2	5	3
5	Agriculture	1	5	5	5	5	3	1	1	1
6	Tourism	1	3	5	3	5	1	1	3	3
7	GMS Corridors	1	5	5	5	1	5	5	5	1
8	Asian / ASEAN	1	5	5	5	1	5	1	3	5
	Total points		44	44	37	28	24	15	22	36

(5) Validation of the total length of planed expressway network in Cambodia

Survey team examined the validity of 2,200 km, which is the total length of expressway network in Cambodia proposed by the Survey Team, by means of international comparison of expressways. Three indicators are used for the comparison: the ratio of expressway length to land area, the ratio of expressway length to number of population, and the ratio of expressway length to the combination of number of population and land area. Cambodia's value for Indicator 1 is small, because the area is comparatively large. The country's value for Indicator 2 is large, since its number of population is relatively small. Cambodia's value for Indicator 3, the ratio of expressway length to the combination of number of population and land area, is 4.4, which is almost the same as those of other countries. Based on these considerations, the validity of the total length of planed expressway network in Cambodia was confirmed as shown in Table 7.2-8.

Table 7.2-8 International Comparison of Total Length of Expressway Network

Country	Length of Completed Expressway (km)	Land area (1,000 m^2)	Population (million)	Indicator 1	Indicator 2	Indicator 3
	A	B	C	A/B	A/C	$\frac{A}{\sqrt{B}*\sqrt{C}*10}$
USA	93,000	9,629	317	10	290	5.3
France	11,000	552	63	20	170	5.5
China	45,500	9,597	1,354	5	33	1.3
Germany	12,500	357	82	35	150	7.3
Japan	10,000	378	127	26	80	4.6
Japan M/P	14,000	Same as above	Same as above	37	110	6.4
Cambodia	2,200	181	14	12	157	4.4

Source: Expressway general information in Japan 2011

(6) Implementation Program

Implementation program was examined in consideration of the results of overall evaluation.

The implementation program is divided into three (3) stages as:

・Short term plan: 2020 -2025

・Medium term plan: 2025 - 2030

・Long term plan: 2030 - 2040

Table 7.2-9 shows the implementation schedule of each expressway in Cambodia, and Table 7.2-10 shows the investment and implementation schedule for short, medium and long term plans. Survey team considered that E1 and / or E5 and / or ERR 4 would be the candidates for the Japanese ODA.

Table 7.2-9 Implementation Schedule

No.	Route	Related NRs	Length	Term	Period	Cost (USD mil)
E1	PP - Bavet	NR 1	135 km	Short	2020 - 2025	1,350
E3	PP - Sihanoukville	NR 3 / 4	210 km	Short	2020 - 2025	2,100
E5	PP - Poipet	NR 5	355 km	Medium	2025 - 2030	3,550
E6	PP- Sri Sophon	NR 6	400 km	Long	2030 - 2040	4,000
E7	PP - Laos border	NR 7	335 km	Long	2030 - 2040	3,350
E9	Siem Reap - Vietnam border	NR 66 + NR 78	390 km	Long	2030 - 2040	3,900
E10	Krong Kep - Koh Kong	NR 33 + NR 48	220 km	Long	2030 - 2040	2,200
UE	Phnom Penh Ring Road		155 km	Medium	2025 - 2030	1,550
	Total length		2,200 km			22,000

*Unit cost of expressway is estimated at USD 10 mil/km.

Table 7.2-10 Investment and Implementation Schedule in Short-, Medium-, and Long-Term

	Period	Length	Investment	Expressways
Short - Term	2020 - 2025	345 km	USD 3,450 mil	E1,E3 69 km/year USD 690 mil/year
Medium - Term	2025 - 2030	510 km	USD 5,100 mil	E5, UE 102 km/year, USD 1,020 mil/year
Long - Term	2030 - 2040	1,345 km	USD 13,450 mil	E6, E7, E9, E10 134 km /year, USD 1,340 mil/year

Timing of Start of Construction

Construction of expressway network needs to be started at adequate time. If the construction is started late, construction cost, including land acquisition cost would be too high and financial viability would be substantially reduced. Delay in development of expressway network also hinders sound economic growth. Many Asian countries started construction of expressways in 1980s, as shown in Figure 7.2-8. GDP/capita of these countries when they started construction of expressways were less than USD 1,000. In view of that GDP/capita of Cambodia is approaching USD 1,000, it is recommended that Cambodia starts preparation for expressway construction.

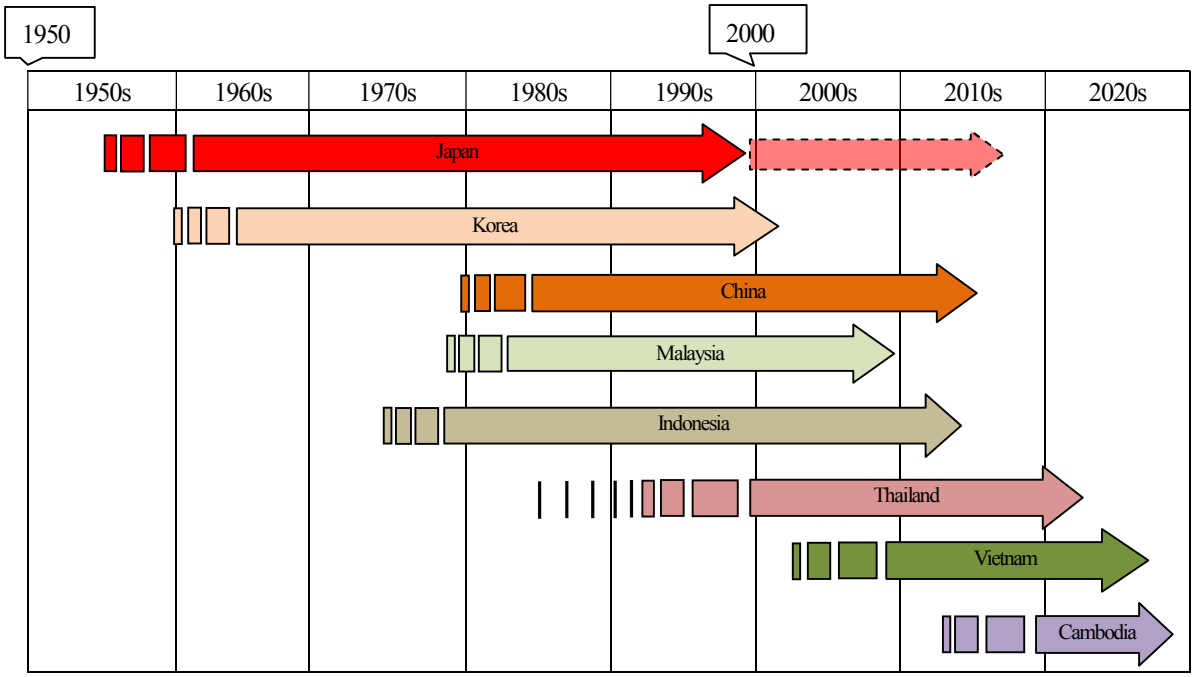


Figure 7.2-8 Timing of Expressway Construction in Asian Countries

7.3 Institutional Setup

Construction of expressway network requires huge amount of fund. Its impacts, both positive and negative, are also very large. Thus, construction of expressway network becomes one of national projects, whether or not it is officially designated so.

In order to implement such a large-scale project as scheduled, diligent preparation, including well-planned institutional setup, is indispensable. Here, the terminology of 'institutional setup' refers not only to organizational arrangement but also to other areas including financial and legal matters. The areas to be covered in the institutional setup include the followings:

- Financial plan
- Authorization of toll road system and toll level policy
- Organization plan

・Legal framework

These items are discussed below:

(1) Financing Plan

The total cost of constructing 2,200 km expressway network is estimated at more than USD 20 billion. It is evident that the government fund alone cannot finance this huge amount of cost. In many countries, the following are the main sources of fund used in expressway construction.

・PPP, including BOT and other forms of private participation

・Loans from multi-lateral and bilateral donors

・Government fund

・Road bond

(a) PPP

Various form of PPP, including BOT, BOO and other forms, have been adopted, or attempted, in many countries as a funding scheme of expressway. The main advantage of PPP is that the government investment at the early stage of the project is minimal. This is the main reason that so many countries tried to adopt it as the main funding source.

The largest disadvantage of PPP is an expressway project cannot be implemented unless there is an qualified investor. Thus, the government is forced to wait until an interested investor appears. Quite often, the amount of investment is huge and there is no guarantee for dividend which encourages such huge investment. As a result, investors becomes hesitant and the expressway projects are not started. Thus, adoption of PPP has caused serious delay in implementation of expressway projects in many countries.

Another disadvantage of PPP is that it is very difficult to evaluate the proposal. Estimation of traffic volume on the expressway and the revenue from it is very difficult. If PPP is to be adopted, it is strongly recommended that the Government establish the expressway authority and let it construct and operate a few lines or sections of expressway and accumulate experience on estimation of traffic volume and toll revenue which can be the basis for negotiation for concession conditions of PPP.

(b) Loans from multi-lateral and bilateral donors

This most commonly adopted fund source in many countries. China, for example, has borrowed many loans from ADB for expressway construction. Japanese government financed many expressway projects in many Asian countries including Indonesia and China.

The advantage of such loans is that it can be counted as a stable fund source. Such fund can be secured once the donor and the recipient government agree so.

The disadvantage of such loan is that the available amount is often limited by some reasons, such as annual limit for foreign borrowing set by the recipient government. Any government need to control the total foreign debt from the viewpoint of national economy and government debt or loan borrowing is one of the major areas that the government needs to control.

(c) Government fund

As the economy grows, the government can have some financial capacity to invest in infrastructures including road. One of the most possible fund source for road investment is automobile fuel tax. Usually, automobile fuel tax is used as the main fund source for road maintenance. However, as economy grows and fuel consumption increases, there may be some surplus which can be spent on new investment (new construction). Of course such surplus is usually far smaller than the amount required for expressway construction. However, even small subsidy to expressway construction can substantially reduce the burden of the interest of the loan which is the main source of financial burden in toll road financing. Especially, subsidy of constant amount every year can be considerable contribution in amortization of loan in the long run.

(d) Road bond

Two kinds of road bond is possible; one sold domestically (within the country) and one sold in the international financial market.

Bond sold in the international financial market is similar in nature to the loan by multi-lateral donors, except its interest rate is usually higher than those of loan by the international donors. Domestically-sold bond may sound unrealistic in developing countries. However, domestic capitals are steadily accumulated even in a developing stage of economy.

One of the largest advantages of domestically-sold bond is that it is not influenced by exchange rate between the national currency and the foreign currencies. Quite often, considerable inflation occurs during the period of expressway construction, induced by the rapid economic growth. This inflation often result in severe depreciation of the national currency against the major international currency, such as US dollar. If large amount of fund has been borrowed in the form of foreign currency, amortization of such will become difficult because of low appreciation of the national currency, or high appreciation of foreign currency against the national currency. It needs to be noted that the main income of toll road which can be used in amortization of the loan is in the form of the national currency.

Table 7.3-1 summarizes the advantages and disadvantages of these different types of fund sources.

Table 7.3-1 Advantage and Disadvantage of Fund Source

Fund Source	Description	Advantage	Disadvantage
PPP	Various form of participation of private investment:	No or very little government fund is necessary.	Expressway cannot be constructed unless there is an investor. Thus, implementation is often delayed.
Loan by Donors	Loan by ADB, WB, JICA etc.	Stably obtained.	There is limit depending on the poly on national debt.
Government Fund	Subsidy from the Government's own account.	Constantly supplied.	Available amount is small.
Bond (domestic)	Fund is obtained by selling bond (domestically)	Not influenced by foreign exchange rate.	Need certain accumulation of domestic capital.

(2) Authorization of toll road system and toll level policy

Justification of toll road system

In many countries, road is one of the typical public facilities which is considered to be free of charge. Thus, legal justification for charging toll to the users of toll road is necessary.

In many countries, basic justification of toll road system is given as below:

- Many governments are in shortage of fund for road network development.
- Better roads can give road users economic benefits: If road users can obtain economic benefits by using a better road larger than the toll charge for using it, road users would be willing to pay such toll. (This concept is often called **"Beneficiary-Pay Principle"** or **"Fee-for-Service Concept"**. This concept is easy to understand and is accepted in many countries.)

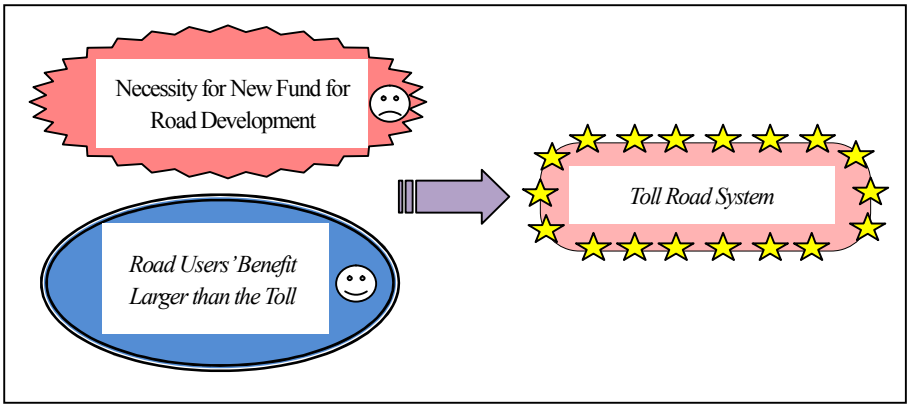


Figure 7.3-1 Justification of Toll Road System

Toll level policy

In many countries where toll road system is adopted, the following basic principles are accepted, with or without explicit stipulations in the relevant legislations, before the actual toll levels are determined:

(a) Toll level should be equal to or less than the benefit enjoyed by the users of the toll road.

(b) Toll level should be set to cover the cost for maintenance / operation and / or construction of the toll road.

Among the above two principles, Principle (a) is adopted in most of the countries while Principle (b) is sometimes not adopted depending on the financial viability of toll roads or other reasons.

In many countries, there is a rule that an alternative road needs to be provided for the road users who do not want to pay toll charge. This rule comes from the principle that the road users who cannot obtain benefit larger than the toll charge should not be forced to use the toll road.

(3) Organizational plan

To actually implement the projects for construction and operation of the proposed toll expressway network, some government agency need to deal with a vast volume of tasks to tackle a wide spectrum of problems. This is the case even if the entire network will be constructed and managed by the private entities, if the Government is to plan PPP packages, evaluate the proposals, negotiate with the proponents and monitor the implementation including management of the expressway. In addition to this, following facts necessitates a new organization:

(a) A toll expressway network is a novel transport infrastructure for Cambodia. Design, construction, maintenance and operation of this new transport infrastructure needs to be based on a new ideas not influenced by the precedent cases or old ideas.

(b) The proposed expressway network is to cover many provinces where the road projects (mainly rehabilitation and maintenance) were executed by DPWTs and MPWT has very limited experience of direct project execution.

In many countries where the toll road system is extensively used, organizations for construction / operation of toll expressways have been established. Table 7.3-2 shows some of the examples of such toll road organizations.

It is recommended that similar organization be newly established for construction and operation of expressway system in Cambodia. Establishment of the new organization should be implemented in steps:

Step 1: Establishment of preparation office in MPWT

Step 2: Establishment of expressway authority mainly for planning and construction of high - priority expressways

Step 3: Development of the expressway authority to be operational for maintenance and operation of completed expressways

Step 4: Further develop the expressway authority to be capable for plan, announce and evaluation of proposal for PPP (if necessary)

In the process of development of the expressway authority, especially during the period preparing for operation and maintenance, considerable capacity development will become necessary. This capacity development includes preparation of various manuals for operation and maintenance.

(4) Legal framework

To legally authorize construction of the expressway network and other matters, new legislations (laws, decrees etc.) need to be enacted:

- Law for toll road
- Law or decree for construction of expressway network
- Low for establishing expressway authority
- Traffic rule on expressway

Table 7.3-2 Expressway Organizations of Various Countries

Country	Name of Organization	Legal Status and Function	Remarks
Asia			
Japan	1. East Nippon Expressway Company, Central & Western Nippon Companies) (Formerly Japan Highway Public Corporation) 2. Metropolitan Expressway Company Ltd. 3. Hanshin Expressway Company Ltd. 4. Honshu - Shikoku Bridge Company Ltd. 5. Toll Road Authorities owned by the local governments	1 & 4: 100% owned and supervised by the central government. 2 & 3: Owned jointly by the central government and the relevant local governments. Mainly supervised by the Minister of Land, Infrastructure and Transport, but basic policy needs to be agreed by the Council where the governors of the local governments are the members. 1: Responsible for the construction & operation of the national expressway network system. 2 & 3: Responsible for the construction & operation of the urban expressway network in and around Tokyo and Osaka - Kyoto - Kobe Area, respectively. 4. Responsible for the construction and operation of bridges and highways connecting Honshu (the main island) and Shikoku Island.	
China	Provincial Expressway Corporations or newly established Expressway Construction Headquarters in the Provincial Government	・100% owned by the Provincial Government or a part of the Provincial Government ・Responsible for construction and operation of the part of the National Trunk Highway System (NTHS) in the Province	Central Govt. is responsible for NTHS planning
Korea	Korean Highway Corporation	・100% owned by the central government ・Responsible for inter-urban expressways	
Indonesia	Indonesian Highway Corporation (PT Jasa Marga)	・100% owned by the central government. The Ministry of Finance act as the shareholder. ・Supervised by the Board of Commissioners, comprising Director General of Roads, Representative of the Ministry of Finance, Representative of National Traffic Police Dept. and others ・Operating large portion of the toll roads in the country ・There are several toll roads constructed and operated by private investors	
Malaysia	Malaysia Highway Authority (Lembaga Lebuhraya Malaysia)	・100% owned by the central government ・Supervised by the Minister of Public Works ・Responsible for construction / operation of toll expressways	
Thailand	Expressway Authority of Thailand (EXAT): Urban expressways DOH: Inter-urban motorways	・EXAT: Responsible for construction / operation of urban expressways network ・DOH: Responsible for construction / operation of inter-urban motorways	
Vietnam	Vietnam Expressway Corporation (VEC)	・Established in 2005 to be responsible for construction / operation of the national expressway network	

Country	Name of Organization	Legal Status and Function	Remarks
Europe*			
Italy	1. ANAS 2. Autostrade S.p.A 3. Concessionaires invested mainly by the local governments	1: 100% owned by the central government and is responsible for construction / operation of expressways (autostrade) 2 & 3: Implement construction / operation of expressways under the contracts with ANAS ・ANAS started construction of the expressways after the World War II	
France	1. SEM: Societes d'Economie Mixte Concessionnaires d'Autoroutes 2. Cofiroute (Private Company) 3. Others	1: Owned either (i) by a single local government, or (ii) jointly by multiple number of local governments, or (iii) jointly by local government and chamber of commerce. There are various SEMs which construct and operate expressways (autoroutes) by the concession with the central government 2: 100% private company. Function is same to SEMs 3: Special companies established to be responsible for operation of particular facilities such as Mont Blanc Tunnel	
Austria	AFINAG: Autobahnen und Schnellstrassen Finanzierung Aktiengesellschft	・AFINAG was established in 1982 to finance expressway projects and remodeled in 1997 to be responsible for toll collection of expressways	

*Source: Express Highway Research Foundation of Japan, "Situation of Expressways in Foreign Countries", May 2005 (in Japanese language)

CHAPTER 8 RECOMMENDATION FOR FURTHER STUDY

The survey as presented above is of a nature of preliminary data / information collection. Further survey / study is desired to accelerate understanding on the necessity and justification of expressway network construction in Cambodia.

8.1 Alternatives of Scope of Work

Two alternatives of scope of work are considered for the further study:

(1) A full expressway master plan study including routes of expressway network, cost estimate, financial plan, institutional plan and maintenance / operation plan.

(2) Pre - feasibility study on E1 Expressway, cost estimates, financial plan, institutional plan and maintenance /operation plan.

In case of the latter, cost estimates, financial plan etc. focus on the case of E1 Expressway, as the pilot case. Merits and demerits of these two alternatives are compared in Table 8.1-1.

Table 8.1-1 Alternatives of Scope of Work

Alternative	Merits	Demerits
Full M/P	・Can clearly show schedule for whole network. ・Priority of E1 can be clearly explained.	・Overlap with M/P study implemented by China. ・Thus, cannot get strong support from MPWT and other stakeholders.
Pre - FS on E1	・Alternative routes can be diligently studied. ・Time to build consensus among stakeholders can be secured before moving to full FS. ・Study on financing plan and other matters (so-called 'soft fields') can be specific and easy to understand. ・Actual project of E1 can be started earlier.	・Priority of E1 needs to be shown without master plan.

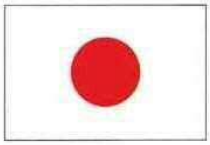
In view of the fact that Chinese Team has already started their master plan study and majority of high-ranked MPWT officials, including the Minister is negative to request Japanese Government the full master plan study, it is recommended that the Alternative (ii) be adopted and pre-FS on E1 with study on the 'soft' fields be conducted.

It should be noted that considerable discussion / consultation among stakeholders are necessary before a route of an expressway can be finalized.

8.2 Outline of Proposed Scope of Work of Further Study

Outline of the proposed Scope of Work for the of E1 Expressway is presented in Annex-1.

Annex-2



The Grand Design of the Cambodian Expressway

Saigon East-West Highway (2011-) Japanese ODA Loan

Chalong Rat Expresssway/Bangkok (2000-) Japanese ODA Loan

Bangkok-Chonburi Motorway (1998-) Japanese ODA Loan

September 2013

Preliminary Data collection Survey for Expressway Development

Japan International Cooperation Agency (JICA)

1. Development of Expressway Network

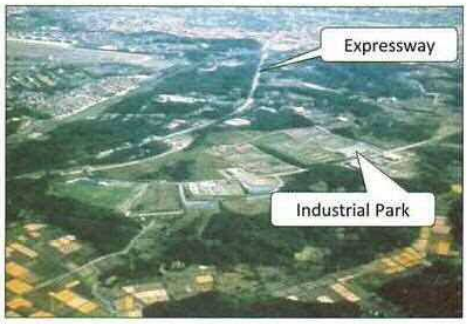
Why Necessary?

	General Features
Expressway	- Designed for high-speed, long distance traffic. - Full access-control (No at-grade intersection, no stop, no direct entrance/exit from/to roadside is allowed; can enter/exit at interchanges only) - Opposite directions are clearly divided by median.
National Road	- Designed for low and medium speed traffic. - Used for daily activities of citizens & local industries. - No access control.

Expressway development realizes high-speed & stable transport, which attracts high value-adding industries and contributes to upgrade industrial structures.
Meanwhile, improvement of National Road needs to be continued for convenient road network and to cope with the increasing traffic volume.

Keyword: Just-In-Time Delivery

Modern industry requires stable and speedy supply of parts & smooth transportation of products:



An industrial park is being developed at more than 600km north of Tokyo, taking advantage of newly opened expressway.

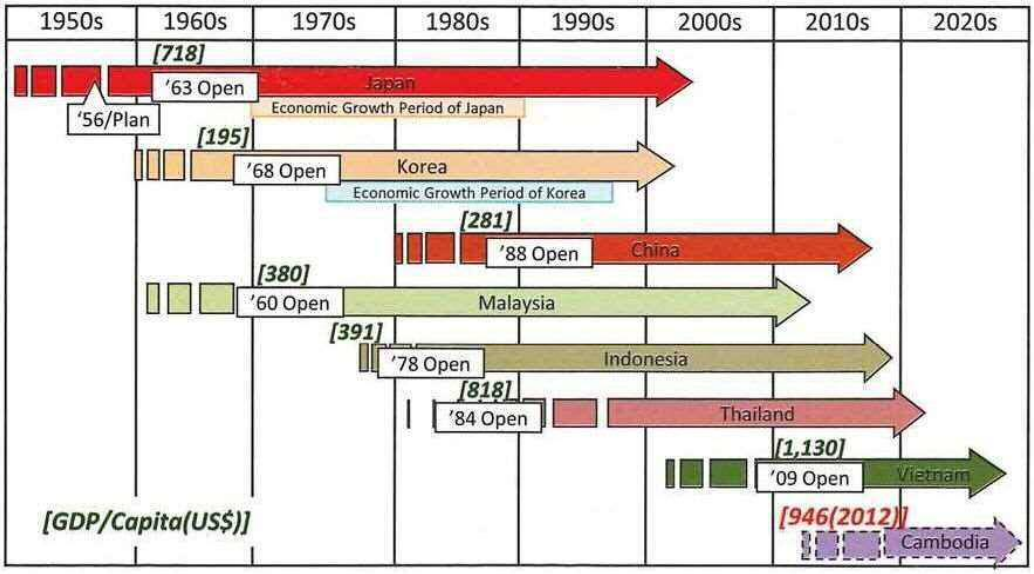
When Necessary?

•Modern industries such as automobile and electric appliances start at economy level of GDP/Capita around US$ 1,000.
•Now many modern industries are constructing their factories in SEZs of Cambodia.

Now, it is time for Cambodia to start development of expressway network.

•Many Asian countries started in 1990's when their GDP/capita < US$ 1,000.
•Neighboring countries (Vietnam & Thailand) are now constructing.
•Japan & Korea had started construction of expressway more than 10 years before economic growth started.

Time of Start of Expressway Construction in Asian Countries



Expressway Network Development starts with discussions on ...

In parallel to the discussion on the technical matters such as routes and design standards of expressways, the good environment for development of expressway network needs to be discussed and consensus should be built among the stakeholders.

Introduction of Toll Road System: Establish concept of toll road system

- Necessity of toll road system as fund source
- Benefit of using expressway
- Acceptable toll level

Financing Plan: How can we get fund for expressway

- Excess dependence on PPP often impedes timely construction of expressway.
- New fund source , such as road bond, needs to be sought.

Establishment of Implementing Institution: New organization exclusively responsible for development of expressway network

- Construction of expressway network is a large-scale and important national project which require huge fund
- New ideas are necessary in planning, construction & operation

Legal Framework

- Toll road system: Requirement for toll road, toll level, etc
- Power & responsibility of implementing institution
- General matters of expressway network: Routes, implementation schedule, design standards, etc

And Equally Important are ...

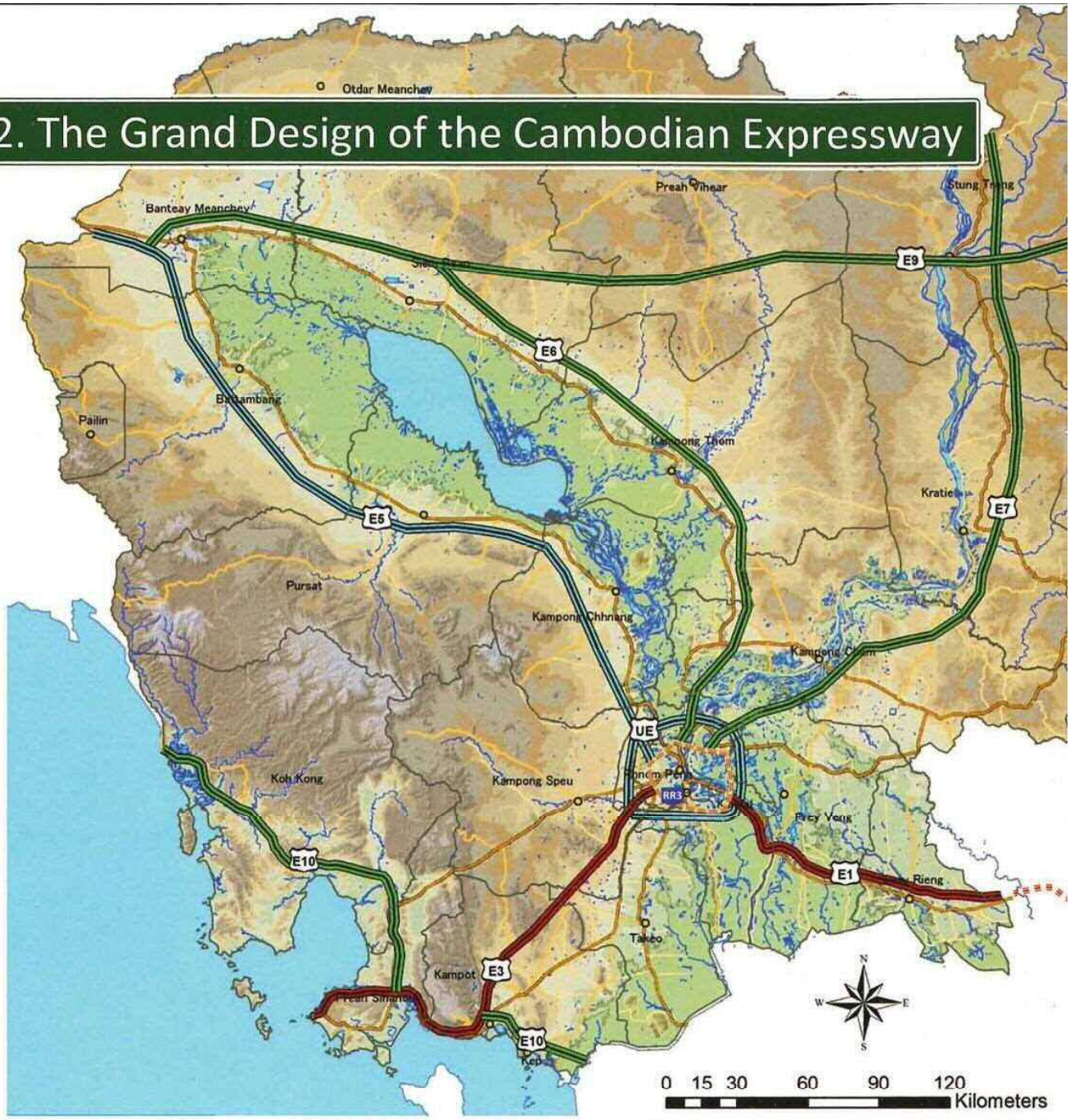
Consensus Building

- Among political leaders, economic /industrial society, researchers and the people

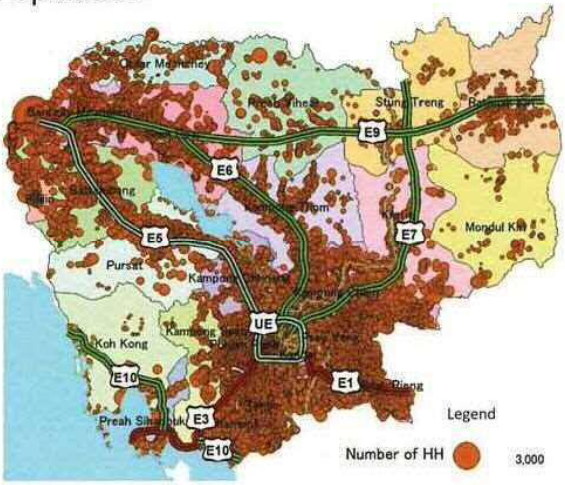
Good Coordination with Neighboring Countries

- Seamless expressway network between neighboring countries to strengthen ASEAN connectivity and maximize benefit from expressway development

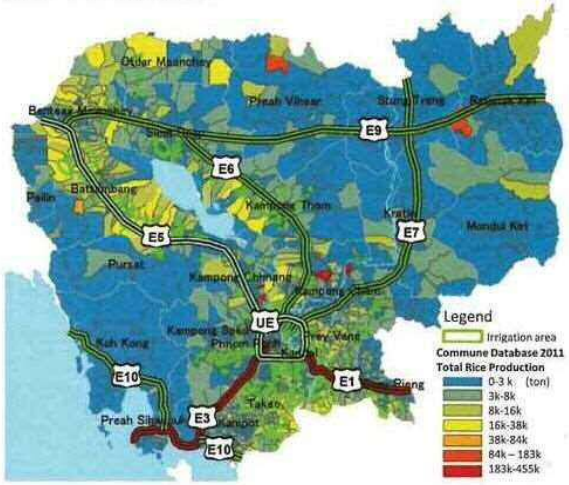
2. The Grand Design of the Cambodian Expressway

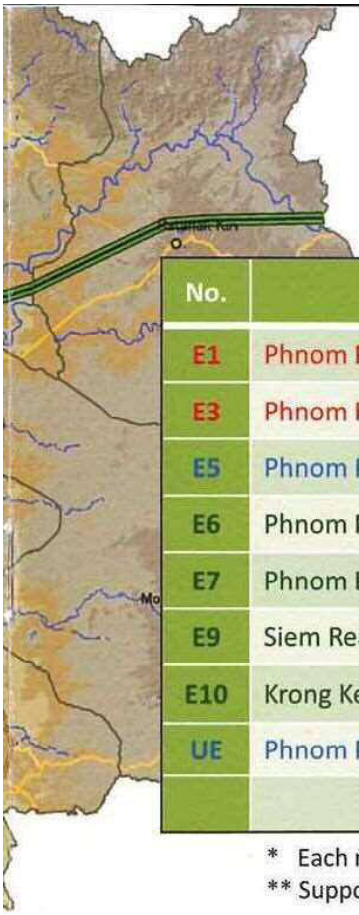


Population



Rice Production





Expressway Development Plan

No.	Route	Length*	Time** (current situation)	Schedule	Operation
E1	Phnom Penh - Bavet	135 km	1:30 (←3:30)	Short	2020-
E3	Phnom Penh - Sihanouk Ville	210 km	2:10 (←4:00)	Short	2020-
E5	Phnom Penh - Poipet	355 km	3:40 (← 10:00)	Medium	2025-
E6	Phnom Penh - Sri Sophon	400 km	4:00	Long	2030-
E7	Phnom Penh - Laos border	335 km	3:30	Long	2030-
E9	Siem Reap - Vietnam border	390 km	4:00	Long	2030-
E10	Krong Kep - Koh Kong	220 km	-	Long	2030-
UE	Phnom Penh Ring Road	155 km	-	Medium	2025-
	Total Length	2,200 km			

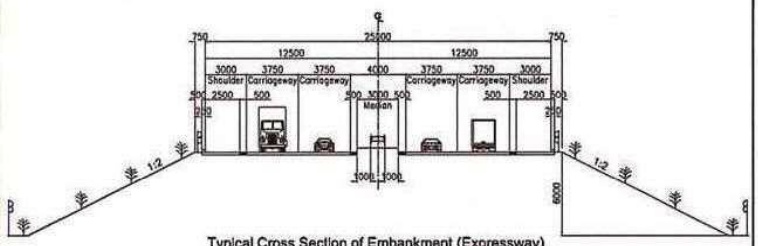
* Each route of E1-E7 begins at the junction of Ring Road 3 (RR3) in Phnom Penh

** Supposed average speed for time calculation: Expressway = 100km/hr, Current road = 40km/hr

Design Standard (Flat Terrain)

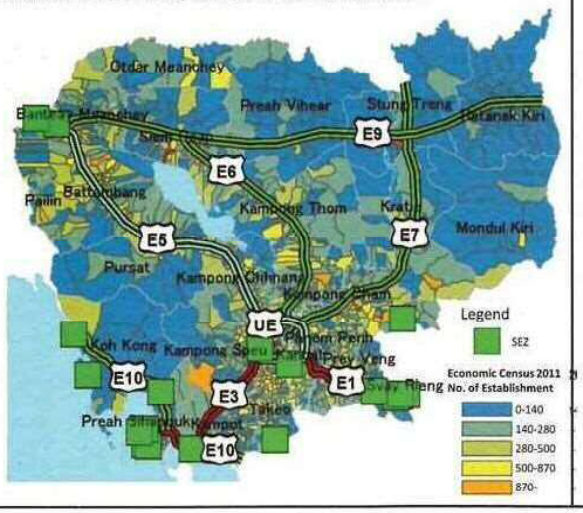
To HCMC

Item		Cross Section
Design speed	120 km/hr	
Minimum limit	70km/hr	
Lane width	3.75m	
Shoulder width	3.0m	
Median Width	4.0 m	
General Maximum Grade	4%	

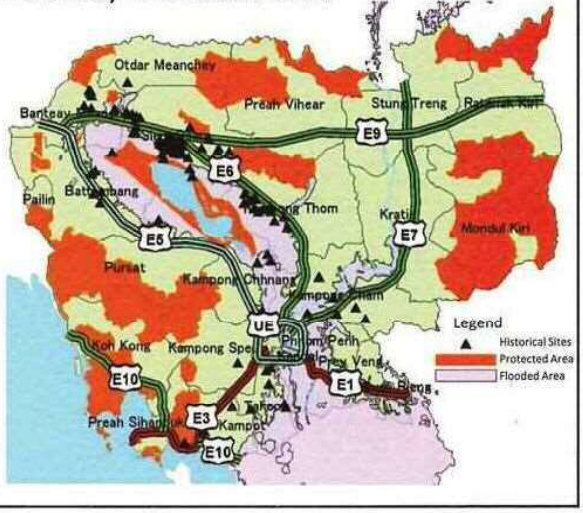


Typical Cross Section of Embankment (Expressway)

Establishment and SEZ Location



Flooded/ Protected area



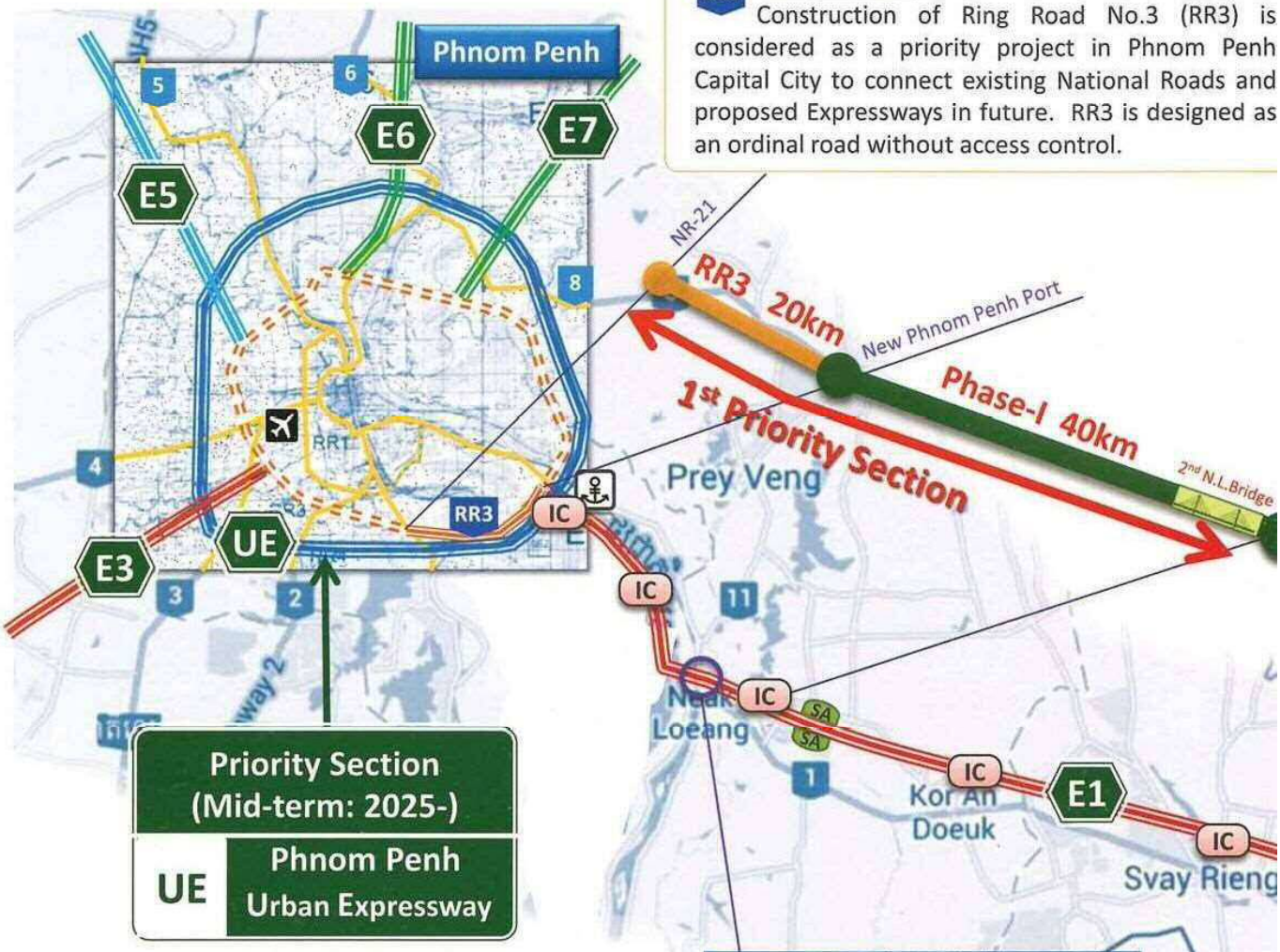
JICA Cambodia Office
GIS Unit

Datum: WGS1984 UTM Zone 48N

Disclaimer:
Boundary of the land and territory does not represent the view of JICA.

Data Source;
- Expressway Network: Made from the draft expressway network by JICA Study Team
- National Road Network: MPWT 2012
- Digital Elevation Map: Ministry of Public Works and Transport, Kingdom of Cambodia and CLEAR
- Lake and River: Geography Department, Ministry of Land Management Urban Planning and Construction
- Wetland: Cambodia Land and Environment Atlas and Resource (CLEAR), August 2012
- Protected Areas: Cambodia Land and Environment Atlas and Resource (CLEAR), August 2012
- Provincial Boundary: Cambodia Land and Environment Atlas and Resource (CLEAR), August 2012
- Provincial Center: Administrative Map of Cambodia, Geography Department, Ministry of Land Management, Urban Planning and Construction (MLMUPC), November 2012
- Historical Site: Cambodia Land and Environment Atlas and Resource (CLEAR), August 2012

3. Priority Sections



RR3 Ring Road 3

Construction of Ring Road No.3 (RR3) is considered as a priority project in Phnom Penh Capital City to connect existing National Roads and proposed Expressways in future. RR3 is designed as an ordinal road without access control.

UE Urban Expressway

Comparing radius of ring roads of expressways in major cities such as Tokyo, Paris, Beijing, Seoul, Hanoi and HCMC, every city has ring road of expressway with the radius ranging from 10km to 20km. Survey team proposes Urban Expressway in Phnom Penh. The proposed project is 155km long and connects E1, E3, E5, E6 and E7.

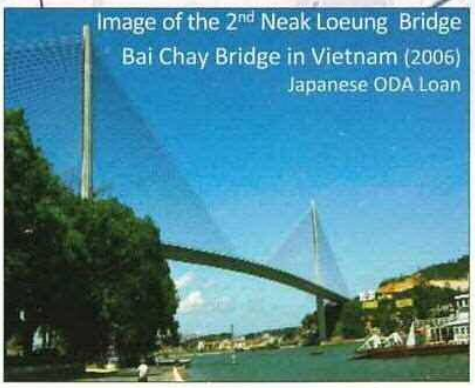
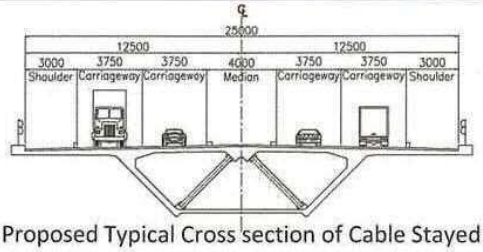
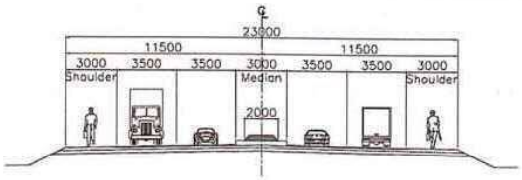


Image of the 2nd Neak Loeung Bridge
Bai Chay Bridge in Vietnam (2006)
Japanese ODA Loan


Urban Expressway in Bangkok



Proposed Typical Cross section of Cable Stayed Bridge (Expressway)



Typical Cross Section of Embankment (Ring Road 3)

Priority Section (Short-term: 2020-)

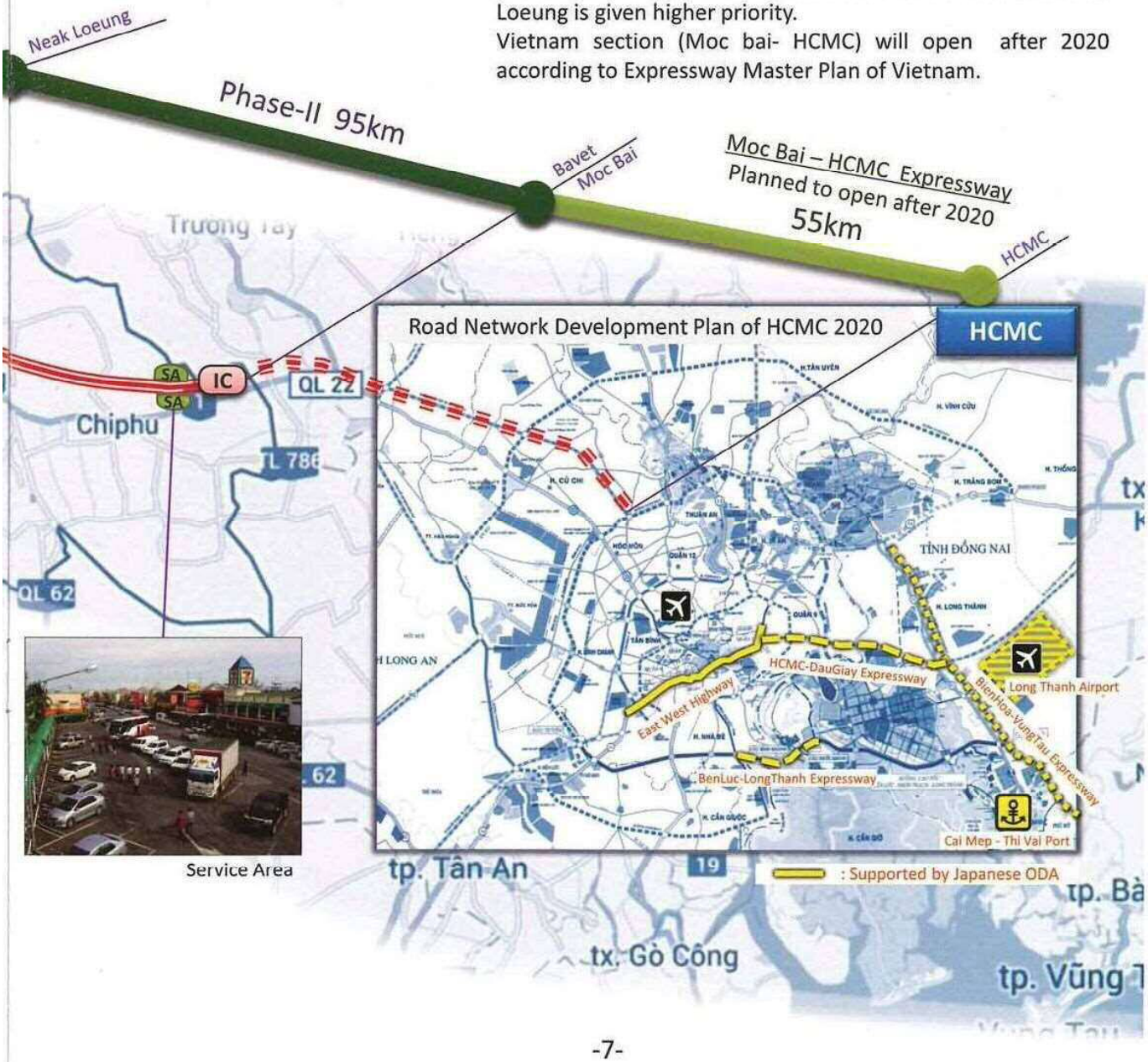
E1 Phnom Penh - - Bavet - HCMC

E1 Expressway Route No.1

E1 and E3 are given higher priorities, followed by E5 and Urban Expressway. Especially E1 is one of the most important routes, which enable to connect Phnom Penh and HCMC in 2.5hours.

Considering the current traffic capacity of NR-1 and traffic demand forecast, the section between Phnom Penh and Neak Loeung is given higher priority.

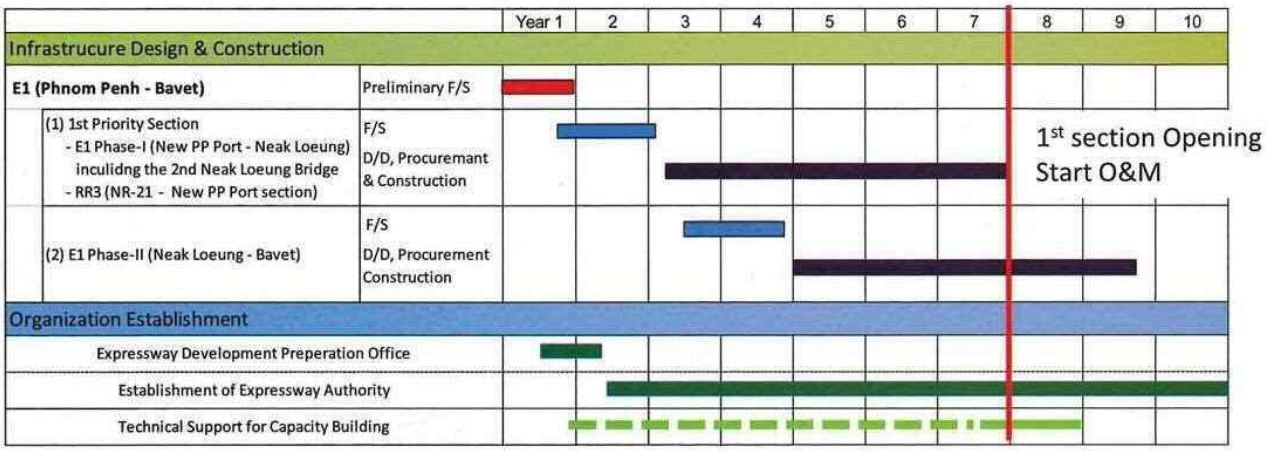
Vietnam section (Moc bai- HCMC) will open after 2020 according to Expressway Master Plan of Vietnam.



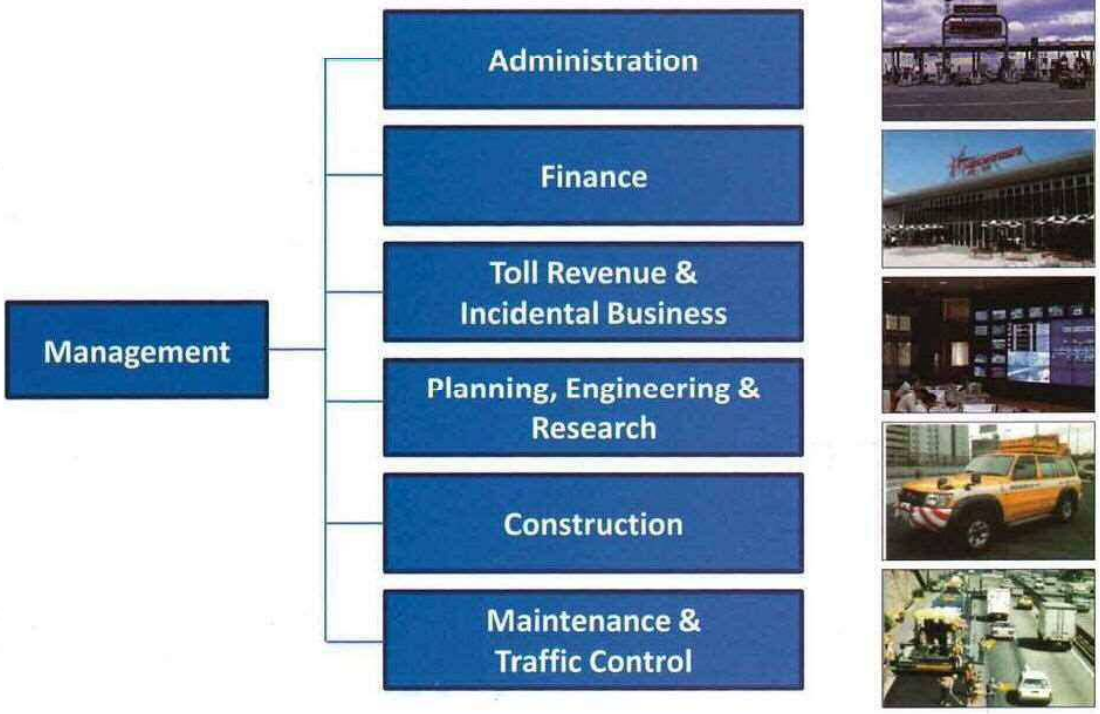
Service Area

4. Implementation Plan

Implementation Schedule



Organizational Structure of Expressway Authority



2013
60th Anniversary
JAPAN and CAMBODIA

Contact Address

JICA Cambodia Office
+855 23-211-673
JICA Transport Policy Advisor
+855 23-428-646

JICA
Japan International Cooperation Agency