

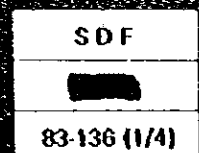
GOVERNMENT OF THE KINGDOM OF THAILAND
MINISTRY OF INTERIOR
EXPRESSWAY AND RAPID TRANSIT AUTHORITY OF THAILAND

Feasibility Study
on
The Second Stage Expressway System
in
The Greater Bangkok

FINAL REPORT
EXECUTIVE SUMMARY

NOVEMBER, 1983

JAPAN INTERNATIONAL COÖPERATION AGENCY



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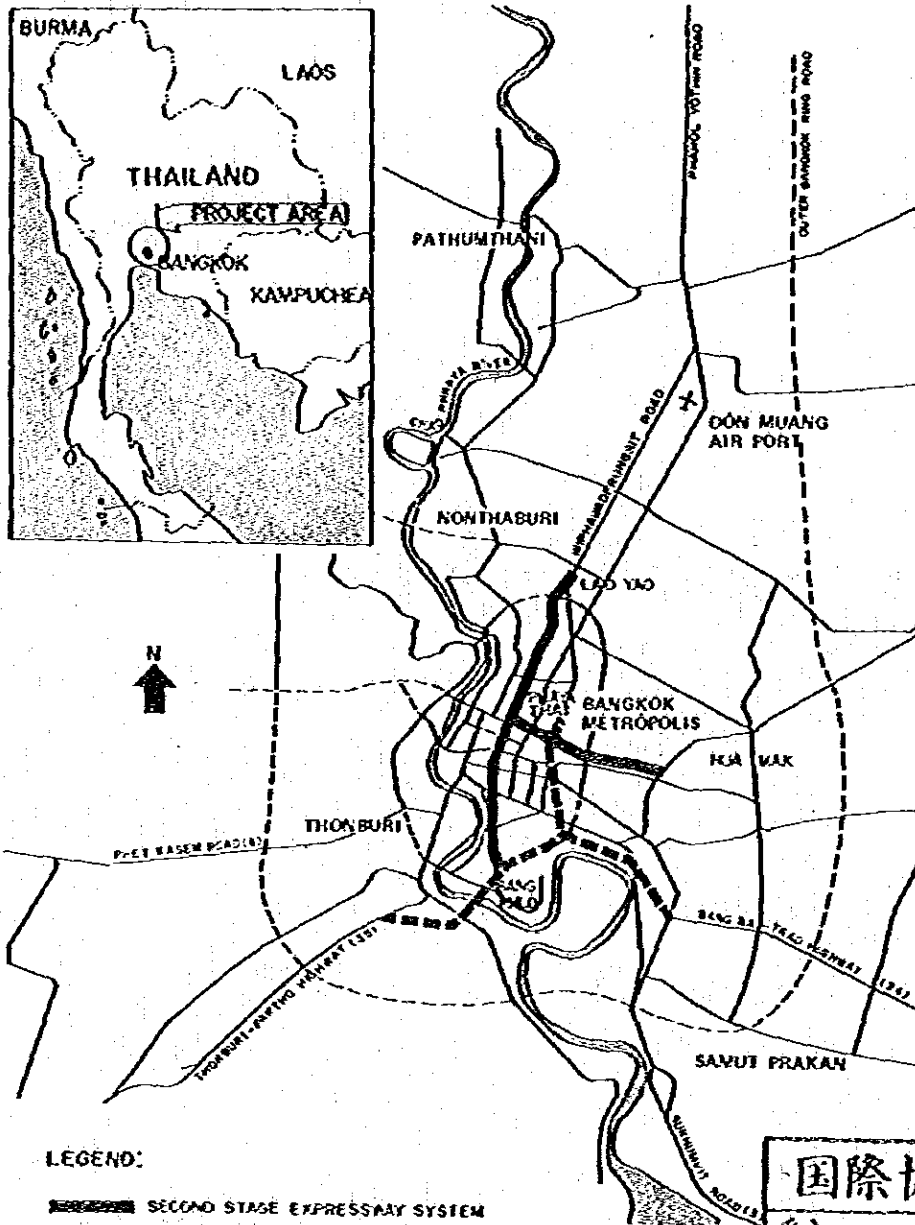
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PROJECT LOCATION MAP



LEGEND:

- SECOND STAGE EXPRESSWAY SYSTEM
- FIRST STAGE EXPRESSWAY SYSTEM

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国際協力事業団	
受入 月日 '84. 3. 29	122
登録No. 10155	61.4
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I PROJECT BACKGROUND

The Greater Bangkok Area has been and will continue to be the main focus of human activities in the Kingdom, generating social and economic benefits that have important multiplier effects over the rest of the country. The population increase in Bangkok leads to a continuing expansion of the urban area and an intensified land use in the built-up area.

The rapid urban expansion in the Greater Bangkok Area has entailed inevitably various urban problems and these have become increasingly serious especially in the central business district and its fringe areas. Inadequacy of basic infrastructures, inappropriate land use, housing shortage and the great need to improve the transportation network are the main problems.

The necessity to strengthen the road network in the Greater Bangkok Area by providing an expressway network is primarily due to the recent increase in vehicle traffic demand accompanying the development of the area. The First Stage Expressway System was thus planned to link the major highways from the north, the south and the east to relieve the traffic congestion in Bangkok. The Din Daeng-Port and Bang Na-Port sections were opened to traffic in October 1981 and January 1983, respectively. Under such circumstances, it is urgent to develop the Second Stage Expressway System since the road traffic demand in the area is foreseen to be extremely large.



TRAFFIC CONGESTION IN SUKHUMVIT ROAD

II CONCLUSIONS AND RECOMMENDATIONS

- I. In the road network of the Greater Bangkok Area, the expressway network forms the backbone, and the Second Stage Expressway System is an integral part of this expressway network. The aims of the Second Stage Expressway System Project (the Project) are to:**
 - Meet the needs of the ever-growing vehicle traffic in the Greater Bangkok Area and facilitate improved traffic flows for the enhancement of urban activities;**
 - Form a nucleus of a road network for the Greater Bangkok Area together with the existing major roads, and provide connections to the First Stage Expressway System so as to allow a smooth flow of vehicle traffic into and away from the city centers; and**

- Manage the expressway network as a tollway system, an efficient way of road system development, which will levy a toll from users who obtain benefits from the utilization of the expressway.

The following items a) to f) describe the important conclusions and recommendations derived from the results of the Study.

- a) The Second Stage Expressway System is recommended to comprise two routes (Table 1) :

TABLE 1. ROUTES COMPRISED IN THE SECOND STAGE EXPRESSWAY SYSTEM

Designation	Length of Route
North-South Route	19.2 Km approx.
East Route	8.7 Km approx.
Total Length	27.9 Km approx.

- b) The greater part of the Second Stage Expressway System is to be built as a 6-lane viaduct. No serious technical difficulty is expected in the construction.
- c) The total project costs of the Second Stage Expressway System are:
- ₪ 16,790 million (in 1983 prices); and
 - ₪ 26,200 million (1983 prices plus 6% p.a. escalation allowance).
- d) The results of an economic analysis produced the following indicators (Table 2):

TABLE 2. ECONOMIC INDICATORS

Present Worth of Benefit at $i = 12\%$	B/C Ratio at $i = 12\%$	IRR (%)
₪ 6,094.2 million	1.65	17.0

- e) The results of a financial analysis revealed the following indicators (Table 3) with toll fare levels shown in Table 6.

TABLE 3. FINANCIAL INDICATORS

Present Worth of Surplus at $i = 12\%$	Financial Revenue/Cost Ratio at $i = 12\%$	Financial IRR
₪ 0.2 million	1.0	12%

- f) Based on the result of the study on alternative options for the funding schedule it is concluded that an overall interest charge should be kept at a low level in order

to yield a surplus under the constraint of the financial return of 12%.

It is recommended that the option (a) or another combination of funds which minimizes the overall interest burden to the debt should be sought (Table 4). It is forecast that all loans can be paid back by year 2006 if all the estimated cash flow surplus is allocated for the refunding.

TABLE 4. ALTERNATIVE FUNDING SCHEDULE

Finance	Option (a)		Option (b)		Option (c)	
	Percent	Interest	Percent	Interest	Percent	Interest
Government Investment	20 ¹	—	—	—	20	—
Loan A (grace period: 10 Yrs) ⁴	40 ²	i = 3%	40	i = 3%	40	i = 8%
Loan B (grace period: 5 Yrs) ⁴	40 ³	i = 12%	60	i = 12%	40	i = 15%
Repayable all loans by	2006		2012		non-payable	

- Notes:
- 1 Equivalent to the percentage of right-of-way acquisition cost.
 - 2 Equivalent to the percentage of foreign currency component.
 - 3 Equivalent to the percentage of local currency component.
 - 4 After the grace period, the repayment over twenty years for Loan A and ten years for Loan B.

2. The Second Stage Expressway System is planned to form an inner ring expressway in the central urbanized area together with the First Stage Expressway System and to provide two trunk radial routes in the core area of the Greater Bangkok Area extending north and east. Thus, the development of the Second Stage Expressway System will not only strengthen the road network in the Greater Bangkok Area, but also greatly increase the use of the First Stage Expressway System.
3. The implementation of the construction of the Second Stage Expressway System should be effected at the earliest possible date, before land acquisition and compensation become more difficult due to the extraordinarily rapid development of the urban area, especially within the ring formed by the expressways.
4. Delay of implementation would entail increasingly difficult traffic management during construction due to increased traffic congestion in the existing road network and would result in increased construction time and cost.
5. The construction of the Second Stage Expressway System requires a large investment. For this reason a staged construction program is recommended, commencing detailed engineering design early in 1985 and completing the construction of the last priority segment in 1995.
6. The priority for construction of the different segments of the Second Stage Expressway System should be as follows, from the viewpoints of land acquisition and compensation as well as by traffic demand (Table 5 and Fig. 1).

TABLE 5. CONSTRUCTION SEGMENT AND PRIORITY

Construction Priority	Construction Segment	Route
1	N-3 and E-1	N-S and East Routes
2	N-2	N-S Route
3	N-1	N-S Route
4	E-2	East Route
5	N-4 and N-5	N-S Route
6	E-3	East Route

7. The adoption of a flat toll tariff system is recommended for the expressway network which comprises the First and Second Stage Expressway Systems. The recommended toll fare levels are shown in Table 6.

TABLE 6. RECOMMENDED TOLL FARE LEVELS

Applicable Expressway	Year	Fare at 1983 Prices	
		Toll Fare in Baht Small Vehicle	Toll Fare in Baht Large Vehicle
First Stage Expressway System, 1st and 2nd Legs	1982-1987	10	20
Entire First Stage Expressway System and Second Stage Expressway System Segments Opened by Stage	1988-1995	15	25
Entire First and Second Stage Expressway Systems	After 1996	20	30

III NECESSITY OF THE PROJECT

1. To serve and maintain Greater Bangkok as a well functioned capital city, the development of the Second Stage Expressway System is urgently needed (Fig. 2). The result of the Study shows the following socio-economic growth by the year 2000 in the Greater Bangkok Area (Fig. 3).
 - The estimated total urbanized area in 2000 is about 1.5 times that of 1982;
 - Although the growth rate has been forecast to taper off somewhat in the future, the population is expected to continue to grow to 8.7 million by 2000; and
 - The economy of the Greater Bangkok Area is characterized by the dominance of the tertiary sector. The gross product will expand from 133 billion Baht of 1982 to 280 billion Baht in 2000 in terms of 1972 prices.
2. Planned as an integral part of the expressway network in the Greater Bangkok, the Second Stage Expressway System is expected to play the following important roles:
 - Maintenance of urban activities by avoiding serious traffic congestions;
 - Breaking a deadlock in road development which is facing a great right-of-way difficulty; and

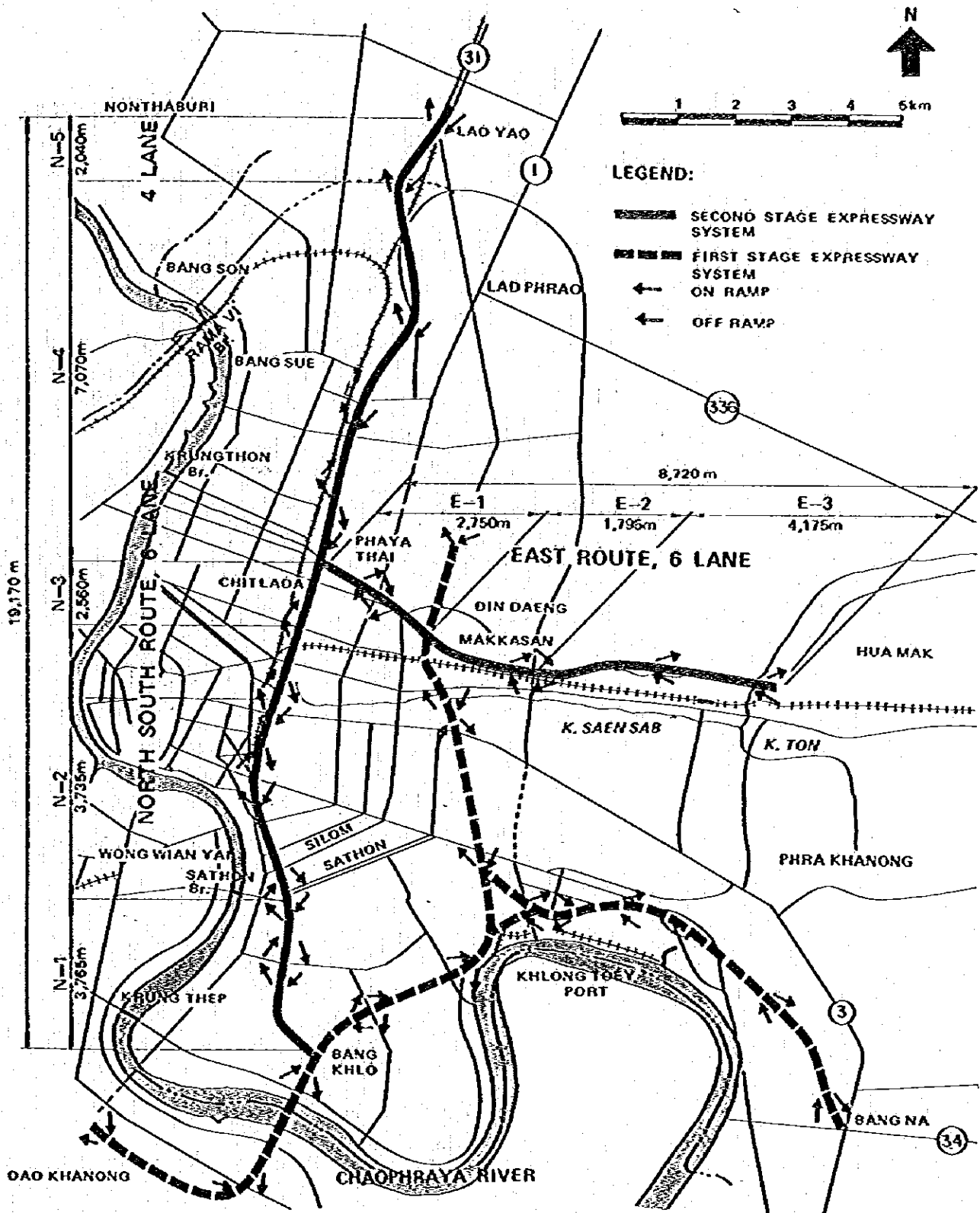


FIG. 1 EXPRESSWAY ROUTES AND CONSTRUCTION SEGMENTS

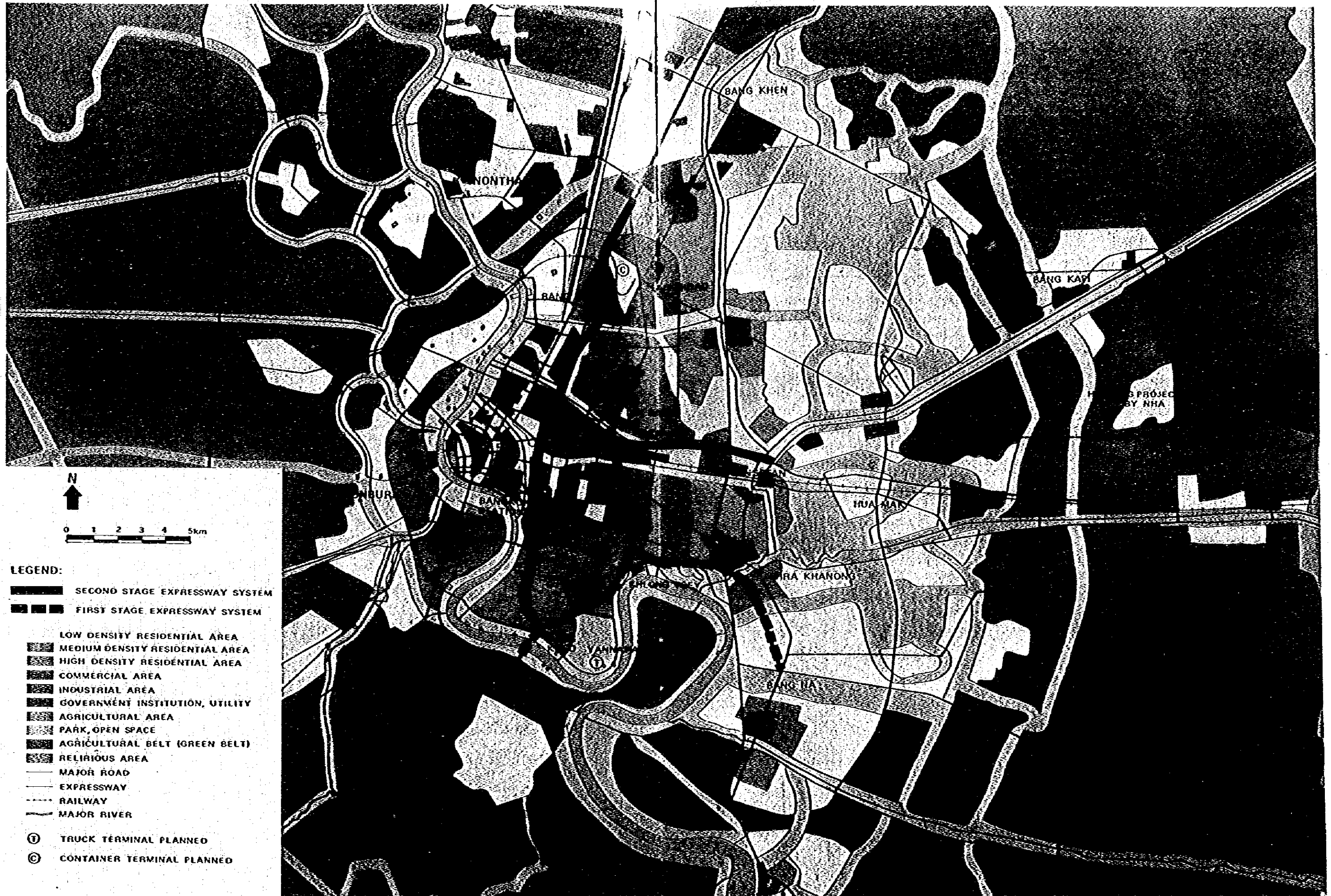


FIG. 2 FUTURE LAND USE AND EXPRESSWAY SYSTEMS

- Supplement any to the function of the First Stage Expressway System and the Mass Transit System.

1) It is foreseen that a continued increase in the vehicular traffic demand will deteriorate further the traffic congestion on the roads which has already reached an intolerable level. Present and future traffic demand in the Greater Bangkok Area is summarized in the following table (Table 7).

TABLE 7. DAILY TRAFFIC DEMAND IN GREATER BANGKOK AREA

Items	1982	2000	2000/1982
Person trips ('000)	8,555	13,260	1.55
Vehicle trips ('000)	2,223	4,425	1.99

- 2) In parallel with the development of the First Stage Expressway System, the Government is promoting the strengthening of other road networks in the Greater Bangkok Area. However, a difficulty in right-of-way acquisition is a roadblock in the at-grade road network strengthening/development programme in urbanized areas.
- 3) The First Stage Expressway System is planned to link the major highways from the north, the south and the east to relieve the traffic congestion in Bangkok, with a total length of 27 km. However, this expressway system serves only a few corridors without giving access to other important parts of the Greater Bangkok Area. Under the increasing traffic demand in the area, the expansion of the expressway network within the framework of the Second Stage Expressway System is an urgent necessity.

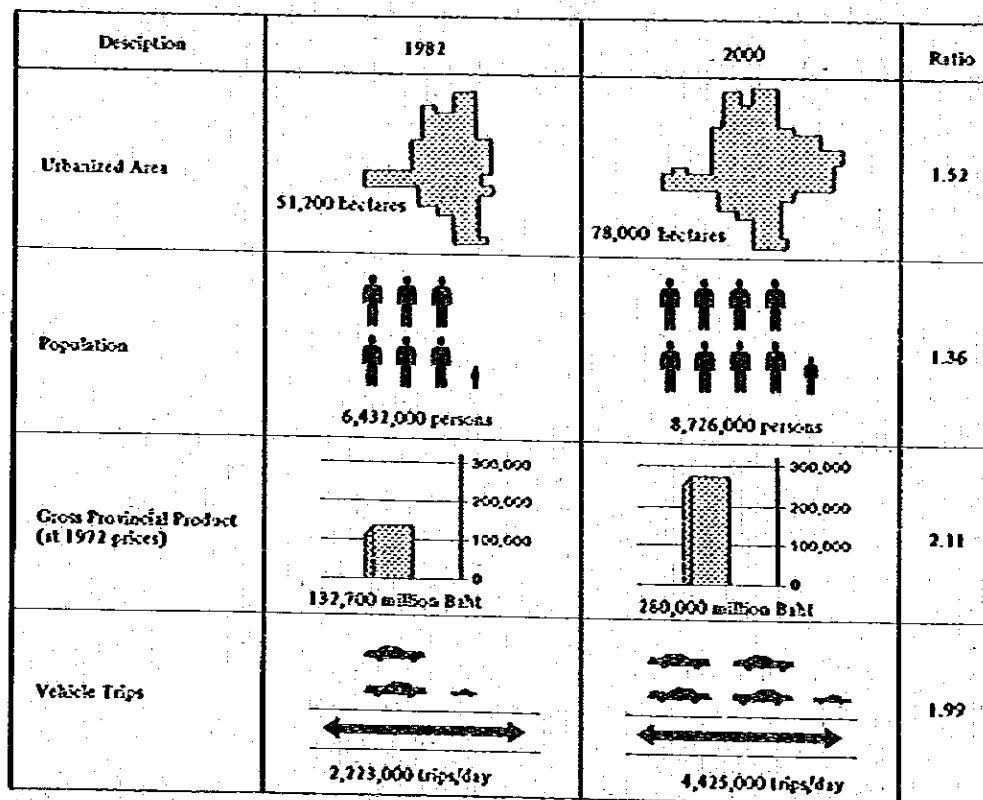


FIG. 3 CHANGES OF SOCIO-ECONOMIC AND TRAFFIC SITUATION IN THE GREATER BANGKOK AREA

IV EFFECT OF THE PROJECT

1. The development of the Second Stage Expressway System will improve the traffic condition in the Greater Bangkok Area, especially in its central urbanized area. Accordingly, the transport mobility and accessibility in the Greater Bangkok Area will be greatly improved (Fig. 4).
2. Since the Greater Bangkok Area is a population concentrated city, transportation services have a great impact on urban well-being, as well as on the national economic growth. The result of the Study revealed that the reduction of traffic costs would reach to approximately 14 million Baht a day by the year of 2000 (Table 8 and Fig. 4).

TABLE 8. OVERALL TRAFFIC COST

Cost in million Baht per day in 1983 prices

Items	1982 ¹	2000		
		With FES	With FES & SES	Ratio (3)/(2)
	(1)	(2)	(3)	(4)
Vehicle running cost	60.74	154.87	152.66	0.98
Passengers' time cost	12.30	68.05	56.33	0.83
Total vehicle operating cost	73.04	222.90	208.99	0.94

Notes: 1 Traffic cost in 1982 was simulated on the road network assuming that the Port-Bang Na section was already opened.

- FES : First Stage Expressway System
- SES : Second Stage Expressway System

3. The Second Stage Expressway System will provide a vital portion of the expressway network in the Metropolis and distribute traffic around the area, preventing serious traffic congestion which would otherwise occur in certain radial and circumferential roads. There will be a reduction of 20% in vehicle-hours and an increase of 24% in average travelling speed if the Second Stage Expressway System is developed (Table 9).

TABLE 9. AVERAGE TRAFFIC SPEED AND AVERAGE EXPRESSWAY TRIPS

Items	1982 ¹	2000		
		With FES	With FES & SES	Ratio (3)/(2)
	(1)	(2)	(3)	(4)
Average traffic speed in GBA (km/hr)	38.3	22.4	27.7	1.24
Vehicle hours ('000 Hr/day) in GBA	571	2286	1871	0.80
Average expressway trips per day ('000)	76	269	594	2.20

Notes: 1 Traffic demand in 1982 was simulated on the road network assuming that the Port-Bang Na section was already opened.

- GBA : Greater Bangkok Area
- FES : First Stage Expressway System
- SES : Second Stage Expressway System

4. Land use in the Greater Bangkok Area will be improved by the development of the Second Stage Expressway System, as inefficient concentrations can be decentralized and inefficient dispersions can be integrated. Existing community overcrowding will be reduced by the growth of new communities promoted by investors and inhabitants in the Greater Bangkok Area and the establishment of better communities will enhance the comfort of the area.


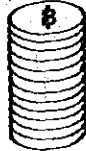
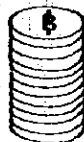
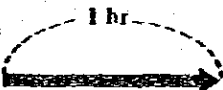
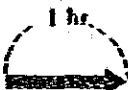



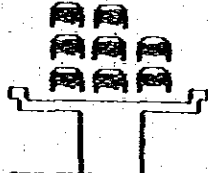
Items	1982	2000		Ratio (3)/(2)
	(1)	(2) with FES	(3) with FES & SES	
Overall Traffic Cost (in 1983 prices)	Assuming Bang Na Section opened  73.0 million Baht per day	 222.9 million Baht per day	 209.0 million Baht per day	0.94
Average Traffic Speed	 38.3 km/hr	 22.4 km/hr	 27.7 km/hr	1.24
Average Expressway Trips	 76,000 trips/day	 269,000 trips/day	 594,000 trips/day	2.21

FIG. 4 EFFECT OF THE PROJECT

V FUTURE TRAFFIC VOLUME ON THE EXPRESSWAY

1. Traffic volume in the expressway network of both the First and Second Stage Expressway Systems was forecast as 594 thousand trips per day in 2000. This indicates that the present trips in the First Stage Expressway System will jump 7.4 times, and 13% of all of the trips estimated in the Greater Bangkok Area will use the expressway network.
2. The average traffic volume per kilometer in 2000 is estimated as 108,000 vehicles per day. By comparing this with the designed traffic capacity of the expressways, the average congestion rate is calculated to be 60%. An average trip length on the expressways is estimated as 12 km.
3. Upon completion of the project, traffic volume on the First Stage Expressway System will increase by 20%. Also the traffic volume on the ordinary roads within the central urbanized area will decrease by about 14% with the completion of the Second Stage Expressway System.

4. It is foreseen that the expressway network will be mainly used by passenger cars rather than by trucks and buses (Table 10)

TABLE 10. VEHICLE COMPOSITION IN YEAR 2000

Vehicle Type	Expressway Systems	GBA Road Network
Passenger Car	82.1%	75.8%
Bus	1.5%	1.4%
Light Truck	10.4%	12.9%
Heavy Truck	6.0%	9.9%
Total	100.0%	100.0%

5. The estimated traffic volumes on the expressway network in the year 2000 is shown in Fig. 5.
6. The result of overall traffic forecast shows that even after the completion of the Second Stage Expressway System there will still remain a traffic problem in the Greater Bangkok Area. Therefore, efforts at strengthening the ordinary road network by appropriate agencies should be continued to avoid the traffic problems which are foreseen in very near future.

VI GENERAL FEATURES OF THE SECOND STAGE EXPRESSWAY SYSTEM

1. The Second Stage Expressway System consists of the following two routes :
 - 1) The North-South Route runs in a northerly direction for a route length of 19.2 km from the planned Dao Khanong-Port Section of the First Stage Expressway System to the national road No. 31; and
 - 2) The East Route of 8.7 km length runs easterly from the connecting point with the North-South Route to Phra Khanong-Bang Kapi road.
2. Both of these routes are inter-related and are indispensable to the expressway network in the Greater Bangkok Area. A part of the North-South Route and the initial stretch of the East Route are intended to compose an integral part of the ring expressway which together with the Din Daeng-Port-Bang Khlo section of the First Stage Expressway System will serve the central urbanized area of Bangkok.
3. The Expressway is planned to be 6 lanes except for a stretch between the Middle Ring Road and the terminus of the North-South Route where 4 lanes are planned (Fig. 6).
4. The First and Second Stage Expressway Systems will be operated using a flat tariff and on-ramp toll collection system. The locations of the on and off ramps have been determined as shown in Fig. 1.

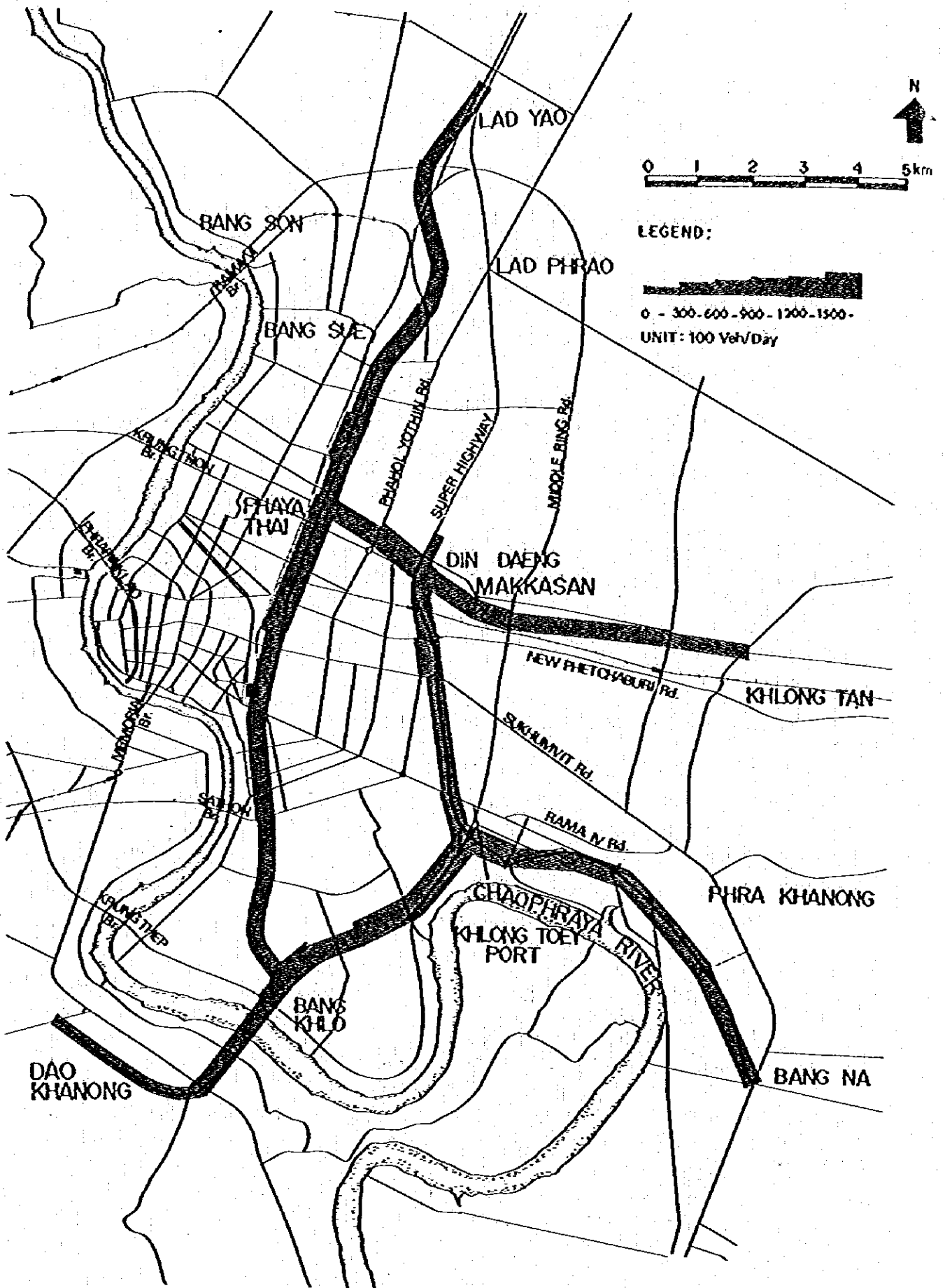
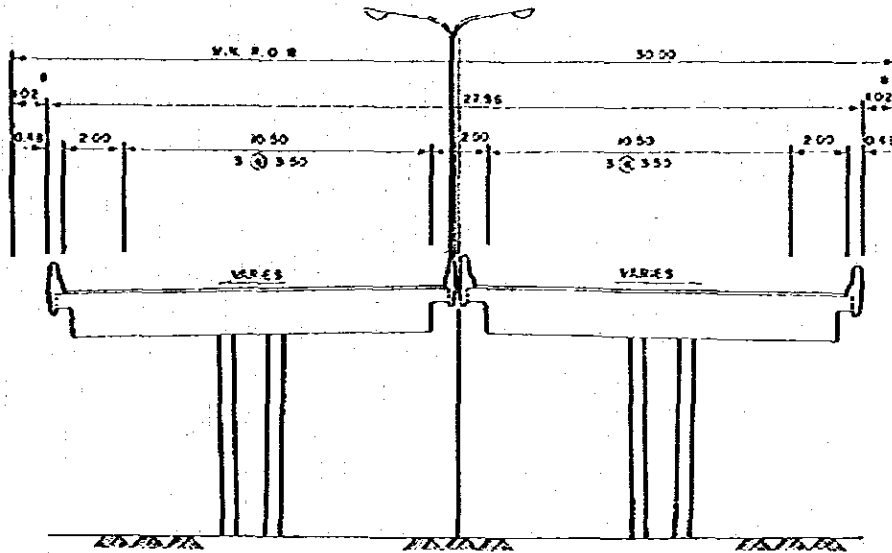


FIG. 5 ESTIMATED TRAFFIC VOLUMES, IN THE YEAR 2000

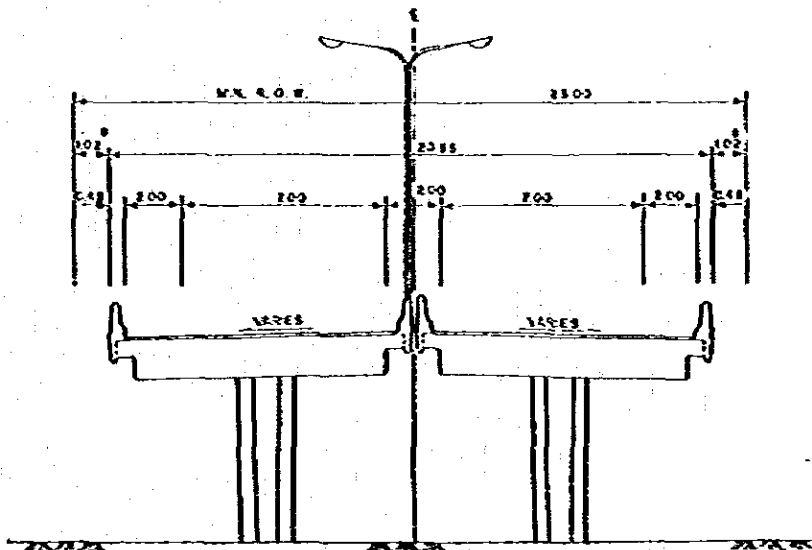
5. The following supporting facilities are to be provided for the Second Expressway System :

- Toll collection facilities;
- Traffic control system; and
- Expressway lighting.

6-LANE ELEVATED EXPRESSWAY



4-LANE ELEVATED EXPRESSWAY



NOTE: The figures with asterisk show absolute minimum values. They shall be substituted by 5 meters of desirable minimum values to provide set back distance where the viaducts are planned within the row of the existing or planned streets.

FIG. 6 TYPICAL CROSS SECTIONS OF THE EXPRESSWAY

VII PROJECT COSTS AND IMPLEMENTATION SCHEDULE

- Following shows the summary of the estimated project costs at 1983 prices (Table 11):

TABLE 11 ESTIMATED PROJECT COST

Designation	Cost in million Baht		
	Foreign Currency Portion	Local Currency Portion	Total
Construction Cost	5,750 (51.6%)	5,380 (48.4%)	11,130 (100%)
Land Acquisition and Compensation Cost	—	3,480	3,480
Contingencies and Others	870 (39.9%)	1,310 (60.1%)	2,180 (100%)
TOTAL	6,620 (39.4%)	10,170 (60.6%)	16,790 (100%)

- The implementation of the Project requires an extremely large investment. For this reason, and to obtain maximum economic and financial benefit a staged construction approach is recommended as shown in the following figure (Fig. 7):

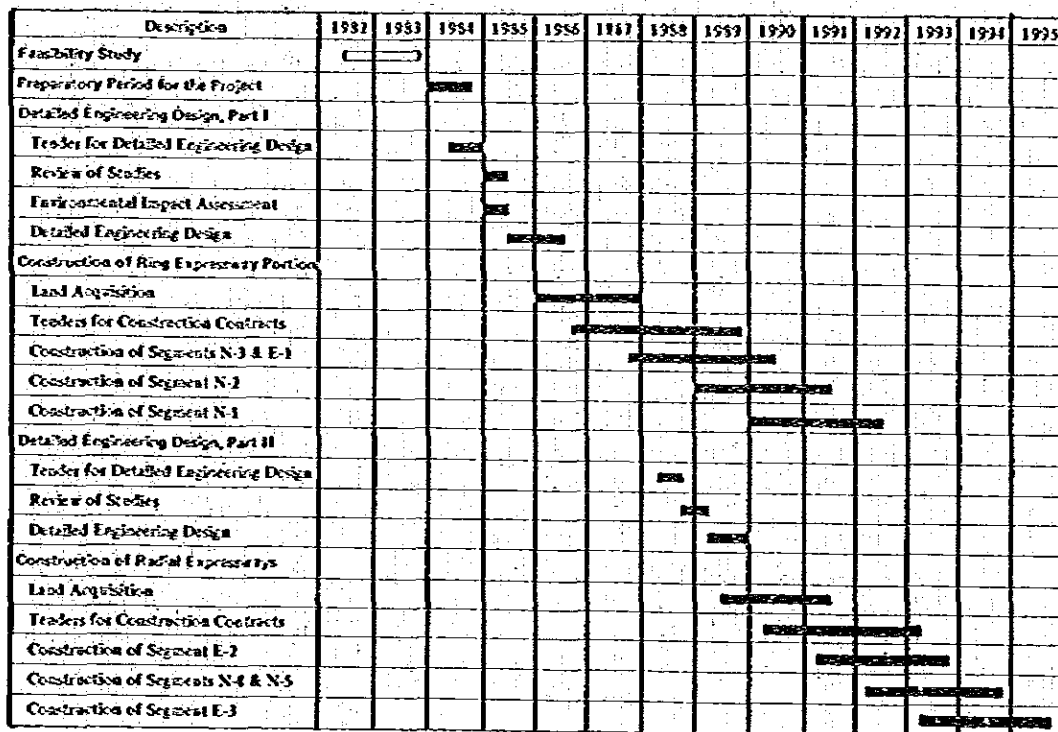


FIG. 7 RECOMMENDED IMPLEMENTATION SCHEDULE OF THE SECOND STAGE EXPRESSWAY SYSTEM PROJECT

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