POTENTIAL IMPACT OF AN EAST-WEST ELEVATED ROAD ON BANGKOK TRAFFIC CONGESTION

Weeradej CHEEWAPATTANANUWONG
Senior Engineer
Road Safety Division
Department of Highways
Sri Ayutthya rd. Bangkok 10400,Thailand
Fax: +66-2-616-7850
E-mail: weeradej@hotmail.com

Pichai TANEERANANON
Associate Professor
Department of Civil Engineering
Prince of Songkla University
Hatyai, Songkhla 90112, Thailand
Fax: +66-74-446-519
E-mail: breathislife@yahoo.com

***Abstract*:** The 6-lane East-West Ngamwongwan road is one of the major arterial roads in Bangkok; it has a crucial role in determining the city's level of traffic congestion. This is due to the fact that a substantial number of road users come from suburbs in the Western part of Bangkok. Two large provinces in its area of influence are Nonthaburi and Pathumthani where more than 2.2 Million people live on the western side of the Chao Praya River. The present capacity of the bridges crossing the river is not enough to serve the demand of traffic. Furthermore, the 6 at-grade U-turns on the road have an adverse influence on the road users in terms of travel time and fuel consumption. The 6- lane wide road also makes it difficult for drivers to manoeuvre ; this has led to many serious accidents. A strategic response to the above situation by the Department of Highways is to construct an elevated road above and along the Ngamwongwan road. This paper describes the result of the traffic, economic and financial feasibility study of the 32- kilometre elevated road project.

Key Words: traffic congestion, elevated road, TRIPS model

1. INTRODUCTION

The East-West Ratanatibet - Ngamwongwan road (Highway no. 302) is one of the major arterial roads in the city of Bangkok (See Figure 1); it has a crucial role in determining the level of traffic congestion in Bangkok where the average speed during morning and evening rush hours was 22.0km/hr in 2002 (www.otp.go.th). This is due to the fact that a substantial number of road users (~10 % of total traffic volumes of about 700,000 vehicles per day on the 5 major roads from the Northern part of Bangkok going to Bangkok CBD) come from the suburbs in the Western part of Bangkok. Moreover, this road is the principal arterial road linking western and eastern parts of Bangkok. Two large communities in its area of influence are Nonthaburi and Patumthani provinces. Specifically, more than 2.2 Million people who live on the western side of the Chao Praya River (River of King) are residents of these two provinces. The present capacity of the bridges crossing the river are not enough to serve the demand of traffic. The new "Pra Nung Khlao" bridge crossing the Chao Praya River on Ngamwongwan road with 4- lane capacity during off peak and 6- lane capacity during peak hour has played a major role in easing the time consuming crossing of the River of King. However, the 6 at-grade U-turns on the road have an adverse influence on the road users in terms of travel time (typically it requires > 45 minutes to travel 3 kilometres during peak hours), delay time (>10 minutes at a typical U-turn), and caused a significant increase in fuel consumption. Furthermore, the 6- lane wide road with many side road connections makes it difficult for drivers to manoeuvre; this has led to many serious accidents which average 3 crashes per day. A strategic response to the above situation by the Department of Highways is to construct an elevated road above and along the Ngamwongwan road through Sukhapibal 1 road. This paper describes the result of the engineering, economic and financial feasibility study of the 32- kilometre elevated road project which has the major objective of relieving traffic congestion (See Figures 2 and 3). The study looked into the benefits and the high capital investment costs required and the method of funding the project by tolling. Various toll rates were investigated so as to arrive at the optimum toll while keeping it below the road users' willingness to pay' cost.

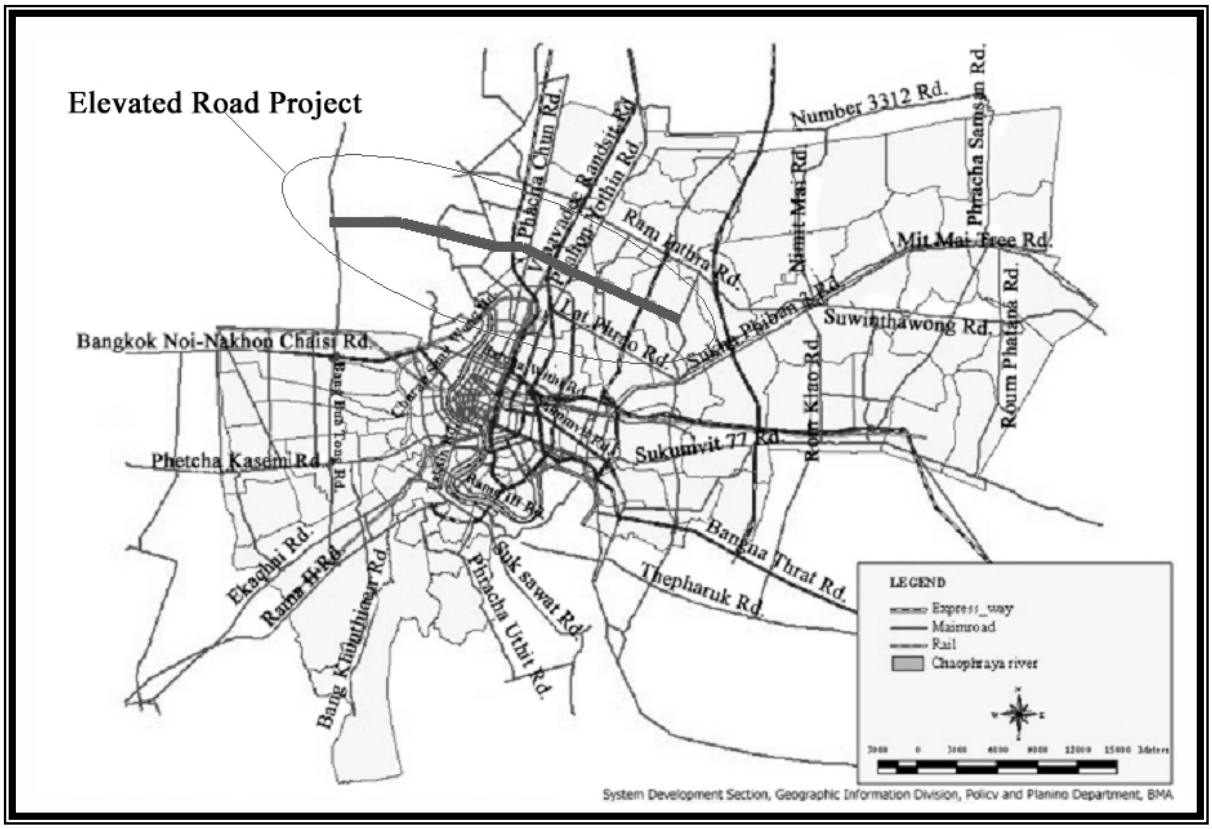

Figure 1. Road network in Bangkok showing the project location

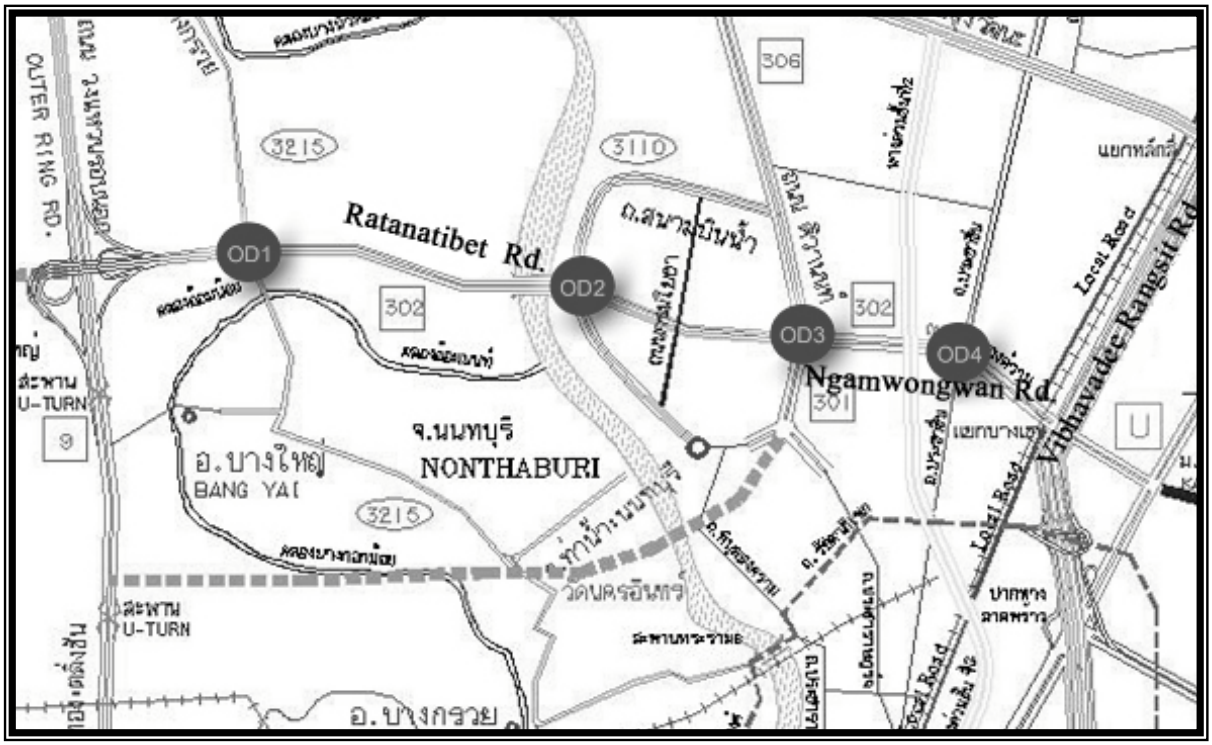

Figure 2. The western alignment of the project (section 1)

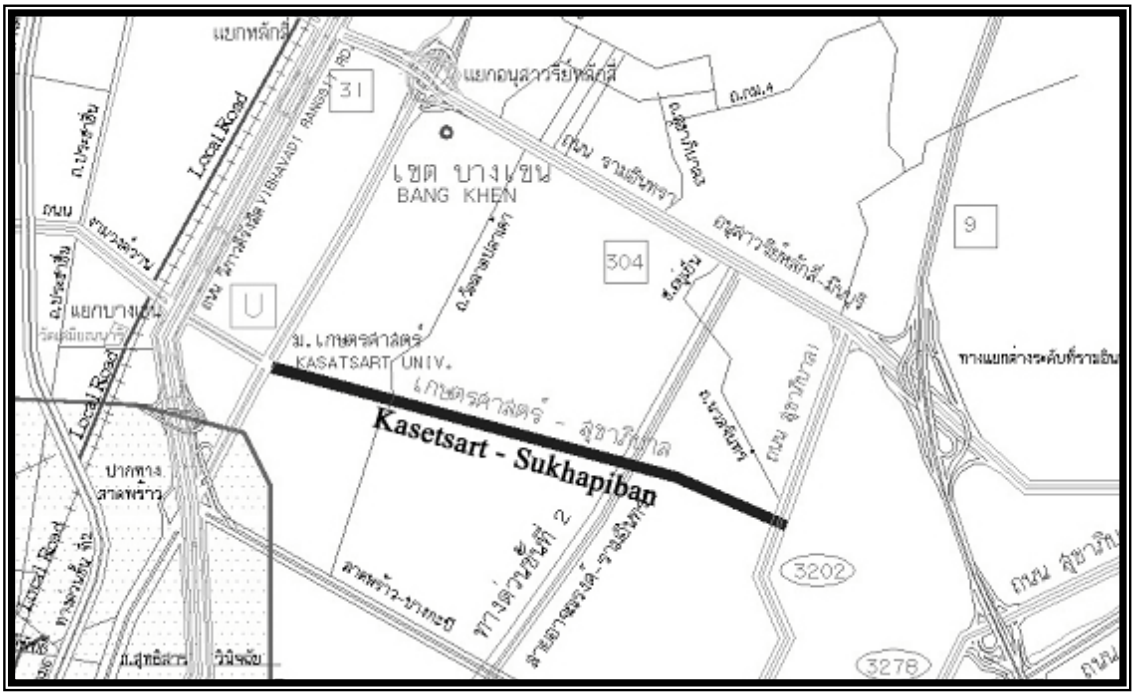

Figure 3. The eastern alignment of the project (section 2)

1.1 Objectives

The main objectives of the feasibility studies are as follows:

- To study the current traffic situation of the Ratanatibet – Ngamwongwan Corridor and other networks
- To examine all future projects that may have an effect on the elevated road project.
- To estimate the basic construction expenses and evaluate the cost – benefit of the project

1.2 The Scope of the Study

The scope of the study are divided into 2 sections. The first section starts from the western part of Bangkok (Bangyai) to the middle part of Bangkok (Vibhavadee Road) covering about 17.1 km. The second section starts from Vibhavadee Road to the eastern part of Bangkok terminating at Sukhapibal 1 road, totaling about 14 km.

2. CURRENT TRAFFIC SITUATION

2.1 General Situation

The new community which is located on the western part of Bangkok has a major traffic impact on the Pranangkhlao Bridge. Although there are 6 lanes on the bridge, free flow is not available for vehicles during peak hours. In other words, the bottleneck at the bridge presents a major problem, as a consequence, daily traffic congestion occurs in the morning and evening peak hours. The annual trend of the population growth rate of community increases substantially. Although, the Public Works Department (PWD) has provided the new highway named the Nonthaburi bypass to help distribute the traffic volumes from the West of Nonthaburi to its Eastern part, the traffic volumes on Pranangkhlao Bridge still exceeds its capacity.

The existing 6 lane-road between Vibhavadee Road and Paholyothin Road in front of Kasetsart University will be upgraded to 8 lane capacity in the year 2004 to increase the efficiency of the road. The road will be connected to a new road (Kasetsart – Sukhabibal Road) (See Figure 3) with the 8 lane capacity to carry traffic to the eastern part of Bangkok. The proposed capacity will be enough for traffic volumes of about 170,000 vehicles per day.

However, the travel time during rush hour will increase by about 25 % of the normal travel time.

2.2 Impacts of Infrastructure Projects

There are twelve projects that will have an impact on the elevated road, these are:

- the new motorways from Bangyai – Banpong
- the new interchanges at Saima and Bangpul intersection
- the new Pranangkhlao Bridge
- the 4 u-turn bridges on Ratanatibet road
- the Nonthaburi bypass
- the subway project
- the second and third stage expressway
- the road on the public water channel
- the road on the railways project
- the ultimate road at Kasetsart University
- the third stage expressway project from Kasetsart University to Sukhapibal 1 road
- the new road from Sukhapibal 1 road to Motorway (East)

3. THE TRAFFIC MODELLING

3.1 Traffic Assignment

The *TRIPS Model* is used in the project to forecast traffic volumes on the elevated road taking in account the impacts of the various projects mentioned above.

The 4-step TRIPS model used the collected origin –destination data on the networks from Bangkok to the regional cities (9 zones), trend of population in each zone, GDP-Gross Domestic Product, and GPP- Gross Provincial Product in the analysis. A simplified model is shown in Figure 4.

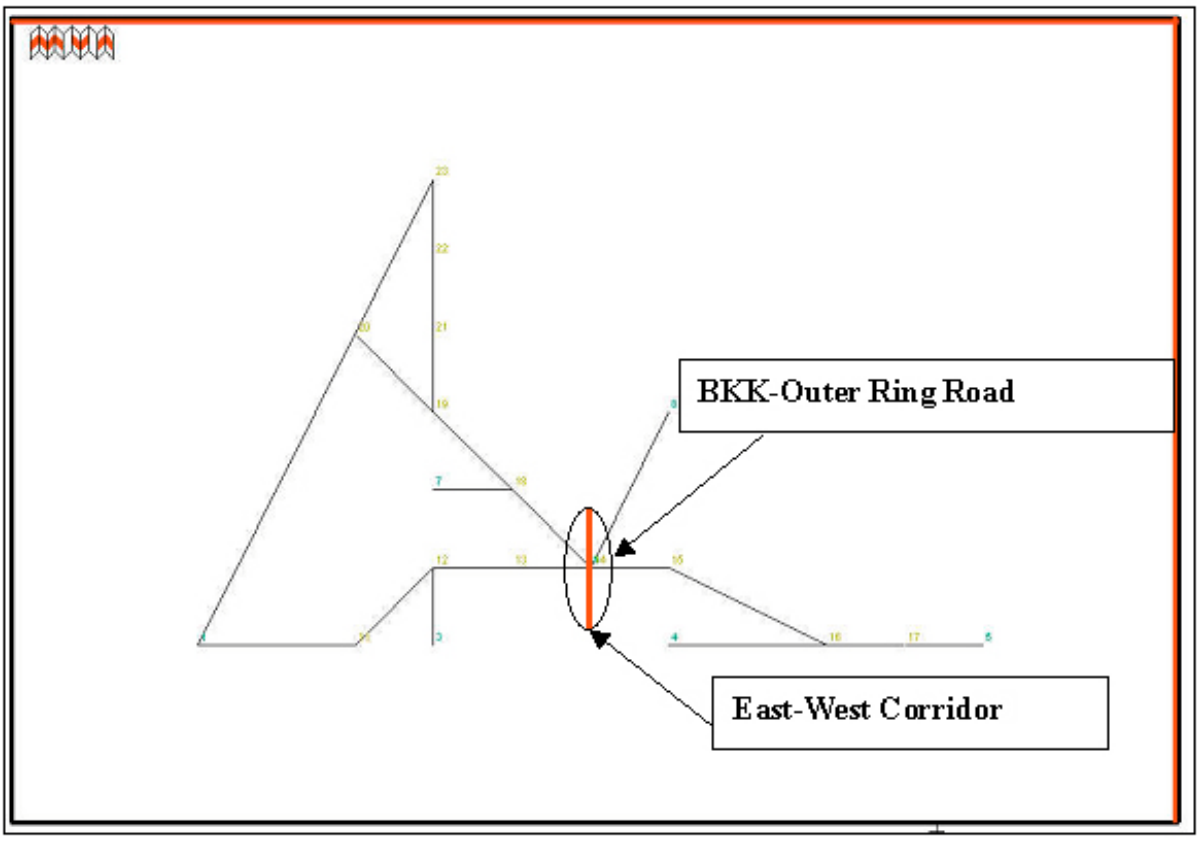

Figure 4. Simplified model of the elevated road in the network

3.2 Traffic Diversion

The *traffic diversion model* (use to study only the traffic volumes after the completion of the impacting projects) is based on the toll rate (Baht/km), the saving in travel time (Mins/km), and speed on the elevated road and the existing road (km/hr) is illustrated below;

$$P = K/(1+a(C/T*CF)^b/T^c))$$

Where: P = Percentage of Diversion
K = Calibrating Factor in Bangkok is equal to 0.9
CF = Shift Factor in Bangkok is equal to 0.85
C = Toll Rate (Baht/ km)
1.00 Baht/km for passenger car
2.60 Baht/km for 6 wheels truck
3.50 Baht/km for >10 wheels truck
T = Saving in Travel Time (Mins/km)

a- passenger car = 0.616
b- passenger car = 1.073
c- passenger car = 1.035
a-6 wheels truck = 0.978
b-6 wheels truck = 1.062
c-6 wheels truck = 1.088
a-10 wheels truck = 0.049
b-10 wheels truck = 1.505
c-10 wheels truck = 1.542

3.3 Capacity of the Elevated Road

The proposed capacity of the elevated road is about 2,000 vehicles per hour per lane during peak hour or 200,000 vehicles per day per 6 lanes.

4. RESULTS OF TRAFFIC STUDIES

The results of the study show that the elevated road will help distribute traffic volumes on Ratanatibet, Ngamwongwan, and the road section that links to the eastern ring road. It is expected that traffic volume on the elevated road in the year 2006 (the time when the elevated road is planned to be opened) will be about 50,000 vehicles per day (about 53% and 33% of the whole traffic volumes on Ratanatibet and Ngamwongwan Roads, respectively). Table 2, 3 and 4 show the future traffic volumes on the existing Ratantibet and Ngamwongwan roads and the future Kasetsart – Sukhapibal road as well as the diverted volumes on the elevated road.

Table 1. Traffic Growth Rate on Ngamwongwan Road

Year	Percentage
2002 – 2006	4.63
2007 – 2011	4.66
2012 – 2016	4.49
2017 – 2024	4.35

Table 2. The Forecast of Traffic Volumes on Ratanatibet Road

	All impact projects	The elevated road		
Year.	On the existing road (Veh/day)	On the existing road (Veh/day)	On the elevated road (Veh/day)	Proposed lanes on the elevated road
2002	115,903	76,369	39,534	2
2006	138,905	91,392	47,513	2
2014	199,264	130,721	68,543	4
2024	306,266	200,174	106,092	4

Table 3. Forecast of Traffic Volumes on Ngamwongwan Road

Year.	All impact projects	The elevated road		
	On the existing road (Veh/day)	On the existing road (Veh/day)	On the elevated road (Veh/day)	Proposed lanes on the elevated road
2002	173,057	130,653	42,404	2
2006	207,403	156,441	50,962	2
2014	297,525	224,007	73,518	4
2024	457,293	343,503	113,790	6

Table 4. Forecast of Traffic Volumes on Kasetsart-Sukhapibal Road

Year.	All impact projects	The elevated road		
	On the existing road (Veh/day)	On the existing road (Veh/day)	On the elevated road (Veh/day)	Proposed lanes on the elevated road
2002	144,480	84,773	59,707	2
2006	173,154	101,811	71,343	4
2014	248,394	145,510	102,884	4
2024	381,780	222,605	159,175	6

5. THE PROJECT APPRAISAL

The Break Even point of the project is more than 14 years due to the fact that construction cost (6 lanes) of this project is costly (more than 18,000 MB (420 Million Dollar: 1US$ = 43 Baht) or 720 MB/km). If the government subsidizes half of the construction cost, the economic indicators (within 20 years period) such as, Net Present Values (NPV) will be 23,692 Million Baht. Benefit /Cost (B/C) Ratio will be 2.68, at the interest rate of 7% and the Internal Rate of Return (IRR) will be 13.42. Furthermore, the Break Even will reduce to about 10 years (2012).

The construction of the elevated road is problematic as it is difficult to locate the columns at some intersections because of the right of ways, the existing overpass and underpass. Especially, at the Kasetsart intersection, the height of the elevated road columns is more than 30 metres and the length of elevated road passing the intersection is more than 100 metres in order to cross the existing overpass and underpass.

From our experience in Bangkok, if the toll increase, the toll revenues will decrease. In other words, the toll rate has an influence on the traffic volumes on the elevated road. Therefore, the government should consider a subsidy for the toll by the funding part of the project construction as mentioned above.

6. CONCLUSIONS

The feasibility study of an East – West elevated road project in the northern part of Bangkok has been described. Results of the project appraisal indicate that the project would be feasible only with government subsidy, for example, funding part of the construction costs.

REFERENCES

Department of Highways (2002) **The Feasibility Study of East – West Elevated Road Project Report.** Royal Thai Government.

www.otp.go.th