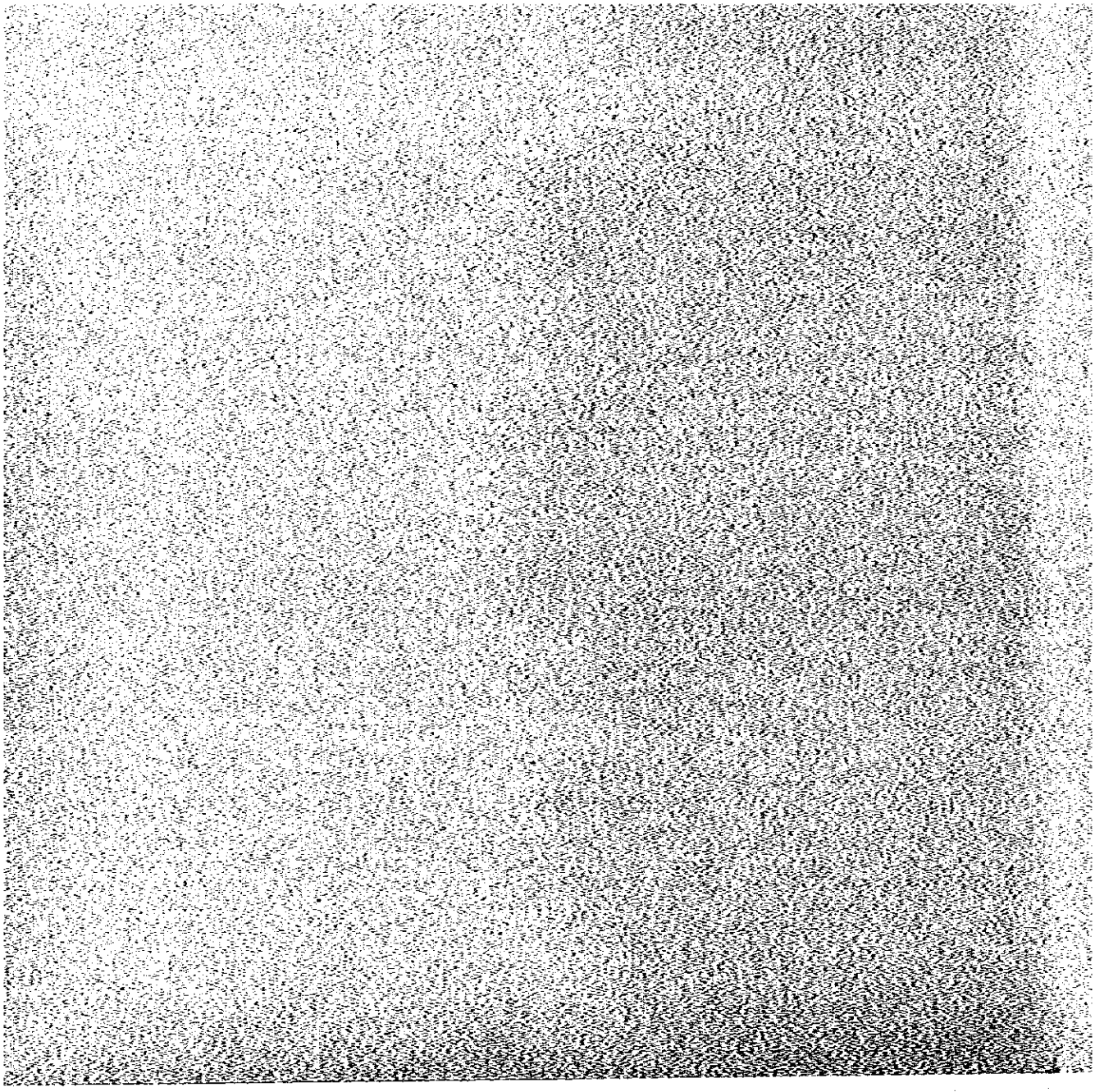
CHAPTER 6
ENVIRONMENTAL CONSIDERATION



CHAPTER 6 ENVIRONMENTAL CONSIDERATION

6.1 GENERAL

The environmental problems caused by the Project during and after its construction are discussed in this chapter. Since these environmental problems are intricately involved with the natural, social and economical environmental conditions their assessment and judgement are somewhat difficult. However, taking due consideration of the regional characteristics of the project, studies are made here mainly on the problems largely affected by the Project.

6.2 INDICATORS OF ENVIRONMENTAL CONSIDERATION

Various factors such as the physical, social and economical factors can be considered as the indicators in the environmental assessment. The factors which are considered deeply related to the Project are listed below.

6.2.1 Physical Indicators of Assessment

a) Topography and geology
b) Hydrology (drainage, floods)
c) Meteorology (climate and weather)
d) Traffic nuisances (noise, air pollution, vibration and other nuisances)
e) Traffic accidents
f) Construction nuisances.

6.2.2 Social and Economical Indicators of Assessment.

g) Transport mobility and accessibility
h) Land use potentiality
i) Population distribution
j) Tourism
k) Regional spectacle
l) Community cohesion
m) Resident displacement
n) Industrial and agricultural production
o) Land price
p) Prices of commodities

The above indicators of assessment are further studied for the following 2 stages:

- During the period of construction : A
- After the project is opened for service : B

6.3 ENVIRONMENTAL CONSIDERATION & PROTECTIONAL MEASURES

Next, the above assessment indicators are examined in combination. Further, each of these combinations is represented by the alphabetic notations used for each of the above items.

6.3.1 Environmental Consideration During Construction and Protectional Measures

(1) A-a: As a result of the cutting of borrow pits and hillocks along the route, the general topography will be altered, and especially the water seeping through cut surfaces during the rainy season can flow into paddy fields etc., and remain there for sometime leaving sandy deposits. Therefore, it is necessary to take precautional measures against drainage failure of slopes etc.

Further, since the project road runs through soft marshy ground in some areas, adequate measures should also be taken to prevent nuisances caused to the surrounding areas by the replacement, hauling etc., of peat and muddy soils.

(2) A-b: Specially during the rainy season, since houses etc., may be expected to undergo submergence due to blockage of waterways and changes in the drainage and irrigation facilities etc., caused by earthworks, adequate measures will be necessary to confirm the drainage and irrigation systems in the area and to provide temporary waterways appropriately.

(3) A-c: Since the construction difficulties and the impact on the surrounding region differ with the meteorological conditions, it is desirable to prevent nuisances to the people of the region by proper planning and supervision of construction, for example, by concentrating the construction works during the dry season when the conditions are much favourable.

(4) A-d: When the construction vehicles use the feeder roads, traffic of ordinary vehicles will be hindered. Moreover, due to passage of heavy vehicles such as the dump trucks, vibration of houses, hindrance to traffic by the spilling of the loaded soil and mud, damage to road surface and shoulders and so on can also be expected. Therefore adequate measures should be taken to avoid such problems and also to repair and rehabilitate the existing roads thus affected.

(5) A-e: Since there are possibilities for the occurrence of traffic accidents where the construction vehicles, specially the large vehicles enter the existing roads or pass through near schools etc., it is necessary to secure safety of traffic by appointing traffic guides and by other suitable measures.

(6) A-f: Since various construction nuisances could be anticipated, for example, vibration and noise due to pile driving, obstruction to traffic by sending large construction machinery and vehicles, suitable measures are necessary to prevent such problems by the proper selection of construction machinery and construction methods and by moving the large vehicles during the off-peak hours.

(7) A-g: It may be sometimes necessary to close temporarily or to detour the traffic on existing feeder roads crossed by the Project Roads during the construction of interchanges, on-off ramps or other facilities. Therefore construction planning and supervision aimed at rapid completion of construction works at these intersections so as to avoid obstructions to regional traffic is extremely important.

(8) A-l: Since the structures for passenger and vehicle crossing are not ready during the construction of the project roads, it will be inevitable for the people of the region to take detours, causing a temporary barrier to communication due to regional partition by the project roads. Therefore it is necessary to take measures in construction planning and supervision to complete these crossing structures as early as possible.

6.3.2 Environmental Consideration After the Project is Opened for Service and Protectional Measures

(1) B-a: By the construction of the project roads, the topography in the cut section will be altered leaving exposed slopes. Sufficient attention should be given to the protection of these slopes to avoid damages to neighbouring dwellings etc., due to slope failures specially during the rainy season.

As the project roads run through marshes and soft ground, sand piles etc. will be employed to improve the soft and weak ground. However, even after this treatment, settlements can still be anticipated after construction, it is necessary to take sufficient attention on the maintenance.

(2) B-b: Although drainage and flood relief structures are provided with the project roads to protect the surrounding areas from inundation, it is important to repair and maintain the other relevant channels and waterways so that the function of these structures are fully utilized.

(3) B-c: Since high speed driving on the Expressway during the rainy season could be disastrous causing serious traffic accidents, adequate measures should be taken on the safety of traffic.

(4) B-d: After the construction of this Project a portion of the ordinary traffic from Negombo Road will be diverted to the Expressway thereby relieving specially the areas along Negombo Road to some extent from noise, air pollution and other nuisances due to motor traffic and creating a much quiet living environment than otherwise experienced without the Expressway. In other words the pollution of environment by motor traffic can be generally dispersed.

Therefore, characteristic of Negombo Road as a Community Road could be ascertained which is desirable from the stand of road policy.

(5) B-e: As it is believed that the drivers are not accustomed to high speed driving on the expressways, the occurrence of a larger number of traffic accidents is feared. Therefore, besides the obvious traffic safety measures taken by the expressway management, it is necessary to take efforts to educate the road users on safety driving, and maintenance of vehicles.

(6) B-g: Since the major feeder roads are connected to the expressway through the interchanges or on-off ramps, the accessibility to the expressway is considered good. However, it is extremely important to develop and improve the feeder roads adequately in order to upgrade the mobility and accessibility of the project road and to promote regional development.

Further, by using part of the Expressway and the feeder roads, it will be possible to cover the shortcomings of radial road network. For example, traffic from Colombo International Airport in Kandy direction, which once had to come to Colombo City and then to move from Colombo City in Kandy direction, will now be able to use part of the Expressway and the feeder roads thereby to reduce travel time and distance.

Further, the traffic which so far had to use the winding feeder roads to enter Negombo Road on travelling to Colombo will now be able to save travel cost and travel time and to travel with comfort by directly using the Expressway.

With the construction of the Port Access Road (Section P-1), a road that contributes to relieve congestion of traffic within Colombo City by preventing containers and heavy lorries from mixing with the ordinary traffic will be realized.

Further, in order to help the public to use the Expressway safely and conveniently, it is necessary to adequately provide with suitable road signs, safety signs, illumination and fences to prevent entry.

(7) B-h: It is considered that the land use potentiality of this Project will rise specially in the areas surrounding the interchanges and on-off ramps. With the development of feeder roads, such trend of land use potentiality limited to a specific

area will change and land use potentiality will be promoted over a wider area. Therefore, improvement and development of feeder roads is indispensable in promoting the land use and development potentialities.

(8) B-i: With the increased convenience in travelling brought in by this Project, accompanied by the high land prices within Colombo City, it is expected that distribution of population due to urban expansion will begin to take place.

Therefore, it is important to facilitate an Expressway Bus Service in the future as a mass-transportation system effectively using the Expressway and to connect this service smoothly with the railway and the ordinary Bus Services.

(9) B-j: With the realization of the Expressway, the tourists will be able to travel comfortably between the Colombo International Airport and Colombo City and this will improve the image of Colombo as a tourist resort. Further, this project road contributes to the smoothening of business and administration of the GCEC Area of Authority and the neighbouring regions.

(10) B-k: Since the scenery of the area will be damaged by the exposed earth cut surfaces, measures to improve the road scenery, for example, by vegetation to cover the exposed surfaces, or by slope protection works, will be necessary.

(11) B-l: Although structures are provided where necessary, to cross the project roads the community will still be separated to some extent. Therefore it is necessary to make efforts to eliminate the inconveniences owing to such regional separation by future improvement of feeder roads, specially those in the north-south direction, and to avoid future regional separation, as far as possible, by planning the future land use and distribution of facilities systematically and appropriately in the regions where dwellings are not distributed densely at present.

(12) B-m: The area surrounding the project road consists mainly of paddy fields, marshes and hillocks and since this area is not densely distributed with houses, there is no major problem although a few houses have to be relocated.

However, in the case of Port Access Road (Section P-1), since there are many shanties concentrated along the railway line, it is necessary to relocate these shanty dwellers after making arrangements to receive them elsewhere sufficiently taking into consideration of the social problems.

(13) B-n: KIPZ and other facilities which so far depended solely on the Negombo Road will have fast and comfortable access to Colombo Port, Colombo City and Colombo International Airport when the Expressway is materialized. Therefore, having one of the fundamental requirements of the industries in the GCEC Area of Authority and the neighbouring areas satisfied, the development of industries is expected to be accelerated.

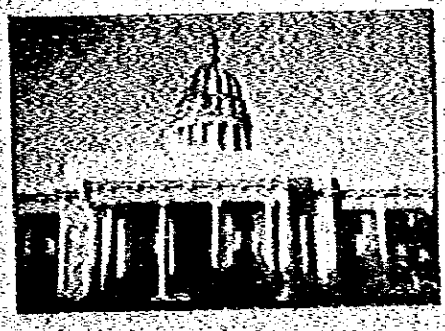
Further, with the possibility to use the Expressway for the smooth transportation of agricultural products, to the Colombo City, the market for fresh agricultural products will increase thereby promoting development of agriculture in the interior areas.

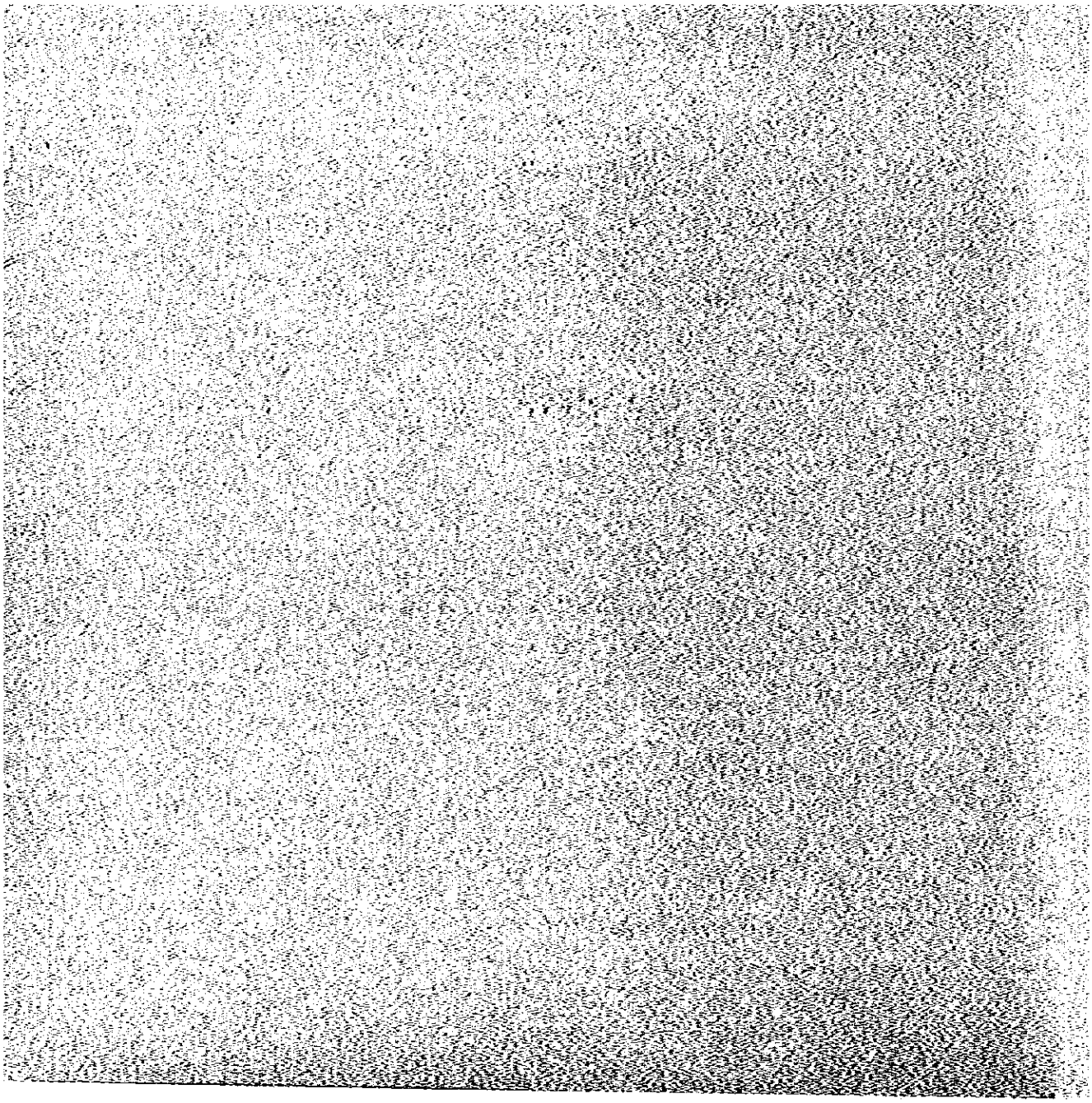
On the other hand a smooth distribution of goods can be expected from Colombo Port with the realization of Project B, and in this way, it is possible to contribute to the promotion of industrial development and economic growth even from the point of view of national economy.

(14) B-o: The Expressway passes mainly through paddy fields, marshes and hills. Although there is a difference according to land use, at present, the land prices along the project road are about 1/3 – 1/15 times the prices along Negombo Road. The land values in the areas surrounding the Project Roads will increase with the realization of the Project.

(15) B-p: Reduction in transportation cost will be expected with the smoothening of traffic flow and this is expected to be reflected as some reduction also in the price of goods.

CHAPTER 7
ESTIMATION OF THE PROJECT COST





CHAPTER 7 ESTIMATION OF THE PROJECT COST

7.1 GENERAL

7.1.1 Procedure for Cost Estimation

The project cost is estimated using the data collected on costs in the Phases I and II of the Study and reexamined and updated with the information on basic cost presented by GCEC and the other relevant government agencies.

The cost estimation process is summarized in Fig. 7-1.

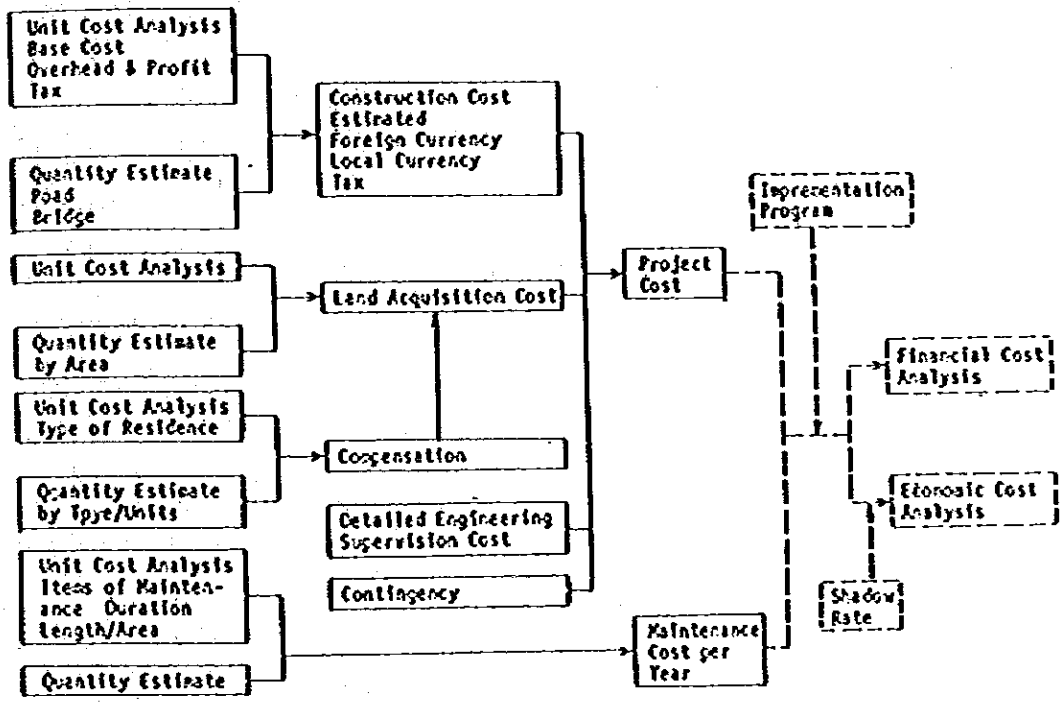


Fig. 7-1 Procedure for Cost Estimation

7.1.2 Components of the Project Cost

The basic components of the project cost include:

Construction cost
Land aquisition cost
Compensation
Detailed Engineering & Supervision costs
Overheads
Taxes and the contingencies.

Some of the above are composed of the Foreign Currency, Local Currency Components and the Tax. The basic policy of cost estimation is as follows:

1) The project cost is based on the prices in the month of May 1983.

2) The exchange rate of currency is :

1 US Dollar = 225 Yen = Sri Lanka Rs.23.00.

3) The conditions for the proportioning of foreign and local components are considered as follows:

Item	Foreign	Local
a) All equipment, plant and material for construction directly imported by the contractor.	100	0
b) Cement, Asphalt and Fuel	100	0
c) Prestressing tendons for P.C. Beams	100	0
d) Mild steel bars	70	30
e) Labour	0	100
f) Raw materials such as sand, stones and crushed stones which are locally available	0	100
g) Major materials for pavement produced in plants	100	0
h) Secondary concrete products such as pipes, piles, U shaped ditches etc.	0	100
i) Timber materials for farmwork	0	100

4) Land acquisition and compensation costs are calculated with the unit cost presented by GCEC.

5) Overheads of each unit cost are appropriated with 30% to both foreign and local component.

6) Contingencies of project costs are assumed at 15% of the construction, land acquisition cost. (This includes cost and compensation construction changes and for a rise in prices).

7) The cost of detail engineering and supervision is assumed at 10% of the construction cost.

7.2 UNIT COST ANALYSIS

7.2.1 Components of Unit Cost

The unit cost itself is divided into three parts, as foreign currency, local currency and tax. The foreign currency and local currency includes two components, namely base cost and overheads (including profit of contractor).

Table 7-1: Percentage of Cost Component

Item	Ratio
a. Base Cost (Construction cost)	1.0
b. Overhead & Profit of Contractor (When base cost is 1)	0.3

7.2.2 Labour Cost

Based on the data collected, the unit labour cost is set up as shown in Table 7-2.

Table 7-2: Labour Cost

(in Rs. at 1983 prices)

Item	Unit Cost per Day
1. Unskilled Labour	58.4
2. Skilled Labour	89.7
3. Truck Driver	89.7
4. Operator	115.2
5. Foreman	110.0

7.2.3 Cost of Construction Material

The cost of major materials for construction is derived after discussions with GCEC and other related government agencies and corporations. A list of the cost of major materials is shown in Appx. Table 21.

7.2.4 Cost of Fuel

The cost of fuels used in vehicle operating cost in the economic analysis is used also for the analysis of construction equipment as shown in Table 7-3.

Table 7-3: Cost List of Fuel

(Rs./Litre at 1983 price)

Item	Market Cost
1. Gasoline	12.00
2. Diesel Oil	6.75
3. Engine Oil for Petrol Vehicles (Normal)	17.00
4. Engine Oil for Petrol Vehicles (Multi)	27.00
5. Engine Oil for Diesel Vehicles	21.00

7.2.5 Construction Equipment

CIF costs are the basic data for calculating equipment expenditure and they are shown in Appx. Table 22, 23. Breakdown of major equipment operation cost is shown in Appx. Table 24. Hiring charges of equipment per service day are calculated using the following constants.

a) depreciation rate
b) regular repairing rate
c) repairing rate at the construction site
d) managing charges
e) service period
f) standard annual service days

Results of hiring charge rate is in the range from 0.093% to 0.052%. Hiring charges of equipment are appropriated as 100% foreign currency.

7.2.6 Result of Unit Cost Analysis

The results of unit cost analysis is shown in Appx. Table 25 ~ 27. This unit cost consists of base cost and overheads (including profit of contractor).

7.3 CONSTRUCTION QUANTITIES ESTIMATE

7.3.1 General

On the basis of preliminary design on the Photo Contour Map of scale of 1:10,000 the construction quantities were estimated by each alternative section. The sections of the road are shown in Fig. 2 (Summary).

7.3.2 Construction Quantities

Construction quantities of each section of the roads are shown in Table 7-4.

Construction quantities of each alternatives are shown in Appx. Table 28, 29.

7.4 CONSTRUCTION COST

7.4.1 General

The construction cost is estimated by using the construction quantities of each section and unit cost of each work. Each unit cost is divided into three components namely, foreign currency, local currency and tax. The construction cost in this section is the total of these factors.

Table 7-5 shows the construction cost of each main work (earth work, paving work, miscelleneous work & bridges) in each section. The project cost consists of construction cost, land acquisition, contingency and engineering service etc.

The project cost per km of road is estimated at Rs.36 million for Project A and Rs.53 million for Project B. The project cost of each alternative used for comparison is shown in Appx. Table 30.

7.4.2 Road Construction Cost

In the case of applying the unit cost in the calculation of road construction cost, the items considered are as follows:

1). The respective unit costs according to the hauling distance were used in the calculation of cutting and filling cost in order to improve the accuracy. For this reason the earth volume of each hauling distance is calculated by the mass curve and the method of cutting, haul and filling. Then cutting and filling cost is calculated by using unit cost and earth volume of each hauling distance. The mass curve of each section is shown in Appx. Fig. 22.

For cutting and filling temporary roads are to be used and for borrow filling the use of existing roads are considered.

Table 7-4: Main Construction Quantities (Project – A, B, Plan – B)

	ITEM	DESCRIPTION	CLASS	Unit	QUANTITY P=1	P=2	P=3(C)	X=1(C)	X=2(B)	X=3(B)	P=4,5	X=6~7
EARTH WORK	Cutting & Filling	Clearing & Grubbing		m²	–	–	–	173,000	226,000	274,000	–	14,700
		Cutting & Filling	Soil	m³	2,400	–	–	394,000	631,000	354,000	–	6,800
		Borrow Filling	–do–	m³	96,600	–	207,700	26,900	20,000	211,000	41,200	16,600
	Soft Ground Work	Sand Mat		m³	50,400	–	76,400	73,300	18,100	–	–	–
		Sand Drain Pile	ϕ0.40	m	51,600	–	61,100	–	–	–	–	–
		Sand Compaction Pile	ϕ0.70	m	–	–	–	–	–	–	–	–
	Others	Slope Protection	Turf Patching	m²	13,200	–	33,600	54,800	97,200	66,300	9,000	6,600
		Box-Culvert	4.0×3.0	each	1	–	–	1	2	–	–	–
			3.0×3.0, 3.0×2.5	each	–	–	–	10	13	17	–	–
		Pile-Culvert	ϕ1.80, 1.50	each	2	–	–	2	3	3	–	–
			ϕ1.20, 0.90	each	–	–	3	3	3	1	2	3
		Road Drainage		km	2.51	–	3.54	7.01	8.23	8.76	1.00	5.36
PAVING WORK	Carriage Way	Surface Course	Asphalt	ton	(3,000)	(2,430)	(5,220)	(11,700)	(13,300)	(14,100)	(720)	(5,240)
		Binder Course	–do–	ton	6,770	7,300	15,000	23,000	26,000	27,000	1,430	10,500
		Base Course	Bituminous Stabilization	ton	5,850	–	8,040	23,000	26,000	20,700	–	–
			Crushed Stone	m³	5,320	–	9,070	20,000	17,700	18,800	940	7,140
		Sub Base Course	Gravel and C.Stone	m³	5,320	–	9,070	20,000	–	–	1,300	–
			Soil Cement	m³	–	–	–	–	17,700	18,800	–	9,520
	Others	Shoulder Pavement		m²	–	–	12,200	29,500	32,900	39,200	3,500	–
		Curve	P.C.C. Curve	m²	6,000	1,790	5,240	–	–	–	–	–
			Asphalt Curve	m²	–	–	1,300	2,420	2,440	3,080	–	–
		Lane Mark	Paint	m²	6,840	–	17,700	42,200	47,400	51,100	11,400	16,300
MISCELLANEOUS WORK	Miscellaneous	Median Strip	Plantation	m²	–	–	–	7,010	8,230	8,050	–	–
		Guard Rail	Steel	m	3,730	1,790	10,500	6,600	9,750	15,700	2,000	1,620
		Illumination		set	0.5	–	1.5	3.0	2.5	2.0	0.6	–
		Traffic Signal		set	2.6	2.0	4.5	–	–	–	1.0	1.0
		Road Sign		set	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Fence	Panel Fence	m	3,030	–	2,400	–	–	–	–	–
			Barbed Wire Fence	m	–	–	3,030	14,000	16,500	19,500	–	–
		Frontage Road		m								
BRIDGE WORK	Main Road	Highway Bridge	L=15m	m	262.5	–	175	1,102.5	1,085	402.5	–	–
			L=35m	m	612.5	–	612.5	455	980	945	–	–
			L=60m	m	–	–	–	210	–	1,400	–	–
	Crossing Road	Over Bridge	L=20m	m	–	–	221.2	663.6	1,327.2	884.8	205.4	181
			L=50m	m	–	–	–	442.4	442.4	–	–	–

Table 7-5: Project Construction Cost (Case-5) (Financial)

(in million Rs.)

Item \ Section	PROJECT (B)				PROJECT (A)				TOTAL			
	Foreign	Local	Tax	Sub-Total	Foreign	Local	Tax	Sub-Total	Foreign	Local	Tax	Sub-Total
-Earth Work	48.80	36.31	5.66	90.77	110.72	59.62	11.12	181.46	159.52	95.93	16.78	272.23
-Paving Work	41.53	10.97	4.04	56.54	163.11	27.51	15.04	205.66	204.64	38.48	19.08	262.20
-Miscellaneous Work	39.86	1.63	1.38	42.87	72.93	11.48	3.28	87.69	112.79	13.11	4.66	130.56
-Bridge	10.44	9.51	1.30	21.25	63.02	57.27	8.76	129.05	73.46	66.78	10.06	150.30
-Construction Cost	140.63	58.42	12.38	211.43	409.78	155.88	38.20	603.86	550.41	214.30	50.58	815.29
-Land Acquisition	-	33.59	-	33.59	-	146.52	-	146.52	-	180.11	-	180.11
-Contingency	21.09	13.80	1.86	36.75	61.48	45.36	5.73	112.57	82.57	59.16	7.59	149.32
-Engineering Service etc.	14.06	5.84	1.24	21.14	40.98	15.59	3.82	60.39	55.04	21.43	5.06	81.53
Total Cost	175.78	111.65	15.48	302.91	512.24	363.35	47.75	923.34	688.02	475.00	63.23	1226.25
Percentage (%)	58	37	5	100	56	39	5	100	56	39	5	100

2) The unit cost of sand for sand mat, which shall be sea or river sand to be supplied by the local contractor, differ in Project A and Project B according to the average hauling distance.

3) Sand for sand drain and sand compaction piles shall be well-graded with a high permeability. For this reason, unit cost of river sand supplied by dredger pump is applied in the estimate.

4) Crushed stones and soil cement are used for sub-base course. Soil cement is applied to Sections (k-2) and (K-3) due to inavailability of rock in this area and hence the crushed stones which is to be produced in a crusher plant.

The cost difference of these two items is small with Rs.335/m^3 for crushed stone and Rs.340/m^3 for soil cement.

5) Aggregates which can be supplied locally are assumed to be of granite or gneiss in origin and are considered not to have sufficient bonding with asphalt. Therefore, cement is considered as the filler on the estimate of the paving work.

7.4.3 Structure Construction Cost

As for the major structures, the costs are estimated one by one using quantities of major materials, items of work and their unit costs.

Whereas the cost of minor structures are estimated by reading a graph prepared for major materials of standard design and their unit costs, according to the site topography and other conditions. The unit construction cost per M^2 of the PC super-structures is shown in Fig. 7-2.

The construction costs of major structures are given in Table 7-6.

The construction costs of representative standard design structures are given in Table 7-7.

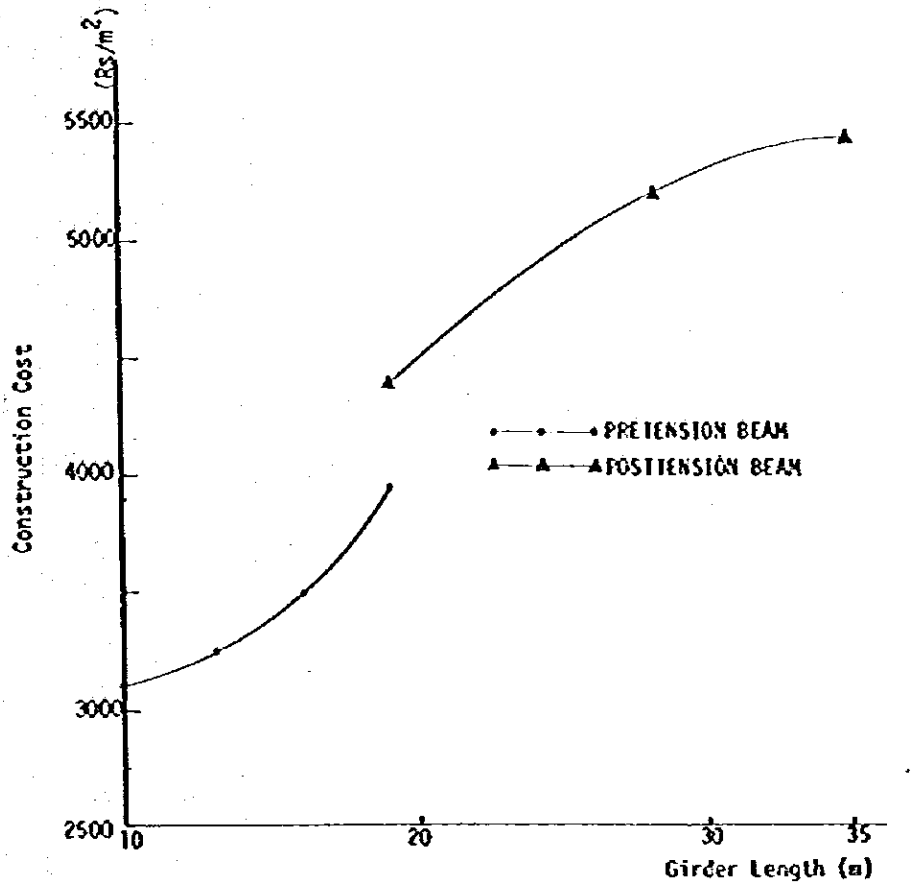


Fig. 7-2: Unit Costs of PC Beam Superstructure

Table 7-6: Construction Costs of Major Structures

(Unit = 1000 Rs.)

Item	Breakdown Cost			Total
	Foreign	Local	Tax	
1. Port Entrance Box Culvert (P1-Section)	3,384	2,136	518	6,038
2. Demolition of Peliyagoda Structures (P3-Section)	950	1,278	136	2,366
3. Horape Railway Flyover (K1-Section)	5,556	5,154	740	11,450
4. Ja-Ela Canal Bridge (K2-Section)	2,742	3,212	294	6,250
5. Dandugam Oya Bridge (K3-Section)	7,962	5,106	702	13,770

Table 7-7: Construction Costs of Standard Designed Structures

(Unit = 1000 Rs.)

Item		Breakdown Cost			Total
		Foreign	Local	Tax	
1. Pretensioned beam Superstructure	L=10m	282	224	46	552
	L=13m	418	260	72	750
	L=16m	506	404	90	
2. Post tention beam Superstructure	L=19m	980	402	56	1,438
	L=28m	1,748	714	98	2,560
	L=35m	2,354	960	132	3,446
3. Box Culvert	V=5m×5m	589	517	112	1,218
	V=6m×6m	752	619	140	1,511
	V=7m×7m	938	735	172	1,845
	V=8m×8m	1,140	862	207	2,209
4. Pipe Culvert (10m)	D= φ0.9m	9	16	2	27
	D= φ1.2m	18	26	3	47
	D= φ1.5m	26	41	5	72
	D= φ1.8m	39	57	7	103
5. Abutment (4 Lanes)	H=4m	130	100	22	252
	H=6m	248	184	44	476
	H=8m	398	292	72	762

7.5 LAND ACQUISITION COST AND COMPENSATION

7.5.1 Land Acquisition Cost

Unit costs of land acquisition is estimated in Rs/m² using the data presented by GCEC. These unit costs are classified into those of the nine area (Colombo, Peliyagoda, Ragama, Kiribathgoda, Kandana, Ja-Ela, Ja-Ela Suburbs, Gampaha and Katunayake) and into 3 land categories (such as, residential coconut lands, paddy fields and marsh).

The unit costs range between 70 and 1200 Rs/m², for residential lands between 8 and 320 Rs/m² for paddy field, between 6 – 280 Rs/m² for marsh. Details are shown in Table 7-8.

Land acquisition costs of each section are calculated by multiplying land areas to be reserved for the road in each section by their unit costs.

Land acquisition costs and compensation costs in section 7.5.2 are based on the data obtained from the relevant A.G.A. Divisions. As these data vary widely the costs used in this estimate are the average values.

Table 7-8: Unit Cost of Land Acquisition

(in Rs./M² at 1983)

Name of Area	Residential & Coconut Lands	Paddy Field	Marsh
• Colombo	1,190	317	278
• Peliyagoda	317	158	119
• Ragama	119	14	8
• Kiribathgoda	198	14	8
• Kandana	159	12	10
• Ja-Ela	198	10	16
• Ja-Ela Suburbs	73	8	6
• Gampaha	159	12	6
• Katunayake	238	10	8

Source : Valuation Department

7.5.2 Compensation

Compensation costs are estimated into two categories namely, densely populated areas and less densely populated areas, with reference to aerial photo maps and field survey. And their costs are estimated using unit cost per km for the proposed route given in Table 7-9.

Table 7-9: Unit Cost of Compensation

(1000Rs)

Item	Unit	Cost
Densely Populated Areas	km	4,980
Less Densely Populated Areas	km	885

The basic unit costs are the same as those for land acquisition. (Table 7-10)

Table 7-10: Baisc Unit Cost of Compensation

(in Rs/m²)

Classification of House	Cost
Fine House (more than 100 m²)	2,700
Common House (50 – 100 m²)	1,800
Small House (less than 50 m²)	1,500
Shanty	150

The compensation costs are included in the land acquisition cost. (See Table 7-5).

7.6 MAINTENANCE COST

This project road is the first Expressway Project to be planned in Sri Lanka. Therefore, the available data for the estimation of maintenance cost limited to ordinary highway and are not sufficient for this study.

As there is no direct co-relation between maintenance cost of existing road and that of this project road due to the difference in pavement system etc. Therefore, the data from South-East Asia and Japan were referred to in setting up the policy of maintenance cost estimation.

Maintenance cost consists of the following items. The policies of cost estimation between Project (A) and Project (B) differs.

(1) Resurfacing Cost
(2) Sweeping Cost
(3) Electricity Cost
(4) Miscellaneous (= (1) + (2) + (3)) x 0.1)

Maintenance cost per km are calculated based on the above costs and summarized in Table 7-11.

Table 7-11: Annual Maintenance Cost

Unit: Rs/Km year

Items	Project (A)	Project (B)
Resurfacing Cost	71820	89120
Sweeping Cost	62225	24335
Electricity Cost	17125	19685
Miscellaneous	15120	13310
Total	166290	146450

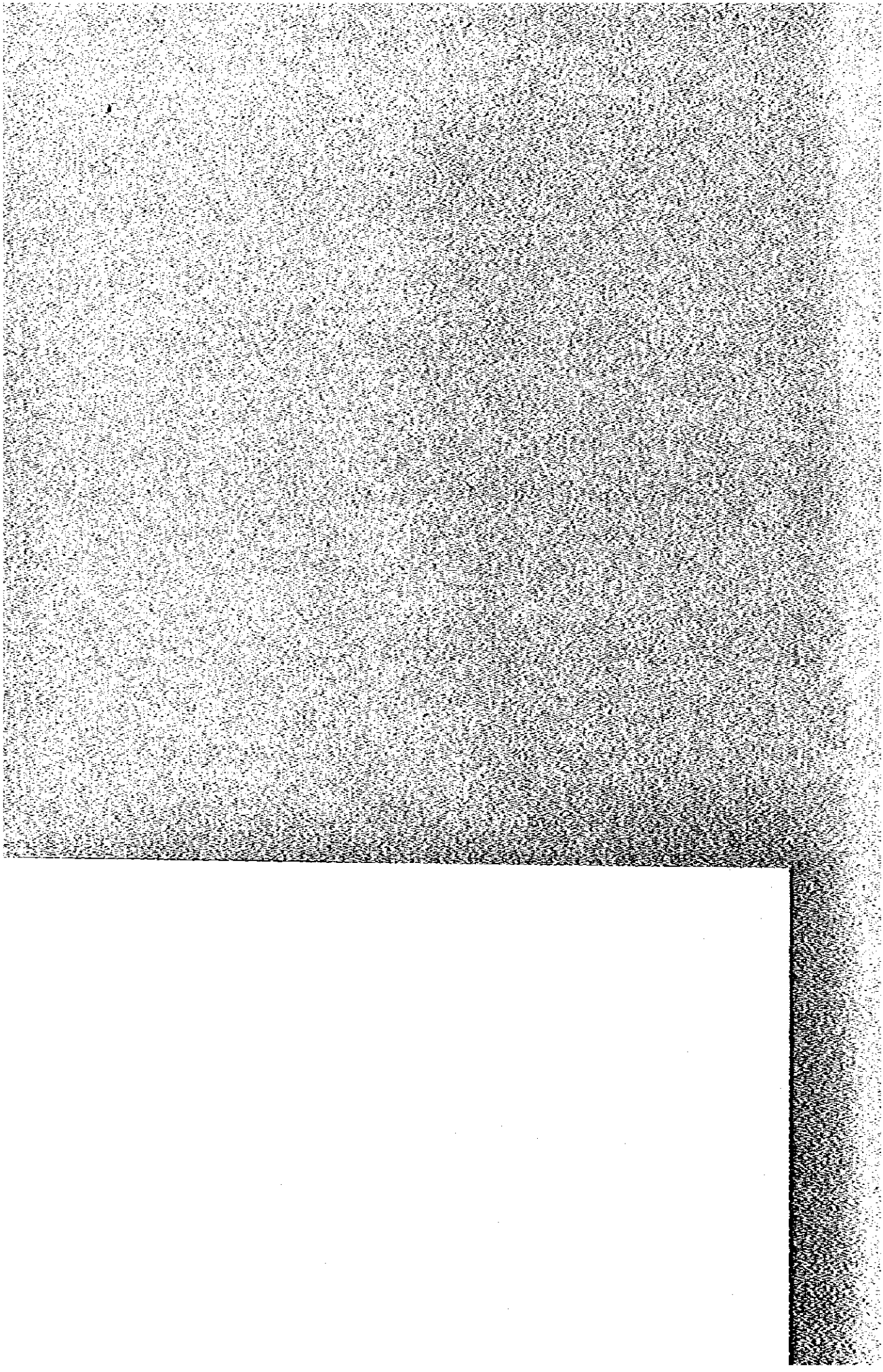
Table 7-12: Periodical Maintenance Cost

(Rs/Km)

Period	Project (A)	Project (B)
After 5 years	2257700	3226700
After 15 years	1613400	2257700

The above costs consist of tax. Annual maintenance costs of both Project (A) and Project (B) are divided with 76% for foreign, 19% for local and 5% for tax. Periodical maintenance costs are divided with 86% for foreign, 6% for local and 8% for tax respectively.

CHAPTER 8
PROJECT EVALUATION



CHAPTER 8 PROJECT EVALUATION

8.1 GENERAL

8.1.1 Procedure

The procedure for the evaluation of the Project Road is summarized in Fig. 8-1. The important parts of the evaluation are strongly connected with the traffic forecasting and especially with the traffic assignment. The economic benefits realizable from the implementation of the project are the savings in the traffic cost which were quantified through effectiveness of traffic movement on the road network including the proposed road. The traffic cost was estimated by applying the vehicle operating cost per Km and the passenger time value per minute to the traffic on roads through a computer simulation.

Investment cost and maintenance cost of the Project Road were shown by economic cost: Transfer elements in the cost such as taxes and duties were deleted. Investment cost and maintenance cost of the Project Road were divided into foreign and local components. Shadow exchange rate and shadow wage rate were applied by each component to arrive at economic cost.

8.1.2 Indicators for Economic Evaluation

Three types of economic indicators were used in this economic evaluation.

(1) Internal Rate of Return (I.R.R.)

The I.R.R. shows the discount rate which gives the break even point between the present value of benefit and that of cost as given by the following formula:–

$$B(R) - C(R) = 0$$

$$B(R) = \sum_{t=1}^{n} \frac{B_t}{(1+R)^t}$$

$$C(R) = \sum_{t=0}^{n-1} \frac{C_t}{(1+R)^t}$$

(R): Internal Rate of Return
B_t : Benefit in the year (t)
C_t : Cost in the year (t)
n : Project life in years

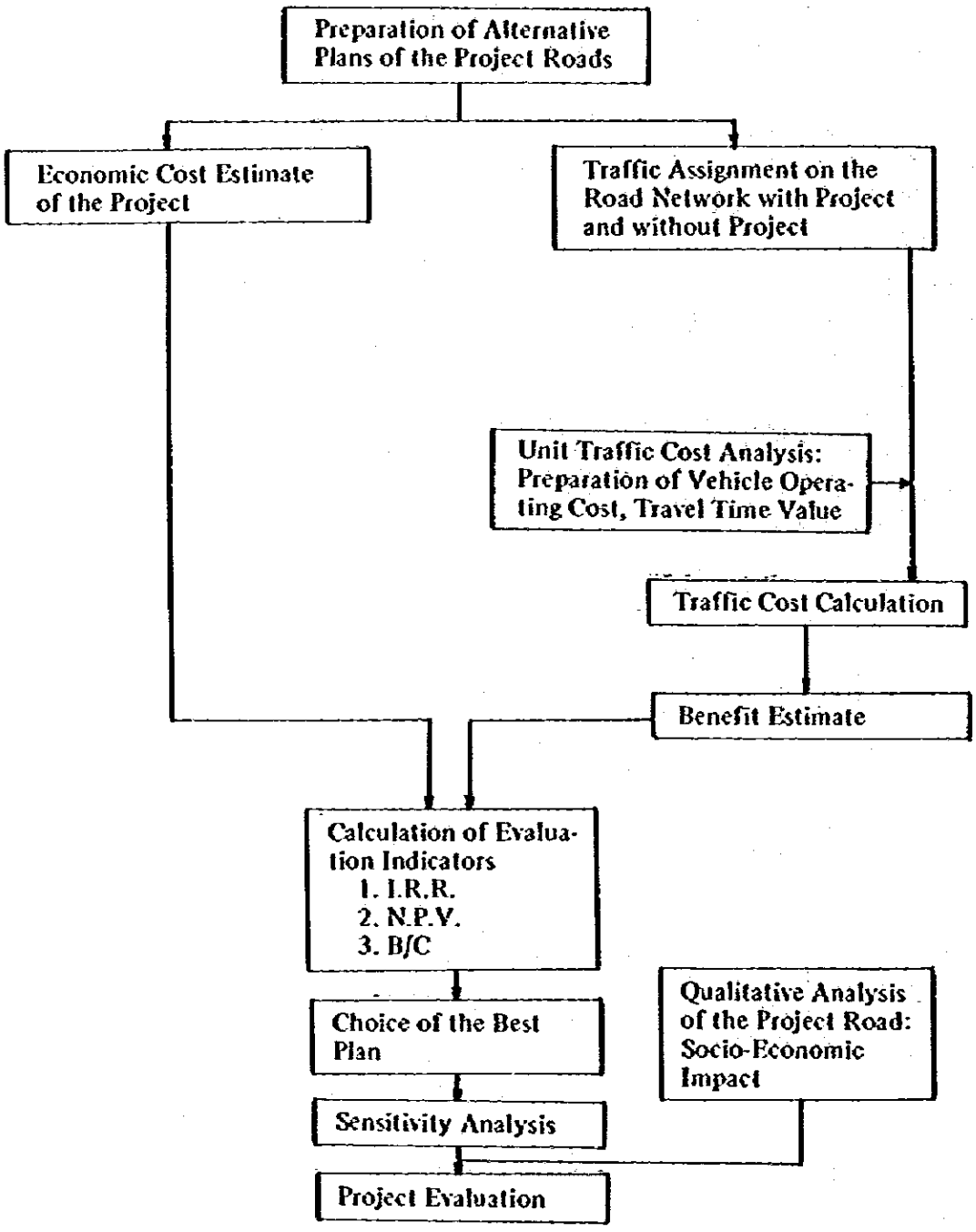


Fig. 8-1: Procedure for Project Evaluation

In order that the project be economically feasible, the I.R.R. should be more than the opportunity cost of capital in Sri Lanka.

(2) Net Present Value (N.P.V.)

The N.P.V. will indicate the difference between the discounted benefit and cost using the rate of opportunity cost of capital. A positive N.P.V. means the project is economically feasible.

(3) Benefit Cost Ratio (B/C Ratio)

The B/C ratio is the ratio obtained by dividing the present value of benefit by that of cost:--

Benefit Cost Ratio = B/C

where

$$B = \sum_{t=1}^{n} \frac{B_t}{(1+i)^t}$$

$$C = \sum_{t=0}^{n-1} \frac{C_t}{(1+i)^t}$$

B_t : Benefit in the year (t)
C_t : Cost in the year (t)
i : Discount rate
n : Project life in years

8.2 ALTERNATIVES

Preparation of alternatives is important as the first step in the project analysis. In general, economic evaluation is one of the decision making tools to select the best answer among the appropriate alternatives.

Many alternatives were discussed from the engineering and some other points of view with respect to the following items (refer to Chapter 5 Section 6 and 7).

- Route
- Cross-Section
- Access to the Expressway (including number of interchanges/ramps)
- Stage construction

And finally, the alternatives for economic evaluation were decided upon 5 cases as shown in Table 8-1 for the purpose of this Study.

Table 8-1: Cases for Economic Evaluation

Case No.	Sections Included in Route							Type of Structure of P-3 Section	Cross-Section Plan	Access Type to Expressway	Stage Construction	
	P-1	P-2	P-3 P-5	K-1 K-4	K-2	K-3 K-7	K-5					
1	○	(1)	–	–	–	–	–	–	4-Lane	–	–	
2	○	○	○	–	–	–	–	Lowbank	4-Lane	–	–	
3	–	–	–	○	○	○	○	–	4-Lane	(2) Plan B	–	
4	○	○	○	●	●	●	●	Lowbank	4-Lane	Plan B	1st Stage ○	P-1 P-2 P-3 P-5
											2nd Stage ●	K-1 K-2 K-3 K-4 K-5 K-7
5	○	○	○	○	○	○	○	Lowbank	4-Lane	Plan B	–	

Note: (1) Cost of Paving Work, Guard Rail, Traffic Signals, Road Sign are included.
(2) Plan B : Expressway with fully grade separated, but provided 7 half interchanges in addition to Main Interchanges (refer to Chapter 5, Section 6).

8.3 ECONOMIC COST ESTIMATES

8.3.1 Construction Schedule for Economic Cost Estimates

Construction schedule is one of the factors that influence the results of the project evaluation. But the detail construction schedule is to be established in Implementation Program. The preliminary construction schedule for the evaluation is assumed as shown in Fig. 8-2. Accordingly, the project road is assumed to be opened to traffic in the year 1990. It is necessary to apply the same construction schedule to each of the cases, although the scale of investment is different from each other, *in order to exclude the influence of different schedules in the evaluation.*

In the construction schedule of case No. 4, the same schedule pattern as for the first stage is applied to the second stage. These construction schedules are only tentative ones. In real situations, other conditions such as financial and political aspects should be taken into account in the preparation of the Implementation Program.

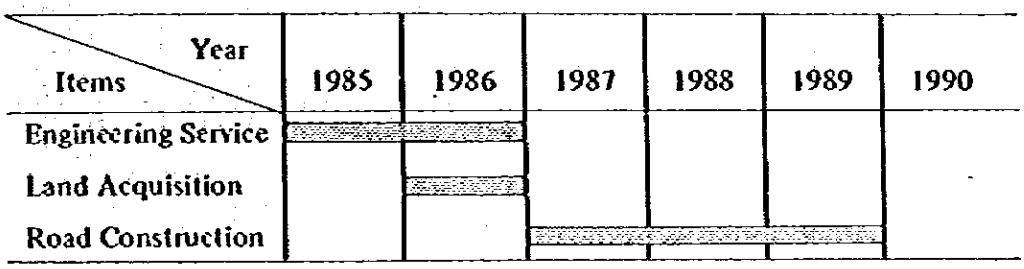


Fig. 8-2: Preliminary Construction Schedule

8.3.2 Economic Cost

The estimation of the Project costs was already described in detail in Chapter 7. The Project costs consist of land acquisition and compensation cost and construction cost (including structure). Contingencies and Engineering Fees were estimated as well.

For the economic evaluation of the Project, the costs (and benefits) should be shown by economic values. Therefore, the following modifications were made to estimate the economic cost:

1) Transfer elements in the cost such as taxes and duties were deleted.
2) Shadow Exchange Rate (SER) was applied to the foreign currency component and Shadow Wage Rate (SWR) was applied to the local currency component making allowance for the market distortions.

In this study, the conversion factors to modify the foreign component and local component were estimated to be 1.08 and 0.98 respectively by considering SER and SWR (The concepts and calcualtion process of SER and SWR are explained in Appendix 4).

The results of the economic cost estimates of each alternatives are shown in Table 8-2.

The marsh areas and other unused areas through which the Project Road will pass will remain in that state even in the future if the Project Road is not constructed, therefore, opportunity cost of land is negligible.

Table 8-2: Economic Costs by Cases

(In Rs. 1000, 1983 prices)

Case No.	Foreign Currency (1)	Local Currency			Tax	Total (Financial Cost)	Economic Cost 1.08 x (1) + (2) + 0.98 x (3)
		Land Acquisition (2)	Construction (3)	Sub-Total			
1	64310	35630	27850	66450	5950	136740	135378
2	175780	38630	73020	111650	15480	302910	300032
3	512240	168500	194550	363350	47750	923340	912672
4 *	175780	38630	73020	111650	15480	302910	300032
**	512240	168500	194550	363350	47750	923340	912672
***	655020	207130	267870	475000	63230	1226250	1212704
5	655020	207130	267870	475000	63230	1226250	1212704

Note : Including engineering fee and contingency.
* : First Stage
** : Second Stage
*** : Total

8.3.3 Stream of Economic Costs

As explained in Fig. 8-2, the implementation period of the Project Road will take about 5 years. Allocation pattern of investment cost during that period was assumed as shown in Table 8-3.

Table 8-3: Stream of Economic Costs

Items \ Year	1985	1986	1987	1988	1989
Engineering Service	60%	40%	–	–	–
Land Acquisition	–	100%	–	–	–
Road Construction	–	–	20%	50%	30%

In case of the second stage of case No. 4, the same allocation pattern described above was applied.

8.3.4 Maintenance Cost

The maintenance cost which is described in chapter 7 was used for the economic evaluation.

Unit cost (Rs/Km) of annual and periodic maintenance costs are shown in Table 8-4 and Table 8-5.

Table 8-4: Annual Maintenance Cost of Project Road

(Per km in Rs.1000 1983 Prices)

Project	(1) Foreign Currency	(2) Local Currency	Tax	Total	Economic Maintenance Cost 1.08 x (1) + (2)
Project A (Expressway)	123.4	35.1	7.9	166.4	168.4
Project B (New Port Access)	108.9	29.9	7.7	146.5	147.5

Table 8-5: Periodic Maintenance Cost of Project Road

(Per km in Rs.1000 1983 Prices)

Project		(1) Foreign Currency	(2) Local Currency	Tax	Total	Economic Cost 1.08 x (1) + (2)
Project A (Expressway)	I	1946.4	141.4	169.9	2257.7	2243.5
	II	1390.9	101.1	121.4	1613.4	1603.3
Project B (New Port Access Road	I	2781.9	202.1	242.8	3226.8	3206.6
	II	1946.4	141.4	169.9	2257.7	2243.5

Note I : Overlay cost 5 years after opening
II : Overlay cost 15 years after opening
Conversion factor is applied to the Foreign component only because the weight of the Local component are small.

8.4 TRAFFIC COST ESTIMATES

8.4.1 General

The traffic cost on the road network can be composed of two components: vehicle operating cost and travel time cost. The first step for estimating traffic cost is to decide the unit traffic cost: Rs/Km and Rs/minute. In the second step, these unit costs are applied to traffic assignment. Therefore, the traffic cost estimate is closely associated with the computer simulation process of traffic assignment (refer to Chapter 4).

Every zone pair trip in the OD matrix was sliced into portions (0.2, 0.2, 0.2, 0.2 and 0.2). The zone pair trips in a sliced group could find a minimum time path on a given network under 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 the daily capacity and a quantity – velocity formula which indicates varying travelling speed corresponding to various levels of traffic volume.

When the assignment and 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 by five times on a given network condition.

The traffic cost was estimated by using the travelling speed on each link at each repetition, and the summation of five repetitions brought in the traffic cost per day.

8.4.2 Vehicle Operating Cost

(1) Vehicle operating cost

Vehicle operating costs (VOC) are composed of fuel consumption, lubricating oil consumption, tyre consumption, depreciation, maintenance (parts and labour), capital and interest cost, crew cost, registration fee, insurance fee and overhead cost (standing cost).

Vehicle operating cost of the representative vehicle types is estimated as in Appendix. 5. The summary is shown as the basic VOC in Table 8-6. Caused by frequent speed changes in congested traffic, the VOC increases in response to the increasing traffic congestion. VOCs in different speed levels were also estimated and stated in Appendix 5.

(2) Vehicle types and vehicle operating cost

VOCs were originally estimated based on the following vehicle types:

1) Motorcycle
2) Tricycle
3) Passenger car
4) Taxi
5) Van, Wagon, Pickup
6) Bus (SLCTB)
7) Medium & Micro bus (Private line)
8) Medium lorry
9) Heavy lorry & Container trailer

Table 8-6: Basic Vehicle Operating Cost (Economic Cost at Basic Running Conditions)[1)]

(Rs./1000KM)

Items \ Type of Vehicle	Motorcycle	Tricycle	Passenger Car, Taxi	Van	Bus (SLCTB)	Medium & Micro Bus	Medium Lorry	Heavy Lorry Container
Fuel	387.7	455.4	775.3	1092.0	1335.3	671.3	697.7	1090.8
Oil	8.7	10.2	17.4	24.6	41.5	20.9	21.7	33.9
Tyre	22.6	43.2	143.3	172.6	238.5	265.2	235.7	447.6
Depreciation	31.2	539.9	275.9	227.4	174.9	259.1	147.0	183.6
Maintenance (Parts)	25.8	209.3	339.8	352.5	349.1	517.1	336.9	420.9
Maintenance (Labour)	20.0	80.0	30.0	66.7	44.7	75.0	50.0	40.0
Capital & Interest	16.3	41.5	127.1	88.9	157.3	175.5	121.3	189.4
Crew (Wages)	–	30.8	13.6	61.5	187.5	136.7	72.7	168.1
Registration Fee	1.0	0.5	3.8	5.1	2.6	4.4	4.8	5.3
Insurance Fee	2.6	1.3	14.4	10.3	–	25.0	12.1	27.3
Overhead	–	141.2	174.1	525.4	632.9	537.8	425.0	651.7
Total	515.9	1553.3	1914.7	2627.0	3164.3	2687.8	2124.9	3258.6

Source : The summary of Appendix 5.
Note : 1) On level and paved roads. Running speed is around 55 ~ 66 km per hour.

And then, these costs were put together into two categories: i.e. cars (including private passenger car, taxi, buses, but excluding motorcycle and tricycle) and lorries (including van, wagon, pickup, medium & heavy lorry and container trailer). The purpose of this classification was to fit the kind of vehicle with those dealt with in the forecasting of traffic demand.

When VOC for cars determined as in Appendix 5 was applied for the traffic assignment, the weighted VOCs at 68.1% for private passenger cars, taxis, 12.2% for CTB buses and 19.7% for medium & micro buses (private line) were used. For the VOC of lorries the weighted mean of 46.5% for vans, wagons, pickups, 11.6% for medium lorry and 41.9% for heavy lorries, container trailers was taken into account. These percent shares were determined by reviewing the traffic composition of the traffic survey in February 1983. The values of these weighted VOC by each speed level are shown in Table 8-7.

Table 8-7: VOC (Applied to Traffic Assignment)

(Rs/1000 km)

Speed / Vehicle	5(km/h)	10	15	20	25	30	35	40
Cars	7166	4942	4007	3453	3095	2838	2654	2521
Lorries	9155	6325	5111	4386	3917	3602	3338	3181

Speed / Vehicle	45(km/h)	50	55	60	65	70	75	80
Cars	2415	2337	2279	2235	2217	2224	2234	2266
Lorries	3028	2938	2870	2836	2812	2817	2840	2894

8.4.3 Time Cost

Savings in time cost of passenger movement should be measured in terms of money and quantified in economic evaluation. In this study, the time was associated with income level and assessed in terms of economic cost. The two types of unit time cost (Rupees/minute) were prepared:–

1) Unit time cost for car-owning group
2) Unit time cost for non-car owning group

According to a previous survey conducted by the Central Bank of Ceylon, higher income groups tend to spend a greater share of their income on transport (see Fig. 8-3). And it is also pointed out that there is a marked increase in mean expenditure (per spending unit) among those in Rs.1500 – Rs.2000 monthly income category (see Fig. 8-4). This income group probably constitutes *the threshold for the possession of motorised vehicles*[1].

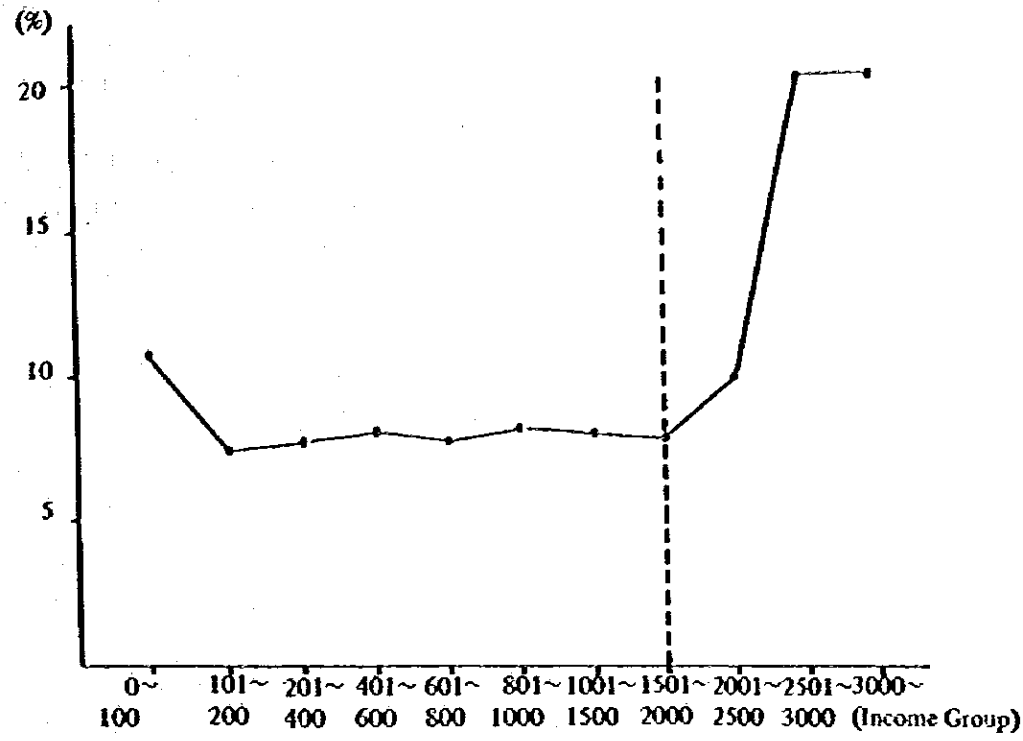


Fig. 8-3 Expenditure on Transport by Income Group as a Percentage of non-Food Expenditure – All Island

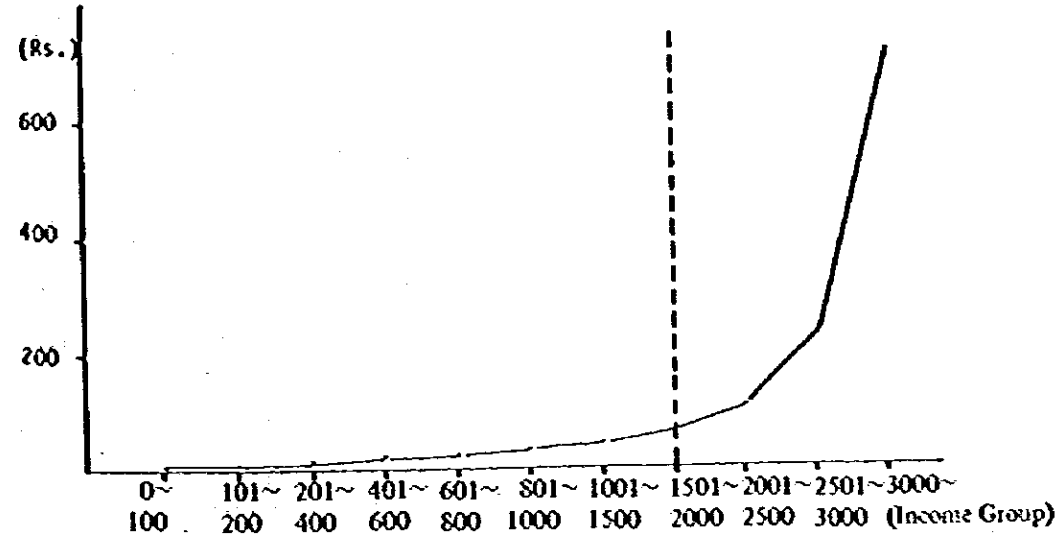


Fig. 8-4: Mean Expenditure on Transport – All Island

By using this information, average monthly income per spending unit was calculated in Table 8-8 which represented that the average income of non-car owning group and of car-owning group were Rs.651 and Rs.3035 respectively. If we consider the average income of 1983, the above figures should be raised by the annual rate of 20% (the average annual rate of increase of per capita GNP shown in Table 8-9) resulting Rs.1367 and Rs.6374 respectively. These are the figures per spending unit and per month. Therefore, average number of income receivers per spending unit, average number of working days per month and average working hours per day are applied to obtain the income per person per hour as–

Car owning group

Rs.6374 ÷ (Average No. of income receivers: 1.64)
÷ (Working days per month: 23 days)
÷ (Working hours per day: 8 hours)
= Rs.21.12/hour

Non car owning group

Rs.1367 ÷ 1.47 ÷ 23 ÷ 8 = Rs.5.05/hour.

Furthermore, it is reasonable to assume that the passenger's travel time value is different depending on the trip purpose. The time value factors shown in Table 8-10 were applied in this study.

Table 8-8: Income Distribution of Spending Units

Income Group of Spending Unit (Rs. for 1 month)	Spending Units		One Month	
	No. of Spending Units	Average No. of Income Receivers	Income (Rs.)	Average Income (Rs.)
(Non-car owning group) 0 – 1500	7,432	1.47	4,835,846	651
(Car owning group) over 1500	952	1.64	2,889,626	3,035

Original Sourse: Central Bank of Ceylon, ibid.

Note 1): Central Bank of Ceylon, 'Report on Consumer Finances and Socio-Economic Survey 1978/1979 Sri Lanka' March 1983.

Table 8-9: GNP Per Capita

(Rs. Million)

	1978	1979	1980*	1981*	1982*	Average Annual Rate of Increase
GNP per Capita						(1979 – 1982)
(a) Current prices	2936	3424	4194	5179	5904	20%
(b) Constant prices (1970)	1221	1274	1320	1352	1399	3%

Source : Central Bank of Ceylon 'Annual Report 1982'
Note : *Provisional

Table 8-10: Time Value Factor by Trip Purpose

Trip Purpose	Time Value Factor
To and from work	50% of hourly income
Work and Business	100% of hourly income
Others	No value

Time cost of each type of vehicle is calculated by the following formula:–

$$C_P = 21.12 \times N_P \times \sum_i (T_P^i \cdot R^i)$$

$$C_B = 5.05 \times N_B \times \sum_i (T_B^i \cdot R^i)$$

C_P : Time cost of passenger car (Rs/hour, per vehicle)

N_P : Average occupancy of passenger car

T_P^i : Composition ratio of trip purpose 'i' for passenger car.

R^i : Time value factor of trip purpose 'i'

C_B : Time cost of bus, taxi (Rs/hour, per vehicle)

N_B : Average occupancy of bus, taxi

T_B^i : Composition ratio of trip purpose 'i' for bus, taxi.

Calculation and data are shown in Table 8-11.

Table 8-11: Calculation of Travel Time Value

Type of Vehicle / Items	Private Passenger Car	Taxi	Bus	
			SLCTB	Private Line
Average Occupancy	1) 3.30	Without Driver 1) 1.91	2) 38.4	3) 15.0
Hourly Income	Rs.21.12/hr	Rs.5.05/hr	Rs.5.05/hr	Rs.5.05/hr
Composition Ratio of Trip Purpose	1)	1)	4)	4)
To and from work	45.2%	17.4%	40.0%	40.0%
Business	23.9%	36.0%	15.0%	15.0%
Others	30.9%	46.6%	45.0%	45.0%
Total	100.0%	100.0%	100.0%	100.0%
Time Valve Factor				
To and from work	50%			
Business	100%			
Others	0%			
Travel Time Valve per Hour per Vehicle	Rs.32.41/hr	Rs.4.31/hr	Rs.67.87/hr	Rs.26.51/hr
Composition Ratio of Traffic Volume 1)	0.614	0.067	0.122	0.197

Note : 1) From traffic survey in February 1983.
2) Statistics Department of Central Bank of Ceylon, 'Economic & Social Statistics of Sri Lanka' Vol. III, No. 2, 1980.
3) 'Transport Requirements of the GCEC area' Interim Report, October 1980.
4) Composition ratios of trip purpose of bus users were not available. Therefore, ratio of bus traffic flow during commuting hours (6.00 ~ 9.00 AM, 4.00 ~ 7.00 PM) obtained from the result of the traffic counting survey was substituted for the ratio of 'To and from work'. And the ratio of 'Business' purpose was assumed to be less than that of Passenger car.

Further, it is necessary to note that the saved time is not always used in other productive activities. Considering the Sri Lanka economy, in which resources and labour are still to be fully employed although the economy has developed steadily, the preliminary time cost of Table 8-11 are to be halved as follows:

Private passenger car	Rs.16.21/hour per vehicle.
Taxi	Rs. 2.16/hour per vehicle.
SLCTB bus	Rs.33.94/hour per vehicle.
Private line bus	Rs.13.26/hour per vehicle.

Namely, 'opportunity cost of time' was assumed to be a half of the earning rates.

Applying the composition ratios of traffic volume which are shown in Table 8-11, weighted economic travel cost of Cars was decided at Rs.16.85/hour per vehicle (= Rs.0.281/minute).

8.5 BENEFIT ESTIMATES

8.5.1 Benefits Accounted

Many kinds of benefits (or economic effect) will be generated from the construction of new roads. In this study the benefits listed below were estimated quantitatively.

- Vehicle operating cost saving
- Passenger travel time cost saving

Namely, the benefit is estimated as the difference of the traffic costs between "without" and "with" project.

8.5.2 Benefit Calculation Method

As explained in previous section, traffic cost estimates are associated with the traffic assignment to road network. Formulas described below were applied to traffic assignment process:

$$(TC) = \sum_i \alpha_i \sum_R \sum_L {}^{RL}Q_i \cdot t^{RL}$$

Here, (TC) : Total time cost.

α_i : Unit time cost of vehicle (i)

${}^{RL}Q_i$: Assigned traffic volume of vehicle (i) on link (L) at the (R)th excution of assignment (R = 1 . . . . 5).

t^{RL} : Travel minutes of link (L) at the (R)th excution.

Therefore, time cost saving is shown as follows:--

$$(TB) = (TC)^{W/O} - (TC)^{W}$$

Here, (TB) : Time benefit

$(TC)^{W/O}$: Total time cost in without case.

$(TC)^{W}$: Total time cost in with case.

Similarly, for vehicle operating cost:

$$(TO) = \sum_{i} \sum_{R} \sum_{L} {}^{R}Q_{i}^{L} \cdot D^{L} \cdot {}^{R\,L\,S}\beta_{i}$$

Here, (TO) : Total vehicle operating cost

D^{L} : Distance of link (L)

${}^{R\,L\,S}\beta_{i}$: Unit cost (Rs/Km) of vehicle (i) related to the speed (S) of link (L) at the (R)th excution.

And,

$$(RB) = (TO)^{W/O} - (TO)^{W}$$

Here, (RB) : Running cost saving

$(TO)^{W/O}$: Total running cost in without case

$(TO)^{W}$: Total running cost in with case

8.5.3 Benefits Calculations

Using the network assignment model and above mentioned calculation method, traffic cost and benefit of each case were calculated as shown in Table 8-12 and 8-13.

In the process of calculation of vehicle operating cost (VOC) shown in Table 8-12, the shadow exchange rate (refer to section 8.3 and Appendix 4) was applied to the foreign component in VOC (such as import CIF price of vehicle, fuel, oil, tyre). So, "economic" vehicle operating costs are expressed in the table.

Table 8-12: Estimated Traffic Cost 1990, 2000

(Economic Cost per day, Rs.1000 in 1983 Prices)

Case No.	Vehicle Operating Cost		Passenger Time Cost	
	1990	2000	1990	2000
(Without case)	8030	18466	604	1432
1	7852	18192	573	1389
2	7761	18050	531	1334
3	7941	17390	549	1303
4	7761	16769	531	1118
5	7692	16769	486	1118
2(H)	7750	18064	530	1342

Table 8-13: Benefit Calculation

(Rs.1000 Per Year, in 1983 Prices)

Case No.	Vehicle Operating Cost Savings		Time Cost Savings		Total Benefit	
	1990	2000	1990	2000	1990	2000
1	64970	100010	11315	15695	76285	115705
2	98185	151840	26645	35770	124830	187610
3	32485	392740	20075	47085	52560	439825
4	98185	619405	26645	114610	124830	734015
5	123370	619405	43070	114610	166440	734015
2(H)	102200	146730	27010	32850	129210	179580

Note : Case No. 2(H) is the case when the High Embankment Type is adopted to Section P-3.
It is temporarily added for the reference.

8.5.4 Development Effect

(1) General

As widely known, the construction of road and its opening to traffic give the society multiple effects (including not only positive but also the negative ones). The positive effects estimated in previous section are only part of them, named "direct effects". There are many other "indirect effects", but their quantitative evaluation is extremely difficult, and need a sophisticated analysis because of their complicated feature. Therefore, in this section, qualitative approach will be held from some aspects to analyse them.

(2) Forward Linkage Effects

The effects generated before the completion of the project road are called "Forward linkage effect". A representative one is multiplier effect of the investment. The total investment cost of Project Road (including Project A and B) are estimated as about 1200 million Rupees (in 1983 prices financial cost). When portions of these amounts are invested every year during the construction period, that investment will stimulate the rest of the economy and induce another investment or consumption. This effect is not merely a localized one but a nation-wide one. In addition to this effect, Project, in itself, requires about 460,000 man days of workers to be directly involved in its implementation, with compared to the figure of 857168, the number of unemployed persons in the whole island as surveyed in the Census in 1980/81. Therefore, the Project will provide the people large opportunities of employment.

(3) Backward Linkage Effect

The effects generated after completion of the project are called "Backward linkage effects". So called "Development effects" are included in this category. Three aspects are adapted to approach them: traffic aspect, economic aspect and social aspect.

1) Traffic aspect

In general, a mixed traffic interrupt the effective use of road network. Therefore, through traffic or heavy vehicles (such as container trailers) should be excluded from the community roads. The Port Access Road and the Expressway will share in that important role.

2) Economic aspect

a. The measure of strategy

There are three main cores in the project area: Colombo Port, Investment Promotion Zone and Colombo Airport. The project road will connect these cores directly. Namely, the project road will be utilized as a tool or measure of regional development strategy and the productivity of these cores will grow up.

Other main development projects (Bloemendhal Development Project, Peliyagoda Integrated Development Project, Third IPZ, and so on) are planned along the Port Access Road and the Expressway. These projects can also be implemented efficiently by the construction of the Project Road.

b. Incentives for new industrial location

In addition to above mentioned projects, development of new location for private factories will be accelerated and the productivity of existing factories will also rise.

These new locations could be anticipated specially around the interchanges or ramps.

c. Expansion of the market size

The construction of new roads, particularly the Expressway, will develop the dormant supply or demand places because of the reduction of traffic costs. For example, a supplier of agricultural or industrial products who has been providing Negombo with his products, will be able to supply also Colombo with his part of products by using Expressway.

3) Social aspect

a. Utilization for commuting

After construction of Project Road, Commuters can arrive their places of work in a shorter time by using their own cars or Expressway buses. For example, according to the result of the survey in 1980,[1] 27% of workers of Katunayake IPZ were commuting from/to Colombo, Wattala and Ja-Ela. They can use KIPZ interchange directly.

b. Decentralization effect of urban population

The construction of the Expressway will reduce the commuting time, as mentioned above, and this makes it possible to promote emigration of a part of urban population to sub-urban areas.

When the decentralization of urban population advances with the decentralization of industries, the urbanization effect could be promoted inside and outside of cores such as Peliyagoda project, KIPZ, third IPZ and so on.

However, it should be pointed out that the development effects cannot be realized only by the construction of the Project Road, but also the investments on the other infrastructures, such as water supply, electricity and private sector's investments will be needed.

Note: 1) "Transport Requirements of the GCEC area" Interim Report, October 1980.

8.6 ECONOMIC ANALYSIS

In this section, the economical justification of the Project Road is investigated by comparing the economic cost with economic benefit.

8.6.1 Premises

1) Construction schedule:
   Preliminary schedule and stream of economic cost during the construction period are assumed already in Fig. 8-2 and 8-3.
2) Project life: 25 years.
3) Opening year for traffic: the year 1990 (as shown in Fig. 8-2).
4) Opportunity cost of capital: 12%
5) Annual benefit streams between the year 1990 and year 2000 were estimated by interpolation. And the annual benefits after the year 2000 were assumed to be the same benefits as in the year 2000 by making allowance for the limit of forecasting.

8.6.2 Evaluation

The results of the economic evaluation (NPV, B/C, IRR) are shown in Table 8-14, and the cost benefit streams are shown in Table 8-15.

The economic indicators raised in Table 8-14 prove that the project is economically feasible with an internal rate of return of 14.4% ~ 30.2% and a benefit cost ratio of 1.32 ~ 3.97 at a discount rate of 12%.

Additional analysis on the structure of P-3 section (Lowbank or Highbank) can be done by comparing the indicators of case No. 2 with No. 2(II) in the same table. The results show that the Low Embankment Type is more feasible than High Embankment Type as the cost of the latter is higher than the former.

8.7 SENSITIVITY ANALYSIS

The purpose of the sensitivity analysis is to test the robustness of the priorities or feasibility of the cases by changing some factors that affect the results. In this study, the sensitivity test was conducted in such a way as shown below:

TEST	(I)	Benefit	: −20%
		Cost	: +10%
TEST	(II)	Project life	: 20 years
TEST	(III)	Discount rate (Opportunity cost of capital): 15%	

The results of the tests are also given in Table 8-14. In all the tests, combination of Projects A & B is feasible.

Table 8-14: Results of Economic Evaluation and Sensitivity Analysis

ECONOMIC EVALUATION				SENSITIVITY TEST (I) (Benefit −20%) (Cost +10%)			'SENSITIVITY TEST (II) (Project Life = 20 Years)			SENSITIVITY TEST (III) (Discount Rate = 15%		
Condition	Original Case											
Case No.	Net Present Value *	Benefit Cost Ratio (B/C)*	I.R.R. (Per cent) %	Net Present Value *	Benefit Cost Ratio (B/C)*	I.R.R. (Per cent) %	Net Present Value *	Benefit Cost Ratio (B/C)*	I.R.R. (Per cent) %	Net Present Value	Benefit Cost Ratio (B/C)	I.R.R. (Per cent) %
1	567095	3.97	30.2	396526	2.89	25.1	523953	3.75	30.1	406941	2.99	30.2
2	820785	2.99	26.3	532972	2.17	21.5	750951	2.82	26.2	557757	2.27	26.3
3	428042	1.32	14.4	−47438	0.96	11.7	−21025	0.98	11.8	−92079	0.93	14.4
4	1896452	2.65	24.6	1172585	1.92	19.9	1624222	2.41	24.2	1158844	2.03	24.6
5	1646702	1.96	18.5	803819	1.42	15.3	1374472	1.80	18.1	753324	1.41	18.5
2(H)	724589	2.46	23.5									

Note : * Opportunity cost of capital is 12%.
Net Present Value is in Rs.1000.

Table 8-15: Cost Benefit Streams

(in Rs.1000)

Case / Year		1		2		3		4		5	
		BENEFIT	COST	BENEFIT	COST	BENEFIT	COST	BENEFIT	COST	BENEFIT	COST
1	1985	0	4640	0	12550	0	35710	0	12550	0	48270
2	1986	0	41730	0	46990	0	192310	0	46990	0	239310
3	1987	0	17800	0	48100	0	136930	0	48100	0	185030
4	1988	0	44510	0	120240	0	342310	0	120240	0	462560
5	1989	0	26700	0	72150	0	205390	0	72150	0	277540
6	1990	76285	230	124830	658	52560	4283	124830	36368	166440	4941
7	1991	79530	230	130021	658	65001	4283	130021	192968	193065	4941
8	1992	82913	230	135427	658	80386	4283	135427	137588	223948	4941
9	1993	86440	230	141059	658	99413	4283	141059	342968	259772	4941
10	1994	90117	5232	146924	14959	122943	61346	146924	220349	301326	76305
11	1995	93950	230	153034	658	152043	4283	349527	4941	349527	4941
12	1996	97946	230	159397	658	188031	4283	405439	4941	405439	4941
13	1997	102112	230	166026	658	232537	4283	470295	4941	470295	4941
14	1998	106456	230	172929	658	287578	4283	545526	4941	545526	4941
15	1999	110984	230	180120	658	355646	4283	632791	62004	632791	4941
16	2000	115705	230	187610	658	439825	4283	734015	4941	734015	4941
17	2001	115705	230	187610	658	439825	4283	734015	4941	734015	4941
18	2002	115705	230	187610	658	439825	4283	734015	4941	734015	4941
19	2003	115705	230	187610	658	439825	4283	734015	4941	734015	4941
20	2004	115705	3730	187610	10664	439825	45063	734015	14947	734015	55725
21	2005	115705	230	187610	658	439825	4283	734015	4941	734015	4941
22	2006	115705	230	187610	658	439825	4283	734015	4941	734015	4941
23	2007	115705	230	187610	658	439825	4283	734015	4941	734015	4941
24	2008	115705	230	187610	658	439825	4283	734015	4941	734015	4941
25	2009	115705	230	187610	658	439825	4283	734015	45741	734015	4941
26	2010	115705	230	187610	658	439825	4283	734015	4941	734015	4941
27	2011	115705	230	187610	658	439825	4283	734015	4941	734015	4941
28	2012	115705	230	187610	658	439825	4283	734015	4941	734015	4941
29	2013	115705	230	187610	658	439825	4283	734015	4941	734015	4941
30	2014	115705	230	187610	658	439825	4283	734015	4941	734015	4941
Discount rate 12%		NPV : 567095		NPV : 820785		NPV : 428042		NPV : 1896452		NPV : 1646702	
		B/C : 3.97		B/C : 2.99		B/C : 1.32		B/C : 2.65		B/C : 1.96	
		IRR : 30.2%		IRR : 26.3%		IRR : 14.4%		IRR : 24.6%		IRR : 18.5%	

8.8 PROJECT EVALUATION

In deriving a suitable implementation program for this Project, it is necessary to evaluate the Project not merely from the economical aspects based on the results of economical analysis, but comprehensively also from the technical, social, environmental and political aspects.

Comprehensive evaluation of the five cases selected for the economic evaluation can be summarized as follows:

Case 1. Implementation of only Section P-1 and Section P-2 of Project B. (with opening year at 1990).

a. Internal rate of return is high with 30.2% and a benefit/cost ratio of 3.97.

b. The above high indicators of feasibility is due to the fact that large benefits can be achieved by the systematization of traffic flow from Colombo Port, and by the diversion of heavy vehicle traffic from urban roads relieving traffic congestion especially in the business centre, Colombo Central and Colombo North areas.

c. However, Implementation of Sections P-1 (and P-2, ie. improvement of road only up to New Kelani Bridge), will not necessarily solve the traffic problems in the area north of Colombo City.

d. Effect on the traffic on A-3 Road is small and the traffic problems there will remain almost the same.

e. As a result, effect on the development of GCEC Area, especially the IPZs will be negligible.

f. Therefore, although this case is very favourable only considering the traffic problems in the City and smoothening of Port affairs, it does not bring any practical direct benefit to the promotion of the development of GCEC Area.

g. It can therefore be concluded that this Case is not a solution considering the objectives of this Project.

Case 2. Implementation of entire Project B (Colombo Port-Dalugama on A-1 Road)

a. IRR is 26.3% and the B/C ratio is 2.99

b. As same as b) in Case 1.

c. Since Section P-3 provides a By Pass to A-1 Road in the section between Dalugama and New Kelani Bridge, traffic on Kandy Road will be benefitted specially by avoiding the Railway Level Crossing at Kelaniya.

d. There is no suitable connecting road to Negombo Road for traffic on that road to be benefitted. Conditions with respect to traffic on Negombo Road will remain almost the same.

e. As same as e) in Case 1.

f. In addition to f) in Case 1, this Case provides only a partial solution to traffic congestion on Negombo Road and Kandy Road.

g. As same as g) in Case 1 above.

Case 3. Implementation of only the Expressway (with Opening Year at 1990).

a. IRR is 14.4 and the Benefit/cost ratio is 1.32.

b. As far as the Road Sections K-1 to K-3 are to be constructed as an Expressway, high standards of design, construction and maintenance are necessary to maintain safety and functions of Expressway.* Therefore in spite of the low volume of traffic that will use this Expressway in the early years, investment will be high.
(*As an expressway, a minimum of four lanes will be required for technical reasons.)

c. Even if the Expressway is constructed, it will serve only between Katunayake and Dalugama, and the urban roads south of Dalugama should be inevitably used to reach the City or Port of Colombo. Specially with the Railway Level crossing and congested roads, any travel time savings gained from the Expressway would be wasted.

d. Construction of the Expressway will induce and promote development in the GCEC Area and above all, improve the overall image of the IPZs and Industrial Zones thereby promoting investment.

e. It can be concluded that, for the Expressway to be effective, it is necessary to improve the integrated road network and especially, since the major activities of the GCEC Area is related to the City and the Port of Colombo, Project B is inseparable. In other words, *Projects A and B should be treated as a SINGLE PROJECT.*

Case 4. Project B is opened by 1990 and the Expressway by 1995.!

a. The IRR is 24.6 and the B/C Ratio is 2.65.

b. Until 1995, the conditions will remain the same as in Case 2.

c. Cost escalation due to inflation etc., will be adversely reflected on the Expressway.

d. Impact of the Project on the GCEC Area will be realized only after year 1995 and this would be too late from the point of view of the urgency for the provision of the essential and vital infrastructure in facilitating attraction of industries and promoting development of the region.

e. Therefore, it is concluded that the implementation of both Projects A and B should be executed simultaneously in order to achieve the best effects of the ENTIRE PROJECT.

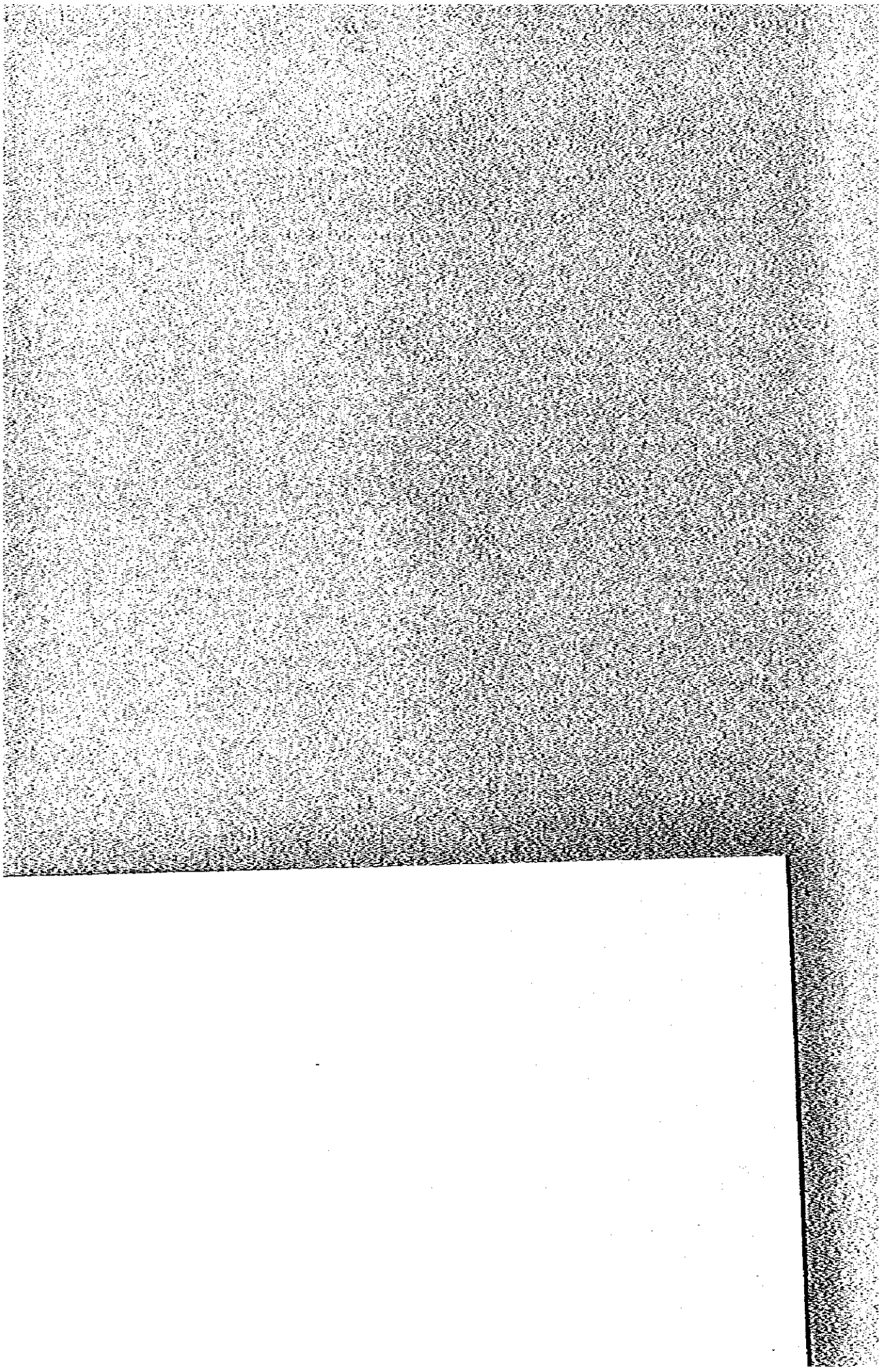
Case 5. Simultaneous implementation of Project A and Project B (with opening year at 1990).

a. Project is satisfactory for investment with an IRR of 18.5% and a B/C ratio of 1.96.

b. Objectives of the Project are fully met with.

Case 5, namely, the simultaneous implementation of Project A and Project B meets the objectives of the Project and is economically feasible. However, in the implementation, careful consideration should be given to the planning of annual investment requirements, taking into account of technical problems and priorities within the Project. Urgency of Section P-1 as a solution to a grave national problem, land acquisition, soft ground treatment by preloading method etc., to save costs are some of the priorities that need attention.

CHAPTER 9
IMPLEMENTATION PROGRAM



CHAPTER 9 IMPLEMENTATION PROGRAM

9.1 GENERAL

The project is feasible, and moreover judging from the development effects and the multiplier effects generated by the simultaneous implementation of Project A and Project B, it is recommended to implement Projects A & B together.

9.2 IMPLEMENTATION SCHEDULE

The implementation schedule presented in Fig. 9-1 after careful study is the most recommendable.

The total construction period is estimated taken into consideration of the following basic data:

1) Number of workable days (excluding rainy days and holidays)
2) Scale of construction
3) Number of major equipment available.

9.3 INVESTMENT REQUIREMENTS

Based on the recommended implementation schedule, the investment requirements for each year is presented with their breakdown into the cost of final engineering services, land acquisition cost, and construction cost, and further divided into the foreign and local components. The prices are that of 1983. The investment requirements are shown by each item in Table 9-1.

Table 9-1: Annual Investment Requirements

(in Rs. million at 1983 prices)

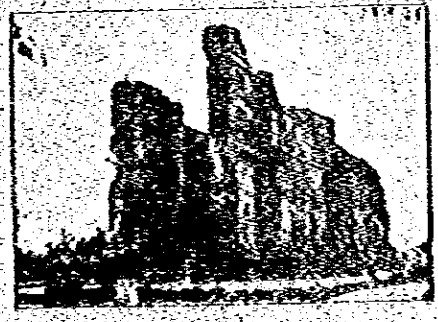
Component / Year	Engineering Service			Land Acquisition	Construction			Total		
	Foreign	Local	Total	Total	Foreign	Local	Total	Foreign	Local	Total
(PROJECT - B)										
1985	9.4	4.7	14.1	19.3	-	-	-	9.4	24.0	33.4
1986	4.7	2.4	7.1	19.3	32.3	16.3	48.6	37.0	38.0	75.0
1987	-	-	-	-	97.0	48.9	145.9	97.0	48.9	145.9
1988	-	-	-	-	32.3	16.2	48.5	32.3	16.2	48.5
1989	-	-	-	-	-	-	-	-	-	-
Total	14.1	7.1	21.2	38.6	161.6	81.4	243.0	175.7	127.1	302.8
(PROJECT - A)										
1985	20.1	10.1	30.2	56.2	-	-	-	20.1	66.3	86.4
1986	20.1	10.1	30.2	112.3	70.7	33.5	104.2	90.8	155.9	246.7
1987	-	-	-	-	164.9	78.1	243.0	164.9	78.1	243.0
1988	-	-	-	-	164.9	78.1	243.0	164.9	78.1	243.0
1989	-	-	-	-	70.9	33.5	104.4	70.9	33.5	104.4
Total	40.2	20.2	60.4	168.5	471.4	223.2	694.6	511.6	411.9	923.5

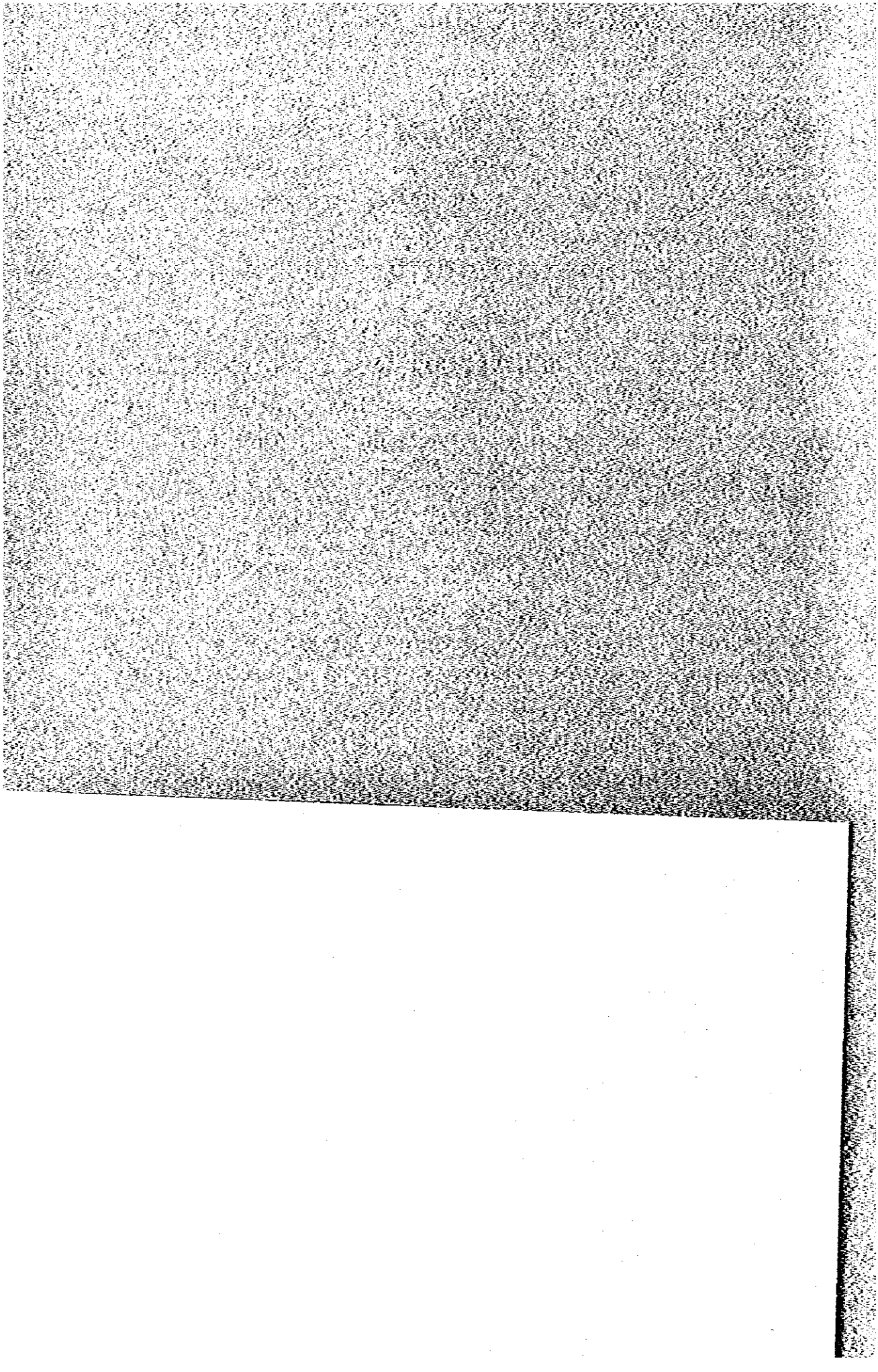
Note : Tax is included in Local Currency

Implementation Item \ Year		85	86	87	88	89	90	91	Total
(PROJECT - B)	Engineering Service	———							21.2
	Land Acquisition	———							38.6
	Construction		———	———	———	———			243.0
(PROJECT - A)	Engineering Service	———	———						60.4
	Land Acquisition	———	———						168.5
	Construction		———	———	———	———	———		694.6
PROJECT COST (In Rs. Million at 1983 prices)	Foreign Currency	29.5	127.8	261.9	197.2	70.9			687.3
	Local Currency & Tax	90.3	193.9	127.0	94.3	33.5			539.0
	Total	119.8	321.7	388.9	291.5	104.4			1226.3

Fig. 9-1 Implementation Schedule and Project Cost

CHAPTER 10
STUDY ON THE VIABILITY OF THE PROJECT (A) AS A TOLL EXPRESSWAY
– FINANCIAL ANALYSIS –





CHAPTER 10 STUDY ON THE VIABILITY OF THE PROJECT (A) AS A TOLL EXPRESSWAY

– FINANCIAL ANALYSIS –

10.1 INTRODUCTION

Financial analysis is usually carried out on projects which are accompanied with revenue. Therefore, in the case where Project A (the Expressway) is to be a toll road, a study must be done not only from an economic viewpoint but also from a financial viewpoint as well. The main objective of a financial analysis is to make clear whether or not the revenue from the Project itself is enough to carry out implementation, maintenance and operation. The contents considered are the items below –

1) Investment costs (Construction cost)
2) Annual financial expenditure
   - Maintenance cost
   - Operation cost
   - Other financial costs
3) Revenue calculation
4) Financial evaluation indicators
   - Revenue/cost ratio
   - Financial Internal Rate of Return (F.I.R.R)
   - Investment limit
   - Repayment period
5) Sensitivity analysis
6) Management system of toll road

10.2 METHOD FOR ANALYSIS

The method for financial analysis is summarized in Fig. 10-1. At first, the financial costs consist of construction cost, annual maintenance cost, annual operation cost and other annual financial costs. Each cost item includes transfer elements such as taxes and duties.

Shadow prices which were applied to economic analysis were taken away in financial analysis, consequently, they are expressed in market price. Furthermore, the effect of inflation on the construction cost is taken into account as well. Second, forecast of future traffic demand after introducing toll fee was carried out and the toll rate that brought about maximum revenue was studied. The procedure for estimation of future traffic demand is as follows: Every zone pair trip in future OD matrix was divided into 5 equal portions. First 20% of each zone pair trip was assigned to minimum trip cost path.

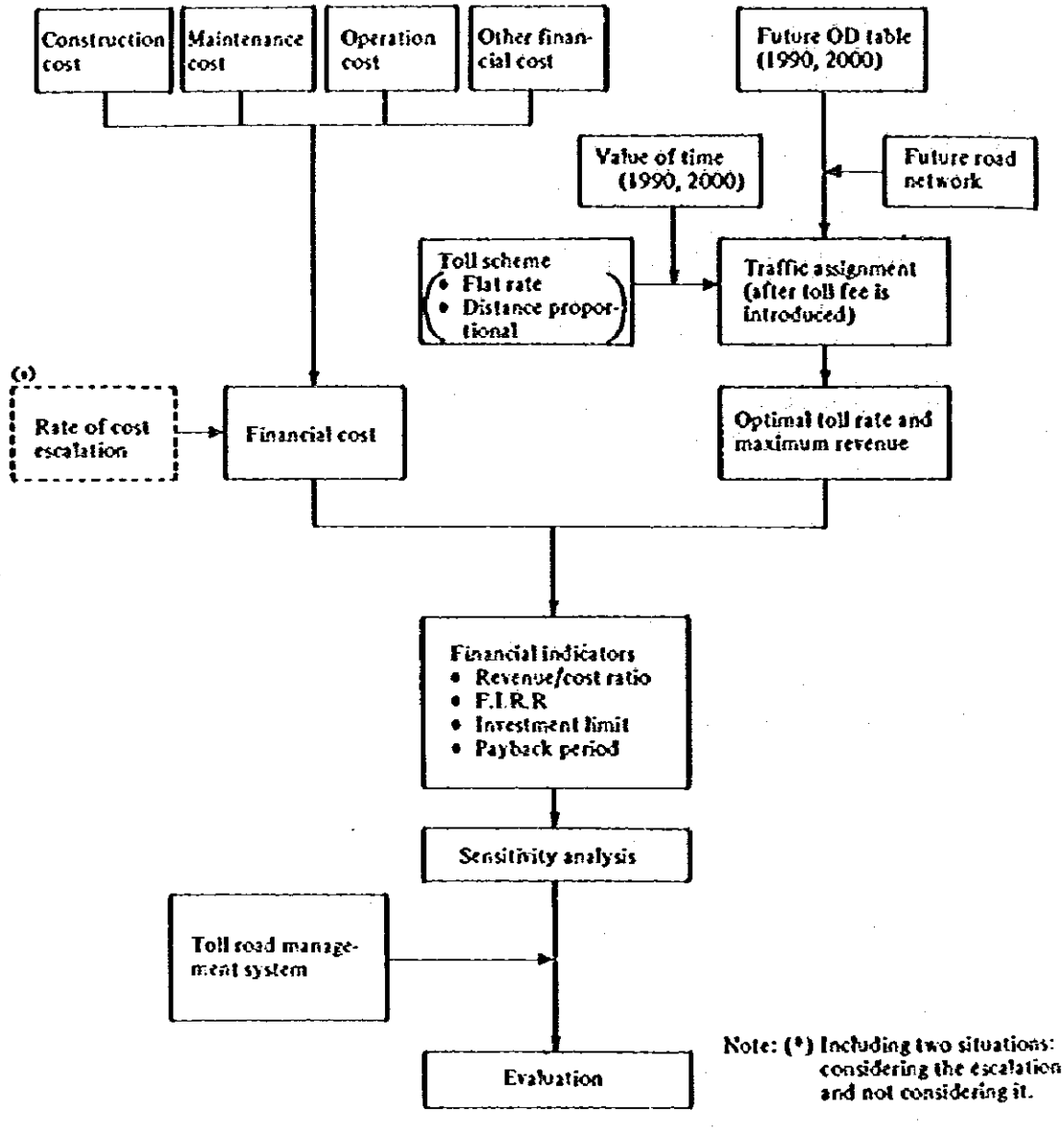


Fig. 10-1: Total Flow Chart for Financial Analysis

After assignment of first portion by each zone pair, these trips were summed up on each link of the path, and associated with Q-V formulas which indicate the relationship between traffic volume and travel speed. When the assignment and summation were over, the travel speed for the link was re-estimated. This speed was a condition with which the second 20% of each zone pair trips would find minimum trip cost path. Traffic demand estimation was carried out by five repetitions of above-mentioned process. In order to find out the maximum revenue paid, some toll rate levels were prepared, and this maximum revenue was adopted in the financial analysis.

By using financial project costs and toll revenue, four financial indicators listed below were calculated:

(1) Revenue/Cost Ratio (R/C ratio)

The R/C ratio is obtained by dividing the present value of revenue by that of cost:

$$\text{Revenue cost ratio} = R/C$$

$$R = \sum_{t=1}^{n} \frac{Rt}{(1+i)^t}$$

$$C = \sum_{t=0}^{n-1} \frac{Ct}{(1+i)^t}$$

Here, Rt : Revenue in the year (t)
Ct : Cost in the year (t)
i : Rate of interest
n : Repayment calculation period in years

If R/C ratio is more than unity, the project is financially viable.

(2) Financial Internal Rate of Return (F.I.R.R)

The F.I.R.R shows the rate of interest which gives the break even point between the present value of revenue and that of cost as given by the following formula:

$$R(r) - C(r) = 0$$

$$R(r) = \sum_{t=1}^{n} \frac{Rt}{(1+r)^t}$$

$$C(r) = \sum_{t=0}^{n-1} \frac{Ct}{(1+r)^t}$$

Here, r : Financial Internal Rate of Return
Rt : Revenue in the year (t)
Ct : Cost in the year (t)
n : Repayment calculation period in years

If F.I.R.R is more than the normal rate of interest, the project is financially viable. Namely, F.I.R.R means the maximum rate of interest that the project could pay while repaying the project costs.

(3) Investment Limit

Investment limit means the maximum investment cost that can be covered by the annual revenue of the project and is shown by the following formula:

$$G = \sum_{t=1}^{n} \left\{ \frac{Rt}{(1+i)^t} - \frac{Kt}{(1+i)^{t-1}} \right\}$$

Here, G : Investment limit
Rt : Revenue in the year (t)
Kt : Expenditure in the year (t), such as maintenance cost and so on.
i : Rate of interest
n : Repayment calculation period

If the Investment limit is more than the financial project cost (including the interest cost during the construction period), the project is also financially viable. Furthermore, the above formula shows that the annual revenue can cover the annual expenditure such as maintenance cost, operation cost and so on as far as the Investment limit is positive, even if the construction cost can not be covered.

(4) Repayment Period

In the above formula, when G is given a value and n is an unknown variable, the value of n arrived through astriction calculations is the repayment period (or Pay Back Period). Repayment period means the minimum period needed to pay back the amount of principal investment and interest. Therefore, the shorter the period, the better is the financial condition.

Next, sensitivity analysis was carried out by changing the factors as shown below and the variances in financial indicators were investigated.

1) Toll scheme (flat rate system, distance proportional system)
2) Composition ratio of foreign portion and local portion.
3) Cost escalation

And finally, some suggestions on the toll road management system were provided in order that the Project-A (Expressway) could function as a toll road effectively.

10.3 INVESTMENT COST (CONSTRUCTION COST)

The financial construction cost of the Expressway is estimated as Rs.923.5 million (in 1983 price) and according to the implementation program recommended in the economic analysis, the cost allocation during the construction period is shown in Table 10-1.

Table 10-1: Construction Cost

(Million Rupees)

Year	1985	1986	1987	1988	1989	Total	
① 1983 constant price	86.4	246.7	243.0	243.0	104.4	923.5	
② Escalation rate: 5% p.a.	95.3	285.6	295.4	310.1	139.9	1,126.3	②/① 1.2
③ Escalation rate: 10% p.a.	104.5	328.4	355.8	391.4	185.0	1,365.1	③/① 1.5
④ Escalation rate: 15% p.a.	114.3	375.2	425.0	488.8	241.5	1,644.8	④/① 1.8

When the annual cost escalation during construction is assumed to be 5%, 10%, 15%, the escalation rate to the 1983 constant price is 1.2, 1.5, 1.8 times respectively.

10.4 MAINTENANCE COST

The annual maintenance costs and overlay costs of the periodic maintenance costs 5 and 15 years after opening to traffic were obtained as shown in Table 10-2 by applying the financial unit cost (Rs./km per year).

Table 10-2: Maintenance Cost

(in 1983 price)

Items		Unit Cost	Cost
Annual maintenance cost		(Rs. 1,000/km) 166.4	(Rs. 1,000) 4,232
Periodic maintenance cost	5 years after opening	2,257.7	57,425
	15 years after opening	1,613.4	41,037

10.5 OPERATION COSTS (INCLUDING TOLL COLLECTION COST)

Operation costs are the costs involved in the staff and facilities necessary to supervise a toll road. The amount differs depending on the size of the operating organization, mode of toll collection, etc., and for this study, 1% ~ 2.5% of annual revenue were accounted as cost.

10.6 OTHER FINANCIAL COSTS

10.6.1 The Cost for Contingency

In order to settle unforeseenable expenses, part of the annual revenue should be accounted as a cost. But in the case of a single independent toll road, such cost may not be accounted. In this study, 2% of the annual revenue was prepared for several cases and for the rest of the cases none were prepared.

10.6.2 Interest Costs

Of the construction cost, the interest of the foreign loan portion was presumed at 3% p.a., and on the other hand, for the local loan portion, the rate of the Central Bank of Ceylon 16% was applied with reference to the long term capital loans in Sri Lanka (see Table 10-3).

The composition ratio of foreign and local portion for Project A are shown below.

Foreign portion	:	55%
Local portion	:	45%

Therefore, the weighted average rate of interest is about 9% p.a. Although the above shares differ from year to year, the average rate of interest 9% was used for each year.

Table 10-3: Interest Rates for Long Term Capital Loans in Sri Lanka

Sources of Loans	Rates of Interest
Under Central Bank refinance scheme	15% ~ 16%
Under priority criteria approved by Development Finance Corporation of Ceylon (DFCC) and National Development Bank (NDB)	17% ~ 18%
Through Commercial Bank on satisfying lending criteria (market rate)	20% ~ 25%

15 June, 1983

Source : Bank Supervision Department of Central Bank of Ceylon.
Note : Rate is decided on the basis of duration as well.