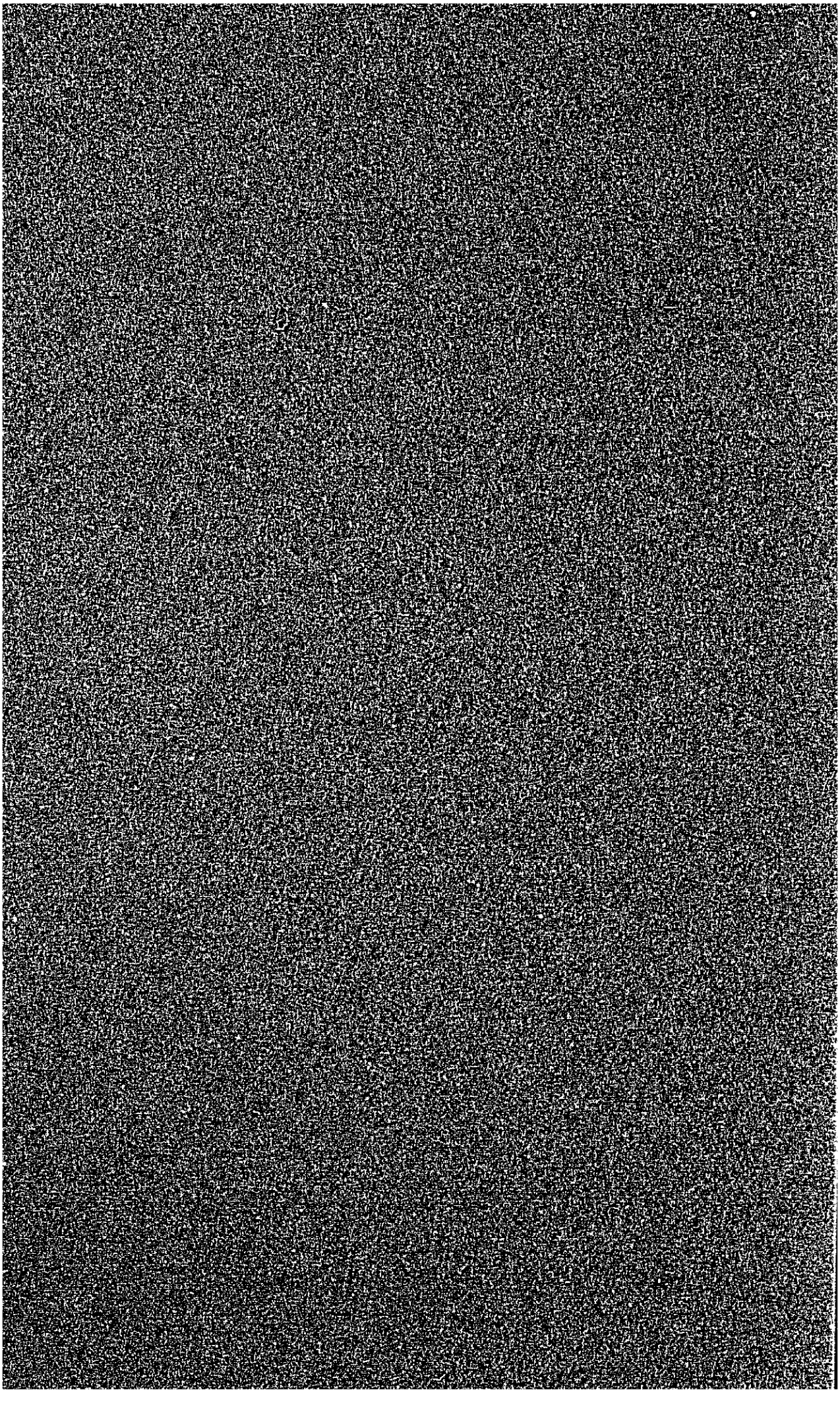
Chapter 12
ECONOMIC ANALISIS



CHAPTER 12 ECONOMIC ANALYSIS

12.1 General

12.1.1 Approach

In Phase I of the Study, economic analysis was conducted to find the result of comparison of the alternative SES network plans. The Phase I Study recommended that two routes, North-South of 19.5 km and East of 14.2 km, should be reassessed their viability in Phase II of the Study. Other routes proposed were considered better to be studied at a later time for the following stages after SES.

In Phase II of the Study, economic analysis was conducted to determine if the routes recommended by the Phase I Study are reasonable and viable. The eastern-most section, 5 km, of East Route was assessed better postponed into the latter stage planning, while the northern-most section of N-S route was found better to be incorporated in the Second Stage Expressway Plan. In addition, an economic study on the use of public buses was conducted, resulting in a recommendation of the "passing through" service of public buses.

12.1.2 Conditions

The economic benefits realizable from the implementation of the project are the savings in the traffic cost which were quantified through improved traffic movement on the road network including the proposed expressways. The traffic cost was estimated by applying the vehicle operating cost per km and the passenger time value per hour to the traffic on the roads in the GBA through a computer simulation.

Investment cost was approximated and shown by economic cost. Transfer elements in the cost such as taxes and duties were deleted to arrive at economic cost. The cost was divided into local and foreign currency components. Maintenance and operation costs of the Expressway were determined by studying the budget of ETA. No shadow pricing was applied because it was considered the effect on the economic assessment would be quite modest.

There are plans of improvement and construction of roads and bridges under the execution of BMA, DOH and DPW. It is hard to confirm the implementation programs of these plans for a long period of years to come, particularly for more than five years from now. An approach to these authorities resulted in updated information of the most likely plans of construction during the eight years up to 1990. They are shown in Fig. 6–12 of Chapter 6. In the economic analysis these roads were assumed to be constructed before the completion of the Expressway. Accordingly, their cost was treated as the sunk cost.

The Government has already prepared the engineering design of three lines of the MTS. However, due to the high cost of construction, the Government is looking for private sectors to participate in the construction and management under a concession term. It will take more than a year to reach a conclusion. Under the circumstances, this study assumed that the Rama Line and its branch to the workshop would be completed before the SES.

Most of diverted users to the MTS were estimated to come from the current bus users. Reduced number of bus users and hence reduced number of buses were taken into account for the estimate of the traffic volume on urban roads. It was found that the influence of MTS

on the use of Expressway was quite minimal; i.e. approximately 3% larger benefit in the case of "without MTS" than that "with MTS" in 2000. The main reason was that MTS and SES would not compete within the same corridor.

12.2 Phase I Study

12.2.1 Alternatives

The alternative plans for economic evaluation are composed of those ranging from a modest construction plan to an extensive network plan. The comparative study of the network is expected to find the most appropriate magnitude of the expressway network plan to be implemented in a certain period of years as in the SES program. Accordingly, it should be understood that the SES alternatives are staged construction programs together with the First Stage Expressway System towards the completion of the expressway network in GBA. The network alternatives studied in Phase I are summarized in Table 12–1 and Fig. 12–1, referring to Chapter 6.

TOR Plan is the expressways proposed in terms of reference prepared by ETA for the discussion with JICA. These routes were part of a long range expressway network development plan recommended by BTS.

Master Plan is a network developed in this study through its urban and traffic planning view points. The plan is recommended to be a target of the expressway construction program in the stages following FES. It is composed of two rings and a few radial expressways.

SES/P is the Provisional Second Stage Expressway System. It proposes the formation of an inner-ring expressway together with the three direction radial expressways. The plan indicates the construction of the outer-ring expressway should be phased in the following stages.

SES is a plan deleting the crossing of Chaophraya River from the SES/P. The reason would be that the cost of the crossing is high and also other alternative crossing plans are not investigated yet. The plan suggests that this SES is closer to FES in its expressway length.

12.2.2 Traffic Cost

(1) Vehicle Operating Cost

a) Vehicle Operating Cost

Vehicle operating cost (VOC) of the representative vehicle types is estimated as in Appendix 12.1. The summary is shown as the basic VOC in Table 12–2. Caused by frequent speed changes on roads in urban area, travelling speed decreases and VOC increases. VOCs in different speed levels were also estimated and stated in Appendix 12.1.

There were minor changes in prices of VOC components during several months since September 1982. Fuel prices have been revised and tax elements on them were updated since March 1983, although the change was quite modest. Other cost components were found eventually at the same level through this period.

TABLE 12–1 ALTERNATIVE PLANS FOR ECONOMIC EVALUATION

Case	Proposed Expressway Length, km [1]	MTS[2]	Economic Analysis[3]
Alternatives			
– Master Plan	105	Rama Line	B/C. PW & IRR
– TOR Plan	100	Rama Line	B/C. PW & IRR
– SES/P Plan	66	Rama Line	B/C.- PW & IRR
– SES Plan	61	Rama Line	B/C. PW & IRR

Notes: 1) FES of 27 km included

2) Rama Line accompanied with a branch line to the Hua Mak Workshop was assumed to be opened by 1990 for all cases. Users of MTS shifting from buses were forecasted by applying a modal split model shown in Chapter 6.

3) The traffic cost and benefits were estimated for the three years of 1990, 2000 and 2010 together with the traffic assignment. The benefits for other years upto 2016 were interpolated and/or extrapolated by finding the average annual increasing rate between the years.

TABLE 12–2 BASIC VEHICLE OPERATING COST AND ECONOMIC COST AT BASIC RUNNING CONDITIONS[1]

(Baht/1,000 km)

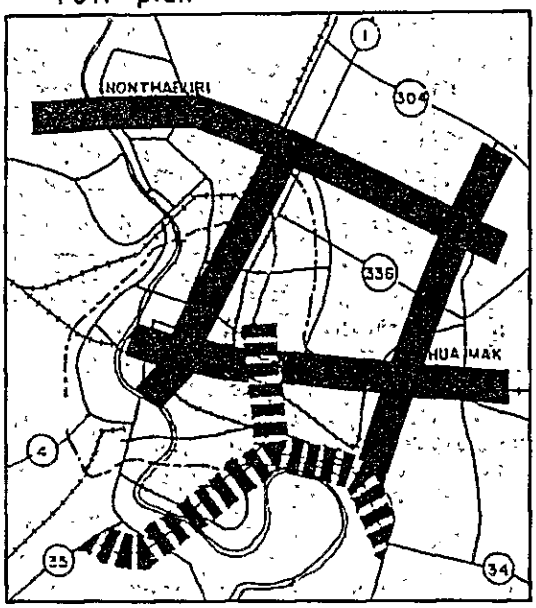
Item	Motor-cycle	Passenger Car	Light Bus	Medium Bus	Heavy Bus	Light Truck	Medium Truck	Heavy Truck
Fuel	247.08	614.20	571.64	788.92	1315.27	703.22	916.58	1191.85
Oil	11.08	29.90	35.88	56.35	56.35	35.88	61.25	61.25
Tire	18.00	72.00	65.70	137.00	245.00	64.00	249.00	428.00
Dep. & Int.	270.94	1278.80	821.29	1107.76	2994.97	665.77	1872.99	2139.62
Wages	-	-	675.00	972.00	1530.00	450.00	1350.00	1728.00
Maintenance								
Part	5.41	89.52	65.70	210.47	550.43	53.26	355.87	420.89
Labor	21.41	58.33	64.61	191.98	308.28	69.41	191.98	308.28
Overhead	-	-	107.26	193.86	963.25	-	372.50	855.84
TOTAL	573.87	2142.75	2407.08	3658.34	7963.55	2041.54	5370.14	7133.73
Normal Speed k/H [2]	60	70	60	60	60	70	60	60

Sources: The summary of Appendix 12.1, April 1983

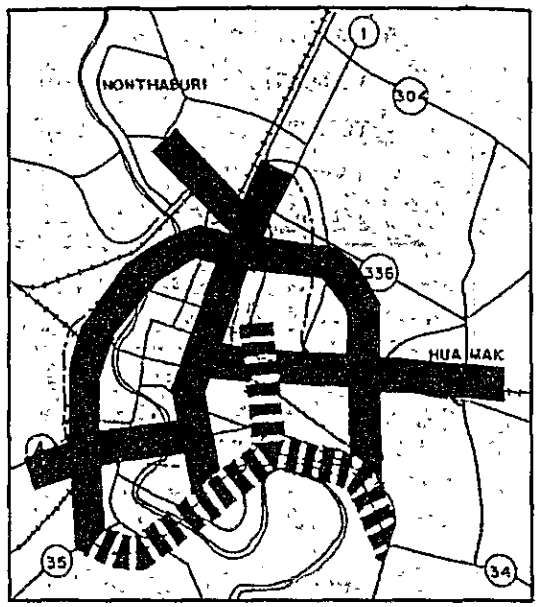
Notes: 1) On level and paved urban roads.

2) Normal travelling speed is used to determine a basic VOC.

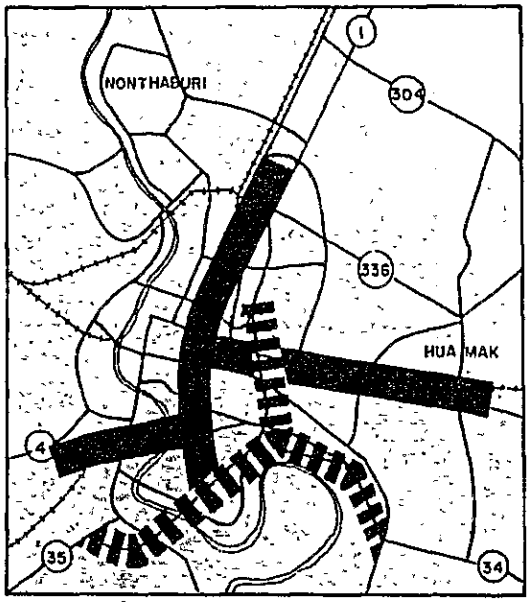
TOR plan



Master plan



SES / P plan



SES plan

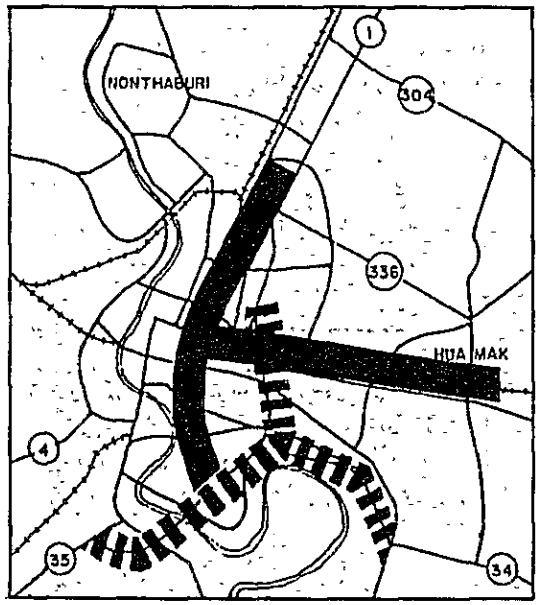


FIG. 12 - 1 ALTERNATIVE PLANS IN THE PHASE I STUDY OF SES

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

b) Vehicle Types and Vehicle Operating Cost

Trucks were divided into small trucks and large trucks in the OD matrices. The division was determined by finding a rate of registration in 1982, i.e. 60% for small trucks and 40% for large trucks. This rate is supposed not to change all through the years in the study.

When VOC for buses determined as in Appendix 12.1 was applied for the OD matrix of buses, the weighted VOCs at 34% for medium buses and 66% for heavy buses were used. For the VOC of large trucks the weighted mean of 60% for medium trucks and 40% for heavy trucks was taken into account. These percent shares were determined by reviewing the percent composition of the traffic surveyed in July 1982.

(2) Time Value of Passengers and Vehicles

Time value of passengers was estimated by using the data such as income raising persons, family income, working hours and trip purpose composition. The data were the result of the home interview person trip survey conducted in July 1982. (Refer to Chapter 4). It is felt the monthly income collected through the interview is less than the actual level since it is generally said that people are likely to cover part of their income and this tendency is very common to higher income classes. However, the conservative estimate thus obtained would cause no specific problems in the economic assessment.

As stated in Chapter 6, the average number of occupants per vehicle was assumed to decrease slightly during the years up to 2000. Time value per vehicle was estimated by taking this assumption together with a growth in per capita GPP. The values estimated are shown in Table 12–3.

TABLE 12–3 TIME VALUE OF VEHICLES

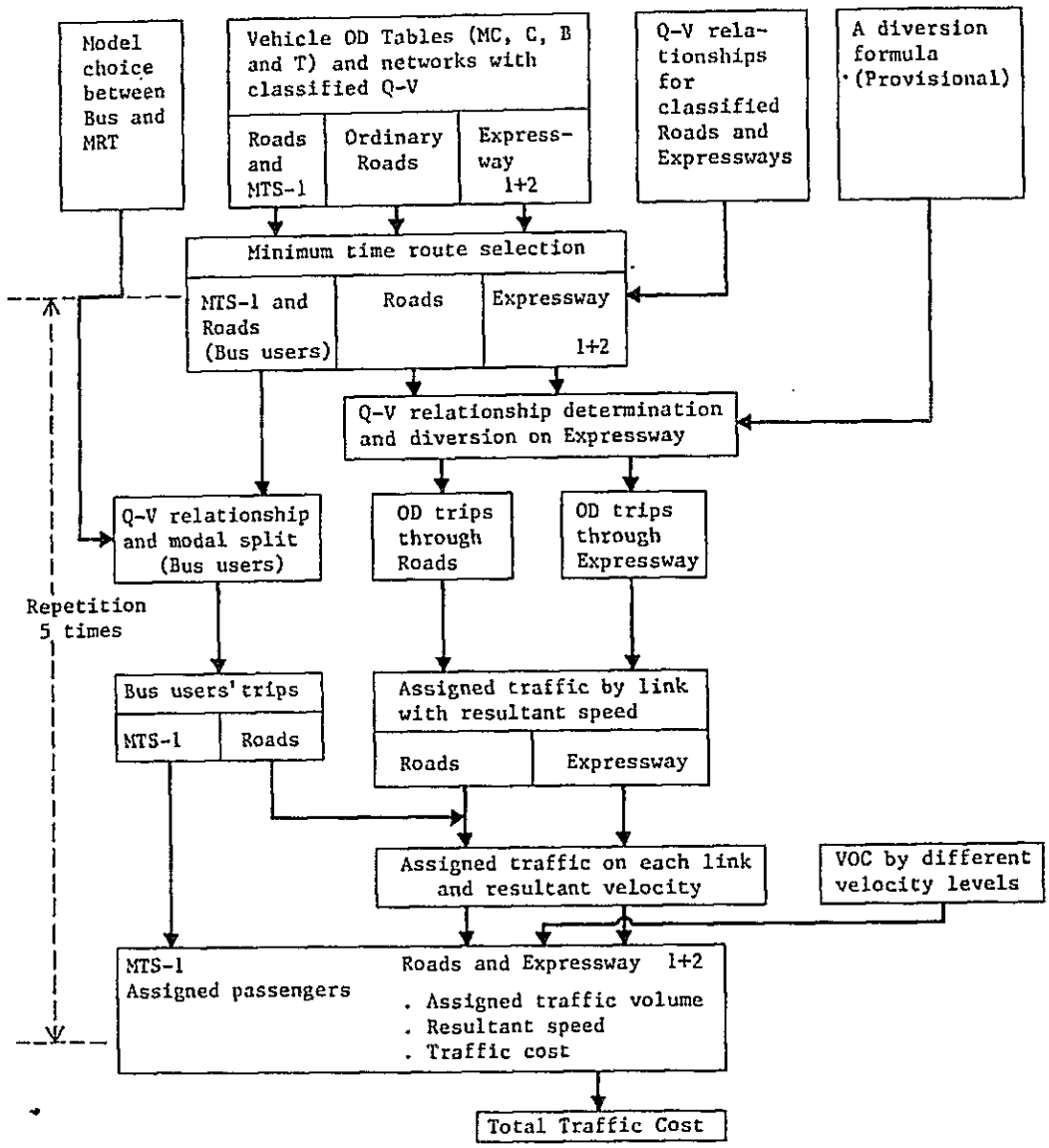
(Baht/vehicle/hour)

Year		Car	Motorcycle	Public Bus
1982	1)	22.20	5.62	171.08
1990	2)	26.79	6.73	193.77
2000	1)	38.87	8.44	226.40
2010	3)	39.31	9.79	262.74

Notes: 1) From Appendix 12.1
2) Interpolated
3) Extrapolated at 60% of 1982–2000 in the annual growth rate of GPP per capita.

(3) Traffic Cost

The traffic cost estimate is conducted consecutively with the computer simulation process of traffic assignment. The conceptual flow of the process is shown in Fig. 12–2.



Legend : 1) MTS-1 = Assuming Rama IV Line is completed

2) Expressway 1+2 = The 1st Stage Expressway plus an alternative of the 2nd Stage

FIG. 12-2 | **FLOW CHART: TRAFFIC ASSIGNMENT AND TRAFFIC COST, A SES ALTERNATIVE**

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

Every zone pair trip in the OD matrices was sliced into five portions (0.3, 0.2, 0.2, 0.2 and 0.1). The zone pair trips in a sliced group could find a time minimum path on a given network with given conditions. When the paths for all zone pairs were determined, these trips were assigned to the road links of the paths. On each link of the path, the trips were summed up to a volume which was associated with a volume velocity formula which indicates varying travelling speed corresponding to various levels of the traffic volume (Refer to Chapter 6).

When the assignment and the traffic summation were over, the travel speed for the link was estimated. This speed was a condition with which the second sliced group of the zone pair trips would find the minimum time path. In this way the repetition of minimum time path, assignment, summation, and the travel speed determination was conducted for five times on a given network condition. The traffic cost was estimated by using the summarized volume and the travelling speed at each repetition on each link. And the total of five repetitions is the traffic cost for ADT.

12.2.3 Benefits

(1) Quantified Benefits

Traffic cost was estimated for all vehicle movement on two road networks – one with an alternative expressway network and the other without the expressway network but including the First Stage Expressway sections. Plans of improvement and new construction of urban roads during the 1980s and a MTS plan were incorporated in the network regardless of the expressway alternatives. Accordingly, it can be understood that the balance of the cost between "with" and "without" is the savings in traffic cost generated by the construction of an expressway network. The savings were estimated for the years 1990, 2000 and 2010. The savings in other years between these years were interpolated and extrapolated by using a compound growth rate, resulting in a benefit stream from 1990 to 2015.

The benefit consists of the savings in VOC of those who would divert to new expressways and those who would remain on urban roads but running in less congested traffic flows which could be realized by the diversion to the expressways. MTS users were estimated and they were assumed to divert from the bus users. The reduced number of bus users would result in the reduced number of buses which would contribute to the decongestion of the urban roads. The decongestion was taken into the traffic cost estimate for all cases of with and without.

The percent shares of the VOC and the time cost in the traffic cost are shown in Appendix Table 12–24. It was found that the percent share of the time cost was approximately 30% in the total cost on the network, however, the share was 70% when the savings in the total traffic cost was estimated. It was understood that the former indicated that the time cost was not excessively evaluated in the overall traffic cost and the latter indicated that vehicles ran to shorten the travelling time at an expense of travelling longer distances with a higher speed.

(2) Unquantified Benefits

It is to be noted that there are a number of unquantified impacts resulting from the completion of the road project. These main unquantifiable and/or qualitative impacts are listed below:

– Changes in the rate of traffic accidents;
– Multiplier effects of the project investment;
– Changes in landuses, land values and rents;
– Changes in environmental circumstances; and
– Changes in community composition and space.

12.2.4 Investment and Maintenance Cost

(1) Investment Cost

Investment cost of each alternative case was studied in Chapter 11 and summarized as in Table 12–4. The cost excluding duties and tax component was used in the economic evaluation. Disbursement was conventionally assumed to be in the years of 1986 to 1989.

TABLE 12–4 INVESTMENT COST

(In Million Baht of 1982 Prices)

Item	Foreign Cost	Local Cost	Economic Cost	Taxes and Duties	Financial Cost
Master Plan	11,924	17,005	28,929	3,780	32,709
TOR	10,593	14,951	25,544	3,320	28,864
SES/P	6,217	8,961	15,178	1,971	17,149
SES	5,256	7,663	12,919	1.665	14,584

(2) Maintenance Cost

Annual road maintenance cost was estimated in Chapter 11. It covered the items of ditch cleaning, surface patching and reparing, lighting, painting, etc. Resurfacing at every 7 years was assumed. The cost excluding duties and taxes was also determined for the years of 1990 to 2015. Annual operational and maintenance costs for the toll facilities were also approximated in terms of annual expense. (Refer to Chapter 13)

12.2.5 Cost Benefit Analysis

(1) Evaluation Criteria

The analysis was conducted based on the following criteria:

– Discount rate : 12% p.a.
– Benefit streams : 1990 to 2015
– Construction period : 1986 to 1989
– Residual Value : none

(2) Cost-Benefit Estimate

a) Alternative Networks

Cost-benefit streams of these alternative plans were shown in Appendix Table

12–25, and the result of the cost-benefit analysis is shown in Table 12–5. The three network alternatives were compared at first. The simplified grid pattern shown as an example in TOR was found not compatible with the result of the IRR of 9.5%. The master plan was marginally viable with the IRR of 10.8%. It was considered that this master plan should be constructed with stages over a longer period.

The SES/P (Provisional Second Stage Expressway System) plan was found viable with better figures in B/C analysis. It resulted in B/C ratio of 1.16 at i = 12% and the IRR of 13.3%.

TABLE 12–5 ECONOMIC EVALUATION

A. NETWORK

Description	Master Plan	TOR	SES/P
Present Worth (in million Baht)	–3,483.3	–5,195.0	2,077.50
Benefit Cost Ratio	0.86	0.76	1.16
IRR (percent)	10.75	9.50	13.30

B. SES ALTERNATIVES

Description	SES/P	SES
Present Worth (in million Baht)	2,077.50	3,331.70
Benefit Cost Ratio	1.16	1.30
IRR (percent)	13.30	14.30

C. SENSITIVITY TEST

Description	Master Plan		TOR		SES/P		SES	
	Cost +20%	Time Val. –30%	Cost +20%	Time Val. –30%	Cost +20%	Time Val. –30%	Cost +20%	Time Val. –30%
Present Worth (In million Baht)	–8453.0	–7756.4	–9624.8	–8584.4	–572.2	–980.6	1112.6	446.3
Benefit Cost Ratio	0.72	0.69	0.637	0 612	0.96	0.93	1.08	1.04
IRR (percent)	9.50	9.10	8.00	7.90	11.70	11.40	12.60	12.20

Remarks: 1. i = 12% for present worth and benefit cost ratio.
2. Cost-benefit streams are in Appendix Table 12–25.
3. The reduction of Time Value by 30% is equivalent to the reduction of benefits by 20%.

b) SES Alternatives

Two alternative SES plans were assessed. The one named SES/P was found viable as in the above evaluation. The plan was composed of the N-S route, East route, and the river crossing West route with the total of 39 km.

SES plan (the Second Stage Expressway System) was proposed which deleted the river crossing West route, with the total of 34 km.

These two SES alternatives were compared and found that SES would be better although both of them were in the range of feasible criteria. SES resulted in the B/C ratio of 1.30 at the discount rate of 12% and the IRR of 14.3%. It was found that if the bridge construction over the Chaophraya River was deferred for a while, the cost decreases and the economic return would increase simultaneously.

12.2.6 Conclusion of Phase I Study

The economic analysis has revealed that both plans of SES/P and SES are economically viable. The difference between the two plans is whether it includes the West route (the Chaophraya River crossing) or not. The lengths of the routes composing SES/P and SES are shown below:

North-South route from Lad Yao to Bang Khlo	:	19.4 km
East route from Phaya Thai to Hua Mak	:	14.2 km
SES Total	:	33.6 km
West route from Bang Yi Rua to Silom	:	5.1 km
SES/P Total	:	38.7 km

The result of the economic analysis indicates that SES is more viable having the internal rate of return (IRR) of 14.3%, the benefit cost (B/C) ratio of 1.30 and the present worth (PW) of 3,332 million Baht, while SES/P had 13.3%, 1.16 and 2,078 million Baht, respectively.

The total financial construction cost of SES was estimated at 14,584 million Baht while that of the SES/P at 17,149 million Baht. If the construction of the West Route over the Chaophraya River is deferred for a while, the traffic running westwards can use either the existing bridges or the Dao Khnong Port section of the First Stage Expressway System which is scheduled for completion by 1988 without causing a serious trouble in traffic flows on this corridor.

It is concluded that the study efforts should be concentrated within the scope of SES and that the West Route and circumferential sections should be deferred to the following stages.

The above economic evaluation is preliminary. Overall review of the traffic assignment, route location and resulting economic evaluation of SES selected are duly conducted in Phase II of the Study.

12.3 Phase II Study

12.3.1 Alternative Plans of SES

A preliminary feature of the SES was determined as stated in the previous section, 12.2. The alternative plans of the SES were determined by deleting some sections without altering the basic network. They are shown in Fig. 12–3. Traffic assignment and economic analysis were carried out for these alternative settings.

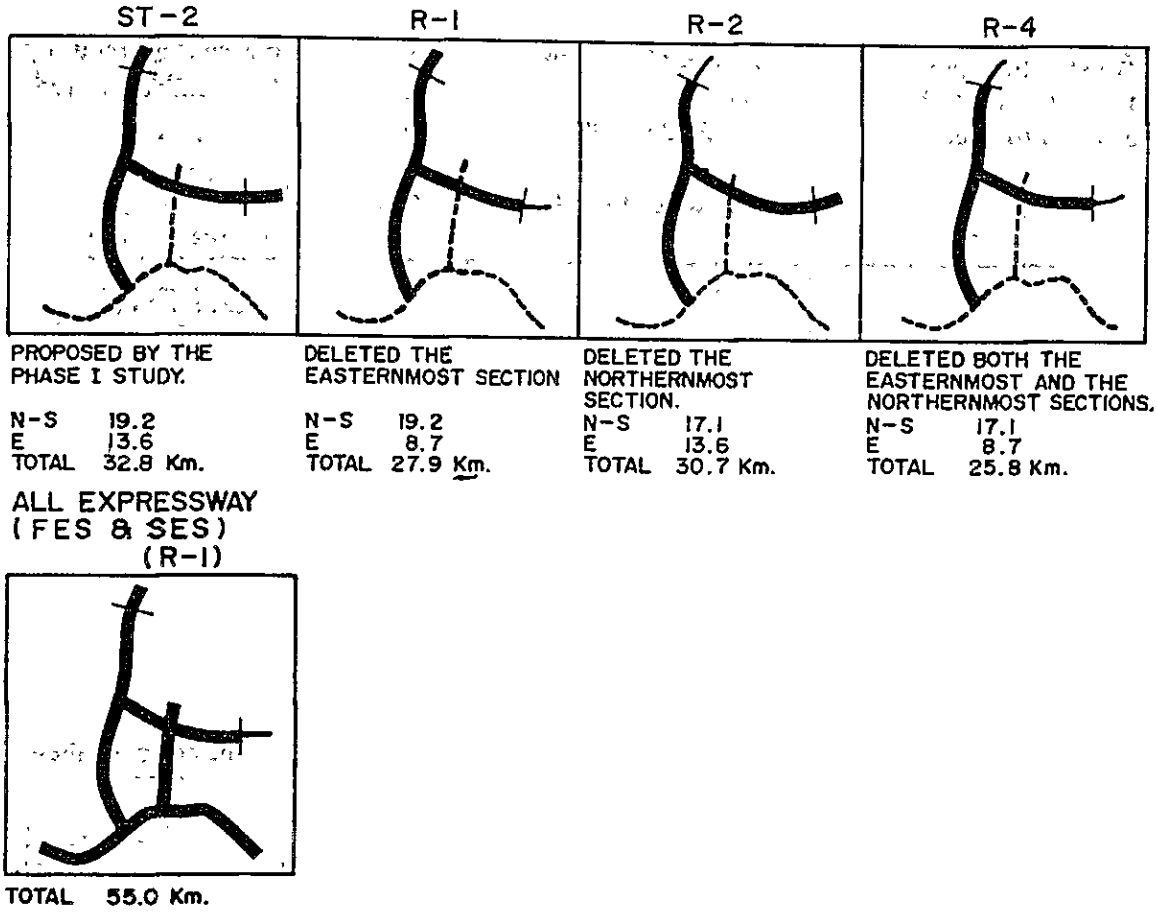


FIG. 12–3 THE SES ALTERNATIVES

The balance of the cost and benefit stream between each of these alternatives and the "without case" was estimated, where the "without case" included the completion of the FES.

An economic assessment was conducted to see the viability of the joint system FES & SES by comparing with "the without case" which assumed no Expressway in the GBA. R–1 plan was used in this case. In addition to these five alternatives the cases with normal bus services were assessed assuming the R–1 network.

12.3.2 Traffic Cost and Benefits

The economic benefit was estimated by the saving in traffic cost. The process of simulation, the economic vehicle operating cost, and time values used in the analysis are stated in the previous section of 12.2. It is noted again that the savings are estimated by the traffic cost of overall traffic in the GBA since the Expressway will not only result in direct savings to the users but also achieve the decongestion of traffic on ordinary roads. Table 12–6 presents the simulated traffic cost per day in 1982 and in 2000. It is found that the construction of the SES will reduce the overall traffic cost by 6% (13.91 million Baht in 1983 prices in 2000.

Benefits for the years during the staged development were estimated for each stage by using the percent of the opened section in the total. The sections N–3, N–2 and E–1 were assumed to open in 1990, N–1 and E–2 in 1993 and others in 1996.

TABLE 12–6 OVERALL TRAFFIC COST

(Million Baht in 1983 prices per day)

Cost	1982 [1] (1)	2000		
		FES only (2)	FES & SES [2] (3)	Savings (3)/(2) (4)
Veh. Run. Cost	60.74	154.87	152.66	0.98
Passengers Time Cost	12.30	68.03	56.33	0.83
Total Veh. Op. Cost	73.04	222.90	208.99	0.94

Notes: 1) The traffic cost in 1982 was estimated on the road network assuming Port-Bang Na Section already opened.

2) R–1 plan of SES.

12.3.3 Cost of Investment, Operation and Mantinance

The cost of investment was estimated in Chapter 11 from which the economic costs for these alternatives are summarized and shown in Table 12–7.

TABLE 12–7 PROJECT COST OF THE SES ALTERNATIVES

(Million Baht in 1983 prices)

Component	R–1	ST–2	R–2	R–4	All Expressway[1] (FES and SES (R-1))	FES[1]
Foreign	6,617.94	7,101.99	6,850.51	6,366.46	11,327.76	(4,709.82)
Local	8,603.50	9,016.83	8,822.90	8,409.57	13,430.01	(4,826.51)
Econ. Cost	15,221.45	16,118.82	15,673.41	14,776.03	24,757.78	(9,536.33)
Taxes	1,571.54	1,687.51	1,627.51	1,511.54	2,871.96	(1,300.47)
Total	16,792.98	17,806.33	17,300.92	16,287.57	27,629.71	(10,836.75)

Notes: 1) The cost of FES covers the cost of the Dao Kanong Section expected to be opened in 1988. In June 1983, ETA.

Annual and periodic road maintenance cost were estimated also in Chapter 11. The financial cost of road maintenance and resurfacing in the case of the R–1 plan was estimated and shown in Appendix Table 13–1. The economic costs of R–1 and other plans were estimated from the Table by taking into account the difference in the Expressway lengths and by deleting the tax component.

The toll operation cost was estimated in financial terms as stated in Chapter 13. In terms of economic cost it was also estimated in a similar way as the road maintenance cost.

12.3.4 Cost Benefit Analysis

(1) Evaluation Criteria

- Discount rate : 12% p.a.
- Benefit stream : 1990–2014
  (The first section in 1990. The second section in 1993 and the all sections in 1996)
- Toll fare level : 20 ฿ (small vehicles) and 30฿ (large vehicles)
- Residual value : None

Cost-benefit streams of the SES alternative plans are shown in Appendix Table 12–26.

(2) Cost-Benefit Estimate

The result of cost-benefit analysis is summarized in Table 12–8. It is found that the case of R–1 indicates the highest value in the cost-benefit figures, B/C ratio = 1.65, PW = 6,094 million Baht and IRR 17%, while the differences with the resultant figures of other plans are very slight.

TABLE 12–8 ECONOMIC ASSESSMENT

Alternative	R-1			ST-2			R-2			R-4		
Conditions	Normal	Cost +20%	Cost+20% Ben.-20%	Normal	Cost +20%	Cost+20% Ben.-20%	Normal	Cost +20%	Cost+20% Ben.-20%	Normal	Cost +20%	Cost+20% Ben.-20%
B/C ratio, i=12%	1.65	1.38	1.10	1.60	1.33	1.07	1.52	1.27	1.02	1.51	1.27	1.02
PW = B-C Mil ฿, i=12%	6094.2	4222.1	1131.2	5889.0	3930.0	793.2	5015.7	3101.4	184.0	4757.0	3099 0	288.6
IRR in %	17.0	14.9	12.5	16.7	14.8	12.6	16.1	14.3	12.1	16.0	14.4	12.1

Alternative	Bus passing through R-1			Bus bay use R-1			All Expressway, FES & SES R-1		
Conditions	Normal	Cost +20%	Cost+20% Ben.-20%	Normal	Cost +20%	Cost+20% Ben.-20%	Normal	Cost +20%	Cost+20% Ben.-20%
B/C ratio, i=12%	1.67	1.39	1.11	1.68	1.40	1.12	1.49	1.25	1.00
PW = B-C Mil ฿, i=12%	6282.4	4410.3	1281.7	6410.8	4533.7	1374.4	3656.8	2177.0	-34.2
IRR in %	17.1	15.2	13.0	17.2	15.2	13.0	16.1	14.2	12.0

Whilst the Daokanong section of the FES is not yet constructed, the FES and SES is brought together to find the viability of the Expressway (FES and SES) construction. It is found feasible also since the result has B/C ratio = 1.49, and IRR 16.1%.

If the "passing through" normal bus service was added to the R–1 plan, there would be a higher result of the B/C ratio 1.67 and IRR 17.1%. The normal bus service accompanying the use of the bus stopping bay was also found feasible with a higher return. The result is stated also in Chapter 7 together with conclusion and recommendations concerning the bus service.

(3) A Relationship with the Financial Analysis

A relationship between the result of economic analysis and that of financial analysis was studied by changing the toll fare level on the R–1 Alternative. The toll fare level and the rate of return are estimated as follows:

Case	Toll fare level in Baht (Small vehicle)	(Large vehicle)	Economic Rate of Return	Financial Rate of Return
(1)	10	20	18.5%	1.0%
(2)	20	30	17.0%	12.0%
(3)	30	40	13.0%	22.0%

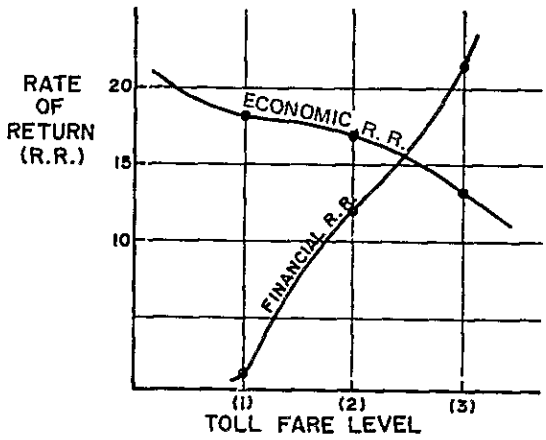


FIG. 12–4 TOLL FARE AND RATE OF RETURN: R–1

The relationship is shown in the above Fig. 12–4 from which the following points are noted.

– There will be an inverse relationship between the financial return and the economic return. The former is measured by the toll revenue, while the latter is measured by the overall traffic cost saving on the Expressway and the ordinary roads.

If the toll fare rises as from (2) to (3) in Fig. 12–4, the financial return will go up substantially. However, the economic return will decrease because of less traffic on the Expressway, but larger congestion on the ordinary roads.

– It can be said that the policy objective will be pursued in two directions:

(A) To maximize the economic return within the viable financial returns; and

(B) To maximize the financial return within the viable economic returns.

It is found that the proposed toll fare level of 20 Baht (small vehicles) and 30 Baht (large vehicles) is in the mid-point of (A) and (B). The selection of policy direction (A) or (B) should be decided by the Government.

12.3.5 Conclusion

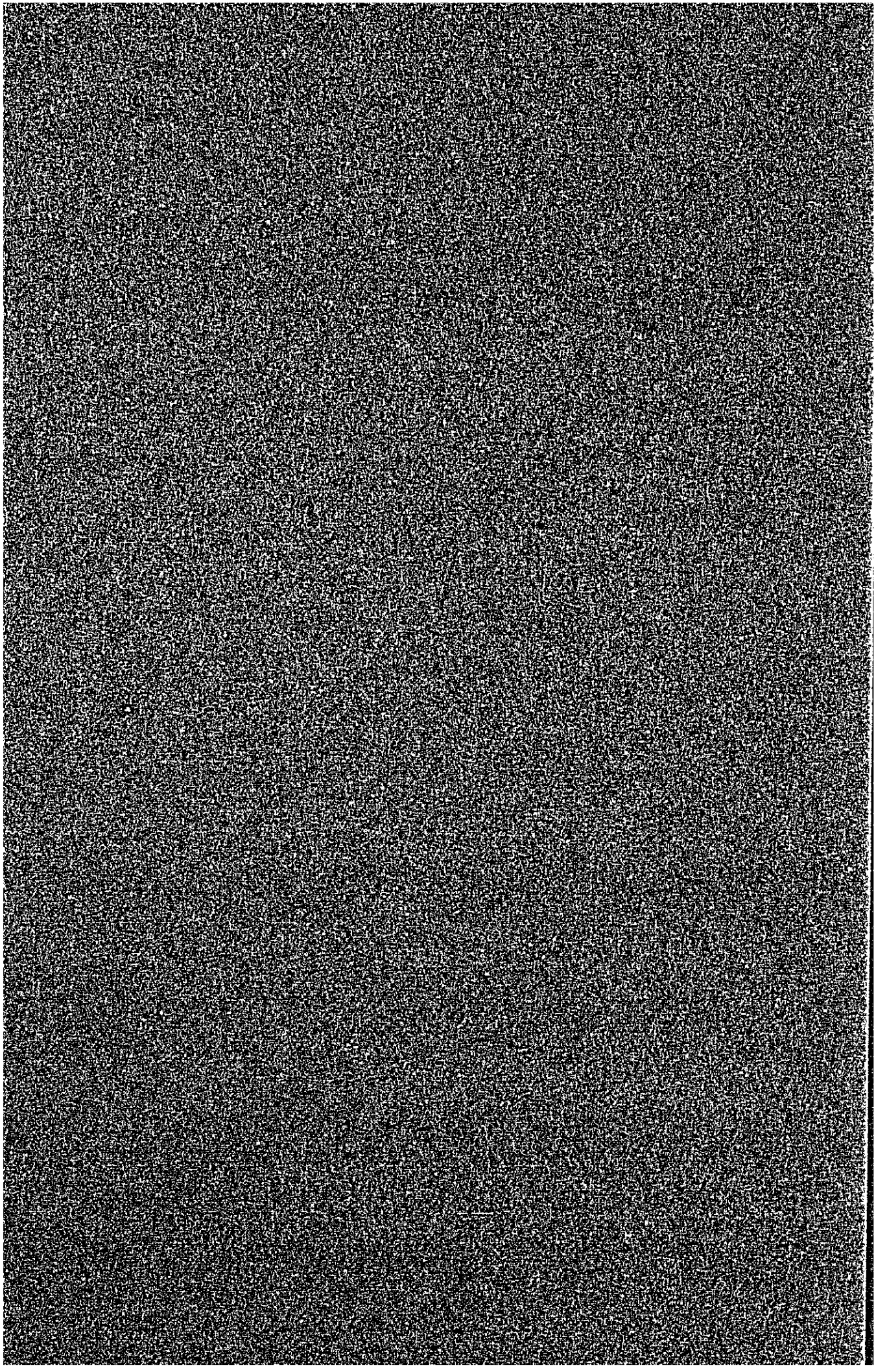
The economic analysis has resulted in the B/C ratio (i=12%) = 1.65 and IRR=17% for the R–1 plan. The result indicates that SES should be constructed on the basis of R–1. The construction of the easternmost section of 4.8 km is better incorporated in the third stage program which will expand the Expressway System beyond the SES network.

If the FES and the SES are put together to find the return for the total expressway system by comparing the case without any expressway, it supports the construction of the SES, since the total system has viable figures in the economic analysis: B/C Ratio = 1.49 and IRR=16.1%. It indicates that the Expressway would occasion a better result if it expanded to this SES plan rather than remaining at the FES network level.

In accordance with the selected R–1 plan, the financial analysis was carried out by using the toll fares of 20 Baht (small vehicles) and 30 Baht (large vehicles) and the estimated revenue. The result indicated a feasible forecast with the financial B/C ratio (i=12%) = 1.0, present worth of revenue 0.2 million Baht, and financial IRR=12%. All the loans comprising 80% of the total investment cost would be refunded in 11 years after the completion, i.e. by 2006 (Refer to Chapter 13).

It is concluded that the R–1 plan in the total of 27.9 km should be prepared and constructed as the Second Stage Expressway System.

Chapter 13
TOLL REVENUE AND FINANCIAL ANALYSIS



CHAPTER 13 TOLL REVENUE AND FIANNCIAL ANALYSIS

13.1 General

Since the opened sections of the First Stage Expressway System (FES) are simple in the network and short in length in relation to the roads in Bangkok, it is likely that the toll fare of 10 Baht for small vehicle and 20 Baht for large vehicles is accepted as reasonable by the majority of users. An average 80,000 vehicles per day used the Din Daeng-Port-Bang Na section in February 1983.

However, when the Thai economy develops further and the expressway is expanded to include the Second Stage Expressway system, there arise questions concerning the suitability of the toll fare level. The toll fare level determines the toll revenue in total which, in turn, is associated with user benefits, funding programs, loan amortization schedules, and the utilization of net revenue, etc. Relationships among these factors are studied in this chapter.

In studying the financial consequences of SES, the existing situation is first identified. Alternative methods in toll collection system are reviewed, from which the current flat tariff system is considered a realistic system applicable to the FES and SES. Then, a research is conducted to find a toll fare level which maximizes the total revenue. This result and the current toll fare level are taken into account to determine the toll fare when the SES is completed.

Revenue, expenditure and net income are forecast in financial terms, from which cash flow analysis tables are prepared and the financial return of SES is estimated. In this financial analysis the price level of mid-1983 is used and no inflation is assumed in the same way as the economic analysis of Chapter 12.

13.2 Present Situation

13.2.1 Policy Determination

The Board of Directors of ETA is authorized to determine the toll fare level under Announcement No. 290 of the Revolutionary Party, November 1972, in Article 12 (10):

Article 12 (10)

"The Board shall have the power and duties to lay down policy and supervise general affairs of ETA. Such power and duties shall include the issuance of rules or regulations regarding collection of toll for the expressway".

Upon the determination of the Board of Directors, Minister of Interior announces the following publication as prescribed in Article 47 (3), of No. 290 above.

Article 47 (3)

"Minister shall have the power to issue a publication in the Government Gazette prescribing the toll rate for the Exclusive Roadway System".

13.2.2 Toll Fare Level of FES

(1) Toll Farc Level on Din Daeng-Port-Bang Na Section

When the first section of 9 km, Din Daeng-Port, opened in October 1981, the toll fare was determined on a flat tariff base as follows:

- Small vehicles with 4 wheels (Private cars, taxis, micro buses, light trucks, vans, pick-up trucks, etc.) ..... 10 Baht
- Large vehicles with 6 wheels and more (large buses, large trucks, dump trucks, trailers, tank rollies, etc.) ..... 20 Baht

The second section of 8 km, Port-Bang Na, opened January 1983. The total expressway length was increased from 8 km to 15 km. However, the toll fare remains unchanged.

(2) Changes in Toll Fare Level of FES

ETA determined a toll fare on the opened section of Din Daeng-Port in 1981 by assessing the benefits of user vehicles and by comtemplating a relationship with the level of prices in general. However, it is assumed that the fare will be revised from 10 Baht to 15 Baht for small vehicles and 20 Baht to 25 Baht for large vehicles when the Dao Khanong section of 10 km is added in 1988.

13.3 Toll Fare

13.3.1 Types of Toll Fare

(1) Flat Tariff System

The toll fare is the same for a type of vehicle when it enters any toll gate regardless of the running distance on the expressway. There is no toll fare differentiation except vehicle types. Vehicle types are grouped into two or three classes according to the axles, or weight, or wheels. Handling efficiency in toll fare receipt is high since the fare is classified into only two or three levels. It may be more advantageous for long distance users of the expressway than short ones since the fare is not proportional to the distance they use. The present toll fare system on the Din Daeng-Port-Bang Na Expressway is under this flat tariff system.

(2) Zone Tariff Ssytem

The zone tariff system (i.e. block tariff system) is a toll fare charging system which divides the expressway network into a few zones (blocks). If a vehicle moves from one zone to another through the expressways, additional fare is charged. Vehicles may be classified into two or three types.

Under this system, additional toll collection gates must be provided together with operation facilities on the borders between the zones.

The zoning system requires users to pay the tariff in proportion to the number of zones they pass through, however, the tariff collection procedure at the gates on the zone borders may cause queuing of traffic on the expressway.

(3) Distance Related Tariff System

This is a toll system which requires that users pay the fare in proportion to the expressway distance they run through. The system should control entry and exit or the distance of the expressways. For this purpose, in-gates as well as exit-gates are constructed with operational facilities.

Vehicles have to stop at an in-gate to register the entrance and stop again at an exit-gate to check the distance and pay the fare. While the users pay the fee proportional to the distance they use, it may be less efficient in handling and more expensive in the cost of additional gates compared with other systems. The tariff system is preferable on "Inter-Urban Expressways" where the users of the expressway travel for long distances from one city to others.

13.3.2 The System Considered for the SES

Since traffic congestion on roads is quite common and is likely to increase in the future in the large urban area of GBA, efficiency in passing the traffic at toll gates should therefore be given high priority. Inefficient handling at toll gates will cause vehicle-queuing on the adjacent roads, which will thus increase the traffic congestion.

A number of engineering problems can be anticipated from the need to construct additional gates on the expressway system suitable to a zone tariff or a distance related tariff system. Also the additional construction and maintenance cost is high, and less efficient in traffic flow operation.

The flat tariff system has already been applied in FES since its opening in 1981 and is apparently operating well. No specific reasons are identified to suggest any need to change it.

It is considered better to continue the flat rate toll collection system on the network of FES and SES. No zoning will be necessary between FES and SES.

13.3.3 Toll Fare Level of SES

(1) Toll Fare Level of SES

The toll fare charged on the vehicles is determined by assessing the service of the expressway. However, when the fare has been set for the expressway, it cannot be changed easily even during a period of inflation. The situation is the same with other public or semi-public organization such as MEA, SRT, BMTA, etc.

In determining the toll level for SES a realistic approach was conducted. The possibility of revision of the FES fare was studied at first. When the first section of Din Daeng-Port was opened in October 1981, the fare was set at 10 Baht (small vehicles) and 20 Baht (large vehicles). The fare was not revised when the Port-Bang Na section opened in January 1983.

It is pre-supposed in this study that the fare will be revised to 15 Baht (small vehicles) and 25 Baht (large vehicles) in 1988, when the Dao Khanong-Port section is opened. When the Expressway is expanded into the Second Stage System, it is considered better to assume the fare of 20 Baht (small vehicles) and 30 Baht (large vehicles) when it is completed in 1995. These changes are set out in Table 13–1. This setting was

based on the assumption of no change in price level.

TABLE 13–1 TOLL FARE LEVEL

(In 1983 prices)

Applicable Expressway	Year	Toll Fare in Baht	
		Small Veh.	Large Veh.
First Stage Expressway System			
– 1st and 2nd legs	1982–1987	10	20
– Entire FES	1988——	15	25
Second Stage Expressway			
– Sections opened by stage with entire FES	1988–1995	15	25
– Entire SES and FES	After 1996	20	30

It is to be noted that the average distance of travel on the Expressway would not increase in proportion to the total Expressway length. (See Chapter 6 for reference).

(2) Toll Fare and Revenue

A computer simulation was conducted to find a toll fare level which would maximize the toll revenue in 2000 on the network of SES. It is stated in Appendix 13.1. The toll fare level which maximizes the revenue is found to be 60 Baht (small vehicles) and 80 Baht (large vehicles) under the simplified conditions.

It is premature to claim the validity of the above result since there are a number of problems to be studied extensively in finding the toll fare which maximizes the revenue. It should also be emphasized that the revenue maximization does not mean the optimum service of the Expressway in terms of economic return.

13.4 Financial Analysis

13.4.1 Conditions

Financial analysis was conducted to see how the investment of the Expressway would yield returns by the toll revenue in certain years of operation. Two cases were studied: one for the second stages system of R–1 and the other for the joint system of the Frist and the Second Stage Expressways.

Just like the economic analysis, the cost-net revenue streams were estimated from which the present worth of net revenue, the cost-revenue ratio and the financial return were estimated.

Cash flow tables were prepared to forecast the debt repayment viability. There would be several sources of the investment fund with different interest rates. They were grouped into two or three sources according to the level of the interest rate.

At first, the revenue was estimated with the trips on the expressway of FES and SES (R–1) under a toll fare level of 20 Baht to 30 Baht. Then the revenue with the trips on the FES only was estimated under a toll fare level of 15 Baht to 25 Baht. The balance was assumed as the revenue of the SES (R–1).

13.4.2 Revenue and Expenditure

(1) Net Revenue

a) Gross Revenue

Gross revenue was estimated for 1990, 2000 and 2010 and that for other years was interpolated by applying the average annual rate. The gross revenue was the product of total trips and the flat toll fare. For the years during the staged development up to 1996, the revenue was adjusted in the same way as the economic benefit estimate.

b) Administration Cost

The administrative cost (The head office cost) of ETA from 1975 to 1983 was provided by the Financial Department. The annual cost for the coming years was assumed to increase by 5% per annum.

c) Toll Operation Cost

The budgets in 1983 and 1984 are also given by the Financial Department. The cost is assumed to increased by 5% per annum. When the new section is opened for use, the percentage increase in the Expressway length is used to estimate the increase in the cost of operation in that year.

d) Road Maintenance

The annual cost of daily maintenance work including lighting was estimated in Chapter 11. The cost is assumed to increase by 5% every 5 years. It is considered necessary to resurface the roadway every 7 years. This cost is estimated also in chapter 11. In addition, replacement cost of the electronic operation system is added to the periodic maintenance cost.

Net revenue is determined by the claculation of (a) – (b+c+d) in the above items. The streams of the above revenue and cost are shown in Appendix Tables 13–1 and 13–2.

(2) Investment

Based on the implementation program of R–1 as determined in Chapter 14, the annual disbursement schedule was assumed for the financial analysis. The detail is stated in Chapter 11 and the summary is shown as follows. In the case of ongoing FES project, the updated schedule with the total of 10,837 million Baht is used for the forecast of the return and the repayment program.

INVESTMENT SCHEDULE OF SES : FINANCIAL

(In 1983 prices of million Baht)

1985	100.67	1991	1,412.07
1986	988.05	1992	1,055.11
1987	2,204.78	1993	2,447.97
1988	1,026.57	1994	2,178.19
1989	2,424.30	1995	584.06
1990	2,371.19	TOTAL	16,792.98

(3) Fund Sources

In studying the repayment program the following funding sources were assumed as the basic case of the SES:

a) 20% as the investment from the Government budget. No repayment of the invested fund. This amount covers the cost to acquire the right-of-way.

b) 40% as the loan fund with an interest rate of 3% per annum, 20 years of repayment period after 10 years of grace period.

c) 40% as the loan fund with an interest rate of 12%, 10 years of repayment period after 5 years of grace period.

Changes in the percent share were studied and the resultant findings are stated in the following conclusion in 13.4.3.

13.4.3 Conclusion

(1) Financial Return

The fianncial return and the cost-revenue ratio were estimated in a similar way to the economic analysis and shown in Table 13–2. The toll fare of 20 Baht (small vehicles) and 30 Baht (large vehicles) was assumed for 1996 when all sections of the SES would be completed (Refer to Table 13–1).

TABLE 13–2 FINANCIAL ANALYSIS

Item	SES (R–1)			FES and SES		
	Basic [1]	Cost [2] +25%	Cost+25% Ben. –20%	Basic [1]	Cost +25%	Cost+25% Ben. –20%
Revenue Cost ratio (12%)	1.00	0.81	0.64	1.01	0.84	0.67
PW in net revenue (million Baht)	0.2	–585.5	–1,081.0	35.8	–900.0	–1,852.2
Financial rate of return %	12.0%	9.9%	7.8%	12.0%	10.3%	8.5%

Notes: 1) The government's investment which would share 20% of the total is not included. Only the loan funds are included.

2) If the cost (i.e. debt) is increased approximately by 25%, it will cover the total cost of SES including the assumed investment by the Government.

In the case of SES (R–1) the financial consequence is estimated at the revenue-cost ratio = 1.00 and the financial return = 12.0%. The return is not as high as in the economic analysis, however, it indicates the viability of the project. If the cost is increased by 25%, which means the invested Government fund is to be paid back, the financial return will be 10%.

If the FES and SES are treated together, no different results are found. The joint system will yield the financial reutrn of 12%. The revenue-cost streams of basic cases are shown in Appendix Table 13–3.

The relationship between the financial return and the economic return in changing the toll fare level is stated in 12.3.4 of Chapter 12.

(2) Funding Program and Repayment Forecast

The cash flow analysis was conducted by assuming the repayment and interest payment schedule, the short term operational loan and repayment, and the net revenue estimate for the period of 1985–2014. The operational loan is assumed to pay the interest charge with 12% per annum. The cash flow table of the basic case are shown in Appendix Table 13–4. The options in funding programs are:

a) It is forecasted that the estimated revenue of the basic case will begin to raise surplus in 2003 after paying back all the short term operational loan. If it is assumed that the remaining debt amount at the year end of 2003 is to be paid back by the surpluses of the following years discounted by 12%, all the remaining debt can be paid back by 2006. It takes 11 years after the completion of all sections in 1995. If the percent share of "the fund with 3% interest" is changed from the above 40% to 32% (consequently "the fund with 12%" increases upto 48%) it will result in the same repayment period.

b) In a case where the Government fund is 0%, "the fund with 3%" is 40% and "the fund with 12%" is 60%, the project will begin to raise surplus in 2011 and the overall repayment year will be 2012. It is marginally repayable. However, such a long period of repayment will inevitably contain much more uncertain factors than (a) above. It is considered a little risky to assertain that the funding schedule such as this is a feasible plan.

c) If the fund composition changes as: Government investment 20%, the fund with 8% interest rate is 40%, the fund with 15% interest rate is 40% and operational loan with 15% interest rate, the net revenue cannot repay the debt under the same conditions.

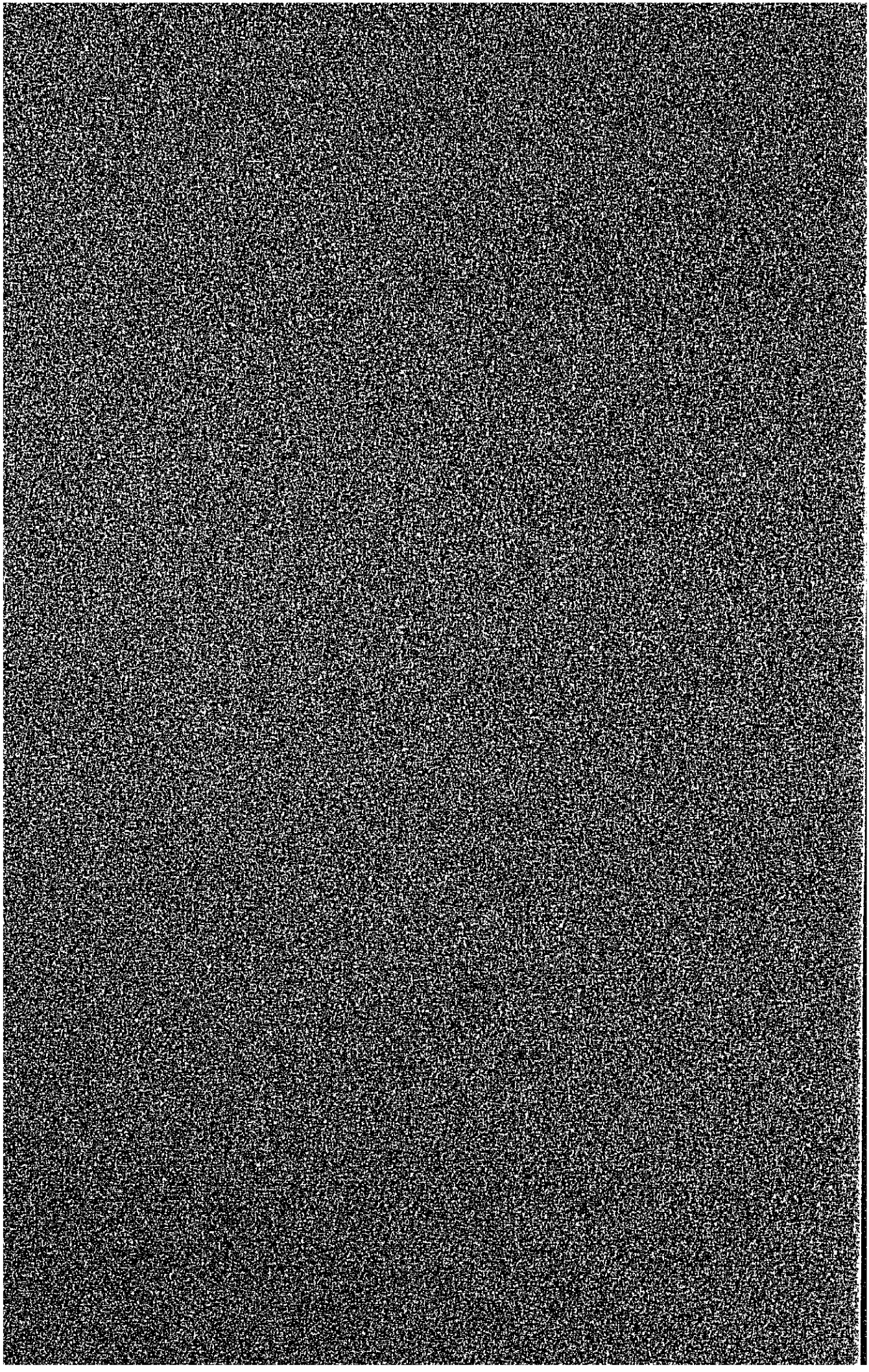
As shown in the Appendix Table 13–5, if the cash flow analysis is applied to the joint operation of FES and SES, no substantial changes are seen in the repayment period: the joint system will begin to raise the surplus in 2000 and the outstanding debt at that year will be paid back in 2004.

(3) Conclusion

It is forecast that the financial return will be 12% for the above basic case, while the repayment period will be 11 years after the completion of all three sections in 1995. The funding schedule should be in the composition as mentioned in 13.4.2 (3) or in another way which minimizes the interest burden of the debt. These figures indicate that the project is not a high profit yielding one, but a reasonable and viable infrastructure project.

In practice, conditions, policies, and inflation rate would influence the financial return. Review and revision of the toll fare level should be conducted during the years of construction and of operation, if the situation changes.

Chapter 14
IMPLEMENTATION PLAN



CHAPTER 14 IMPLEMENTATION PLAN

14.1 General

The implementation schedule was prepared on the condition that the entire construction of the SES would be completed by the end of 1995.

After careful study of the project implementation method, it was found that each route should be sub-divided into various sections having regard to the scale of the work and the employment of stage construction technique.

Before beginning the construction it is necessary to carry out such pre-construction works as topographical survey, soils investigations, detailed engineering design, land acquisition, and financial procurement as explained in the following pages.

Especially, since the routes of the SES pass through the urban area, the land acquisition and compensation of ROW are foreseen as difficult. Therefore, this situation was also reflected in the formulation of the project implementation schedule.

14.2 Project Costs

Following shows the summary of the estimated property costs at 1983 prices.

TABLE 14–1 ESTIMATED PROJECT COST

Cost in million Baht

Designation	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(100%)	3,480(100%)
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%)

14.3 Stage Construction

The construction of the tollway requires a very large investment due to various construction requirements. For this reason and to obtain larger economic and financial benefit it is desirable to adopt the stage construction approach.

For the determination of the order of priority of each construction segment the factors such as ROW acquisition situation, traffic demand, and the need of the build up of the expressway ring were taken into account.

The entire SES was divided into eight construction segments based on the characteristics of existing road network in GBA, traffic demand as well as ease of financial procurement (see Fig. 14–1).

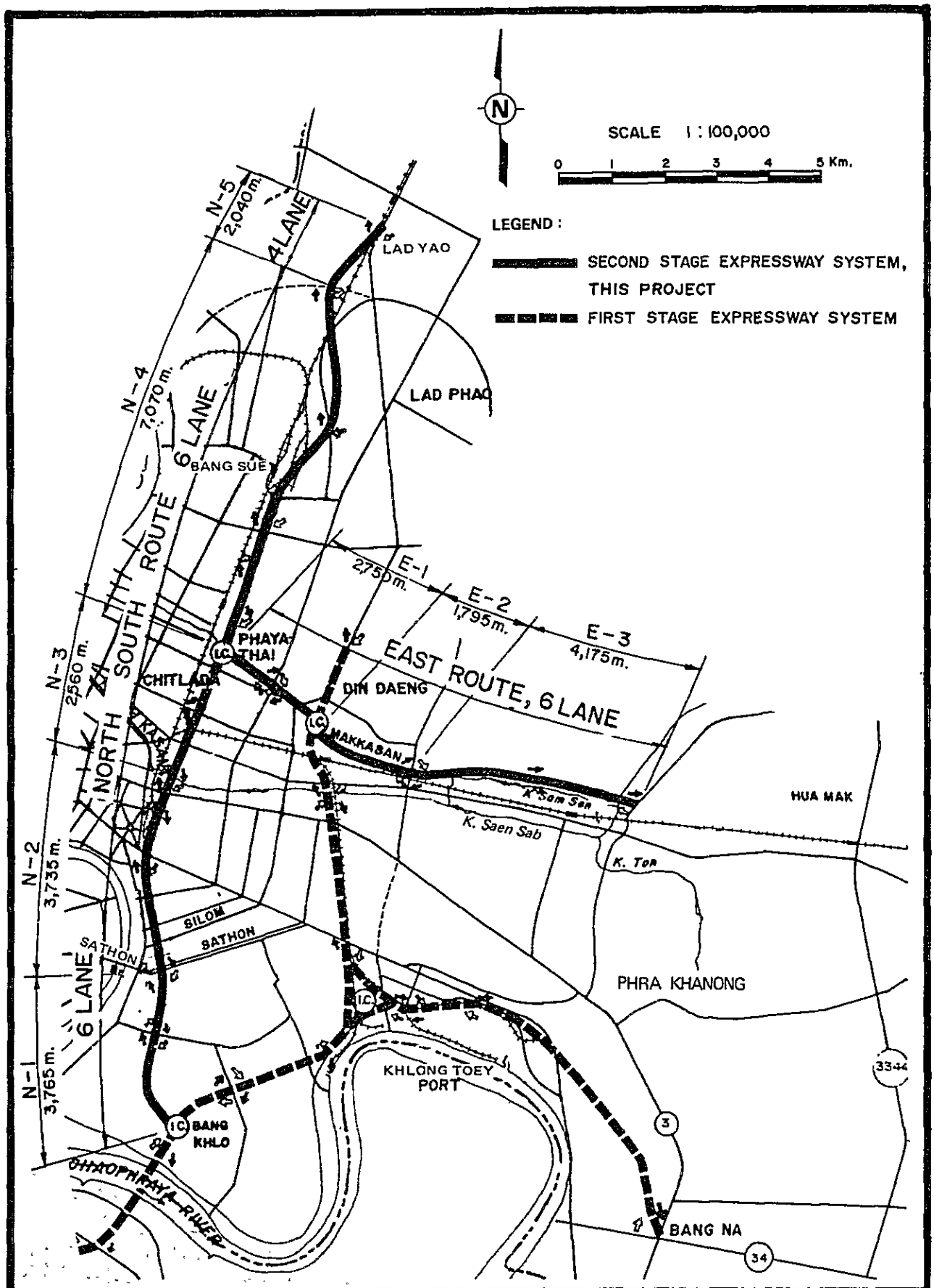


FIG. 14-1 CONSTRUCTION SEGMENTS

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

The following order of stage construction was recommended :

Construction Stage	Segment
No. 1	N–3 and E–1
2	N–2
3	N–1
4	E–2
5	N–4 and N–5
6	E–3

14.4 Implementation Schedule

The overall project implementation schedule that has been prepared upon the abovementioned requirements in shown in Fig. 14–2. The economic and financial studies were carried out based on this schedule. The requirement of each major activity is as described below :

(1) Detailed Engineering Design

The design of the first package will be required to be completed in 18 months and the second package in 12 months respectively.

If there are changes in socio-economy, policies of urban planning and transportation, etc., the review of feasibility study should be conducted at the beginning stage of the detailed engineering design.

(2) Tender Process

After completion of the detailed engineering design and financial arrangement, a few months will be required for the tender process. The prequalification of contractors will also be required before the tender call.

(3) Land Acquisition and Compensation

Since the constructions are taken place in the urban area, it is foreseen that serious problems of land acquisition and compensation would occur. Therefore, the period of the land acquisition and compensations are estimated at 18 months.

(4) Construction

Almost all of the construction sites are in the traffic-congested areas and some parts are in the business center. Therefore, the construction methods will be limited and the construction will take a longer period compared with that in other areas. From this reason the construction period was estimated at least 30 months including the test operation before the actual opening of the Expressway.

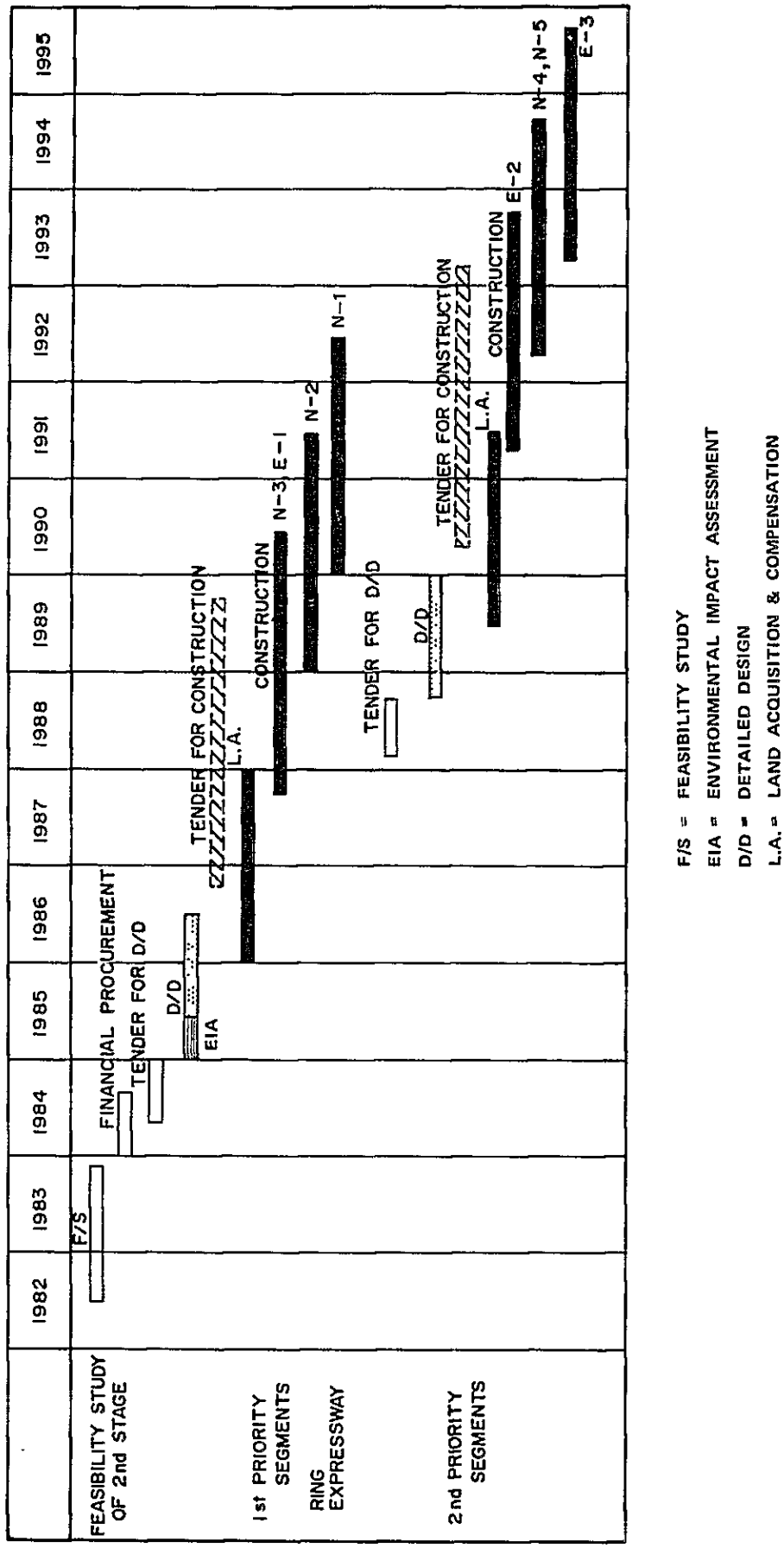
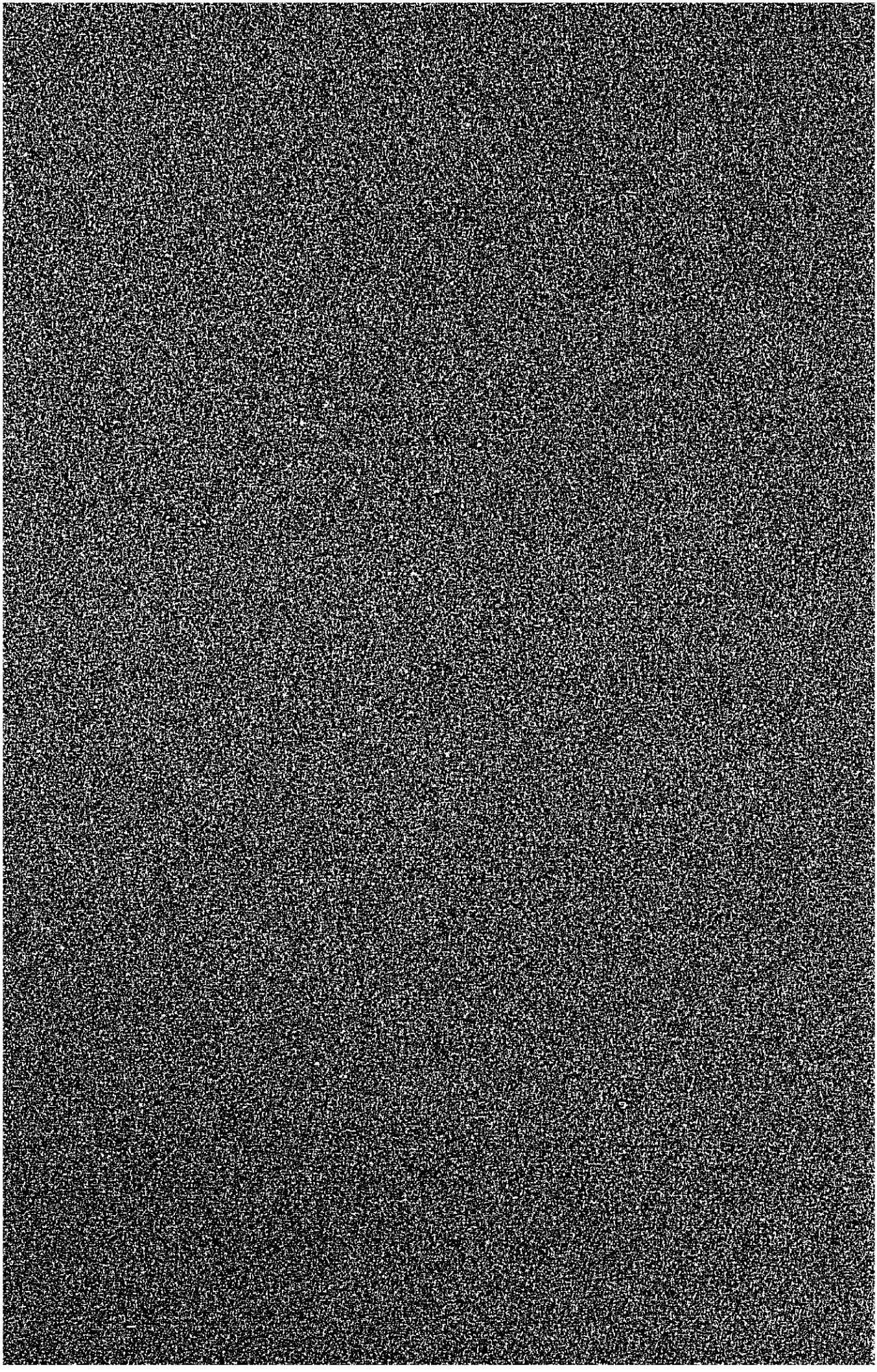


FIG. 14 – 2 OVERALL IMPLEMENTATION SCHEDULE OF 2 nd STAGE EXPRESSWAY SYSTEM

THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK

Annex "A"
SCOPE OF WORK



ORIGINAL

SCOPE OF WORK

ON

THE FEASIBILITY STUDY FOR THE SECOND STAGE EXPRESSWAY SYSTEM IN THE GREATER BANGKOK IN THE KINGDOM OF THAILAND

AGREED BETWEEN

EXPRESSWAY AND RAPID TRANSIT AUTHORITY OF THAILAND (ETA)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DATED MARCH 4, 1982

SIGNED

Charan Burapharat

(Mr. Charan Burapharat)

General Manager

Expressway and Rapid Transit

Authority of Thailand

SIGNED

S. Samukawa

(Mr. Shigeomi Samukawa)

Leader

The Japanese Survey Team

ORIGINAL

I. INTRODUCTION

In response to the request made by the Government of the Kingdom of Thailand, the Government of Japan has decided to conduct a feasibility study on the Second Stage Expressway System in the Greater Bangkok (the Study), under the "AGREEMENT ON TECHNICAL CO-OPERATION BETWEEN THE GOVERNMENT OF JAPAN AND THE GOVERNMENT OF THE KINGDOM OF THAILAND" dated November 5, 1981.

The Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will carry out the Study in close cooperation with the Expressway and Rapid Transit Authority of Thailand (ETA) and the authorities concerned of the Government of the Kingdom of Thailand.

II. OBJECTIVES

The objectives of the Study are;-

1. To identify high priority projects in the proposed Second Stage Expressway System by reviewing and assessing the Bangkok Transportation Study, Engineering and Economic Investigations for the First Stage Expressway System and other relevant studies (Phase I Study).
2. To carry out the feasibility study on one or two routes identified in the above-mentioned high priority projects (Phase II Study).

III. SCOPE OF WORK

1. Study Area

The Study area covers the Greater Bangkok Area including its satellite cities eg: Pathum Thani, Nontha Buri, Samut Prakarn, Chon Buri.

2. Activities of the Study

In order to achieve the objectives mentioned above, the Study is to be performed according to the following two (2) phases:

2.1 Phase I

Phase I Study will cover the following:

(1) Collection and Analysis of Data and Reports on:

a. Population

b. Commerce and industry

c. Land use

d. Transportation

e. Other socio-economic aspects

(2) Traffic Study

a. Traffic data collection, traffic survey and its analysis

b. Forecast of future traffic demand

c. Traffic assignment

(3) Establishment of the Network Plan of the Second Stage Expressway

(4) Rough Cost Estimates

(5) Rough Economic Evaluation

(6) Identification of the High Priority Projects

a. Ranking of all links of the Second Stage Expressway

b. Selection of high priority projects on which the feasibility study will be carried out in Phase II Study

2.2 Phase II

The Phase II Study will cover the following :

(1) Data Collection and Analysis

(2) Refinement of the Alignment

(3) Design Standards and Preliminary Engineering Design

a. Design standards

b. Construction methods

c. Field survey necessary for the preliminary design

d. Preliminary design

(4) Cost Estimation

a. Right-of-way acquisition cost

b. Construction cost

c. Maintenance cost

(5) Economic Evaluation

a. Estimation of benefits

b. N.P.V., I.R.R., B/C

c. Sensitivity analysis

(6) Financial Study

a. Investment cost

b. Financial expenditure and cost

c. Toll rate and Revenue Calculation

d. Repayment program

e. Sensitivity analysis

(7) Foreseeable Economic and Social Impact Studies

(8) Implementation Program

Implementation Program based on the engineering and financial study

IV. STUDY SCHEDULE

The Study is to be completed within eighteen (18) months after the commencement of the Study.

The tentative study schedule is attached hereto (Annex 1).

V. REPORTS

JICA will present the following English reports on the Study to the ETA:

1. Inception Report (50 copies)

   At the beginning of the Study

2. Progress Report (I) (50 copies)

   Within four (4) months after the starting date of the Study

3. Interim Report (50 copies)

   Within seven (7) months after the starting date of the Study

4. Progress Report (II) (50 copies)

   Within eleven (11) months after the starting date of the Study

5. Draft Final Report (50 copies)

   Within fifteen (15) months after the starting date of the Study.

   The ETA will provide JICA with its comments within one and a half ($1\frac{1}{2}$) months after the reciept of the Draft Final Report.

6. Final Report (150 copies)

   Within one and a half ($1\frac{1}{2}$) months after the reciept of the ETA's comments on the Draft Final Report.

VI. UNDERTAKING BY THE GOVERNMENT OF THE KINGDOM OF THAILAND

1. To exempt the JICA Study Team from taxes and duties on the materials. equipment and personal effects brought into the Kingdom of Thailand by the Team.
2. To exempt the JICA Study Team Members from income taxes and charges of any kind imposed on or in connection with the staying expenses remitted from abroad.
3. To assign Thai counterparts (Liaison officer/Transport engineer/ Civil engineer etc.) for the Study during the study period.
4. To approve necessary field survey upon request from the JICA Study Team.
5. The Thai Coordination Committee consisting of representatives from ETA, OCMRT and if necessary other agencies will be Organized by ETA.
6. To provide the JICA Study Team with all available data, information, reports and materials necessary for the Study, and allow the Team within its authority to take them to Japan.

7. To provide the JICA Study Team with a suitable office space with necessary equipment for the Study.
8. To provide the JICA Study Team with necessary facilities and means for the Study, such as vehicles, photo-copier, typewriter etc..

VII. UNDERTAKING BY THE GOVERNMENT OF JAPAN

1. JICA will organize the Study Team consisting of the Japanese experts.
2. The Japanese Steering Committee for the Study will be organized by JICA.
3. JICA will provide the members of the Study Team with the remuneration, subsistence and other allowances as well as costs of their travel necessary for the Study.
4. JICA will conduct on-the-job training and technology transfer to the Thai counterparts during its stay in Thailand.
5. JICA will receive Thai counterparts in Japan for training in the course of the Study.

Annex 1. TENTATIVE STUDY SCHEDULE