10.7 REVENUE CALCULATION

10.7.1 Forecast of Future Traffic Demand after Toll Fee is Introduced.

Method for traffic volume forecasting after introduction of toll fee is basically same as the one used in the economic evaluation. But the toll fare is converted to travel time by applying the value of time. The road network used for the traffic assignment is Case 5 (the case where Projects A and B are both opened).

In this calculation, trip cost (T) was defined as

$$T = t + F/V$$

Here,
- T : Trip cost (in terms of time)
- t : Original travel time (minutes)
- F : Toll charge (in Rs.)
- V : Travel time value (in Rs./minutes)

Value of time was assumed as shown below, by applying 0.281 Rs./min (figure used in the economic evaluation) for passenger cars, 0.409 Rs./min for lorries (time related vehicle operating cost), and average travel time value was calculated at 0.34 Rs./min (in 1983 price) by using the composition ratio of traffic volume. Then, the real growth rates of per capita GNP were applied to get the future time value in 1990 and 2000:

Year 1990 : 0.42 Rs./min
Year 2000 : 0.56 Rs./min

10.7.2 Toll Rate and Toll Revenue

The changes in traffic volume and toll revenue were investigated by changing the toll rate. 2 types of toll rates were taken into account: Flat rate system and Distance proportional rate system. Traffic assignment simulation was carried out for each type of toll system according to the toll rates shown in Table 10-4. Here, the ratio of toll rate between light, medium and heavy vehicles was assumed to be 1 : 2 : 3. And only the weighted average toll rates were applied to traffic assignment process.

The results are shown in Table 10-5, Fig. 10-2. In Table 10-6 and Fig. 10-3 average utilized distance of Expressway are shown by each toll rate.

Eventually, maximum toll revenue can be attained at the toll rate of 10 Rs./trip (light vehicle, year 1990, flat rate system) and 0.5 Rs./km (light vehicle, year 1990, distance proportional rate system). In the year 2000, although the maximum revenue point cannot be found out in the case of flat rate system, the rate of 1.25 Rs./km (light vehicle) will provide the maximum toll revenue.

These maximum revenue were adopted in the financial analysis.

10 Rs./trip or 0.5 Rs./km (for light vehicle) is considered as a reasonable toll level compared to other transport modes (for example, the bus service from Colombo ~ Airport), and with the ability of car-owners.(1)

Table 10-4: Toll Rates

Toll System	Case No.	Light Vehicle	Medium Vehicle	Heavy Vehicle	Average Rate
Flat rate system (Rs./trip)	1–1	5	10	15	8
	1–2	10	20	30	16
	1–3	15	30	45	24
	1–4	20	40	60	32
	1–5	25	50	75	40
	1–6	30	60	90	48
Distance proportional system (Rs./km)	2–1	0.25	0.50	0.75	0.40
	2–2	0.50	1.00	1.50	0.80
	2–3	0.75	1.50	2.25	1.20
	2–4	1.00	2.00	3.00	1.60
	2–5	1.25	2.50	3.75	2.00
	2–6	1.50	3.00	4.50	2.40

Note) 1. Average rates were obtained by applying the composition ratio of traffic volume in 1983 as the weight.

2. Light vehicles include private passenger car, van pickup; Medium vehicles include medium lorry, micro bus; and Heavy vehicles consist of heavy lorry, container trailer and Central Transport Board (CTB) bus.

3. Distance proportional toll rates can be obtained by dividing the flat rates with the average utilized distance of Expressway in the case of free (approximately 20 km per trip).

Note) (1) : According to the report on "Transport Requirements of the GCEC Area, October 1980", a suggestion was given about the toll rates such as 10 Rs. for light vehicle and 50 Rs. per heavy vehicle.

Table 10-5: Relationship between Toll Fare, Traffic Volume, Revenue

Flat Rate System

Case		1 – 0	1 – 1	1 – 2	1 – 3	1 – 4	1 – 5	1 – 6
Average Rate (Rs./trip)		0	8	16	24	32	40	48
Year 1990	Traffic Volume (Vehicles/day)	27,474	9,267	6,842	2,746	1,793	655	0
	Revenue (Rs./day)	0	74,136	* 109,472	65,904	57,376	26,200	0
Year 2000	Traffic Volume (Vehicles/day)	53,048	28,501	21,743	18,386	16,466	13,871	11,814
	Revenue (Rs./day)	0	228,008	347,888	441,264	526,912	554,840	567,072

Distance Proportional Rate System

Case		2 – 0	2 – 1	2 – 2	2 – 3	2 – 4	2 – 5	2 – 6
Average Rate (Rs./trip)		0	0.4	0.8	1.2	1.6	2.0	2.4
Year 1990	Traffic Volume (Vehicles/day)	27,474	9,638	6,509	4,758	3,652	1,873	1,237
	Revenue (Rs./day)	0	67,642	* 85,567	76,091	63,660	26,760	17,031
Year 2000	Traffic Volume (Vehicles/day)	53,048	32,052	24,314	22,549	20,548	19,869	13,289
	Revenue (Rs./day)	0	228,063	334,301	470,741	545,643	* 615,737	484,469

Note: *Maximum revenue.

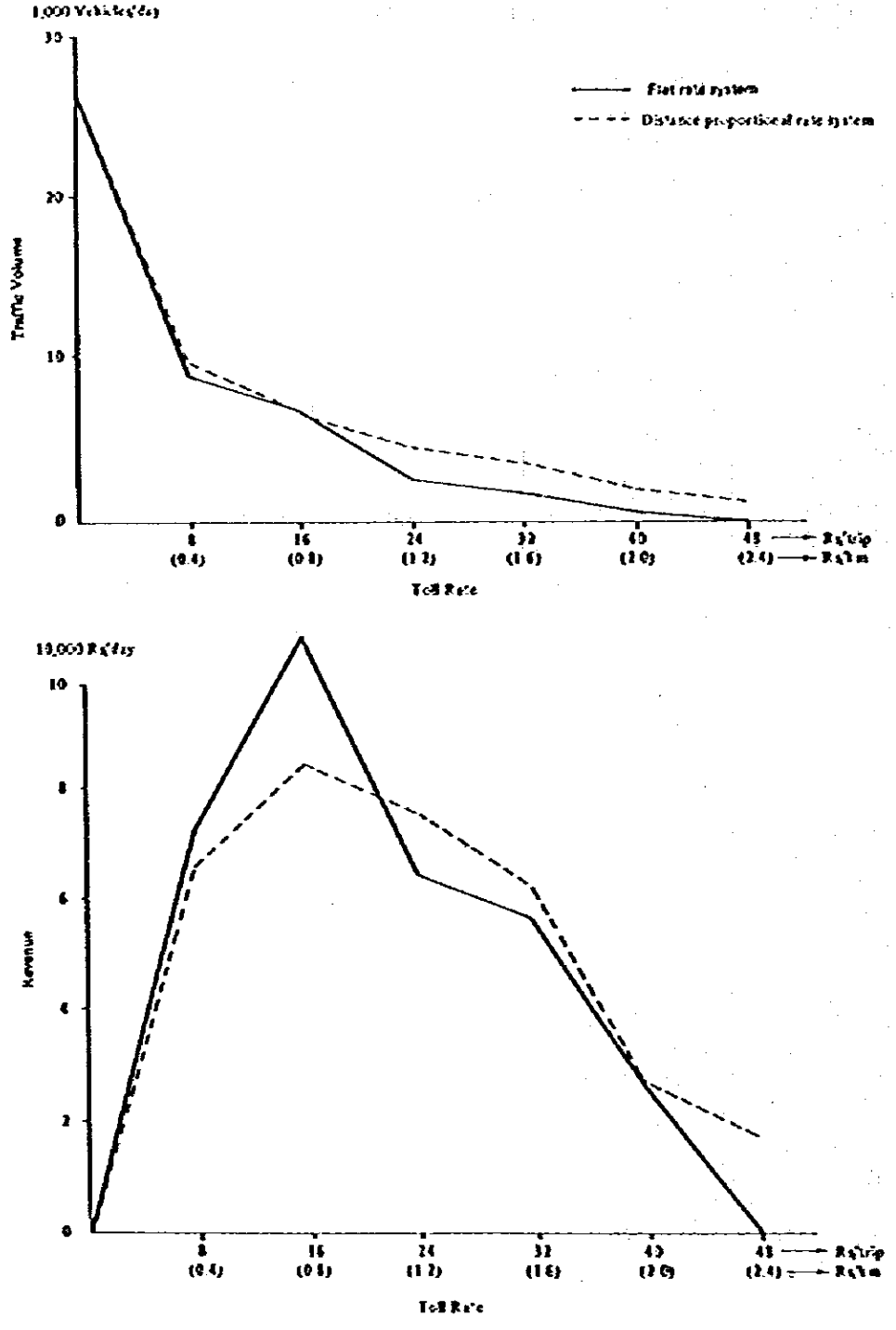

Fig. 10-2 Relationship between Toll Rate, Traffic Volume, Revenue (year 1990)

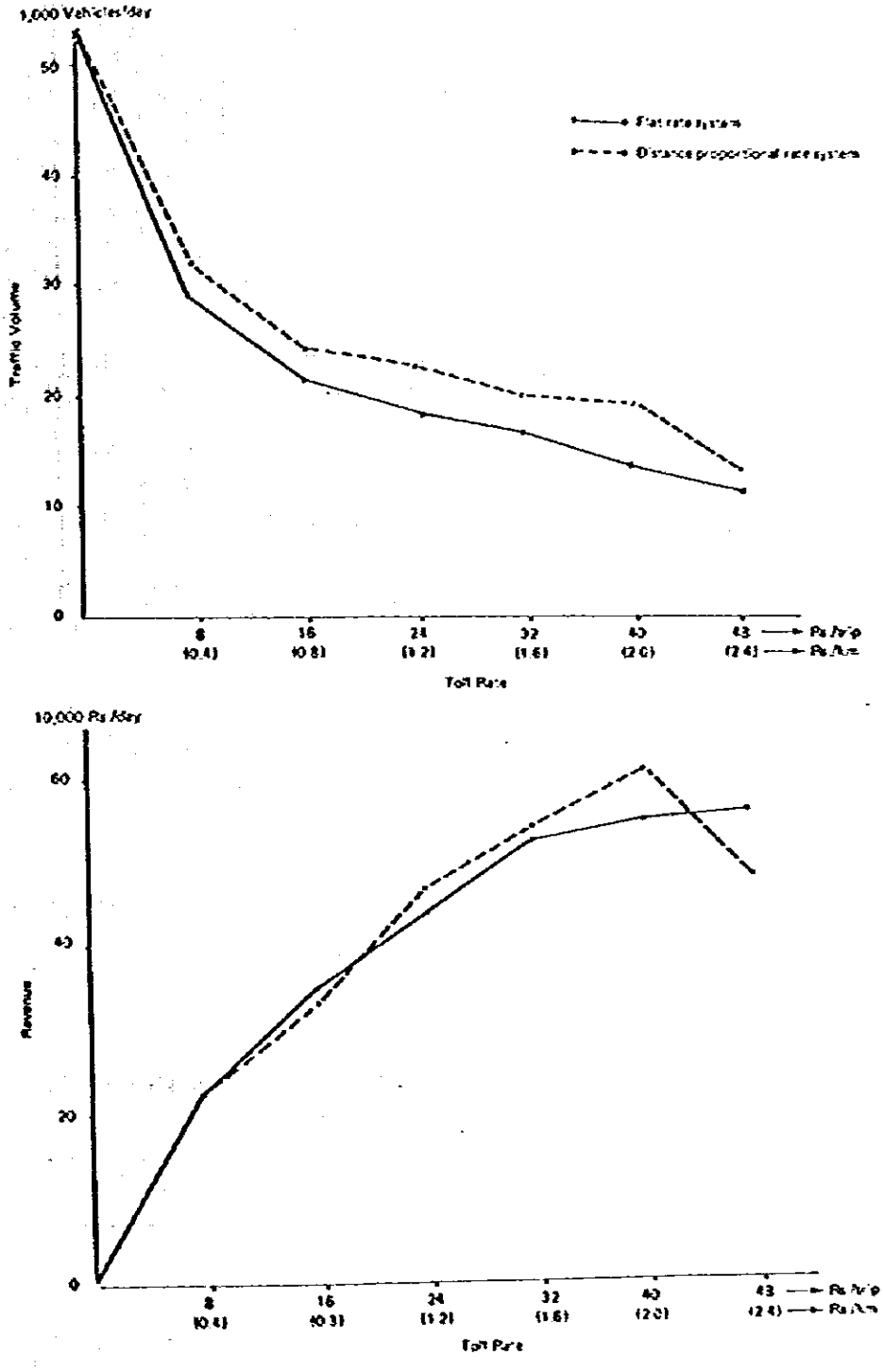

Fig. 10-3 Relationship between Toll Rate Traffic Volume, Revenue (year 2000)

Table 10-6: Average Utilized Distance of Expressway

Flat Rate System [km]

Case	1 – 0	1 – 1	1 – 2	1 – 3	1 – 4	1 – 5	1 – 6
Average Rate (Rs./trip)	0	8	16	24	32	40	48
Year 1990	19.2	19.8	18.6	23.2	24.9	25.4	–
Year 2000	18.9	18.8	18.6	19.8	20.5	21.2	–

Distance Proportional Rate System [km]

Case	2 – 0	2 – 1	2 – 2	2 – 3	2 – 4	2 – 5	2 – 6
Average Rate (Rs./km)	0	0.4	0.8	1.2	1.6	2.0	2.4
Year 1990	19.2	17.5	16.4	13.3	10.9	7.1	5.7
Year 2000	18.9	17.8	17.2	17.4	16.6	15.5	15.2

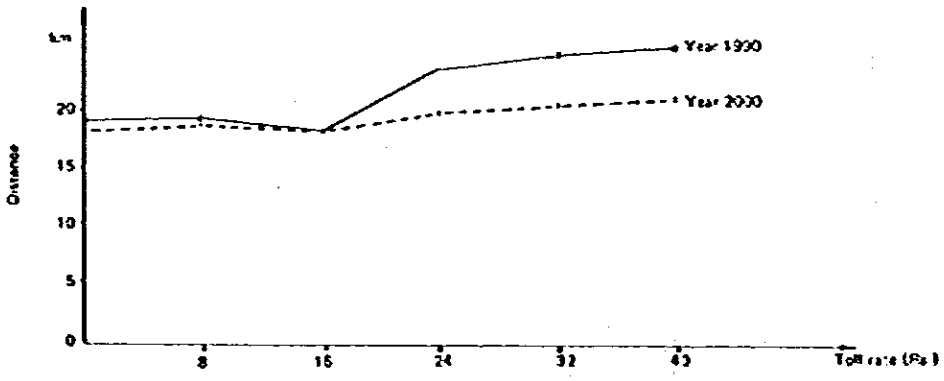

Fig. 10-4 Average Utilized Distance (Flat Rate System)

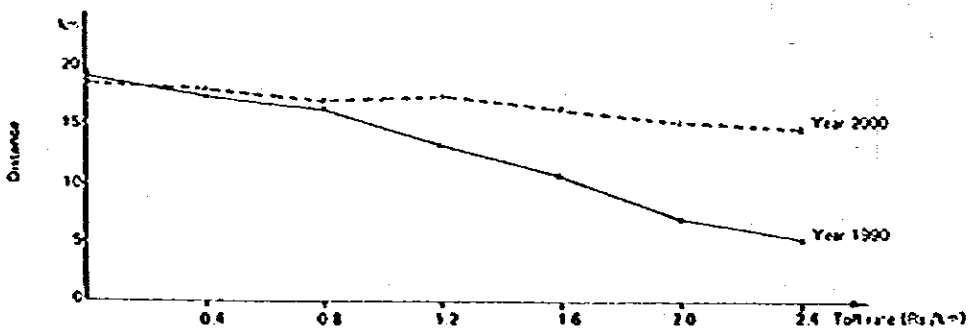

Fig. 10-5 Average Utilized Distance (Distance Proportional Rate System)

10.8 FINANCIAL EVALUATION

10.8.1 Premises

1) Repayment calculation period : 30 years
2) Composition ratio of foreign and local portion : Foreign = 55%, Local = 45%
3) Average rate of interest : 9% p.a.
4) Operation cost : 1.0%, 2.0%, 2.5% of annual revenue
5) Annual revenue after the year 2000 were assumed to be the same revenue as in the year 2000.
6) Distance proportional rate system was assumed to be employed with the toll rate 0.8 Rs./km (in 1990, average rate) and 2.0 Rs./km (in 2000, average rate).
7) No consideration for cost escalation (but it will be taken into account in sensitivity analysis).

10.8.2 The Results of the Evaluation

The financial indicators were calculated according to the above-mentioned premises and shown in Table 10-7 as analysis No. 1 ~ No. 3 (the cost for contingency was also estimated in analysis No. 3 at 2.0% of annual revenue). As a result, R/C ratios were 1.00 ~ 1.03, F.I.R.R were 9.01 ~ 9.26% and the investment limit was larger than total investment costs (including the interest during the construction period). Furthermore, repayment period necessitated was 27 ~ 30 years after opening for traffic. Therefore, Project A (Expressway) as a toll road is financially viable as far as these results are concerned.

10.9 SENSITIVITY ANALYSIS

The variances in financial indicators were investigated by changing some factors as shown below, and the results were expressed by TEST(I) ~ TEST (VII) in Table 10-8.

a. Toll rate system : Flat rate system with 16 Rs./trip (light vehicle) in the year 1990 and 40 Rs./trip (light vehicle) in the year 2000.

b. Composition ratio of loan : Foreign = 45% · Local = 55% (Average rate of interest is 10.2%.)
Foreign = 40% · Local = 60% (Average rate of interest is 10.8%.)

c. The rate of cost escalation : 5.0%, 15.0%, 16.0% p.a.

Table 10-7: Results of Financial Analysis

Analysis No.	Conditions for financial analysis												Financial indicators			
	Cost escalation		Toll sheme		Level of toll rate		Annual operation cost	Annual deposit to contingency	Share of loans		Average rate of interest	Total investment cost **	Revenue /cost ratio *	F.I.R.R. *	Investment limit *	Repayment period
	Construction	Maintenance cost	Distance proportional	Flat	1990	2000			Foreign	Local						
1	-	-	O	-	(Rs./km) 0.8	(Rs./km) 2.0	1.0% of annual revenue	-	55%	45%	9%	(Rs. million) 1,198.3	1.03	9.26%	(rs. million) 1,250	(Years) 27
2	-	-	O	-	"	"	2.0% of annual revenue	-	"	"	"	"	1.02	9.19	1,236	28
3	-	-	O	-	"	"	2.5% of annual revenue	2.0% of annual revenue	"	"	"	"	1.00	9.01	1,202	30

Note* Repayment period is assumed to be 30 years

** Average rate of interest is applied to construction period

Table 10-8: Sensitivity Test

TEST No.	Conditions for Sensitivity Analysis												Financial Indicators			
	Cost escalation		Toll scheme		Level of toll rate		Annual operation cost	Annual deposit to contingency	Share of loans		Average rate of interest	Total investment cost **	Revenue /cost ratio *	F.I.R.R. *	Investment limit *	Repayment period
	Construction	Maintenance cost	Distance proportional	Flat	1990	2000			Foreign	Local						
I	"	"	"	○	(Rs.) 16	(Rs.) 40	1.0% of annual revenue	"	55%	45%	% p.a. 9	(Rs. million) 1,198.3	0.99	8.9%	1,196	31
II	"	"	"	○	"	"	2.5 % of annual revenue	2.0% of annual revenue	"	"	"	"	0.96	8.70	1,150	35
III	"	"	○	"	(Rs./km) 0.8	(Rs./km) 2.0	"	"	45%	55%	10.2%	1,239.5	0.84	9.01	1,032	More than 50
IV	"	"	○	"	"	"	"	"	40%	60%	10.8%	1,260.6	0.77	9.01	960	"
V	% p.a. 5.0	% p.a. 5.0	○	"	"	"	"	"	55%	45%	9	1,453.2	0.78	7.24	1,089	"
VI	% p.a. 15.0	% p.a. 15.0	○	"	"	"	"	"	"	"	"	2,099.8	0.39	"	66	"
VII	% p.a. 16.0	% p.a. 16.0	○	"	"	"	"	"	"	"	"	2,176.0	0.35	"	-202	"

Note* : Repayment period is assumed to be 30 years.

**: Average rate of interest is applied to construction period.

The results are summarized as follows:

1) Financial viability of the flat rate system is not so strong as the distance proportional rate system (the differences of toll collection costs between flat rate system and distance proportional rate system are not taken into account here).

2) When the composition ratio of local portion increases, the rate of interest for total investment costs also increase. And the boundary between financially viable area and unviable area is thought to exist where the ratio of foreign portion is 55% and local portion is 45%.

3) There are no tests that can be financially viable when the cost escalation is taken into account.

4) But, the investment limit can maintain positive value if the rate of cost escalation stayes within 15% p.a. Therefore, as far as the escalation can be kept under the level of 15% p.a., annual revenue will be able to cover the maintenance cost, operation cost and contingency.

10.10 MANAGEMENT SYSTEM OF TOLL ROAD

10.10.1 Introduction

In order to promote the Project effectively and certainly, some back-up systems are needed from the administrative aspects. The toll road management system includes:

1) Supervision of toll road operation (including the toll collection)
2) Maintenance and repair of toll road facilities and equipment.
3) Traffic control, traffic safety and provision of information.
4) Administration

Furthermore, it is necessary to specify the execution subject or the organization which has responsibility of above-mentioned works, and the enactment of law for levying the toll fee.

Management system of toll road, especially, the specification of the execution subject and what the organization should be, depend on the features of the administrative structure of Sri Lanka. Therefore, the general ideas will be investigated to set up a reasonable system with reference to the examples of other Asian countries.

10.10.2 The Objectives of Toll Road System and Execution Subject

The foundations for levying the toll on road utilization are listed as follows:

1) Repayment of construction cost, maintenance cost and so on.
2) Principle of social equity or beneficiaries pay principle.
3) Realization of efficiency in road use.

Execution subjects in other Asian countries are decided corresponding to the objects of toll road system as shown below (see Table 10-9 and Table 10-10 as well).

- Repayment of construction cost is needed – Government-related corporation or Special private company.
- Repayment is not necessarily needed – Government-directly-operated system.

Table 10-9: Examples of the Objectives and the Reasons for Toll Road System

Name of Country	Primary Reason	Secondary Reason	Repayment of Construction Cost
Republic of Korea	A	B	Necessary
Thailand			
(ETA)(1)	A	B	Necessary
(DOH)(2)	B	A	Not necessary
Philippines	A	B	Necessary
Hong Kong			
(LRT)(3)	C	A	Not necessary
(CHT)(4)	A	C	Necessary
Malaysia			
(PWD)(5)	B	A	Not necessary
(HAM)(6)	A	B	Necessary
Indonesia	A	B	Necessary

Note A : Repayment of fund
B : Beneficiary pay principle
C : Efficient use of road
(1) : Expressway and Rapid Transit Authority of Thailand (ETA)
(2) : Department of Highways (DOH)
(3) : Lion Rock Tunnel (LRT)
(4) : Cross-Harbour Tunnel (CHT)
(5) : Public Works Department (PWD)
(6) : Highway Authority Malaysia (HAM)

Table 10-10: Examples of Execution Subject and Toll Road System

Name of Country	Execution Subject	Toll Road System
Republic of Korea	「Korea Highway Corporation」 Government invested the total amount of fund for establishment. (The number of staff is 2,282)	Highway Corporation was established when the highway network planned by the government was completed partly, and since then, the corporation has conducted the planning, construction and maintenance by the self-supported finance.
Thailand (ETA)	「Expressway and Rapid Transit Authority of Thailand」 Authority is organized as corporation and supervised by Ministry of Interior. (No. of staff is 250).	The authority manages the charged transportation works (expressway and mass transit) in Bangkok Metropolitan area by the self-supported finance.
(DOH)	Ministry of Communication directly supervises.	Toll system is not adapted perfectly, and applied to only one section flexibly.
Philippines	Private corporation named 「Construction & Development Corporation of Philippines」 (No. of staff relating to the expressway is about 2000)	CDCP has been granted a franchise throughout 30 years, and executes the maintenance of existing road sections, repayment of construction cost, expansion and extension.
Hong Kong (LRT)	Hong Kong government (No. of staff is about 100)	Toll system is supervised by government directly instead of self-supported finance.
(CHT)	「Cross Harbour Tunnel Company Limited」 The government invested 25% of fund.	Private company has franchise throughout 30 years, and conducts the construction, maintenance and repayment of costs.
Malaysia (PWD)	Public Works Department	A bypass of state road is used as the toll road convenientry. (This toll road is planned to be managed by HAM in future).
(HAM)	「Highway Authority Malaysia (incorporation)」 (No. of staff is 50)	Regular toll road system for the sake of construction, maintenance of nationwide expressway network.
Indonesia	「Indonesian Highway Corporation」(P.T. JASA MARGA). 100% Government fund (No. of staff is 350)	Main work at present is maintenance of roads constructed by the government. But in future, self-supported finance and regular toll system is aimed at.

10.10.3 Toll Collection System

In the financial analysis explained above, toll rate that will bring the maximum revenue was applied in order to investigate whether or not the revenue can cover the project costs. But, in actual implementation, it seems necessary to study the flexible toll policy such as the introduction of more cheaper toll fare, until the users become acquainted with the toll road and comprehend its amenity, or on the stage before the regular toll expressway.

Detailed classification of the vehicle type in toll collection is desirable from the viewpoint of the equity principle if the determination of the toll rate is based on the "benefit." But, when the number of classifications become larger, the toll collection cost will also increase. Therefore, simplified classification is better from the financial viewpoint. In this Project, 2 types of vehicles (light and heavy) or 3 types (light, medium and heavy) will be proposed.

It is desired to reduce the number of classification, especially in the case of distance proportional rate system because the toll collection cost tends to become higher compared with flat rate system.

Toll collection in distance proportional rate system will be in such a way that the delivery of the tickets is at the on ramp and collection of toll fare at the off ramp. On the other hand, in the case of flat rate system, toll collection can be done at the on ramp only, and no staff will be needed at the off ramp.

Some examples of the toll collection systems and the principles for the determination of the toll rate are shown in Table 10-11.

10.10.4 Traffic Control and Information Systems

Traffic control and information systems are required from the viewpoint of traffic safety and keeping the traffic flow smooth, in order to avoid traffic accidents and congestion, and to recover to normal condition as fast as possible if an accident occurs. This system includes following contents:

1) Grasp of accidents and traffic congestion
2) Collection and distribution of the information
3) Traffic control on the toll road
4) Maintaining a security service

Table 10-11: Examples of the Toll Collection System and the Determination of Toll Rate

Name of Country	Toll Collection System		Determination of the Toll Rate		
	System	Collection Method	Organization Deciding the Toll Rate	Principle Applied for the Determination of the Toll Rate	Past Revision of Toll Rate
Republic of Korea	Open (832 km) Closed (401 km)	Printed ticket	Approval by the Government	Within the scope of user's perceived benefit (the ratio of the toll fare to the benefit is 38% for passenger car, 14% for truck)	Passably frequent
Thailand (ETA) (DOH)	Closed Open	Printed ticket Printed ticket	Approval by Ministry of Interior Decision by Ministry of Interior	Repayment of construction cost in 25 years. Appropriation to the maintenance cost.	No experiences No experiences
Philippines	Closed	Magnetic card	The toll regulatory board	Repayment of construction cost, maintenance cost and appropriation to the next construction cost for extending the toll road.	Once up to the present
Hong Kong (LRT) (CHT)	Closed Closed	Printed ticket Printed ticket	Government Approval by the Government	Within the range in which users do not feel dissatisfaction and the level that can control the traffic volume Repayment of construction cost in addition to above principle.	No experiences No experiences
Malaysia (PWD) (HAM)	Open Closed (partially open)	Printed ticket Printed ticket	Public Work Department Approval by the Government	Appropriation to the maintenance cost Below to some extent from the economical optimum level.	No experiences No experiences
Indonesia	Closed	Printed ticket	President	Within the 70% of user's benefit.	No experiences

Note) Open system: A system that includes some road sections free of charge.
Closed system: No free sections are included.

10.11 CONCLUSION

1) The distance proportional rate system is desirable from the financial point of view, compared with the flat rate system.

2) If the influence of the cost escalation is take into account, the project will not be viable financially. Therefore, it is necessary to revise the toll rate periodically (once in 2 years or 3 years) referring to the general price level, then, soundness for financial aspects will be maintained by doing so.

3) Even if the construction cost cannot be completely paid back, it seems possible to cover the annual expenditures such as maintenance cost by the annual revenue.

4) The conclusions mentioned above are those which were obtained from the assumptions prepared for the analysis. Hence, changes in the surroundings or the environment in the future should be taken into account carefully, and re-investigation is desirable at the stage of implementation in order to make the toll system and operation system correspond with such changes.

APPENDIX

APPENDICES

LIST OF TABLES (APPENDICES)

LIST OF FIGURES (APPENDICES)

APPENDIX 1: MOTOR VEHICLE IMPORT RESTRICTION IN SRI LANKA

Before 1977, there were restrictions on the import of vehicles, which allowed only the following companies or persons to import motor vehicles, according to a Cabinet Memoranduni by the Ministry of Trade:

i. Foreign firms and establishments having a branch office in Sri Lanka

ii. Local firms and establishments in business with foreign participation or working in collaboration with foreign firms.

iii. Local firms and establishments in –
*the plantaion sector and industrial sector
*the import and export trade united to the economy, functioning as agents of foreign principles.

Other than the abovementioned, invalid persons who cannot use the public transport are also allowed to import a motor vehicle After 1977, the aforementioned restriction has been relaxed as follows:

i. Those who earned the foreign currency can buy one new car or up to three second hand cars upto Rs. 150,000/-. These cars can be gifted to blood relatives and/or close relatives.

ii. As for the commercial vehicles, there is no restriction at all.

iii. Doctors, Engineers, Civil Officers etc., if they have money, can import cars.

As a result, the number of motor vehicles has gradually increased after 1977, as shown in Table (1).

Table (1): No. of Motor Vehicles Registered by Year and the Type of Vehicle

Item	1973	1974	1975	1976	1977	1978	1979	1980
1.0 Private Transport								
1.1 Cars	85,939	86,871	87,840	89,795	92,910	99,620	109,273	114,443
1.2 Motorcycles	22,134	22,501	22,773	23,384	24,435	29,690	45,087	79,808
2.0 Public Transport								
2.1 Hiring Cars & Taxis	3,832	3,861	3,888	3,974	4,100	4,275	5,180	6,430
2.2 Buses - CTB	11,146	11,562	11,698	11,956	12,859	13,466	14,212	15,000
2.3 Private Coaches	1,046	1,057	1,117	1,186	1,264	1,530	3,105	5,752
3.0 Lorry Transport								
3.1 Lorries & Vans	34,222	34,434	34,438	34,689	35,512	40,386	46,649	55,838
3.2 Tractors Registered as Lorries	1,195	1,195	1,192	1,189	1,185	1,207	1,206	1,245
3.3 Others Registered as Lorries	128	137	135	135	184	235	274	364
3.4 Trailers (Lorries & Cars)	2,830	2,831	2,828	2,832	2,848	2,895	2,932	3,088
4.0 Land Vehicles								
4.1 Tractors	16,736	18,690	19,900	20,930	22,450	24,982	32,043	37,588
4.2 Trailers	8,052	8,407	8,742	9,156	9,834	11,093	13,515	17,208
4.3 "Others"	411	416	421	434	445	588	604	823
Total	187,671	191,962	194,972	199,660	208,026	229,967	274,080	337,367

Source : Economic & Socil Statistics of Sri Lanka
Statistics Department of the Central Bank of Ceylon

APPENDIX 2: BACKGROUND OF THEORETICAL MODEL

(1) Examination of Data for the Number of Motor Vehicle Registered

The population, GDP, and the number of motor vehicles registered are the necessary input data for the determination of future traffic based on the past trend. The growth rate of overall traffic has a strong relationship with these growth rates. Unfortunately, the relationship between the traffic volume and these socio-economic indicators cannot be derived in Sri Lanka, due to the absence of the time series data on the traffic volume. However, the traffic volume is generally considered to have a stronger relationship with the number of motor vehicles registered than with the other socio-economic indicators available for traffic study.

In this study, the growth rate of overall traffic volume is forecasted based on the growth rate of the number of motor vehicle registered. However in Sri Lanka unlike in many other countries, the import of motor vehicles has been restricted by the national policy. Therefore, prior to forecasting the traffic volume, the examination of the past trend of motor vehicle registration is perfomed.

As shown in Fig. 3-2, before 1977 the increase of the number of motor vehicles registered as extremely small. However, there is a sudden increase after 1977. GDP also shows a similar trend of expansion before and after 1977 as shown in Fig. 3-3. Therefore, judging from this fact, it may be concluded that irrespective of the existence of vehicle import restrictions, there seems to be a strong correlation between the growth of the number of vehicles registered and the GDP. Based on past trend, it may be, therefore, reasonable to adopt such a correlation as a basic assumption in the future traffic forecasting.

The original source of data in Table (1) in Appx. 1 is the Department of Motor Traffic. However, according to 'Transport Statistics in Sri Lanka 1974 ~ 1981', published by the National Planning Division, Ministry of Finance and Planning, August 1982, there is the following note attached to these figures:

> "The number of vehicles on registers is believed to be a significant over-estimate to the number of vehicles which are active as it is thought to include many vehicles which have been scrapped but not removed from registers. For example SLCTB has approximately 7,500 buses in its fleet but 15,024 still on registers."

Judging from this comment, the scrapped or condemned buses in the SLCTB amounts to approximately 50% of the registered number. Therefore, it could be infered that a situation similar to this may be valid in the case of other vehicles indicating a high rate of scrapped vehicles. Data are not available at this stage to determine the scrapped rate by vehicle type. However, for the purpose of this study it may be reasonable to assume that the percentage of vehicles scrapped each year remain almost a constant.

On the other hand, the estimate of future traffic volume examined here is forecasted not on the basis of total volume itself but on the growth rate of the number of motor vehicles registered. Therefore, the percentage of vehicles scrapped each year will not really pose a problem.

(2) Relationship between the per capita number of motor vehicles registered and per capita GDP in Asian countries.

Table (1) shows the number of motor vehicles registered and per capita GDP of some Asian countries.

Table (1): Comparison of the Per Capita Number of Motor Vehicles Registered and Per Capita GDP by Asian Country

Country	Density of Population (persons/km^2)	Per Capita GDP (US$)	Motor Vehicles Registered (Vehicle/100 persons)
Sri Lanka	216	158	1.5
Republic of Korea	378	950	6.3
Thailand	88	412	1.6
Philippines	155	459	2.1
Republic of China	446	1,074	4.0
Malaysia	39	1,080	6.6
Indonesia	76	320	0.7
Japan	306	6,903	27.2

Source: Kaigai Keizai Kyoryoku Binran (1980) (in Japanese)

The above data plotted in Fig. (1) shows a strong correlation between the number of motor vehicles registered per capita and the per capita GDP. The higher the per capita GDP, the more the number of motor vehicles registered. In fact, by statistical analysis this relationship can be represented by the following equation for the countries other than Sri Lanka:

$$X = 1.4659 \times 10^{4} . X^{1.52134}$$

Although the per capita GDP in Sri Lanka is lowest among these countries as shown in Fig. (1) the per capita number of motor vehicles registered is considerably high. This may be a result of the aforementioned statistical problem, that is, the inclusion of scrapped vehicles in the number of motor vehicle registered, whereas the actual number of vehicles running on the road is considered to be very much lower.

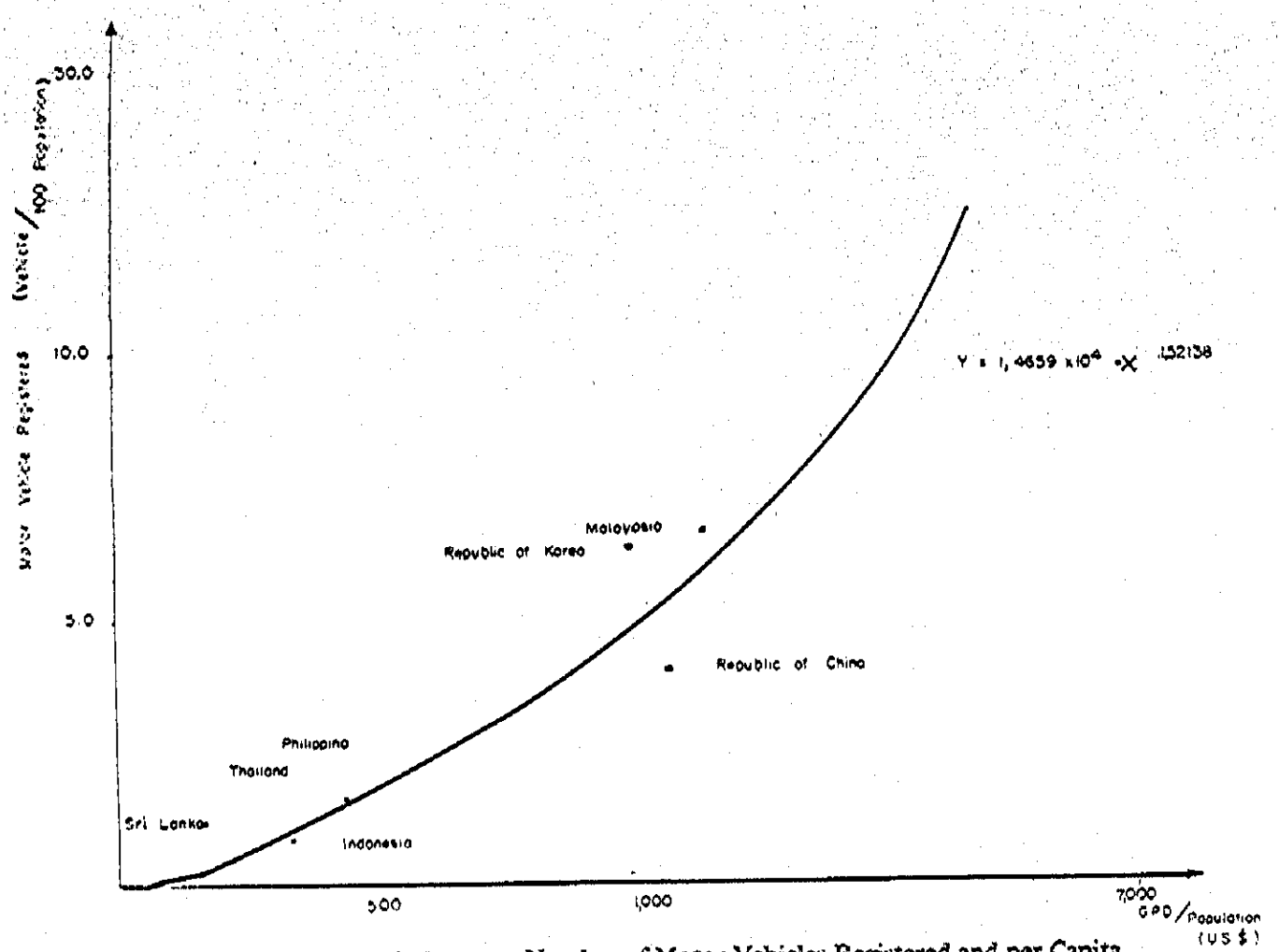

Fig. (1) Relationship between Number of Motor Vehicles Registered and per Capita GDP in Some Asian Countries (1977)

With the gradual growth of economy and increase of per capita GDP, it could be expected that the number of vehicles per capital increase in a trend similar to the curve shown in Fig. (1).

(3) Relationship between the number of motor vehicles registered and running vehicle kilometer.

From what discussed above it became clear that the number of motor vehicles registered has a strong correlation with the socio-economic indicators such as the per capita GDP. However, the relationship between the number of motor vehicles registered and the volume of traffic is not yet clear. To clarify this, the above relationship is examined with the concept of running vehicle kilometers.

The concept of running vehicle kilometers is defined as follows:

$VK : = \sum^{n} V_i \cdot D_i$

VK : Vehicle kilometer
V : Vehicle tripped
D : Distance travelled in each trip
i : 1, 2, ... , n (No. n trip)
n : The number of vehicle tripped

This is a well known measure to represent the traffic conditions which depend on the number of trips and the distance travelled in each trip. Generally, the average number of trips per vehicle and the average trip distance per vehicle do not change drastically. In other words, vehicle kilometer varies depending mainly on the number of vehicles, which is obtained on the basis of the number of motor vehicles registered.

This relationship based on experience in Japan is shown in Fig. (2).

This figure represents clearly the proportional relationship between the number of motor vehicles registered and the running vehicle kilometers, except in the case of lorries from 1970 to 1975, during which period, the movement of goods and material decreased extremely due to sudden economic recession in Japan followed by the first oil crises. As soon as the business activities adjusted to the new economic structure, the relationship between these two indicators recovered as same as before.

Therefore, in the analysis the growth rate of the number of motor vehicles registered is used in order to forecast the future overall traffic volume.

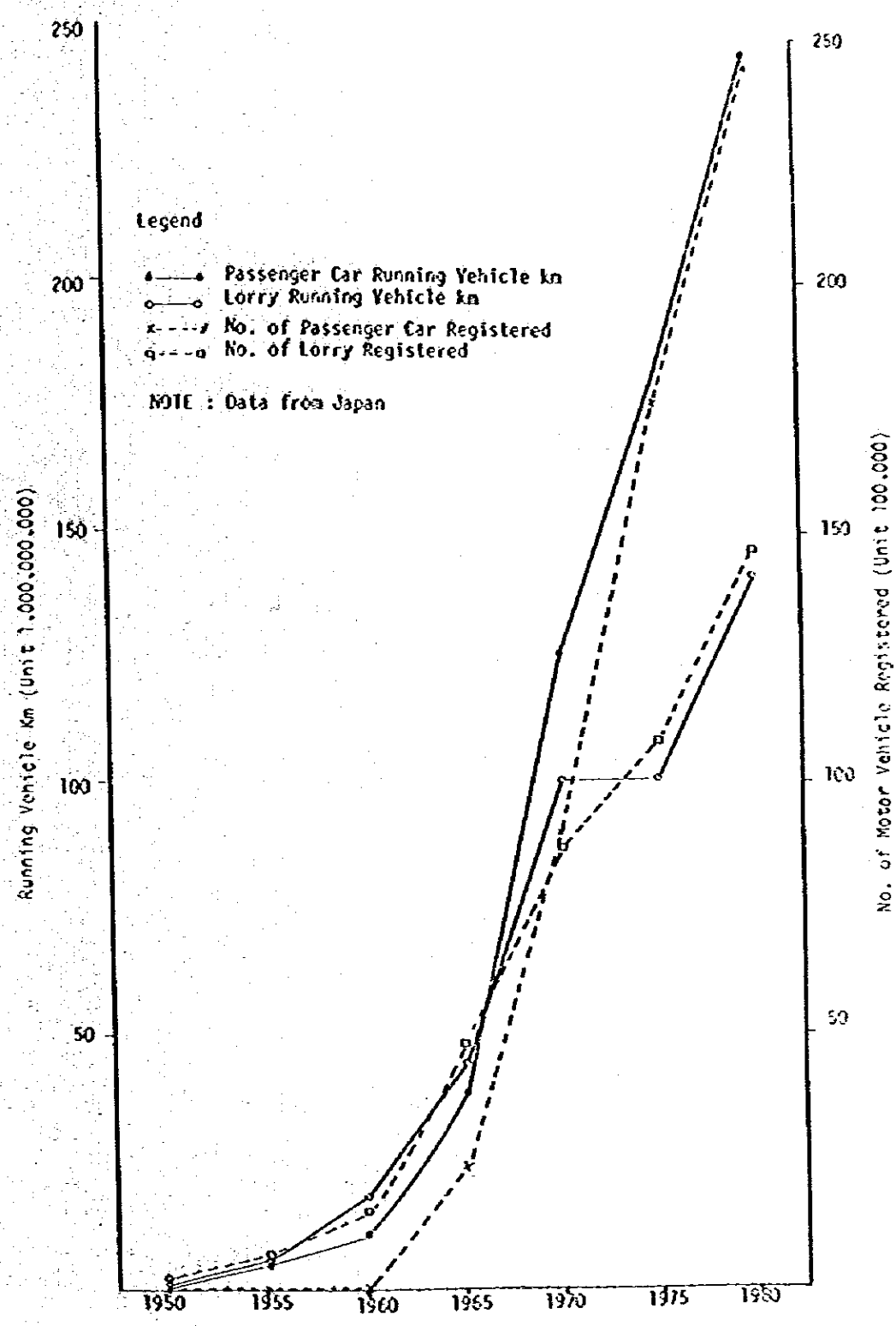

Fig. (2) Relationship between Number of Motor Vehicle Registered and Running Vehicle Kilometer

APPENDIX 3: MODEL BUILDING AND ESTIMATION OF PARAMETERS

(1) Model Building

Technical Note 1

Traffic volume of basic year (indicated by suffix) is assumed to be represented by the following equation

$$T_0 = \alpha \cdot (P_0)^{\beta} \cdot (G_0)^{\gamma} \quad \cdots\cdots (1)$$

T : Traffic volume
P : Population
G : GDP or GNP
α, β, γ : Parameters

Future traffic volume (indicated by suffix 1) is represented by the equation (2) using equation (1):

$$T_1 = \alpha \cdot (P_1)^{\beta} \cdot (G_1)^{\gamma} \quad \cdots\cdots (2)$$

Equation (2) is divided by equation (1)

$$\frac{T_1}{T_0} = \left(\frac{P_1}{P_0}\right)^{\beta} \cdot \left(\frac{G_1}{G_0}\right)^{\gamma} \quad \cdots\cdots (3)$$

By definition,

$$\frac{T_1}{T_0} = t + 1, \quad \frac{P_1}{P_0} = p + 1, \quad \frac{G_1}{G_0} = g + 1$$

By introducing ϵ equation (3) takes into account of the effect of increase of G on the increase of T.

Rewiring the variables in equation (3)

$$t = (p + 1)^{\beta} (\epsilon g + 1)^{\beta} - 1 \quad \cdots\cdots (4)$$

(2) Estimation of Parameters

In order to determine β and γ, the least squares method is applied to the following equation:

$$T = \alpha \cdot P^{\beta} \cdot G^{\gamma} \quad \cdots\cdots (3)$$

where
T : Traffic volume
P : Population
G : GDP
α : Constant term

Using the data shown in Table (1), the Parameters α, β and γ are estimated.

Table (1): The Number of Motor Vehicles Registered, Population and GDP by Year

Year	Passengers	Lorries	Total	Population (10^3 persons)	GDP (10^5 Rs.)
1971	120,596	59,686	180,282	12,608	13,209
1972	122,468	61,628	184,096	12,861	13,631
1973	124,097	63,574	187,671	13,091	14,138
1974	125,852	66,110	191,962	13,284	14,585
1975	127,316	67,656	194,972	13,496	14,987
1976	130,295	69,365	199,660	13,717	15,431
1977	135,568	72,458	208,026	13,942	16,078
1978	148,581	83,412	231,993	14,190	17,401
1979	176,857	97,223	274,080	14,471	18,501
1980	221,433	115,949	337,382	14,738	20,653
1981	246,199	127,911	374,110	14,850	21,330

Using these parameters and substituting the projected growth rates of GDP and population in 1990 and 2000 in the above equation, the growth rate of the future motor vehicle registration can be easily obtained.

Annual average growth rates of population and GDP were estimated as follows (Ref. – Technical Report on Regional Economy):

Growth Rate	1980 ~ 1990	1990 ~ 2000
Population	1.78%	1.88%
GDP	4.93%	5.48%

The elasticity (E) in terms of per capital vehicle/per capita GDP differs from year to year as shown in Table (2).

Table (2): Elasticity (E) in Terms of Per Capita Vehicles/per Capita GDP (1977 ~ 1980)

Type of Vehicle	1977	1978	1979	1980
Passenger Car	0.848	1.714	1.288	3.635
Lorry	1.499	3.146	3.365	3.291

The geometric average value from 1977 to 1980 is adopted as the future elasticity of the year of 1990. As for the year of 2000, the value of elasticity is assumed to decrease by 0.3 from the value of 1990, which are shown in Table (3).

Table (3): Future Elasticity (E) in Terms of Per Capita Vehicle/Per Capita GDP

Type of Vehicle	1980 ~ 1990	1990 ~ 2000
Passenger Car	1.6	1.3
Lorry	2.6	2.3

The annual average growth rates determined by substituting the values of P, β, γ, and E into equation (2), are shown in Table 3-8.

APPENDIX 4: SHADOW PRICES

(1) General

Shadow prices may be regarded as the general case, of which the transfers such as taxes and duties are a special case, where market prices do not represent real social resources. As widely known, in economic evaluation, input resources and outputs of the project should be grasped in real value. If the markets were perfect and fully competitive, market prices would reflect the real value. But, there are many market distortions in actual situation. Where there is unemployment of labour, for instance, estimated wage costs should reflect the alternative opportunities for work rather than the actual wage cost. Sometimes the alternative opportunity cost is zero because the labour would otherwise be unemployed.

Another resource for which it may be legitimate to count a shadow price is foreign exchange. In many developing countries, the value of foreign currency is considered to have more higher value than the official rates because of shortage of foreign exchange. In such case, a conversion factor in excess of unity should be attached to any foreign exchange expenditure or earnings involved in projects, and the shadow price of foreign exchange would then be its actual price multiplied by this conversion factor. The correct pricing of factors of production, including labour, capital, land and foreign exchange, is highly complex. Therefore, simplified methods were adapted in this study.

(2) Shadow Wage Rate

According to the survey of labour force 1980/81, unemployment rate of 15.3 per cent and of 18.6 per cent were estimated for All Island and Urban areas respectively. (Refer to Table (1)).

Under such situation, marginal productivity of unskilled labourers are supposed to be at a considerably lower level than the average market wage rate. Therefore, Study Team assumed the economic value of unskilled labourers to be one half of its market price.

On the other hand, market wage rate of skilled labourers is thought to reflect the opportunity cost of labour because the market mechanism well functions. Therefore, no Shadow Wage Rate was applied to skilled labour.

Total labour cost in Project Roads was estimated approximately 37 million Rupees as shown in Table (2). Among this figure, the cost of unskilled labourers is about 11 million Rupees, and share of this cost to total local component (excluding the land acquisition cost) is 5 per cent. Therefore, the conversion factor for translating the market value of local component to the economic cost is calculated as follows:

$$(0.05 \times 0.5) + 0.95 = 0.98$$

Table (1): Unemployment Rate*

Sector	1971 Census of Population	1980/81 Labour Force Survey
All Island		
Male	14.3	12.4
Female	31.1	23.0
Total	18.7	15.3
Urban		
Male	17.0	14.5
Female	47.6	29.3
Total	23.4	18.6
Rural		
Male	13.4	11.9
Female	27.4	21.6
Total	17.3	14.6

$$\text{*Unemployment rate} = \frac{\text{Unemployed population}}{\text{Economically active population}} \times 100$$

Source: Department of Census and Statistics Ministry of Plan Implementation, 'Labour Force and Socio-Economic Survey 1980/81 Preliminary Report'

(3) Shadow Exchange Rate

A formula proposed in UNIDO method was adopted to convert the official exchange rate to real one[1]:

$$SER = OER \frac{(M + Ti) + (X - Sx)}{M + X}$$

Here,

SER : Shadow Exchange Rate
OER : Official Exchange Rate
M : CIF (Import)
X : FOB (Export)
Ti : Import Duty
Sx : Export Subsidy

Table (2): Summary of Labour Cost Component in Construction Cost

Road Section	Foreman @ Rs.110 per day		Skilled Labour @ Rs.89.7 per day		Operator @ Rs.115.2 per day		Sub-Total		Un-Skilled (Common) @ Rs.58.4 per day		Total	
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
P-1	2308	253.88	27786	2492.40	6784	781.52	36878	3527.80	15456	902.63	52334	4430.43
P-2	73	8.03	1577	141.46	112	12.90	1762	162.39	357	20.85	2119	183.24
P-3	4136	454.96	35730	3204.98	7723	889.69	47589	4549.63	26954	1574.11	74543	6123.74
Σp	6517	716.87	65093	5838.84	14619	1684.11	86229	8239.82	42767	2497.59	128996	10737.41
K-1	5213	573.43	41432	3716.45	9309	1072.40	55954	5362.28	34482	2013.75	90436	7376.03
K-2	8178	899.58	38427	3446.90	9833	1132.76	56438	5479.24	46913	2739.72	103351	8218.96
K-3	10067	1107.37	54831	4918.34	9628	1109.15	74526	7134.86	62550	3652.92	137076	10787.78
ΣK	23458	2580.38	134690	12081.69	28770	3314.31	186918	17976.38	143945	8406.39	330863	26382.77
Plants (Installation)	173	19.03	1280	114.82	48	5.53	1501	139.38	302	17.64	1803	157.02
Total	30148	3316.28	201063	18035.35	43437	5003.95	274648	26355.58	187014	10921.62	461662	37277.20

Note : Including Overheads but excluding Engineering fees and Contingencies.

: Cost : in Rs.1000

Note 1): UNIDO (United Nations Industrial Development Organization), 'Guide to Practical Project Appraisal' (Vienna, 1978).
This formula was also calculated in the Feasibility Study on Colombo Port conducted by JICA.

Sri Lanka has not so far employed the direct export subsidy system, but instead, export duty system has been adapted. Therefore, in above formula, export subsidy was displaced by export duty.

According to the statistics of external trade shown in Table (3), export of tea/rubber have been sharing over 50 per cent of total export. It is better to exclude the figures of tea/rubber for the purpose of our study, because the conversion factor would be applied to modify the items related to construction work.

Table (3): External Trade Statistics

(In Million Rs.)

Item	1980 Jan. ~ Dec.	1981 Jan. ~ Dec.
Import	33,675	34,598
Import Duty Revenue	3,493	3,960
Export	17,273	19,918
Export Duty Revenue	3,480	3,412
Import except Tea/Rubber	33,237	34,236
Import Duty Revenue except those for Tea/Rubber	3,390	3,872
Export except Tea/Rubber	6,697	9,639
Export Duty Revenue except those for Tea/Rubber	299	320

Source: Sri Lanka Customs, 'External Trade Statistics – Sri Lanka' 1980, 1981.

The results of calculation of the conversion factors were as follows:

1980 – 1.077

1981 – 1.081

Therefore, factor 1.08 was adopted to convert the foreign component to economic cost.

APPENDIX 5: VEHICLE OPERATING COST

(1) General

Studies on vehicle operating cost were conducted for the representative vehicle types, each having different operating characteristics. For each vehicle type, a popular vehicle make was selected.

In general, the vehicle operating cost is composed of running -- distance -- related cost and time-related cost (fixed cost). In this study, time-related cost was converted to distance-related cost.

(2) Representative Vehicles

Vehicles were classified originally into nine types. Among them, the data about the container trailer were not available. Hence, it was grouped into heavy lorry.

The representative vehicles shown in Table (1) were determined by referring some materials 1) and after interviewing a number of dealers and organizations.

These vehicles had the largest share in recent sales or strong popularity. Their characteristics are also presented in the same table.

Note 1): "Statistics of Motor Vehicles, Statement No. 11" and "Registration of Motor Vehicles, Statement No. IV, (Statistics of Motor Vehicles Registered classified by country of origin make and class)".

(3) Running Distance -- Related Cost

Distance related cost is the cost incurred by the movement of vehicles on roads. It is composed of the following items:

1) Fuel Cost

Fuel prices with their breakdown are shown in Table (2). Fuel consumption rate at a normal travelling speed on flat and paved road is shown in Table (3) comparing the experimental data with the results of interviewing the dealers and organizations in Sri Lanka. Decided basic fuel consumption rate is shown as follows:

Type	V = km/H	Litre/km	km/Litre
Motor Cycle	65	0.036	28
Tricycle	55	0.042	24
Passenger Car	65	0.071	14
Pickup	65	0.100	10
Heavy Bus	60	0.217	5
Micro Bus	60	0.109	9
Medium Lorry	55	0.114	9
Heavy Lorry & Container Trailer	55	0.178	6

When the traffic volume on road increases, the travelling speed decreases. Decreases in the travelling speed usually accompany changes in speed cycle such as stopping, slow-down, acceleration, etc. The relationship between the fuel consumption rate and the travel speed is shown in Table (4).

Applying these experimental changing patterns to the above mentioned basic consumption rate (Table (3)), modified and adapted fuel consumption rate was obtained as shown in Table (5).

Engine oil consumption rate was assumed to be 1/100 of fuel consumption rate.

2) Depreciation Cost (Capital Cost)

The depreciation cost is also divided into two components: distance related depreciation cost and time related depreciation cost (capital cost). The depreciation cost per km was estimated by finding the retail price, residual value, years in use, operating distance per year and the discount rate (opportunity cost of capital). Study Team assumed to allocate a half of the depreciation cost on the running distance related cost. Another half of depreciation and interest cost were allocated on time related cost.

The depreciation cost as shown in Table (7) were calculated by the following "Capital Recovery Factor" (CRF).

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Here,

i : Discount rate (= 12%)

n : Life years in use of vehicle

Annualized depreciation cost (F)

= {(Initial price (A) – Present value of residual valve (C)] x CRF
where (C) is assumed at 10% of (A)

= Depreciation cost (related to running distance)
+ Depreciation cost (related to operation hours)
+ Interest charge.

Gross Depreciation cost = (Initial price - residual value)/years in use

Gross Depreciation cost x ½ = Distance related cost per annum.
= Time related cost per annum.

Depreciation cost per km = Distance related cost p.a./annual running km.

Average running km and life years, determined after interview, are shown in Table (6). The price of vehicles and of their components are shown in Table (8).

3) Tyres Cost

Tyre cost per km was calculated from the data on the prices of tyre (refer to Table (8)) and assumed usage in km (refer to Table (6)). The cost per km is shown in Table (12).

It was generally said that when vehicles run at lower speed the tyre wear is less, while at a higher speed the tyre wear becomes larger. However, most of the studies on vehicle running cost do not explicitly explore the tyre wear on congested roads. It can also be said that a low travelling speed of 30 – 20 km/H especially on urban roads, usually means frequent changes in speed with braking which increase tyre friction, and that it is not likely that tyres used by the vehicles running at lower speed have a longer life than those at higher speed if the roads are in the same conditions. Unfortunately there are no experimental data which indicate how the tyre wear differ on the roads under uninterrupted flow and on the roads with frequent speed changes. Accordingly, the tyre wear would be assumed the same regardless of the speed level.

4) Maintenance Cost

The maintenance and repair cost are divided into those of labour and spare parts cost. The spare parts cost is calculated by using the expenditure on spare parts as a percentage of initial vehicle price while the labour cost is calculated based on the labour hours spent for maintenance per annum. These data are shown in Table (9).

Maintenance cost per km is illustrated in Table (12).

(4) Time Related Cost

Time-related cost is part of vehicle operating cost, which is considered suitable to associate with the operating hous regardless of actual running. It is composed of the following items:

1) Capital Cost (Depreciation Cost)

The time-related depreciation cost was calculated simultaneously with distance related cost of depreciation. A half of the depreciation cost was assumed to be the time related cost. Interest charge is also a factor to be included. Calculated costs per hour is shown in Table (7).

2) Crew Cost

The vehicle operation is accompanied by the employment of a driver and assistants (especially in case of commercial vehicles such as taxis, buses and lorries). They receive payment for their work which in turn comprises part of the vehicle operating cost. The current average wage rate was determined as shown in Table (10). Operation hours was also presented in the same table. Crew cost per hour is shown in Table (12).

3) Registration Fees and Insurance Fees

Annual fees of both these are shown in Table (11). Insurance cost was counted as a substitute for part of the accident cost. Per hour cost was calculated in Table (12).

4) Overhead Cost

Overhead cost (or standing cost) includes all costs not covered by the above-mentioned components of the operating costs. These costs include rent, administration, management fees and so on.

According to a previous study[1], the overhead cost are given as a percentage of the total operating costs. And this percentage is shown as 10 percent for private passenger cars and 25 percent for other vehicles. These percentages were adopted in this study.

Note 1): S.W. Abeyanayake, 'Transport and Road Research Laboratory Report 672' 1975.

(5) Total Vehicle Operating Cost by Travelling Speed

Total vehicle operating cost for each vehicle type at various travelling speeds is shown in Table (13) to (18). In these tables, time-related vehicle operating costs (Rs./hour), such as Capital cost, Crew cost, Registration, Insurance and Overhead cost were converted in Repees per 1,000 km by using the corresponding speed. For example, crew cost of

medium lorry was estimated at Rs. 4.0/hour in Table (12). This cost can be converted to Rs. 0.08/km when medium lorry runs at the speed of 50 km/hour.

Table (I): Representative Vehicles Selected for VOC Estimation

Type of Vehicle	Engine HP	Engine CC	Gross Vehicle Weight	Curb Weight	Tyre Size	No. of Tyres	Make
			kg	kg	FR 2.25 - 17		
(1) Motorcycle	7.2	86	76	-	RR 2.50 - 17	2	Honda
(2) Tricycle	5.5	145	610	300	400 x 8	3	Bajaj
(3) Passenger Car	-	1400	-	935	155 - SR - 13	4	Mitsubishi
(4) Wagon, Van Pickup	80	2200	2550	1340	650 - 15 - 8	4	Datsun Pickup
(5) Bus (SLCTB)	110	6075	10500	-	900 x 20	6	Ashok Leyland
(6) Medium & Micro	-	3298	4800	2670	6.5 x 16 6PR	6	Mitsubishi Rosa
(7) Medium Lorry (1-4 ton, 2 axles)	-	3298	5500	2305	6.50 x 16 6PR	6	Mitsubishi Canter FE
(8) Heavy Lorry (More than 4 ton 3 axles) Container trailer	-	6557	9400	2985	8.25 x 20 14PR	6	Mitsubishi Fuso FK

Source : Richard Peiris & Co., Stafford Motor Co. Ltd., Associated Motorways, United Motors, Sri Lanka Central Transport Board.

Table (2): Fuel Prices

(in rupees per litre)

	(1) Market Price	(2) Duties & Taxes	(3) Economic Cost
Gasoline - Super	12.000	1.080	10.920
Diesel	6.750	0.608	6.142
Engine Oil used in petrol vehicles			
1) Normal grade	17.000	1.530	15.470
2) Multi grade	27.000	2.430	24.570
Engine Oil used in Diesel vehicles	21.000	1.890	19.110

May 1983

Source : Ceylon Petroleum Corporation

Note : 5% Import Duty and 4% Business Turnover Tax are included in the market prices

Table (3): Basic Fuel Consumption Rate

(litre/Km)

Type of Vehicle	Fuel consumption rate (Litre per running KM at free flow of traffic*)		
	Experimental data in Japan	Sri Lanka	Adapted rate in this study
Motorcycle	-	-	** (0.0355)
Tricycle	-	3) 0.0417	0.0417
Passenger car	1) 0.0714	3) 0.0710	0.0710
Pickup	-	3) 0.1000	0.1000
Heavy bus	2) 0.2174	-	0.2174
Micro bus	-	3) 0.1093	0.1093
Medium lorry	2) 0.1215	3) 0.1136	0.1136
Heavy lorry	2) 0.2326	3) 0.1776	0.1776
Container Trailer	-	-	0.1776

Sources : 1) Kanto Engineering Office, 'Fuel Consumption of the Vehicle Running on Roads - The Review on the Reports of Survey on Vehicle Fuel Consumption' 1979 Japan.

2) M.Sano, 'Fuel Consumption on Roads' Traffic Engineering Vol.14 No.2, 1979 in Japan.

3) Richard Peiris & Co., Associated Motorways, United Motors, The co-operative Wholesale Establishment.

Note : * Fuel consumption rate is assumed under free flow of traffic on paved, level roads. Running speed is around 55 - 65 Km per hour.

** The figure is estimated from passenger car 3) x 0.5

Table (4): Basic Fuel Consumption Rate (by Each Speed Rank)

Mean Speed (Km/H)	Passenger Car 1)		Heavy Bus 2)		Medium Lorry 2)		Heavy Lorry 2)	
	Fuel consumption (litre/km)	Index	Fuel consumption (litre/km)	Index	Fuel consumption (litre/km)	Index	Fuel consumption (litre/km)	Index
5	0.2083	292	0.7143	329	0.3650	300	0.7692	331
10	0.1667	233	0.5556	256	0.2841	234	0.5882	253
15	0.1389	195	0.4545	209	0.2326	191	0.4762	205
20	0.1190	167	0.3846	177	0.1980	163	0.4000	172
25	0.1064	149	0.3333	153	0.1761	145	0.3448	148
30	0.0962	135	0.2941	135	0.1590	131	0.3125	134
35	0.0885	124	0.2703	124	0.1460	120	0.2778	119
40	0.0833	117	0.2500	115	0.1361	112	0.2632	113
45	0.0787	110	0.2381	110	0.1280	105	0.2439	105
50	0.0758	106	0.2273	105	0.1230	101	0.2381	102
55	0.0735	103	0.2222	102	0.1215	100	0.2326	100
60	0.0719	101	0.2174	100	0.1220	101	0.2353	101
65	0.0714	100	0.2222	102	0.1245	102	0.2381	102
70	0.0719	101	0.2366	107	0.1280	105	0.2439	105
75	0.0725	102	0.2439	112	0.1335	110	0.2564	110
80	0.0741	104	0.2632	121	0.1391	114	0.2778	119
85	0.0758	106	0.2857	131	0.1451	119	0.2992	129

Sources : 1) Kanto Engineering Office, ibid
2) M. Sano, ibid

Table (5): Fuel Consumption Rate Adapted in this Study (litre/1000km)

Speed (KM/H)	Motor Cycle	Tricycle	Passenger Car	Van, Wagon Pickup	Heavy Bus (SLCTB)	Medium & Micro Bus	Medium Lorry	Heavy Lorry Container Trailer
5	103.7	121.8	207.3	292.0	714.3	359.6	340.8	587.9
10	82.7	97.2	165.4	233.0	555.6	279.8	265.8	449.3
15	69.2	81.3	138.5	195.0	454.5	228.4	217.0	364.1
20	59.3	69.6	118.6	167.0	384.6	193.5	185.2	305.5
25	52.9	62.1	105.8	149.0	333.3	167.2	164.7	262.8
30	47.9	56.3	95.9	135.0	294.1	147.6	148.8	238.0
35	44.0	51.7	88.0	124.0	270.3	135.6	136.3	211.0
40	41.5	48.8	83.1	117.0	250.4	125.7	127.2	200.7
45	39.1	45.9	78.1	110.0	238.1	120.2	119.3	186.5
50	37.6	44.2	75.3	106.0	227.3	114.8	114.7	181.2
55	36.6	43.0	73.1	103.0	222.2	111.5	113.6	177.6
60	35.9	42.1	71.7	101.0	217.4	109.3	114.7	179.4
65	35.5	41.7	71.0	100.0	222.2	111.5	115.9	181.2
70	35.9	42.1	71.7	101.0	232.6	117.0	119.3	186.5
75	36.2	42.5	72.4	102.0	243.9	122.4	124.9	195.4
80	36.9	43.4	73.8	104.0	263.2	132.3	129.5	211.3
85	37.6	44.2	75.3	106.0	297.5	143.2	135.2	229.1

Note: Figures above were made by applying the basic consumption rate of TABLE. A8 - 6 to the "Index" of TABLE A8 - 7 . In this calculation process, "Index" of TABLE A8 - 7 were applied as follows :

Index of Passenger Car ------ Motorcycle, Tricycle, Van Wagon Pickup

Index of Heavy Bus ------ Medium & Micro Bus

Consumption rate of Container Trailer was assumed to be the same as Heavy Lorry.

Table (6): Lives of Vehicle, Operation Hours of Vehicles and Lives of Tyres

Items / Type of Vehicle	Life in use Years	Vehicle Life operation km	Operation per day, hours	Tyre Life km per set
(1) Motorcycle	10	200000	5	20000
(2) Tricycle	3	30000	10	20000
(3) Passenger car	12	200000	5	28000
(4) Wagon, Van, Pickup	10	300000	10	32000
(5) Bus (SLCTB)	13	1105000	16	56000
(6) Medium & Micro bus (private line)	13	520000	10	32000
(7) Medium Lorry (1-4 ton, 2 axles)	15	600000	10	36000
(8) Heavy Lorry & Container Trailer (more than 4ton, 3 axles)	15	750000	10	52000

Source : Those dealers or organizations listed in TABLE A8-4. After interviewing, some modifications were made refering to Japanese data.

Table (7): Capital and Interest Cost

Items \ Type of Vehicle	Motorcycle	Tricycle	Passenger Car	Van.Wagon Pickup	Bus (SLCTB)	Medium & Micro Bus	Medium Lorry	Heavy Lorry Container
(A) Initial Vehicle Cost 1) (Economic Cost without Tyres)	12.909	34.878	113.278	141.005	395.584	275.795	179.676	280.600
(B) Vehicles use in years 2)	10	3	12	10	13	13	15	15
(C) Residual Value (Present Worth) 3)	416	2.483	2.908	4.540	9.066	6.321	3.283	5.126
(D) Depreciation Value (A - C)	12.493	32.395	110.370	136.465	386.518	269.474	176.393	275.474
(E) Capital Recovery Factor 3)	0.1770	0.4163	0.1614	0.1770	0.1557	0.1557	0.1468	0.1468
(F) Annual Cost (D x E)	2.211	13.486	17.814	24.154	60.181	41.957	25.894	40.440
(G) Life Operation Km 2)	200.000	30.000	200.000	300.000	1105.000	520.000	600.000	750.000
(H) Annual Operation Km (G/B)	20.000	10.000	16.667	30.000	85.000	40.000	40.000	50.000
(I) Distance-Related Cost (D/B) x I/2 = RS/Km H	0.0312	0.5399	0.2759	0.2274	0.1749	0.2591	0.1470	0.1836
(J) Annual Operation Hrs.	1.500	3.000	1.600	3.000	4.800	3.000	3.000	3.000
(K) Time-Related Cost (D/B) x I/2 = RS/Hr. J	0.4164	1.7997	2.8742	2.2744	3.0971	3.4548	1.9599	3.0608
(L) Interest Charge (F-D/B) + J. in RS/Hr.	0.6411	0.8959	5.3853	3.5025	6.3435	7.0761	4.7115	7.3584

Notes : 1) FROM TABLE A8 - 11

2) FROM TABLE A8 - 9

3) i = 12% PER ANNUM

Table (8): Prices of Representative Vehicle and Price of Tyres per Set

(In Rs.)

Vehicle and (No. of tyres)		Import Price (CIF)	Duties	Local Cost Component	Sales Tax	Total (Retail Price)	W/O Duties and Taxes
Motorcycle	Comp	12300	1845	1060	1669	16874	13360
	Tyres	389	166	62	68	685	451
(2)	Net(w/o tyres)	11911	1679	998	1601	16189	12909
Tricycle	Comp.	23732	3560	12009	3699	43000	35741
	Tyres	750	325	113	132	1320	863
(3)	Net(w/o tyres)	22982	3235	11896	3567	41680	34878
Passenger Car	Comp.	97690	119380	19600	43330	280000	117290
	Tyres	1986	1192	2026	456	5660	4012
(4)	Net(w/o tyres)	95704	118188	17574	42874	274340	113278
Wagon, Van Pickup	Comp.	132731	19970	13796	18563	185000	146527
	Tyres	2134	1280	3388	538	7340	5522
(4)	Net(w/o tyres)	130597	18630	10408	18025	177660	141005
Bus (SLCTB)	Comp.	250792	81508	158150	25813	516263	408942
	Tyres	4354	5138	9005	332	18828	13358
(6)	Net(w/o tyres)	246438	76370	149145	25481	497435	395584
Medium & micro bus	Comp.	260000	26000	24281	34719	345000	284281
	Tyres	2396	1438	6090	696	10620	8486
(6)	Net(w/o tyres)	257604	24562	18191	34023	334380	275795
Medium Lorry	Comp.	160000	24000	28162	22838	235000	188162
	Tyres	2396	1438	6090	696	10620	8486
(6)	Net(w/o tyres)	157604	22562	22072	22142	224380	179676
Heavy Lorry Container Trailer	Comp.	240000	36000	63877	35123	375000	303877
	Tyres	6371	3823	16906	1880	28980	23277
(6)	Net(w/o tyres)	233629	32177	46971	33243	346020	280600

Source : Those dealers and organizations listed in TABLE A8-4, as well as State Trading Corporation, Sri Lanka Customs.

Note : 1) Comp: Completed vehicle including body, tyres.
2) w/o : without
3) Local cost component including dealer's margins and other costs were estimated by the Study Team after interviews.
4) Duties and Sales tax were estimated by refering to 'The gazette of the Democratic Socialist Republic of Sri Lanka (Extraordinary) - Customs Notification 1983.2.18.' and 'Turnover Tax and Customs Duty changes effective, midnight 18/19th Feb. 1983' Satchithananda, Schokman, Pasupati & Co.

Table (9): Annual Maintenance Cost of Vehicle

Items / Vehicle Type	Parts (excluding Tyres)		Labour		
	Expenditures on parts in per cent of Initial Vehicle price	Expenditures on parts in Rupees per annum (Rs/Year)	Labour hours for maintenance per annum	Wage rate per hour (Rs/hour)	Labour cost per annum (Rs/Year)
(1) Motorcycle	4%	516	50	8.0	400
(2) Tricycle	6%	2093	100	8.0	800
(3) Passenger Car	5%	5664	50	10.0	500
(4) Wagon, Van, Pickup	7.5% *	10575	200	10.0	2000
(5) Bus (SLCTB)	7.5%	29669	380 **	10.0	3800
(6) Medium & Micro Bus	7.5%	20685	300	10.0	3000
(7) Medium Lorry	7.5%	13476	200	10.0	2000
(8) Heavy Lorry Container Trailer	7.5%	21045	200	10.0	2000

Source : * Associated Motorways
** Sri Lanka Central Transport Board
Rest of the figures were analogized by Study Team.

Table (10): Crew Cost

Items / Type of Vehicle		Monthly Income per person (Rs.)	Annual Income per person (Rs.)	Annual Crew Cost per vehicle (Rs.)		Operation hours per day	Annual Operation hours 3)
(1) Taxi	Driver	1200	14400	14400		10	3000
(2) Tricycle Taxi	Driver	1000	12000	12000		10	3000
(3) Bus (SLCTB)	Driver	1250	15000	2) 54000		* 16	4800
	Conductor	*1000	12000				
(4) Medium & Micro Bus (Private line)	Driver	1250	15000	24600		10	3000
	Conductor	800	9600				
(5) Van, Wagon, Pickup	Driver	1000	12000	12000		10	3000
(6) Medium Lorry	Driver	1000	12000	12000		10	3000
(7) Heavy Lorry	Driver	1500	18000	27600	1) 27741	10	3000
	Helper	800	9600				
(8) Container Trailer	Driver	1800	21600	31200			
	Helper	800	9600				

Source : * Sri Lanka Central Transport Board. Others were assumed by Study Team.

Note : 1) Average of Heavy lorry and Container trailer weighted by the number of trips obtained from OD survey conducted in February 1983.

2) It was assumed to work in shifts of 8.hours.

3) 300 working days a year, per vehicle.

Table (11): Registration Fees and Insurance Fees

(in rupees per year)

Kind of Fee / Vehicle Type	1) Registration Fees	Insurance Fees		2)
		Compulsory	Comprehensive (all risk)	Total
(1) Motor cycle	100	45	205	250
(2) Tricycycle	100	45	205	250
(3) Passenger Car	400	50	1450	1500
(4) Wagon, Van, Pickup	1000	230	1770	2000
(5) Bus (SLCTB)	750	10	-	10
(6) Medium & micro bus	800	300	4200	4500
(7) Medium Lorry	800	230	1770	2000
(8) Heavy Lorry	900	300	4200	4500
(9) Container Trailer	400	300	4200	4500

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Source : 1) The Office of the Registrar of Motor Vehicles
2) Insurance Corporation

Table (12): Cost Factor per km and per Hour

	Motorcycle	Tricycle	Passenger Car, Taxi	Van, Wagon Pickup	Bus (SLCTB)	Medium & Micro Bus	Medium Lorry	Heavy Lorry Container
(A) Tire								
1) Price of a set (Rs.)	451	863	4.012	5.522	13.358	8.486	8.486	23.277
2) Tire life in Km	20.000	20.000	28.000	32.000	56.000	32.000	36.000	52.000
3) 1) ÷ 2) in Rs/Km	0.0226	0.0432	0.1433	0.1726	0.2385	0.2652	0.2357	0.4476
(B) Maintennnce								
Parts (Rs)	516	2.093	5.664	10.575	29.669	20.685	13.476	21.045
Labour (Rs)	400	800	500	2.000	3.800	3.000	2.000	2.000
1) Total (Rs)	916	2.893	6.164	12.575	33.469	23.685	15.476	23.045
2) Annual operation Km	20.000	10.000	16.667	30.000	85.000	40.000	40.000	50.000
3) 1) ÷ 2) in Rs/Km	0.0458	0.2893	0.3698	0.4192	0.3938	0.5921	0.3869	0.4609
(C) Crew Cost								
1) Wages in a year (Rs)	-	12.000	(1) 1.411	12.000	54.000	24.600	12.000	(2) 27.747
2) Annual operation Hrs.		3.000	1.600	3.000	4.800	3.000	3.000	3.000
3) 1) ÷ 2) in Rs/Hr	-	2.0000	0.8819	4.0000	11.2500	8.2000	4.0000	9.2470
(D) Registration								
1) Annual Fee (Rs.)	100	100	400	1.000	750	800	800	(4) 880
2) Annual operation Hrs.	1.500	3.000	(3) 1.600	3.000	4.800	3.000	3.000	3.000
3) 1) ÷ 2) in Rs/Hr	0.0667	0.0333	0.2500	0.3333	0.1563	0.2667	0.2667	0.2933
(E) Insurance								
1) Annual Fee (Rs.)	250	250	1.500	2.000	10	4.500	2.000	4.500
2) Annual operation Hrs.	1.500	3.000	1.600	3.000	4.800	3.000	3.000	3.000
3) 1) ÷ 2) in Rs/hr	0.1667	0.0833	0.9375	0.6667	0.0021	1.5000	0.6667	1.5000

Note : (1), (3): Average of Private Passenger car and taxi weighted by composition ratio of OD traffic volume in 1983.
(2), (4): Average of Heavy lorry and container trailer.

Table (13): Vehicle Operating Cost : Passenger Car, Taxi

(RS/1000KM)

Speed (Km/H)	Fuel	Oil	Tire	Depreci-ation	Maintenance		Capital Cost	Crew Cost	Registr-ation Fees	Insuran-ce Fees	Overhead Cost	Total
					Parts	Labour						
5	2263.7	50.9	143.3	275.9	339.8	30.0	1651.9	176.4	50.0	187.5	516.9	5686.3
10	1806.2	40.6	143.3	275.9	339.8	30.0	825.9	88.2	25.0	93.8	366.9	4035.6
15	1512.4	34.0	143.3	275.9	339.8	30.0	550.6	58.8	16.7	62.5	302.4	3326.4
20	1295.1	29.1	143.3	275.9	339.8	30.0	413.0	44.1	12.5	46.9	263.0	2892.7
25	1155.3	26.0	143.3	275.9	339.8	30.0	330.4	35.3	10.0	37.5	238.4	2621.9
30	1047.2	23.6	143.3	275.9	339.8	30.0	275.3	29.4	8.3	31.3	220.4	2424.5
35	961.0	21.6	143.3	275.9	339.8	30.0	236.0	25.2	7.1	26.8	206.7	2273.4
40	907.5	20.4	143.3	275.9	339.8	30.0	206.5	22.0	6.3	23.4	197.5	2172.6
45	852.9	19.2	143.3	275.9	339.8	30.0	183.5	19.6	5.6	20.8	189.1	2079.7
50	822.3	18.5	143.3	275.9	339.8	30.0	165.2	17.6	5.0	18.8	183.6	2020.0
55	798.3	18.0	143.3	275.9	339.8	30.0	150.2	16.0	4.5	17.0	179.3	1972.3
60	783.0	17.6	143.3	275.9	339.8	30.0	137.7	14.7	4.2	15.6	176.2	1938.0
65	775.3	17.4	143.3	275.9	339.8	30.0	127.1	13.6	3.8	14.4	174.1	1914.7
70	783.0	17.6	143.3	275.9	339.8	30.0	118.0	12.6	3.6	13.4	173.7	1910.9
75	790.6	17.8	143.3	275.9	339.8	30.0	110.1	11.8	3.3	12.5	173.5	1908.6
80	805.9	18.1	143.3	275.9	339.8	30.0	103.2	11.0	3.1	11.7	174.2	1916.2
85	822.3	18.5	143.3	275.9	339.8	30.0	97.2	10.4	2.9	11.0	175.1	1926.4

Table (14): Vehicle Operating Cost : Van

(Rs./1000km)

Speed (Km/H)	Fuel	Oil	Tire	Depreci-ation	Maintenance		Capital Cost	Crew Cost	Registration Fees	Insurance Fees	Overhead Cost	Total
					Parts	Labour						
5	3188.6	71.7	172.6	227.4	352.5	66.7	1155.4	800.0	66.7	133.3	1558.7	7793.6
10	2544.4	57.2	172.6	227.4	352.5	66.7	577.7	400.0	33.3	66.7	1124.6	5623.1
15	2129.4	47.9	172.6	227.4	352.5	66.7	385.1	266.7	22.2	44.4	928.7	4643.6
20	1823.6	41.0	172.6	227.4	352.5	66.7	288.8	200.0	16.7	33.3	805.7	4028.3
25	1627.1	36.6	172.6	227.4	352.5	66.7	231.1	160.0	13.3	26.7	728.5	3642.5
30	1474.2	33.2	172.6	227.4	352.5	66.7	192.6	133.3	11.1	22.2	671.5	3357.3
35	1354.8	30.5	172.6	227.4	352.5	66.7	165.1	114.3	9.5	19.0	628.1	3140.5
40	1277.6	28.7	172.6	227.4	352.5	66.7	144.4	100.0	8.3	16.7	598.7	2993.6
45	1201.2	27.0	172.6	227.4	352.5	66.7	128.4	88.9	7.4	14.8	571.7	2858.6
50	1157.5	26.0	172.6	227.4	352.5	66.7	115.5	80.0	6.7	13.3	554.6	2772.8
55	1124.8	25.3	172.6	227.4	352.5	66.7	105.0	72.7	6.1	12.1	541.3	2706.5
60	1102.9	24.8	172.6	227.4	352.5	66.7	96.3	66.7	5.6	11.1	531.7	2658.3
65	1092.0	24.6	172.6	227.4	352.5	66.7	88.9	61.5	5.1	10.3	525.4	2627.0
70	1102.9	24.8	172.6	227.4	352.5	66.7	82.5	57.1	4.8	9.5	525.2	2626.0
75	1113.8	25.1	172.6	227.4	352.5	66.7	77.0	53.3	4.4	8.9	525.4	2627.1
80	1135.7	25.6	172.6	227.4	352.5	66.7	72.2	50.0	4.2	8.3	528.8	2644.0
85	1157.5	26.0	172.6	227.4	352.5	66.7	68.0	47.1	3.9	7.8	532.4	2661.9

Table (15): Vehicle Operating Cost : Bus (SLCTB)

(RS/1000KM)

Speed (Km/H)	Fuel	Oil	Tire	Depreci-ation	Maintenance		Capital Cost	Crew Cost	Registra-tion Fees	Insurance Fees	Overhead Cost	Total
					Parts	Labour						
5	4387.2	136.5	238.5	174.9	349.1	44.7	1888.1	2250.0	31.3	-	2375.1	11875.4
10	3412.5	106.2	238.5	174.9	349.1	44.7	944.1	1125.0	15.6	-	1602.7	8013.3
15	2791.5	86.9	238.5	174.9	349.1	44.7	629.4	750.0	10.4	-	1268.9	6344.3
20	2362.2	73.5	238.5	174.9	349.1	44.7	472.0	562.0	7.8	-	1071.3	5356.5
25	2047.1	63.7	238.5	174.9	349.1	44.7	377.6	450.0	6.3	-	938.0	4689.9
30	1806.4	56.2	238.5	174.9	349.1	44.7	314.7	375.0	5.2	-	841.2	4205.9
35	1660.2	51.7	238.5	174.9	349.1	44.7	269.7	321.4	4.5	-	778.7	3893.4
40	1538.0	47.9	238.5	174.9	349.1	44.7	236.0	281.3	3.9	-	728.6	3642.9
45	1462.4	45.5	238.5	174.9	349.1	44.7	209.8	250.0	3.5	-	694.6	3473.0
50	1396.1	43.4	238.5	174.9	349.1	44.7	188.8	225.0	3.1	-	665.9	3329.5
55	1364.8	42.5	238.5	174.9	349.1	44.7	171.6	204.5	2.8	-	648.4	3241.8
60	1335.3	41.5	238.5	174.9	349.1	44.7	157.3	187.5	2.6	-	632.9	3164.3
65	1364.8	42.5	238.5	174.9	349.1	44.7	145.2	173.1	2.4	-	633.8	3169.0
70	1428.6	44.4	238.5	174.9	349.1	44.7	134.9	160.7	2.2	-	644.5	3222.5
75	1498.0	46.6	238.5	174.9	349.1	44.7	125.9	150.0	2.1	-	657.5	3287.3
80	1616.6	50.3	238.5	174.9	349.1	44.7	118.0	140.6	2.0	-	683.7	3418.4
85	1827.2	56.9	238.5	174.9	349.1	44.7	111.1	132.4	1.8	-	734.2	3670.8

Table (16): Vehicle Operating Cost : Medium & Micro Bus

(RS/1000KM)

Speed (Km/H)	Fuel	Oil	Tire	Depreci-ation	Maintenance		Capital Cost	Crew Cost	Registra-tion Fees	Insurance Fees	Overhead Cost	Total
					Parts	Labour						
5	2208.7	68.7	265.2	259.1	517.1	75.0	2106.2	1640.0	53.3	300.0	1873.3	9366.6
10	1718.5	53.5	265.2	259.1	517.1	75.0	1053.1	820.0	26.7	150.0	1234.6	6172.8
15	1402.8	43.6	265.2	259.1	517.1	75.0	702.1	546.7	17.8	100.0	982.4	4911.8
20	1188.5	37.0	265.2	259.1	517.1	75.0	526.5	410.0	13.3	75.0	841.7	4208.4
25	1026.9	32.0	265.2	259.1	517.1	75.0	421.2	328.0	10.7	60.0	748.8	3744.0
30	906.6	28.2	265.2	259.1	517.1	75.0	351.0	273.3	8.9	50.0	683.6	3418.0
35	832.9	25.9	265.2	259.1	517.1	75.0	300.9	234.3	7.6	42.9	640.2	3201.1
40	772.0	24.0	265.2	259.1	517.1	75.0	263.3	205.0	6.7	37.5	606.2	3031.1
45	738.3	23.0	265.2	259.1	517.1	75.0	234.0	182.2	5.9	33.3	583.3	2916.4
50	705.1	21.9	265.2	259.1	517.1	75.0	210.6	164.0	5.3	30.0	563.3	2816.6
55	684.8	21.3	265.2	259.1	517.1	75.0	191.5	149.1	4.8	27.3	548.8	2744.0
60	671.3	20.9	265.2	259.1	517.1	75.0	175.5	136.7	4.4	25.0	537.8	2687.8
65	684.8	21.3	265.2	259.1	517.1	75.0	162.0	126.2	4.1	23.1	534.5	2672.4
70	718.6	22.4	265.2	259.1	517.1	75.0	150.4	117.1	3.8	21.4	537.5	2687.6
75	751.8	23.4	265.2	259.1	517.1	75.0	140.4	109.3	3.6	20.0	541.2	2706.1
80	812.6	25.3	265.2	259.1	517.1	75.0	131.6	102.5	3.3	18.8	552.6	2763.1
85	879.5	27.4	265.2	259.1	517.1	75.0	123.9	96.5	3.1	17.6	566.1	2830.5

Table (17): Vehicle Operating Cost : Medium Lorry (RS/1000KM)

Speed (KM/H)	Fuel	Oil	Tire	Deprec-ation	Maintenance		Capital Cost	Crew Cost	Registration Fees	Insurance Fees	Overhead Cost	Total
					Parts	Labour						
5	2093.2	65.1	235.7	147.0	336.9	50.0	1334.3	800.0	53.3	133.3	1312.2	6561.0
10	1632.5	50.8	235.7	147.0	336.9	50.0	667.1	400.0	26.7	66.7	903.4	4516.8
15	1332.8	41.5	235.7	147.0	336.9	50.0	444.8	266.7	17.8	44.4	729.4	3647.0
20	1137.5	35.4	235.7	147.0	336.9	50.0	333.6	200.0	13.3	33.3	630.7	3153.4
25	1011.6	31.5	235.7	147.0	336.9	50.0	266.9	160.0	10.7	26.7	569.3	2846.3
30	913.9	28.4	235.7	147.0	336.9	50.0	222.4	133.3	8.9	22.2	524.7	2623.4
35	837.2	26.0	235.7	147.0	336.9	50.0	190.6	114.3	7.6	19.0	491.1	2455.4
40	781.3	24.3	235.7	147.0	336.9	50.0	166.8	100.0	6.7	16.7	466.4	2331.8
45	732.7	22.8	235.7	147.0	336.9	50.0	148.3	88.9	5.9	14.8	445.8	2228.8
50	704.5	21.9	235.7	147.0	336.9	50.0	133.4	80.0	5.3	13.3	432.0	2160.0
55	697.7	21.7	235.7	147.0	336.9	50.0	121.3	72.7	4.8	12.1	425.0	2124.9
60	704.5	21.9	235.7	147.0	336.9	50.0	111.2	66.7	4.4	11.1	422.4	2111.8
65	711.9	22.1	235.7	147.0	336.9	50.0	102.6	61.5	4.1	10.3	420.5	2102.6
70	732.7	22.8	235.7	147.0	336.9	50.0	95.3	57.1	3.8	9.5	422.7	2113.5
75	767.1	23.9	235.7	147.0	336.9	50.0	89.0	53.3	3.6	8.9	428.9	2144.3
80	795.4	24.7	235.7	147.0	336.9	50.0	83.4	50.0	3.3	8.3	433.7	2168.4
85	830.4	25.8	235.7	147.0	336.9	50.0	78.5	47.1	3.1	7.8	440.6	2202.9

Table (18): Vehicle Operating Cost : Heavy Lorry, Container Trailer (Rs/1000KM)

Speed (KM/H)	Fuel	Oil	Tire	Depreci-ation	Maintenance		Capital Cost	Crew Cost	Registra-tion Fees	Insurance Fees	Overhead Cost	Total
					Parts	Labour						
5	3610.9	112.3	447.6	183.6	420.9	40.0	2083.8	1849.4	58.7	300.0	2276.8	11384.0
10	2759.6	85.9	447.6	183.6	420.9	40.0	1041.9	924.7	29.3	150.0	1520.9	7604.4
15	2236.3	69.6	447.6	183.6	420.9	40.0	694.6	616.5	19.6	100.0	1207.2	6035.9
20	1876.4	58.4	447.6	183.6	420.9	40.0	521.0	462.4	14.7	75.0	1025.0	5125.0
25	1614.1	50.2	447.6	183.6	420.9	40.0	416.8	369.9	11.7	60.0	903.7	4518.5
30	1461.8	45.5	447.6	183.6	420.9	40.0	347.3	308.2	9.8	50.0	828.7	4143.4
35	1296.0	40.3	447.6	183.6	420.9	40.0	297.7	264.2	8.4	42.9	760.4	3802.0
40	1232.7	38.4	447.6	183.6	420.9	40.0	260.5	231.2	7.3	37.5	724.9	3624.6
45	1145.5	35.6	447.6	183.6	420.9	40.0	231.5	205.5	6.5	33.3	687.5	3437.5
50	1112.9	34.6	447.6	183.6	420.9	40.0	208.4	184.9	5.9	30.0	667.2	3336.0
55	1090.8	33.9	447.6	183.6	420.9	40.0	189.4	168.1	5.3	27.3	651.7	3258.6
60	1101.9	34.3	447.6	183.6	420.9	40.0	173.7	154.1	4.9	25.0	646.5	3232.5
65	1112.9	34.6	447.6	183.6	420.9	40.0	160.3	142.3	4.5	23.1	642.5	3212.3
70	1145.5	36.6	447.6	183.6	420.9	40.0	148.8	132.1	4.2	21.4	644.9	3224.6
75	1200.1	37.3	447.6	183.6	420.9	40.0	138.9	123.3	3.9	20.0	653.9	3269.5
80	1297.8	40.4	447.6	183.6	420.9	40.0	130.2	115.6	3.7	18.8	674.7	3373.3
85	1407.1	43.8	447.6	183.6	420.9	40.0	122.6	108.8	3.5	17.6	698.9	3494.4

Table 1. Results of the Road Inventory (1/2)

SURVEY POINT	NAME OF ROAD	WIDTH (M)	NO.OF LANE	DIVIDED ROAD OR NOT	PEDESTRIAN PLATFORM	AUTHORISED PARKING SPACE	AVERAGE VELOCITY (KM/H)	COMMENTS
1	Galle Face Road	20.0	4	●	●		40	
2	Baladaksha Mawatha	13.6	2	-	-		30	
3	-do-	8.2	2	-	-		30	
4	Sir M.Markar Mawatha	8.2	2	-	●		30	
5	Kollupitiya Road	16.0	4	●	●		40	
6	Barbalapitiya Road	20.0	4	●	●	●	40	
7	Dickman's Road	7.3	2	-	●		30	
8	Havelock Road	12.5	2	-	●		40	
9	T'gasyaya Road	12.5	2	-	●		40	
10	-do-	6.6	2	-	-		30	
11	Kirula Road	7.2	2	-	●		30	
12	Narahenpita Road	6.85	2	-	-		30	Pavement bad
13	Elvitigala Mawatha	7.1	2	-	●		40	
14	-do-	9.2	2	-	-		30	Heavy traffic
15	-do-	9.8	2	-	-		30	
16	Buddhaloka Mawatha	12.4	2	-	-		40	
17	-do-	14.5	2	-	●		40	
18	-do-	11.6	2	-	●		30	
19	-do-	11.8	2	-	●	●	30	Heavy traffic
20	Sir CB Jayatilaka M'tha	15.0	3	-	●	●	30	One way
21	Leyden Bastian Road	10.8	2	-	●	●	30	One way
22	Main Street	21.8	4	-	●		30	Heavy traffic
23	-do-	9.0	2	-	-		30	Many lorries
24	H.M.Abdul Cader Road	11.7	2	-	-		40	Many lorries
25	St.Anthony(Kochikade Rd.)	22.0	4	●	●		35	
26	Srimath Ramanathan M'tha	7.6	2	-	●		40	
27	-do-	10.0	2	-	●		40	
28	Aluthmawatte Road	7.3	1.5	-	-		20	
29	-do-	7.2	1.5	-	-		20	
30	Madampitiya Road	5.5	1.5	-	-		20	Housing area
31	K.Cyril C.Perera M'tha	7.5	1.5	-	-		20	
32	-do-	8.2	2	-	-		30	Housing area
33	-do-	9.1	2	-	-		30	
34	-do-	6.8	1.5	-	-	●		Lorries
35	George R. De Silva M'tha	20.0	4	●	●			Heavy traffic
36	Horton Place	7.2	1.5	-	-		30	Resid. area
37	-do-	11.3	2	-	-		40	
38	D.S. Senanayake M'tha	8.2	2	-	-		25	Heavy traffic
39	Independence Square	10.6	2	-	-		30	One way
40	" Avenue	12.8	2	-	-		40	Good way
41	Albert Crescent	20.0	4	●	●		40	Good way
42	A. Coomaraswamy M'tha	20.0	4	●	●		40	Good way
43	-do-	12.0	2	-	●	●	40	
44	-do-	8.8	2	-	-		30	
45	-do-	15.0	4	●	●	●	35	Congested
46	Hulftsdorf Street	5.4	1	-	-		20	Oneway
47	-do-	10.0	1	-	-		20	One way
48	Hussainia Street	4.8	1	-	-		20	One way
49	Maha Vidyalaya M'tha	11.8	2	-	●	●	30	
50	Jethawana Road	22.0	4	●	●	●	40	Business area
51	St. Joseph's Street	9.9	2	-	-	●	30	Lorries
52	Layard's Broadway	9.1	2	-	-		25	
53	Sri Sumanatissa M'tha	22.0	4	●	●	●	40	Business area
54	Maradana Road	9.4	2	-	-			One way
55	Madampitiya Road	5.2	2	-	-		20	Bus service
56	-do-	12.4	2	-	-		30	
57	Prince of Wales Ave. (near Victoria Br.)	11.6	2	-	●		30	

Table 2. Results of the Road Inventory (2/2)

SURVEY POINT	NAME OF ROAD	WIDTH (M)	NUMBER OF LANES	DIVIDED ROAD OR NOT	PEDESTRIAN PLATFORM	AUTHORIZED PARKING	AVERAGE VELOCITY (KM/H)	COMMENTS
58	Victoria Bridge	7.6	1.5	-	-		30	Victoria Bridge
59	Peliyagoda	11.0	2	-	-		40	
60	New Bridge	18.0	4	●	●		40	New Bridge
61		20.0	4	●	-		40	
62	Prince of Wales Ave.	10.2	2	-	-	●	35	Lorries
63	-do-	12.0	2	●	●		35	
64	Dr.Danister de Silva (Baseline Road)	18.0	4	●	-		40	
65	Stace Road	6.3	2	-	-		20	Roadside bad
66	Avissawella Road	6.6	2	-	-			-do-
67	Dr. Danister de Silva M'tha (Baseline Rd.)	24.0	2	-	-		40	
68	-do-	8.0	2	-	-		30	Heavy traffic
69	-do-	9.7	2	-	-		30	
70	-do-	6.4	2	-	●		30	Heavy traffic
71	-do-	6.4	2	-	●		30	
72	N.H.Ishak M'tha (Deeatagoda Rd.)	8.6	2	-	-		30	
73	-do-	5.4	2	-	-		20	
74	Maradana Rd.	18.5	2	-	●	●	30	
75	York Street	27.2	3	-	●	●	20	One way
76	Chatham Street	23.0	3	-	●	●	20	One way
77	Lotus Road	17.0	2	-	●		30	One way
78	-do-	16.6	4	-	●		30	
79	Sir B.Jayatilaka M'tha	25.3	3	-	●	●	30	One way
80	York Street	17.3	2	-	●	●	30	One way
81	Olcott Mawatha	22.6	4	-	●		30	Buses
82		20.0	4	●	●		35	
83	D.R.Wijewardhana M'tha	18.2	4	-	●		40	
84	Kumaran Ratnam Road	14.0	4	-	●	●	35	
85	C.Gardiner M'tha	16.7	4	-	●	●	35	
86	Ward Place	11.8	4	●	●		40	
87	E.W.Perera M'tha	6.7	2	-	●		30	One way
88	-do-	10.8	2	-	-		30	Hospital
89	A. Rajakaruna M'tha	6.7	2	-	-		20	
90	Dr.Danister de S.M'tha	12.2	2	-	-		30	
91	-do-	8.5	2	-	-		20	
92	D.S.Senanayake M'tha	9.4	2	-	-		25	Pedestrian
93	Castle Street	9.4	2	-	-		20	
94	Union Place	13.4	2	●	-	●	30	
95	-do-	13.0	2	-	●		30	
96	Sir James Peiris M'tha	11.8	2	-	●		40	
97	Kuttiah Road	10.5	2	-	-		40	
98	Sir M. Fernando M'tha	11.0	2	●	●		40	
99	Reid Avenue	14.4	2	-	●		40	
100	Havelock Road	11.3	2	-	●		40	
101	Maya Avenue	10.6	2	-	●		40	
102	Havelock Road	5.9	2	-	-		30	
103	W.A.Silva M'tha	6.4	2	-	-		20	
104	Parankade Road	6.4	2	-	-		20	
105	Nugegoda Road	12.7	4	-	-		30	Heavy traffic
106	Kirulapone Ave.	8.4	2	-	-		30	House
107	-do-	8.4	2	-	-		30	House
108	Polhengoda Road	15.0	4	●	●		40	
109	Deans Road	8.8	2	-	●		30	
110	Messenger Street	7.9	2	-	-		30	
111	Olcott Mawatha	18.0	4	●	●		35	Heavy traffic
112	Kithindu Mawatha	8.2	2	-	●		30	

Note : ● : Yes or available
- : No or not available A2-2

Table 3. Colombo Port Traffic Trip Distribution by Vehicle Types and Zones – February, 1983

Zone / Type of vehicles	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	69	Others	Total	Per.T %
Car	426	11	51	28	32	73	01	12	01	25	27	22	38	87	35	08	15	10	337	1239	14.0
Van	534	08	39	60	48	78	01	30	10	18	14	26	20	40	12	09	06	13	279	1245	14.0
Middle Lorry	186	16	68	31	57	71	02	36	16	11	09	10	07	18	05	12	00	10	249	814	9.2
Heavy Lorry	528	24	202	82	254	182	16	204	210	83	30	46	18	33	69	35	04	24	1035	3079	34.7
Container	20	01	13	04	21	07	02	13	11	02	00	03	00	01	01	00	00	04	64	167	1.9
Taxi	25	00	05	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	10	40	0.5
Tricycle	06	00	04	00	00	02	00	00	00	00	00	00	00	00	00	00	00	00	02	14	0.2
Motor Cycle	520	32	106	96	68	82	05	41	39	34	26	35	24	57	38	11	09	08	830	2061	
All Others	79	02	14	12	07	07	01	04	08	01	02	01	03	09	00	01	01	03	27	198	2.2
Total	2324	94	596	313	487	522	28	340	295	164	108	143	110	245	155	76	35	62	2833	8857	100.00
Percentage	26.2	1.0	6.7	3.5	5.5	5.9	0.3	3.8	3.3	1.9	1.2	1.6	1.2	2.8	1.8	0.9	0.4	0.7	32.0	100	
Heavy Veh1.	734	41	283	117	332	260	20	253	237	96	39	59	25	52	70	47	04	38	1348	4060	45.6
Goods Veh1.	1268	49	322	177	380	358	21	283	247	104	53	85	45	92	82	56	10	41	1627	5305	59.9
Passenger Vehicles	977	43	166	124	100	157	06	53	40	59	53	57	62	144	73	19	24	18	1179	3354	37.9

Table 4. Colombo Port Traffic Trip Distribution by Gates and Zones – February, 1983

Gate Factor	Zone / Gate	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	69	Others	Total	Per. Tr.
1.9	01	44	02	11	05	09	10	00	07	06	03	02	03	02	05	03	01	00	00	54	168	34.2
32.3	02	751	30	193	101	157	169	09	110	95	53	35	46	36	79	50	25	11	20	915	2861	39.6
4.1	03	95	04	24	13	20	21	01	14	12	07	04	06	05	10	06	03	01	03	116	363	26.2
35.5	04	825	33	212	111	173	185	10	121	105	58	38	51	39	87	55	27	12	22	1005	3144	73.8
8.9	05	137	06	35	19	29	31	02	20	17	10	06	08	07	15	09	05	02	04	167	523	26.2
12.8	06	298	12	76	39	62	67	04	44	38	21	14	18	14	31	20	10	05	08	363	1134	
7.5	07	174	07	45	23	37	39	02	26	22	12	08	18	08	18	12	06	03	05	213	664	
100	Total	2324	94	596	313	487	522	28	340	295	164	108	143	110	245	155	76	35	62	2883	8857	
	Percentage	26.2	1.1	6.7	3.5	5.5	5.9	0.3	3.8	3.3	1.9	1.2	1.6	1.2	2.8	1.8	0.9	0.4	0.7	32.0	100	

Table 5. Results of Projection of Population and Number of Workers by Traffic Zone for the Year 1990 (1/2)

Unit: 10^3 persons

No. of Traffic Zone	Population	No. of Workers by Industrial Sector		
		Prieary	Secondary	Tertiary
1	17.0	0.5	17.1	181.1
2	69.7	-	7.5	25.6
3	45.1	-	2.0	51.4
4	19.6	0.2	8.7	43.8
5	55.4	0.9	10.9	20.7
6	35.2	-	2.8	6.6
7	16.6	-	2.3	4.4
8	37.7	-	3.2	13.9
9	73.6	-	6.8	18.7
10	27.8	-	4.0	7.6
11	22.2	0.2	0.2	20.4
12	15.1	-	4.8	42.3
13	13.0	-	1.6	39.9
14	32.7	0.1	1.4	8.3
15	55.0	-	8.0	10.9
16	36.6	-	1.4	10.2
17	51.3	-	4.6	6.6
18	190.6	0.6	12.0	41.6
19	162.1	0.6	8.1	35.8
20	45.0	0.1	1.0	2.0
21	53.0	0.2	1.2	2.2
22	110.6	0.4	7.9	4.7
23	23.0	0.3	0.6	1.5
24	64.6	0.4	1.0	6.5
25	119.1	0.7	4.2	14.4
26	158.3	0.9	5.6	13.9
27	71.1	0.8	8.2	1.8
28	182.1	5.5	8.4	14.6
29	30.7	0.1	4.7	3.2
30	40.9	0.1	7.5	2.0
31	51.1	0.2	3.0	2.7
32	21.9	0.1	1.5	1.2
33	42.3	0.3	5.1	2.9
34	33.1	1.5	3.2	17.5

Table 6. Results of Projection of Population and Number of Workers by Traffic Zone for the Year 1990 (2/2)

Unit: 10^3 persons

No. of Traffic Zone	Population	No. of Workers by Industrial Sector		
		Prieary	Secondary	Tertiary
35	39.6	0.4	2.1	3.7
36	44.5	0.5	1.0	4.0
37	24.7	0.2	1.2	2.9
38	27.2	0.1	2.4	8.0
39	34.7	0.5	21.7	6.9
40	44.5	0.3	68.0	10.0
41	120.1	4.0	7.4	7.2
42	21.9	1.3	1.4	2.9
43	75.2	1.2	9.9	13.9
44	29.4	1.1	11.9	2.9
45	125.2	5.6	26.3	5.6
46	123.1	7.5	11.9	2.9
47	115.3	7.8	8.9	4.4
48	112.4	8.1	1.0	6.6
49	112.6	8.6	3.4	0.7
50	138.6	9.0	0.4	2.2
51	107.2	8.4	0.6	14.9
52	107.8	8.5	0.2	0.7
53	98.9	8.2	1.6	5.1
54	280.6	12.7	8.7	7.3
55	123.6	6.8	1.6	5.1
56	273.2	37.4	2.6	2.9
57	248.6	39.1	2.4	7.3
58	2,152.9	309.4	193.8	216.8
59	918.8	220.6	52.6	65.9
60	753.0	145.8	66.5	75.4
61	1,411.5	288.9	85.8	109.3
62	525.4	75.8	63.7	50.9
63	1,551.8	428.5	116.3	209.2
64	1,175.6	460.2	38.8	90.4
65	927.1	123.2	30.5	47.1
66	1,231.5	237.1	73.7	88.7
67	2,312.4	353.5	124.3	172.3

Table 7. Results of Projection of Population and Number of Workers by Traffic Zone for the Year 2000 (1/2)

Unit: 10^3 persons

No. of Traffic Zone	Population	No. of Workers by Industrial Sector		
		Primary	Secondary	Tertiary
1	17.0	0.4	17.5	238.3
2	70.3	-	10.0	33.6
3	45.7	-	4.9	67.8
4	19.7	0.2	11.7	57.7
5	55.5	0.8	16.2	27.4
6	35.2	-	4.1	8.5
7	18.4	-	4.8	6.3
8	37.8	-	4.4	18.1
9	78.5	-	9.5	24.5
10	30.6	-	5.4	10.1
11	27.9	0.2	0.2	26.9
12	15.2	-	6.5	55.7
13	13.1	-	2.5	52.9
14	38.5	0.1	2.6	11.1
15	59.5	-	10.9	14.4
16	40.4	-	2.1	13.5
17	58.5	-	6.3	8.6
18	210.6	0.6	15.8	54.8
19	197.5	0.6	10.9	47.1
20	49.7	0.1	1.4	2.9
21	56.6	0.2	1.6	2.2
22	118.1	0.4	8.5	6.4
23	24.2	0.3	1.2	1.9
24	75.0	0.5	1.6	8.1
25	148.8	0.8	8.7	18.0
26	210.7	1.0	7.9	18.2
27	72.7	1.0	12.4	2.4
28	240.0	5.7	12.7	19.2
29	35.6	0.1	6.4	5.3
30	46.0	0.2	9.9	2.9
31	55.3	0.2	4.1	3.9
32	24.2	0.1	1.7	2.0
33	50.6	0.3	6.7	3.8
34	43.6	1.6	4.3	23.0

Table 8. Results of Projection of Population and Number of Workers by Traffic Zone for the Year 2000 (2/2)

Unit: 10^3 persons

No. of Traffic Zone	Population	No. of Workers by Industrial Sector		
		Primary	Secondary	Tertiary
35	48.2	0.5	2.4	4.8
36	55.5	0.6	1.4	5.5
37	28.4	0.2	1.8	3.8
38	29.6	0.1	2.7	10.6
39	42.2	0.6	18.7	9.6
40	72.5	0.4	87.6	14.0
41	176.7	4.0	7.8	11.0
42	28.1	1.6	1.8	3.8
43	79.6	1.1	11.1	18.3
44	35.1	1.1	16.0	3.8
45	170.6	5.6	60.5	8.0
46	141.1	7.8	15.9	3.8
47	114.0	7.9	12.0	5.8
48	118.2	8.5	1.4	8.6
49	133.3	9.4	4.6	1.0
50	176.5	9.4	0.6	2.9
51	104.0	8.7	0.7	19.8
52	119.1	8.7	0.3	1.0
53	91.3	8.5	2.1	6.7
54	321.1	13.0	12.6	9.6
55	140.6	7.3	2.0	6.7
56	304.4	39.4	3.9	3.8
57	282.9	41.2	3.5	9.6
58	2,498.5	378.9	277.6	306.9
59	1,076.9	278.7	75.4	93.4
60	840.1	186.4	95.2	106.8
61	1,670.7	367.8	122.9	154.7
62	563.3	99.6	91.2	72.1
63	1,631.2	545.7	166.5	296.2
64	1,187.4	584.3	55.6	128.1
65	1,334.4	169.0	43.6	66.7
66	1,801.3	277.6	88.1	127.0
67	3,235.2	438.0	167.9	244.1

Table 9. Outline of the GCEC Projects/Plans

Name of Project/Plan	Summary of Content	Physical Progress	No. of Traffic Zone	Evaluation of Attainment
1. Katunayake IPZ (KIPZ)	Industrial site. Divided into 3 phases - Phase I : 280 acres Phase II : 130 " Phase III : 80 " Promotion of export-oriented light industries. No. of workers : 46,000	Almost all sites are completed.	40	1985, full attainment of target.
2. Biyagama IPZ (BIPZ)	Industrial site (450 acres) Promotion of export-oriented heavy industries. No. of workers : 30,000	Plantation land, reserved for the project sites. Connecting road, under construction.	45	Site preparation during 1983-1990. 1995, attainment of target.
3. Third IPZ	Industrial site, following KIPZ & BIPZ	Only proposed. At the stage of site selection (Weliśara or North Ja-Ela).	35 or 39	Site preparation during 1988-1995. 2000, attainment of target. Possibly in Zone 39. 18,000 workers.
4. Seeduva - Katunayake Township	Expatriate housing, worker housing and ancillary facilities. 500 houses in total. (690 acres)	Ongoing. Some foreign investors have leased the land lots.	40	Completion in 2000.
5. Katana Township	Worker housing. (228 acres) Housing for 4,000 workers and flats for 12,000 workers.	Under preparation of land reservation.	41	Completion in 2000.
6. Kedolkelle Township	New township south of Negombo City. Divided into two stages: Stage I : 276 acres Stage II : 74 " To cater for 5,000 persons.	Ongoing, construction of sites.	43	Completion in 1990.
7. Sapugaskanda Industrial Cluster	Heavy/Chemical industrial site around the oil refinery.	Designated by GCEC as special industrial zone. Polluting industries should be located within the demarcation.	45	3 or 4 new factories in every 5 years.
8. Peliyagoda Warehousing Project	As proposed by UDA (261 acres). Provision of housing, industrial and warehousing sites.	Ongoing.	29	1985, site completion. 1990, in full commission.

Table 10 Outline of the UDA Projects/Plans (1/2)

Name of Project/Plan	Summary of Content	Physical Progress	No. of Traffic Zone	Evaluation of Attainment
1. Sri Jayavardanapura (Kotte)	New Parliament building on an island (13 acres) in the lake.	Almost all are finished, except for administrative complexes.	22	-
	Administrative complexes at Pellavatte and Battaramulla.		24	1985, completion and functions shifted.
	Hospital and ceremonial approach road, and other facilities.		22	-
	Housing scheme at Wickramasinghapura in association with NHDA (705 housing units).		27	1985, people reside.
2. Echelon Square	Redevelopment with the demolition of Army barrack. 2 hotel companies and 2 commercial companies have leased the lots.	New buildings under construction.	1	1985, 2/3 completion. 1990, full completion.
3. Lotus Centre (Chalmers Granaries)	Warehouses and other building to be demolished. New office building and national square to be established.	The function of food stores has already shifted to Orugodavatte.	1	1985, demolition. 1995, new building constructed.
4. St. John's Market	Construction of new fish market along St. John's Street.	Constructed already.	1	Client to be shifted very soon.
5. Old Town Hall and Edinburgh Market	Preservation as historical buildings, not using for the commercial purpose but for community purpose.	The function of the market shifted already.	1	-
6. Vegetable market, Kachcheri Road	Construction of a new multi-storeyed market place at Kachcheri Road. Phase I and Phase II (extension).	Under construction of the market (Phase I). Extension (Phase II) will follow that completion.	1	1985, Phase I completion. 1995, Phase II completion.
7. Shopping Complex, Ferguson's Road	Construction of a supermarket utilising the land reserved by UDA.	Under preparation.	5	1985, completion
8. Orugodavatte Food Stores	Construction of warehousing for the replacement with the functions of Chalmers Granaries. 11 storehouses in the site of 20 acres.	Completed. Power of handling already handed over to the Food Dept.	8	-

Table 10 Outline of the UDA Projects/Plans (2/2)

Name of Project/Plan	Summary of Content	Physical Progress	No. of Traffic Zone	Evaluation of Attainment
9. Athurugiriya	Athurugiriya industrial site for heavy industry with Steel Corporation factory as a centre. (Worker housing, 300-400 units)	Sites have leased to private companies. Factories locating.	27	Beginning in construction very soon. 2 or 3 new factories in every 5 year.
	Pannipitiya industrial site (5 ha, worker housing 700-800 units).	Site under construction.	25	Site completion by 1985. Factories in full operation by 2000.
	Homagama industrial site.	Only the site area designated.	28	After 2000.
10. Ratmalana Industrial Site	Site for light/heavy industries near to the Ratmalana Airport (7 ha) Approach road construction.	3/4 of land lots have been leased already.	18	1988, factory full completion. 1990, in full commission.
11. Panchikawatte Integrated Development Project	Redevelopment of the triangle area in Maradana. Land acquisition by UDA plot by plot. Mainly for commercial and residential purposes. Small-scale industies are to be located.	Gradually progressed.	3	1995, completion of redevelopment.
12. Peliyagoda Integrated Development Project	Warehousing, small-scale industrial site and housing development. Site area 261 acres: light industries 89, warehousing 88, low cost housing 21, middle income housing 31, commercial and offices 17 and others.	Reclamation of marsh finished. Under the preparation of sites.	29	1985, site completion. 1990, full completion.
13. Educational, Social and Cultural Complex	Race course redevelopment.	Proposal.	11	2000.
	Sugathadasa Stadium expansion.	Under implementation.	8	1985.
	Housing for Tower Hall artists.	Proposal.	18	1990.
14. Slum and shanty upgrading programme	All over Colombo City, in small areas of slum and shanty. Partly depending on foreign aids.	Under implementation.	Scattered in CMC Area.	-
15. Bloemendhal Development Project	Reclamation of marsh of 250 acres. Housing for 600 shanty families in 12 acres. Site 77 acres: residential 12, commercial 4, industry 13, warehousing 45, public use 3.	Proposals. Implementation handed over to the Reclamation Board.	5 and 7	2000, completion.

Table 11. Outline of Projects Carried out by the NHDA and Planning by the Town and Country Planning Department

Agency	Naze of Project	Summary of Content	Physical Progress	No. of Traffic Zone
1. National Housing Development Authority (NHDA)	a. Maligavatte Housing Scheme	2,500 housing units to be constructed on reclaimed marsh land.	1,500 units already completed. 400 units to be constructed in 4 or 5 years.	9
	b. Soysapura Flats	1,058 housing units.	Constructed, already people living.	18
	c. Jayawardene-gama (Wickra-masinghapura)	705 housing units in Kaduwella AGA Division.	Completed. Now under advertising.	27
	d. Katthegoda Scheme	1,201 units in Homagama UC Area.	Completed. To be advertised soon.	28
	e. Maharagama	501 units.	Completed.	25
	f. Raddoluva Special Housing Project	2,022 units in the south-east of the KIPZ.	Completed.	41
	g. Ranpokunavatte Housing Scheme	1,610 units in Attanagalla AGA Division.	Proposal, not commenced.	51
	h. Model Villages	Housing complex construction in rural areas. (40-60 units)	Ongoing. Colombo (2) Gampaha (5) Kalutara (12)	20,25 39,46,49,50,51 54,56,57
	i. Electoral Houses	Housing Development in each Electorate (10-100 units).	Ongoing.	Scattered in various zones.
	j. Aided Self-help Housing Construction	Housing construction aided by the public funds.	Ongoing.	Scattered in various zones.
2. Town and Country Planning Department	a. Ragama	Town planning in the east of railway.	Executed by Ragama TC under the DDC.	35
	b. Gampaha	Town planning.	Proposal.	47
	c. Kiribathgoda	Town planning.	Proposal.	31
	d. Ja-Ela	Town planning.	Proposal.	38
	e. Wattala-Mabole	Town planning in association with CCEC.	Executed by CCEC.	32
	f. Kelaniya Rajamaha Vihara	Planning for a new town and the sacred area.	Proposal.	30
	g. Kotte Temple	Planning for for the sacred area.	Proposal.	22

Table 12. The Results of Interview Survey to Companies Possessing Container Yards and Warehouses

Name of Company	Extent of Area (Acres)	Number of Employees	Volume of Traffic Vehicle/Day		
			Containers	Lorries	Private Car
I. Bartleet Freighters Ltd. , I00, Negombo Road.Wattala.	I ½	204	I7	4	I2
2. C.W. Mackie& Co. Ltd., I29 & I33, Sri Wickrema Mawatha. Colombo I5.	I.0	I25	I0 (Maximum)	8	
3. Aitken Spence Co. Ltd., I70, Sri Wickrema Mawatha, Colombo I5.	I.0	I00	70	I0	
4. McLarens Container Depot, No. 776, Negombo Road Mattumagala, Welisara	4 ½	-	53	45	
5. Cargo Boat Despatch Company Limited, 97/I, Negombo Road, Peliyagoda	-	6	4	-	
6. Tainerport (Pte.) Ltd., 97, Negombo Road, Peliyagoda.	I ½	5	I5	-	
7. East West Enterprises Limited, 346/3, Dutugemunu Mawatha, Peliyagoda	I0	I40	5	25	-
8. Ceylon Shipping Lines Limited , 2/8, Avissawella Road, Orugodawatte.	5	80	I85	I5	-
9. Bartleet Stores Limited, 65I, Bloemendhal Road, Colombo I3.	½	45	-	30 (Maximum)	
I0. Trico Maritime Co. Ltd., 65I, Bloemendhal Road, Colombo I3	½	40	2	-	-

Table 13. Trip Generation and Attraction by Compressed Traffic Zones

Unit : Trip Ends

Item / Year / Zone	Car & Taxi			Bus			Van & Medium Lorry			Heavy Lorry & Container			Motorcycle			All Types of Vehicles		
	1983	1990	2000	1983	1990	2000	1983	1990	2000	1983	1990	2000	1983	1990	2000	1983	1990	2000
1	11881	19863	41470	-	-	-	9213	15953	32781	5900	10068	20792	7266	11546	22859	34260	36147	113750
2	1283	3876	8884	453	1337	2939	899	3168	7500	560	3010	7181	707	2105	4837	3902	11391	26504
3	2368	4121	8973	1178	1844	3613	1456	2580	5686	723	1325	2881	1574	2683	5777	7299	9871	21154
4	1310	2816	6054	513	739	1181	899	2028	4496	394	1058	2308	1008	2091	4469	4114	6641	14040
5	461	791	1738	756	796	1460	330	571	1175	140	245	517	345	590	1283	2032	2404	4891
6	791	1378	3156	263	439	965	658	1144	2643	274	450	956	778	1330	3035	2764	3412	7719
7	222	422	912	321	595	1217	254	500	1061	239	485	966	201	377	817	1237	1996	4156
8	728	1242	2778	224	359	563	508	890	2012	263	596	1270	711	1159	2565	2434	3088	6651
9	1023	1844	4730	746	1350	2102	986	1810	4824	374	687	1940	1099	1933	4966	4228	5691	13596
10	2048	2593	4475	465	192	201	1179	2086	3432	352	595	925	501	249	350	4545	5472	9033
11	1009	1799	3666	622	883	1451	888	1619	3370	511	912	1950	532	950	1947	3562	5213	10435
12	452	732	1535	628	875	1550	296	487	1032	89	152	321	328	516	1068	1793	2245	4439
13	412	620	1187	214	262	396	333	518	1033	129	212	458	283	425	821	1371	1616	3074
14	88	134	262	100	450	594	73	113	230	52	83	173	44	68	134	357	781	1259
15	87	142	297	88	136	270	59	99	211	44	73	160	66	102	210	344	449	938
16	36	135	274	210	270	426	65	104	214	55	93	196	43	66	131	459	604	1109
17	352	518	1173	143	172	236	260	406	885	148	233	790	306	338	742	1209	1330	3084
18	278	523	1065	0	0	0	246	505	1046	306	661	1291	327	624	1182	1157	1689	3402
19	759	1345	2712	0	8	9	478	901	1860	357	677	1370	482	785	1560	2076	2931	5951
20	1068	1760	3655	0	147	154	827	1484	3047	656	1140	2422	616	982	2021	3167	4531	9276
21	237	418	896	0	0	0	214	376	794	317	581	1219	135	222	454	903	1365	2907
22	204	334	712	0	0	0	151	269	578	229	412	953	53	81	176	637	1015	2244
23	89	149	338	0	0	0	50	90	211	75	122	283	12	21	45	226	361	832
24	646	1038	2173	0	154	162	570	938	2019	483	835	1917	168	264	556	1867	2965	6271
25	440	799	1688	0	207	216	345	602	1348	601	1033	2356	131	217	478	1523	2621	5608
26	182	357	848	24	0	0	233	453	1064	525	994	2192	56	103	240	1020	1804	4105
27	1216	1962	4377	0	0	0	1967	1707	5969	3104	5259	10085	1952	2581	3714	8239	10418	20431
Total	29726	51711	110028	6948	1121	19699	23427	41401	90521	16900	31991	67872	19724	30085	66437	96725	128051	306859

Table 14. Railway Passenger Trips – March 1979

Unit : Passenger/Month

Railway Station	Ordinary Tickets		Season Tickets			
	Maradana	Fort	Maradana	Fort	Maradana	Fort
Maradana	-	11,460	-	16,865	-	1,200
Fort	16,865	-	11,460	-	760	-
Kelaniya	10,144	3,909	18,238	6,645	26,280	43,440
Wanawasala	3,618	5,863	3,300	4,771	10,280	15,600
Hunupitiya	11,266	5,779	10,127	7,074	23,240	37,000
Enderamulla	10,169	4,147	10,195	3,671	24,520	25,320
Horape	2,240	2,239	951	1,744	5,520	3,680
Ragama	17,489	16,494	16,984	21,528	40,080	82,560
Peralanda	1,540	1,081	1,162	941	4,400	12,160
Kandana	1,209	1,910	1,406	1,929	9,400	21,120
Kapuwatta	403	181	479	400	2,680	4,920
Ja-ela	1,809	993	2,108	1,813	15,440	30,960
Tudella	248	292	235	336	1,080	3,680
Kudahakapola	1,217	544	799	415	4,160	7,960
Alawatupitiya	604	426	279	317	1,240	5,400
Seeduwa	1,257	1,301	919	814	5,640	10,320
Air port	84	169	211	374		
Katunayake	192	824	412	554	3,000	6,880
Kurana	402	353	275	374	3,160	6,080
Negombo	1,029	1,010	1,336	1,969	6,720	2,080

Source : Sri Lanka Government Railway.

Table 15. Railway Time Table between Maradana and Negombo Stations

Station of Origin / Destination		Formation	Accommod-ation	UP		DOWN	
				Maradana (Departure)	Negombo (Arrival)	Negombo (Departure)	Maradana (Arrival)
Fort	Nattandiya	Double P	2000	01-15	02.41	04.43	06.15
Kollupitiya	Puttalam	Goods	-	02.04	03.06	15.00	00.10
Kelaniya	Kakkapalliya	Oil	-	02.30	03.40	09.40	11.10
Maradana	Negombo	Double P	2000	03.25	04.20	05.55	07.23
Fort	Puttalam	3Tcc 2Tvv	600	03.40	05.25	14.05	16.05
Fort	Negombo	Single P	1000	04.45	06.54	07.14	08.44
Fort	Kakapalliya	Single P	1000	05.10	06.59	07.56	09.13
Fort	Kakapalliya	Single P	1000	05.20	07.26	08.30	09.50
Fort	Negombo	7Tcc 2Tvv	1200	06.10	08.01	10.00	11.26
Maradana	Kochchikade	Double P	1240	09.10	10.43	11.20	12.51
Kollupitiya	Negombo	Goods	-	10.00	13.20	15.00	17.00
Maradana	Chilaw	6Tcc 2Tvv	1050	10.40	12.21	17.55	20.22
Fort (M)	Nattandiya	Single P	620	12.40	14.18	16.18	17.50
Fort (M)	Puttalam	3Tcc 2Tvv	600	14.02	15.33	08.05	10.20
Fort (M)	Kakkapalliya	Single P	1000	15.32	16.55	17.57	19.12
Fort (M)	Negombo	Double P	2000	16.25	17.49	18.40	20.28
Fort (M)	Bangadeniya	9Tcc 2Tvv	1500	17.00	18.02	06.59	08.00
Fort (M)	Negombo	Single P	1000	17.05	18.32	20.00	21.18
Fort (M)	Chilaw	10Tcc 2Tvv	1650	17.45	19.10	06.23	07.44
Fort (M)	Chilaw	9Tcc 2Tvv	1500	18.25	19.53	05.28	06.52
Fort (M)	Negombo	Single P	620	20.14	21.48	22.10	23.43
Fort (M)	Negombo	Single P	620	21.29	22.57	23.10	00.00
			22200				

Note - (M) Destination at Maradana - Source : Sri Lanka Government Railway

Table 16. Distance, Travel Time and Fare by Train from Fort Station

From Fort To	Distance (KM)	Travel-Time (Min.)	Fare (Rs.) 1st Class	 2nd Class	 3rd Class
Maradana	1.89	6	3.00	2.00	1.00
Dematagoda	3.62	11	3.00	2.00	1.00
Kelaniya	6.87	17	5.80	3.60	1.60
Hunupitiya	10.02	22	5.80	3.60	1.60
Ragama	15.54	31	8.00	5.20	2.30
Peralanda	17.07	35	9.00	5.80	2.60
Kandana	18.82	39	9.50	6.10	2.70
Kapuwatta	20.55	41	10.50	6.80	3.00
Ja-ela	22.15	45	11.50	7.40	3.30
Kudanakapola	25.17	51	13.00	8.40	3.70
Alawatupitiya	26.50	55	13.50	8.70	3.80
Seeduwa	28.05	59	14.50	9.30	4.10
Liyanagemulla	30.12	64	15.50	10.00	4.40
Air Port	33.43	66	17.00	10.90	4.80
Katunayake	32.44	70	16.50	10.60	4.70
Kurana	35.30	75	18.00	11.60	5.10
Negombo	38.84	83	28.30	12.50	5.50

Source : Sri Lanka Government Railway

Table 17. Distance, Travel Time and Fare by Bus from Pettah Bus Terminal

From Pettah To	Distance (KM)	Travel Time (Min.)	Fare (Rs.)
Peliyagoda	6.11	15	1.50
Wattala	8.00	18	2.00
Kelisara	13.99	25	2.50
Kandana	16.73	28	3.00
Ja-ela	20.11	33	3.50
Tudella	20.91	35	3.50
Dandugama	22.52	38	3.50
Seeduwa	26.22	40	3.50
Katunayake	30.57	47	3.75
Kurana	31.53	49	4.25
Negombo	37.00	59	4.50

Table 18. Inventory of Flood Relief and Drainage Structures

No.	Location	Existing Structure	Flooding			Existing Condition			Remarks
			Height	Frequency	Duration	Land Use	Water way	Flow	
1	Cruz-Grande (1)	R	1' above field	Once in a yr.	1W	M.F	0	E	Canal W-S-3' R-0'
2	(2) Relief Bridge site	R	2' above field	-do-		F			Near entrance
3	Old railway structure (Sedeatta-Mela)	RR 4'	1' above road			FA			Abandoned structure
4	Railway bridge	RR 2x7'6	2' above field			F.FA			
5	Old Kalupura Rd.	RR	2' above road			M			Normal flood 1' above road
6	Railway near STA 5	RR 1'0, 6'	Above roadway Br.	2-3 times in a yr.		M	D	E	
7	Road (Porana-Talangpatta)	RR 3'6	Below bridge			FA.M	D	E	Approach road submerged
8	Road (5 mile post Kandy Rd.-Kurugalla) site	RR 1'5x1'5	Below bridge			M.FA	D	E	
9	-do- (2)	R 0'2x1	Above road	Once in a yr.		FA	W	E	
10	Railway near STA 9	RR 6'6, R 0'8x3	1.3' below railway	Once in 2-3 yrs.	2D	M.FA	D	E	
11	Road (Matale-Kaleawatta)	RR 3'6	Bottom of Br.	Once or twice in a yr.	1W	M	D	E	
12	Road	RR 5'6x2	Top of bridge	2-3 times in a yr.	2-3W	M	D	E	
13	Railway near STA 10	RR 2x3'3	0'8 below railway			M	D	E	
14	Railway near STA 15-500	RR 2x3'3	-do-			M	D	E	
15	Road (Katana A - Ranaga A) near STA 11+500	R 8 1500	0'7above road	Once in 10 yrs	5D	M	D	E	
16	-do- near Army Base	RR 3'2, R 1'2	Above Br.	Once in a yr.	2D	M	D	E	
17	Road (Ragama-Pelawatta)	RR 3'0	1' above bridge	Once in 4 yrs.	1W	M	D	E	Water reaches at gas station
18	Road (Peradeniya-Ragama A)	RR 1'2x0'8, 1'0x0'8	0'6 above road	Once in a yr.	2-5W	M.FA	D	E	
19	Railway (Ragama-Negombo)	RR 6'1	0'6 below railway	Once in 10 yrs	3D	M.FA	D	E	
20	Road (Palpola-Kalawa-Nagolla)	RR 2x2'6x1'0	Below slab			FA	D	E	Irrigation
21	Road (Gonawila-Ja-Ela)	RR 2'4, RR 0'6x0'6	Above road	Once in 5 yrs.	3D	FA	D	E	
22	Road (Palpola-Kalawa)	RR 4'2	0'6 above Br.	Once in 5 yrs.	4D	FA	D	E	Irrigation
23	Road (Kandy-Colombo-Kurunegala)	RR 3'1	0'6 above Br.	Once in a yr.	1W	FA	D	E	
24		RR 0'6x0'8	0'3 above culvert	Once in 4 yrs.	3D	FA	D	E	Irrigation
25	Road (Kiriwaduna North-Kiriwaduna)	RR 3'6	0'3 above rd.	Once in a yr.	2D	FA	D	E	Irrigation
26	Road (Ja-Ela - Gonawila)	R 3'6x3, 0'6x2	0'7 above rd.	Once in 4 yrs.	2W	FA	D	E	
27	Ja-Ela Oya	None	1'8 above Grassing field	Twice in a yr.	1W	FA	D	S	Width of Waterway 15'
28	Oya	None	Above field	Once in a yr.	2D	F.FA.M	D	E	
29	Kotugoda Irrigation Pipe	None	6'6 above pipeline	Every year	3W	FA	D	E	Irrigation
30	Drainage canal of Nursing School	None							Waterway 6'x1'
31	Tango's Area	None	0'3 above road	Every year	2W	FA	W		
32	Dandugam Oya	None	0'6 above road			M.FA	D	S	At first electric post on Hill side
		R -Pipe Culvert BC-Box Culvert RR-R-Pipe				C-Cay S-Sand	C-Cross ed fields P-Plantation FA-Fields M-Marsh	C-Cross ed fields S-Stream	F-Fast M-Moderate S-Slow N-None

Table 19. Inventory of Existing Crossing Roads

No.	Name	Class	Existing condition							Remarks
			Total width (m)	Carriage width (m)	Pave-ment	Land use	Drain	Traffic	Bus traffic	
1	Old Ratnapura Road	A	7.4	5.8	A	R,F	B	H	Y	
2	Belihul Road	B	9.0	7.0	A	R	B	H	Y	
3	Thorana-Telangapalla	C	6.5	3.7	A	R,F	P	H	Y	
4	6 Mile Post (Kandy Rd.)-Pelmadulla	C	7.5	3.6	A	FA	P	S	N	
5	6 Mile Post (Kandy Rd.)-Nellala	C	6.8	3.6	A	R,F	P	H	Y	
6	Kalugamu-Pelmadulla (New Rd.)	B	15.5	6.9	A	R,F	P	H	Y	
7	Pelmadulla (Gamma Kovila)	B	6.0	2.5	A	R	P	S	N	
8	Elellapitigoda-Pamunuwa (Kandy Rd.)	C	8.2	6.0	A	R	P	S	Y	
9	Nellala-Kahawatta	C	8.1	6.9	A	R	B	H	Y	
10	Enderamulla St.-Enderamulla J.	C	6.6	6.0	A	R	B	S	Y	
11	Peelakanda J. - Enderamulla J.	B	5.5	2.7	G	R	P	S	N	
12	Kahara J.- Moraja J.	B	7.0	2.8	A	R	P	S	N	
13	Moraja J. - Ragama J	E	5.5	3.0	E	R,F	P	S	N	
14	Moraja J. - Ragama chilly path	B	3.8	2.3	A	R	P	S	N	
15	Ragama J. - Kahawatta	E	2.8	0.2	E	R	P	S	N	
16	Ragama - Kahalagoda	C	9.7	5.6	A	R	P	H	Y	
17	Peralanda - Ragama J.	E	2.6	2.6	G	FA	P	S	N	
18	Feeder Road	B	4.4	3.3	G	R	P	S	N	
19	-do-	E	2.9	-	G	R,PL	P	S	N	
20	Ragama-Podiwelakanda	B	6.1	2.9	A	F	P	S	N	
21	Podiwelakanda Boys Town	B	6.2	2.4	A	R	P	S	N	
22	Moragahanda - Walpola	B	5.3	3.0	G	F,PL	P	S	N	
23	Boys Town J. - Batagama J. (1)	B	5.4	2.2	A	R	P	S	N	
24	Boys Town J. - Batagama J. (2)	B	5.0	2.4	A	R,PL	P	S	N	
25	Kandana - Batagama	C	7.4	6.5	A	R	P	H	Y	
26	Pelpitimulakana - Kospalana	B	6.3	2.3	G	PL	P	S	N	
27	Gatemulla - Ja-Ela	B	5.3	2.8	A	R,FA	P	S	Y	
28	Pelpitimulla.	B	6.2	2.3	G	PL	P	S	N	
29	Uthumgalagama - Mirandana	B	8.5	3.9	A	PL,FA	P	S	N	
30	Bandigoda - Mirandana	E	3.2	-	E	R,F	P	S	N	
31	Feeder Rd. (for pedestrian only to paddy)	E	3.3	-	E	R,PL	P	S	N	
32	Bandigoda - Mirandana North	E	6.6	2.4	E	PL	P	S	N	
33	Ja-Ela - Ganemulla	C	8.8	3.6	A	R	P	H	Y	
34	Talhena J. - Talhena	B	5.9	2.5	G	R	P	S	N	
35	Ekala (1)	E	2.8	-	E	R	P	S	N	
36	Ekala (2)	E	2.4	-	E	R	P	S	N	
37	Ekala (3)	E	3.3	-	E	R	P	S	N	
38	Ekala - Kahawatta	C	9.1	5.0	A	R,PL	P	H	Y	
39	Ekala (a)	B	9.0	2.6	E	F	P	S	N	
40	Ekala (b)	E	3.7	-	E	F	P	S	N	
41	Kanagahawatta - Kahagoda	C	12.3	5.7	A	R,F	P	H		
42	Sirilal Kovila	B	5.8	3.3	G	R,F	P	S	N	
43	Seedua Road	B	10.0	6.0	A	R,F	P	H	Y	
44	Kanangamulla Road (1)	E	3.6	2.5	E	R,PL	P	S	N	
45	" " (2)	E	4.0	2.0	E	R,PL	P	S	N	
46	Mwala Road (Ganapola) (1)	B	7.2	3.0	A	R,PL	P	H	Y	
47	-do- (2)	E	4.5	2.4	E	R,PL	P	S	N	
48	-do- (3)	B	6.2	3.0	E	R,PL	P	H	N	
49	-do- (4)	E	5.0	3.0	E	R,PL	P	S	N	
50	Ganapola (1)	E	4.5	2.5	E	R,PL	P	S	N	

Table 20. Discharge and Proposed Structure of Flood Relief Opening and Drainage

Drainage No.	Length of Watershed (Km)		Elevation (M)			Discharge Area (Km^2)		Run-Off Coef.		Time of Concent (Hrs)	Rainfall Intensity (mm/hr)			Discharge (m^3/sec)			Proposed Structure	Remarks
	L_1	L_2	H_1	H_2	H_3	A_1	A_2	C_1	C_2		I_{10}	I_{25}	I_{50}	Q_{10}	Q_{25}	Q_{50}		
1	0.6	3.5	12.5	5.0	3.5	1.46	-	0.5	-	86	36	42	46	7.3	8.5	9.3	BR 2x12[a]	Existing structure at A_1 is 18[a]
2	0.4	1.2	12.5	5.0	4.5	1.41	-	0.5	-	97	34	39	44	6.6	7.6	8.6	BCE 2[a]	
3	0.4	0.6	27.5	10.0	5.5	0.35	-	0.5	-	23	71	83	92	3.4	4.0	4.4	∅ 1.6 [a]	
4	0.2	0.4	12.5	7.5	5.5	0.63	-	0.5	-	18	85	100	105	7.0	8.2	9.1	BR 10[a]	Existing structure on Access R-5.1[a]
5	0.4	0	15	5.0	5	0.35	-	0.5	-	7	106	123	136	2.2	2.5	2.8	∅ 1.5	Invest.No.10
6	2.3	0	12.5	5.0	5	2.85	0.72	0.5	0.7	61	42	49	54	19.3	22.6	24.9	BR 10[a] & ∅ 1.5	-do-
7	0.5	0	20	5.0	5	0.09	-	0.5	-	8	106	123	136	1.3	1.5	1.7	∅ 1.2	
8	0.5	0.7	22.5	5.0	4.5	0.61	-	0.5	-	56	45	52	57	4.0	4.6	5.0	BCE 2[a]	
9	0.2	0	22.5	6.0	4.0	0.04	-	0.5	-	2	106	123	136	0.5	0.6	0.7	∅ 0.8	
10	11.0	0	35	5.0	3.0	29.53	9.23	0.4	0.7	230	22	25	28	112.8	131.3	143.6	BR 2x13[a], BR 10[a]x2	Invest.No.13,14
11	0.3	0	18	5.0	5	0.06	-	0.5	-	5	106	123	136	0.8	1.0	1.1	∅ 0.9	
12	0.4	0	15	6.0	6.0	0.13	-	0.5	-	7	106	123	136	1.9	2.2	2.4	∅ 1.5	
13	3.0	0	30	6.0	4.0	3.08	0.42	0.4	0.7	55	45	53	58	19.5	22.9	25.1	BR 10[a] BCE 2[a]	Railway Br. 5[a]
14																		
15	2.3	0	30	6.0	6.0	1.61	0.40	0.4	0.7	41	53	62	68	13.6	15.9	17.4	BR 10[a]	Invest.No.19
16	0.6	0	34.0	10	10	0.20	-	0.5	-	8	106	123	136	2.0	2.4	2.7	BCE 2[a]	
17	0.3	0	34.0	15	15	0.07	-	0.5	-	4	106	123	136	1.0	1.1	1.3	∅ 1.2	
18	0.3	2.2	38.5	5	2.2	2.32	0.52	0.4	0.7	95	34	40	44	12.2	14.3	15.8	BR 15[a], ∅ 1.2	Invest.No.20
19	3.1	4.6	30	5	2.0	7.64	1.55	0.4	0.7	227	24	27	33	27.6	31.0	36.6	BR 2x13[a]	Invest.No.21,22,23
20	0.4	0.7	34.5	5	2.0	0.43	-	0.5	-	29	61	71	78	4.1	4.8	5.3	∅ 1.5 x 2	Invest.No.24
21	0.3	0	26.0	2.5	2.5	0.13	-	0.5	-	4	106	123	136	1.9	2.2	2.4	∅ 1.5	
22	3.1	6.5	30	5	2.0	11.09	2.00	0.4	0.7	329	19	21	23	30.8	34.0	37.3	BR 2x13[a]	Invest.No.25,54
23	3.1	0	8.0	2.5	-	0.44	-	0.5	-	31	61	71	78	3.7	4.3	4.7	∅ 1.2	
24	1.9	0	30	2.5	-	2.36	-	0.5	-	53	42	49	53	13.7	16.0	17.3	BR 15[a]	Existing Structure BCE 1[a]5, BCE 3[a]x1.5[a]
25	0.5	0	3.0	2.5	-	0.13	-	0.5	-	32	59	69	76	1.0	1.2	1.3	∅ 1.0	Existing Pipe ∅ 1.2
26	1.7	0	7.5	2.5	-	1.04	-	0.5	-	58	46	53	58	5.6	7.6	8.3	BR 10[a]	Invest.No.28
27	0.8	0	7.5	2.5	-	0.34	-	0.5	-	22	72	84	93	3.4	3.9	4.3	∅ 1.8x2	
28	0.6	1.1	30	5	2.5	2.53	-	0.5	-	52	65	54	59	16.3	18.9	20.7	BR 15[a]	Invest.No.29
29	1.5	0	25	5	-	3.12	-	0.5	-	27	64	75	83	9.9	11.6	12.8	BCE 5[a]	Invest.No.30
30	0.3	0	12.5	7.5	-	0.11	-	0.5	-	7	106	123	136	1.6	1.8	2.0	∅ 1.5	
31	0.9	0	12.5	5	-	0.41	-	0.5	-	22	72	84	93	4.1	4.7	5.3	BCE 2[a]	
32	0.8	0	19	3.5	-	0.37	-	0.5	-	20	75	88	96	3.8	4.5	4.9	BCE 2[a]	
33	0.8	0	12.5	3.5	-	0.27	-	0.5	-	18	80	93	105	3.0	3.4	3.8	BCE 2[a]	Invest.No.31
34	0.6	0	13	5	-	0.27	-	0.5	-	16	85	100	113	3.2	3.7	4.2	BCE 2[a]	
35	0.6	0	12.5	5	-	0.24	-	0.5	-	14	93	107	120	3.1	3.5	4.0	BCE 2[a]	
36	0.6	0	30	5	-	0.20	-	0.5	-	8	106	123	136	2.9	3.4	3.7	BCE 2[a]	

[a] Inventory of Flood Area (Appendix)

NOTE : When time of concentration is less than 10 mins, rainfall intensity for 10 mins. is adopted.

Table 21. Cost List of Major Materials

(in Rs.of 1983 price)

Material	Description	Unit	Market cost
Steel bar	Mild steel	t	8,650.0
H shaped steel	300x300x10x15	t	4,140.0
	Tor steel	t	9,460.0
Cement	Poltrand	t	1,590.0
Asphalt	Grade (80-100)	l	6.3
Wood	Plank 25x300x1000	each	44.9
	Scantling 100x150x5000	M^3	88.4
Aggregate	Sand	M^3	85.6
	Gravel	M^3	76.5
	Crushed rock (¾"-0)	M^3	318.8
	Crushed rock (1½"-0)	M^3	350.6
	Crushed rock (2"-0)	M^3	191.3
	Rubble	M^3	106.3
Ready Mixed Concrete	Class P (Ock=350kg/cm^2)	M^3	1,980.0
	Class A (Ock=240kg/cm^2)	M^3	1,680.0
	Class B (Ock=210kg/cm^2)	M^3	1,600.0
	Class C (Ock=180kg/cm	M^3	1,500.0
Pressed concrete beam	Length 10m	each	6,742.0
	Length 13m	each	9,290.0
	Length 16m	each	13,500.0
RCC Pile	355x355x10	each	8,748.4
RC Pipe (10m)	ϕ 600(610x2438)	each	1,045.7
	ϕ 900(914x1219)	each	888.5
	ϕ1200(1219x1219)	each	1,307.6
	ϕ1500(1524x1219)	each	2,282.5
	ϕ1800(1829x2438)	each	5,972.3

Table 22. CIF Prices of Machinery and Plant

(cost in Rs.)

No.	Machinery & Plant Class	CIF Price	Local Charge	No.	Machinery & Plant Class	CIF Price	Local Charge
1	Bull dozer 11 ton soft ground	1,530,000	7,500	25	Vibration Roller 3.5 ton	338,000	1,000
2	" " 15-17 ton	2,660,000	13,000	26	" " 10 ton	1,096,000	7,000
3	" " 19 ton	3,620,000	13,000	27	Sheep foot Roller 6-12 ton	756,000	6,500
4	" " 19 ton with Ripper	2,910,000	13,000	28	Vibration Compacting Plate 90 Kg	96,000	1,000
5	" " 25 ton with Ripper	4,070,000	14,500	29	Air Compressor 5 m^3/min	202,000	4,000
6	Loader 1.0 m^3 wheel type	787,000	7,500	30	Air Compressor 10 m^3/min	415,000	5,000
7	" 1.5 m^3 wheel type	1,124,000	8,500	31	Wheel Crane 5 ton	857,000	1,500
8	" 2.1 m^3 crawler type	3,100,000	14,000	32	Crawler crane 10-15 ton	1,988,000	8,000
9	" 3.0 m^3 wheel type	1,910,000	10,000	33	Truck crane 25 ton	2,117,000	14,000
10	Back-hoe 0.3 m^3	540,000	12,500	34	Crawler crane 40 ton	4,218,000	18,000
11	" 0.6 m^3	1,012,000	15,000	35	Diesel Pile Hammer with 2.5 ton Run	4,650,000	10,000
12	" 1.2 m^3	1,124,000	17,500	36	Belt Conveyor 10 m	250,000	1,000
13	Power shovel 1.2 m^3	1,898,000	18,000	37	Power Broom 2.4 m	1,459,000	1,500
14	Clan shell 0.6 m^3	2,249,000	15,000	38	Asphalt Distributer	1,068,000	5,000
15	Pickup 2 ton truck	209,000	1,000	39	Asphalt Finisher	877,000	5,000
16	" 4 ton truck	309,000	1,000	40	Portable Generator 60 KVA	199,000	5,000
17	Concrete Mixer 3.5 m^3	765,000	1,500	41	" " 100 KVA	312,000	6,000
18	Dump Truck 6 ton	449,000	4,000	42	" " 200 KVA	630,000	7,500
19	" " 8 ton	676,000	6,000	43	Portable Crushing Plant 50 ton	5,451,000	25,000
20	Water Truck 6-10 ton	538,000	6,000	44	Asphalt Mixing Plant 50 ton	5,317,000	20,000
21	Mortar Gradert 3.7 m	1,818,000	8,500	45	Soil Mixing Plant 150 ton	2,700,000	20,000
22	Tyre Roller 6-10 ton	571,000	6,000	46	Dredger 1100 PH	29,440,000	50,000
23	" " 10-20 ton	698,000	9,500				
24	Road Roller 10-15 ton	715,000	9,500				

Table 23. Duty Rate

(Tariff Heading No.)		
(25.22)	1) Lime stone	12.5%
(25.23)	2) Portland cement & Clinker	free
(26.02,03)	3) Slag or ash from manufacture of iron	5%
(27.06)	4) Tar distilled from coal	5%
(27.10)	5) Kerosene & Crude oil	free
	Fuel oil & lubricating oil	5%
(27.14)	6) Petroleum bitumen from industrial asphalt	25%
(27.15)	7) Natural asphalt, asphalt rock or tar sand	50%
(27.16)	8) Cut backs asphalt, mixture of natural asphalt	50%
(68.11)	9) Concrete pipes & fittings	50%
(73.10)	10) Bars and rods of iron or steel	25%
	Wire rods of iron	12.5%
(73.11-15)	11) Angles, shapes of V.I.H. and sheet piling	5%
(73.06)	12) Ingots of iron	5%
(73.17)	14) Tubes and pipes of cast iron	50%
(73.25)	15) Stranded wire, cables	25%
(73.27)	16) Gauge, fencing, netting	50%
(73.31)	17) Nail, staples	25%
	18) Machinery	
(84.22)	A. Lifting, handling, loading	12.5%
(84.23)	B. Excavating shovel. bulldozer	5%
(84.56)	C. Crushing mixing plant	5%
	20) Electrical equipment & goods	
(85.01)	A. Generator	free
(85.09)	B. Lighting & signalling	50%
(85.10)	C. Portable battery	100%
(85.11)	D. Welding machine	50%
	21) Automobiles	
(87.01)	A. Road tractor	5%
(87.02)	B. Sedan	over 40%-120%
(87.02)	C. Mini bus 10-15 persons	25%
	over 15 persons	7.5%
(87.03)	D. Road sweeper, crane etc	25%
(87.06)	E. Parts & accessories of motor vehicles	35%
(87.09)	F. Motorcycles auto cycles	12.5%
(89.01-05)	22) Ship, boats, other vessels but, yachts and other vessels for pleasure or sports	25%

Table 24. Machine Operation Cost

(Rs.)

	Total	Foreign	Local	Tax
Bull Dozer 11 ton	1,608	1,435	116	57
" " 15-17 ton	2,607	2,399	120	88
" " 19 ton	3,326	3,102	120	104
" 19 ton with Repper	3,135	2,892	120	123
Wheel Loader 1.5 m^3	1,498	1,316	117	65
Crawler Loader 2.1 m^3	2,895	2,694	121	80
Wheel Loader 3.0 m^3	2,721	2,472	118	131
Back hoe 0.6 m^3	1,239	1,066	120	53
" " 1.2 m^3	1,686	1,474	121	91
Power shovel	2,089	1,877	121	91
Clamshell 0.6 m^3	1,973	1,796	120	57
Pickup truck 4 ton	966	818	89	59
Dump Truck 6 ton	846	724	91	31
" 8 ton	982	853	92	37
Motor Grader 3.7 m	2,547	2,380	117	50
Tyre Roller 6-10 ton	621	485	115	21
" " 10-20 ton	819	670	117	32
Road Roller 10-15 ton	813	664	117	32
Vibration Roller 10 ton	1,040	896	116	28
Vibration Plate Compactor	230	132	89	9
Air Compressor 5 m^3/min	683	549	91	43
" " 10 m^3/min	1,316	1,137	91	88
Wheel crane 5 ton	752	623	113	16
Crawler crane 10-15 ton	1,524	1,379	117	28
Truck crane 25 ton	1,719	1,561	120	38
Crawler crane 40 ton	2,985	2,819	122	44
Diesel Pile Hammer 2.5ton	3,670	3,473	118	79
Power broom 2.4	1,733	1,478	113	142
Asphalt Distributer 4000 l	2,179	1,960	116	103
Asphalt Finisher 3.6 m	1,616	1,434	117	65
Portable Generator 100 KVA	1,712	1,490	92	130
Portable Generator 200 KVA	2,272	2,017	93	162

Table 25. Results of Unit Cost Analysis

(in Rs. of 1983 price)

Item	Sub-item	Unit	Unit Cost Foreign	Local	Tax	Total
EARTH WORK						
Cut & Fill						
Clearing & Grubbing		M^2	16.19	4.12	1.20	21.51
Cutting & Filling	Soil	M^3	*-1	-	-	-
Borrow Filling	-do-	M^3	*-1	-	-	-
Soft Ground						
Sand Mat	for Project (B)	M^3	63.47	142.70	17.03	223.20
-do-	for Project (A)	M^3	101.11	145.67	19.57	267.35
Sand Drain Pile	ϕ0.40	M	87.17	11.88	5.08	104.13
Sand Compaction Pile	ϕ0.70	M	195.49	23.91	11.63	231.03
Others						
Slope Protection	Tuff Patching	M^2	0.39	54.26	3.07	57.72
Box Culverts		each	*-2	-	-	-
Pipe Culverts		each	*-2	-	-	-
Drainage	4-Lane	XX	102,194	515,476	40,196	657,866
-do-	2-Lane	XX	76,646	386,607	30,147	493,400
PAVING WORK						
Surface Course	Asphalt	ton_2	903.20	65.62	78.82	1,047.64
Tack Coat	-do-	M^2	1.78	0.07	0.17	2.02
Binder Course	-do-	ton_2	759.89	66.55	71.77	898.21
Prime Coat	-do-	M^2	6.33	0.07	0.60	7.00
Base Course	Bituminous Stabilization	ton	517.44	183.39	61.91	762.74
-do-	Crushed Stone	M^3	346.60	55.25	23.34	425.19
Sub Base	Gravel & C.A	M^3	217.93	96.36	20.65	334.94
Course	Soil Cement	M^3	290.38	20.79	29.19	340.36
do Shoulder	Asphalt	M^2	118.79	18.89	5.04	147.72
Pavement Curve	P.C. Curve	M	14.92	249.51	12.39	276.82
-do-	Asphalt Curve	M	51.16	10.27	4.88	66.31
Lane Mark	Paint	M	11.51	0.07	0.38	11.96
MISCELLANEOUS WORK						
Median Strip	Inc. Plantation	M	132.13	158.81	18.73	309.67
Guard Rail	Steel	M	1,027.30	16.80	32.16	1,076.26
Illumination		each	1626,797	49,002	56,637	1732,436
Traffic Signal		each	914,245	10,317	28,835	953,398
Road Sign		LS	*-3	-	-	-
Fence	Steel Panel	M	781.52	54.61	33.34	869.47
-do-	Barbed Wire	M	-	69.68	4.21	73.89
Frontage Rd. Pave.	Crushed Stone	M	319.96	140.04	29.02	489.02
BRIDGE						
Highway Bridge		each	*-4	-	-	-
Over Bridge		each	*-4	-	-	-

Note: *-1 : See TABLE 7-
*-2 : See TABLE 7-
*-3 : See TABLE 7-
*-4 : See TABLE 7-

Table 26. Unit Cost of Cut and Fill

(in Rs.at 1983 price)

Item	Sub-Item	Unit	Unit Cost			
			Foreign	Local	Tax	Total
Cutting & Filling						
L = 80m	Bulldozer Work	M^3	30.16	3.87	1.92	35.95
= 1km	Dump Truck Work	M^3	30.77	4.81	2.06	37.64
= 2	-do-	M^3	38.95	5.55	2.60	47.10
= 3	-do-	M^3	47.13	6.28	3.13	56.54
= 4	-do-	M^3	55.73	7.05	3.76	66.53
= 5	-do-	M^3	64.32	7.81	4.38	76.51
= 6	-do-	M^3	73.64	8.94	5.01	87.60
Borrow Filling						
L = 7km	-do-	M^3	59.07	15.50	4.32	78.89
= 10	-do-	M^3	75.54	18.10	5.47	99.11

Note : Material Carriage Distance

Table 27. Unit Cost of Road Sign

(in Rs.at 1983 price)

Item	Unit	Unit Cost			
		Foreign	Local	Tax	Total
Road Sign					
Double Pole Type	Each	70,298	4,982	2,689	77,969
Hang Over Type	Each	36,852	3,471	1,304	41,627
Over Head Type	Each	66,733	54,719	7,367	126,819

Table 28. Main Construction Quantities (Project A, B)

ITEM		DESCRIPTION	CLASS	Unit	QUANTITY				
					P-1(S)	P-3(H)	K-1(A)	K-2(A)	K-3(A)
EARTH WORK	Cutting & Filling	Clearing & Grubbing		m²	—	14,400	173,000	230,000	242,000
		Cutting & Filling	Soil	m³	2,800	—	394,000	632,000	281,000
		Borrow Filling	-do-	m³	154,000	602,000	26,000	128,000	550,000
	Soft Ground Work	Sand Mat		m³	75,500	100,000	—	—	—
		Sand Drain Pile	φ0.40	m	88,200	91,600	—	—	—
		Sand Compaction Pile	φ0.70	m	—	68,700	—	—	—
	Others	Slope Protection	Turf Patching	m²	13,200	53,400	54,800	82,800	98,900
		Box-Culvert	8.0×5.0	each	1	—	1	1	—
			3.0×3.0, 2.0×2.5	each	—	—	10	13	17
		Pile-Culvert	φ1.80, 1.50	each	2	—	2	3	3
			φ1.20, 0.90	each	—	3	3	3	1
		Road Drainage		km	2.51	2.40	7.01	8.23	8.76
PAVING WORK	Carriage Way	Surface Course	Asphalt	ton	(4,300)	(5,230)	(1,200)	(12,600)	(14,300)
		Binder Course	-do-	ton	11,400	14,800	22,000	24,500	28,000
		Base Course	Bitumious Stabilization	ton	5,850	8,340	22,000	24,500	21,000
			Crushed Stone	m³	7,100	6,710	20,000	18,700	19,100
		Sub Base Course	Gravel and C.Stone	m³	7,690	8,940	20,000	—	—
			Soil Cement	m³	—	—	—	16,700	19,100
	Others	Shoulder Pavement		m²	—	12,000	27,800	30,400	38,200
		Curve	P.C Curve	m	6,980	1,360	—	—	—
			Asphalt Curve	m	—	—	2,420	2,460	3,400
		Lane Mark	Paint	m	8,880	17,700	40,000	44,100	51,100
MISCELLANEOUS WORK	Miscellaneous	Median Strip	Plantation	m	—	—	7,010	8,230	8,050
		Guard Rail	Steel	m	3,730	10,900	9,660	9,840	17,000
		Illumination		vol	0.5	1.5	2.0	1.0	1.5
		Traffic Signal		vol	2.5	—	—	—	—
		Road Sign		Ea	1.0	1.5	2.0	1.0	1.5
		Fence	Panel Fence	m	3,030	2,400	—	—	—
			Barbed Wire Fence	m	—	3,050	14,000	16,500	10,500
		Frontage Road		m					
BRIDGE	Main Road	Highway Bridge	10≦L≦15m	m²	262.5	175	1,102.5	1,085	577.5
			15≦L≦30m	m²	612.5	962.5	455	980	945
			30≦L≦80m	m²	—	—	910	—	1,400
	Crossing Road	Over Bridge	L=28m	m²	—	—	663.6	1,548.4	663.6
			L=66m	m²	—	—	442.4	442.4	—

Table 29. Main Construction Quantities (Project A)

ITEM		DESCRIPTION	CLASS	Unit	QUANTITY K=1 (2)	K=2 (2)	K=3 (2)	K=1 (4)	K=2 (4)	K=3 (4)
EARTH WORK	Cutting & Filling	Clearing & Grubbing		m²	173,000	230,000	242,000	–	–	–
		Cutting & Filling	Soil	m³	312,000	500,000	435,000	81,700	132,000	36,600
		Borrow Filling	-do-	m³	–	38,800	122,000	28,000	87,100	207,000
	Soft Ground Work	Sand Mat		m³	70,300	18,100	–	–	–	–
		Sand Drain Pile	φ0.40	m	–	–	–	–	–	–
		Sand Compaction Pile	φ0.70	m	–	–	–	–	–	–
	Others	Slope Protection	Turf Patching	m²	54,800	82,800	98,300	27,400	41,400	49,100
		Box-Culvert	4.0×3.0	each	1	1	–	–	–	–
			3.0×3.0, 2.0×2.5	each	10	13	17	–	–	–
		Pile-Culvert	φ1.60, 1.50	each	2	3	3	–	–	–
			φ1.20, 0.90	each	3	3	–	–	–	–
		Road Drainage		km	7.01	8.23	8.76	7.01	8.23	8.76
PAVING WORK	Carriage Way	Surface Course	Asphalt	ton	(6,500)	(8,900)	(8,300)	(11,200)	(12,600)	(14,100)
		Binder Course	-do-	ton	12,700	15,500	16,300	10,000	11,800	11,300
		Base Course	Bituminous Stabilization	ton	12,700	13,800	12,100	10,000	11,800	8,630
			Crushed Stone	m³	11,600	9,300	11,200	9,100	8,020	7,850
		Sub Base Course	Gravel and C. Stone	m³	11,600	–	–	9,100	–	–
			Soil Cement	m³	–	9,300	11,200	–	8,020	7,850
	Others	Shoulder Pavement		m²	27,800	36,400	36,800	12,200	14,400	14,100
		Curve	P.C. Curve	m	2,420	2,460	3,400	17,210	1,230	1,700
			Asphalt Curve	m	32,000	35,700	42,000	40,000	43,300	51,100
		Lane Mark	Paint	m	7,010	–	–	7,010	8,230	8,050
MISCELLANEOUS WORK	Miscellaneous	Median Strip	Plantation	m	9,660	9,840	13,600	–	–	–
		Guard Rail	Steel	m	–	–	–	–	–	–
		Illumination		set	2.0	1.0	1.5	–	–	–
		Traffic Signal		set	–	–	–	–	–	–
		Road Sign		set	2.0	1.0	1.5	–	–	–
		Fence	Panel Fence	m	–	–	–	–	–	–
			Barbed Wire Fence	m	14,000	16,300	10,500	–	–	–
		Frontage Road		m	–	–	–	–	–	–
BRIDGE	Main Road	Highway Bridge	L=15m	m	613.9	623.9	231.4	551.3	542.5	201.3
			L=25m	m	281.6	562.5	543.4	227.5	490	472.5
			L=40m	m	–	–	405	455	–	700
	Crossing Road	Over Bridge	L=28m	m	683.6	1,327.2	884.8	–	–	–
			L=56m	m	147.4	147.4	–	–	–	–

Table 30. Project Construction Cost (Case-5). (Financial)

(in million R.S)

SECTION / ITEM	PROJECT(B) P-1	P-2	P-3 (L)	P-5	SUB TOTAL	PROJECT(A) K-1 (B)	K-2 (B)	K-3 (B)	-1 OTHERS	SUB TOTAL	TOTAL	REMARKS
EARTH WORK	31.78	-	53.98	5.01	90.77	52.15	66.33	55.03	5.05	181.46	272.23	(33%) *2
PAVING WORK	18.60	2.71	31.76	3.47	56.54	59.60	62.91	61.36	21.79	205.66	262.20	(32%)
MISCELLANEOUS WORK	10.53	5.18	21.90	5.17	42.87	26.24	24.76	30.55	6.14	87.69	130.56	(16%)
BRIDGE	9.69	-	10.09	1.47	21.25	41.45	49.36	36.75	1.40	129.05	150.30	(19%)
CONSTRUCTION COST	70.60	7.89	117.82	15.12	211.43	179.44	203.36	184.59	34.47	603.86	815.29	(66%)*3 (100%)
LAND ACQUISITION	33.50	-	-	-	33.50	46.04	40.64	51.65	8.10	146.52	180.11	(15%)
CONTINGENCY	15.63	1.18	17.67	2.27	36.75	33.62	36.90	35.45	6.40	112.57	149.32	(12%)
ENGINEERING SURVICE etc.	7.06	0.79	11.78	1.51	21.14	17.94	20.54	18.46	3.45	60.39	81.53	(7%)
PROJECT COST	126.88	9.86	147.27	18.90	302.01	277.24	303.44	290.15	52.51	923.34	1.226.25	(100%)
ROAD LENGTH (KM)	1.50	1.30	2.00	...	5.76	7.14	8.39	9.91	...	25.44	31.20	
TOTAL COST/ROAD LENGTH	81.30	7.60	50.80	...	52.60	38.80	36.20	29.30	...	36.30	39.30	

NOTE *1 OTHERS K-4, K-5, K-7
*2 ( ) : percentage of construction cost
*3 ( ) : percentage of project cost

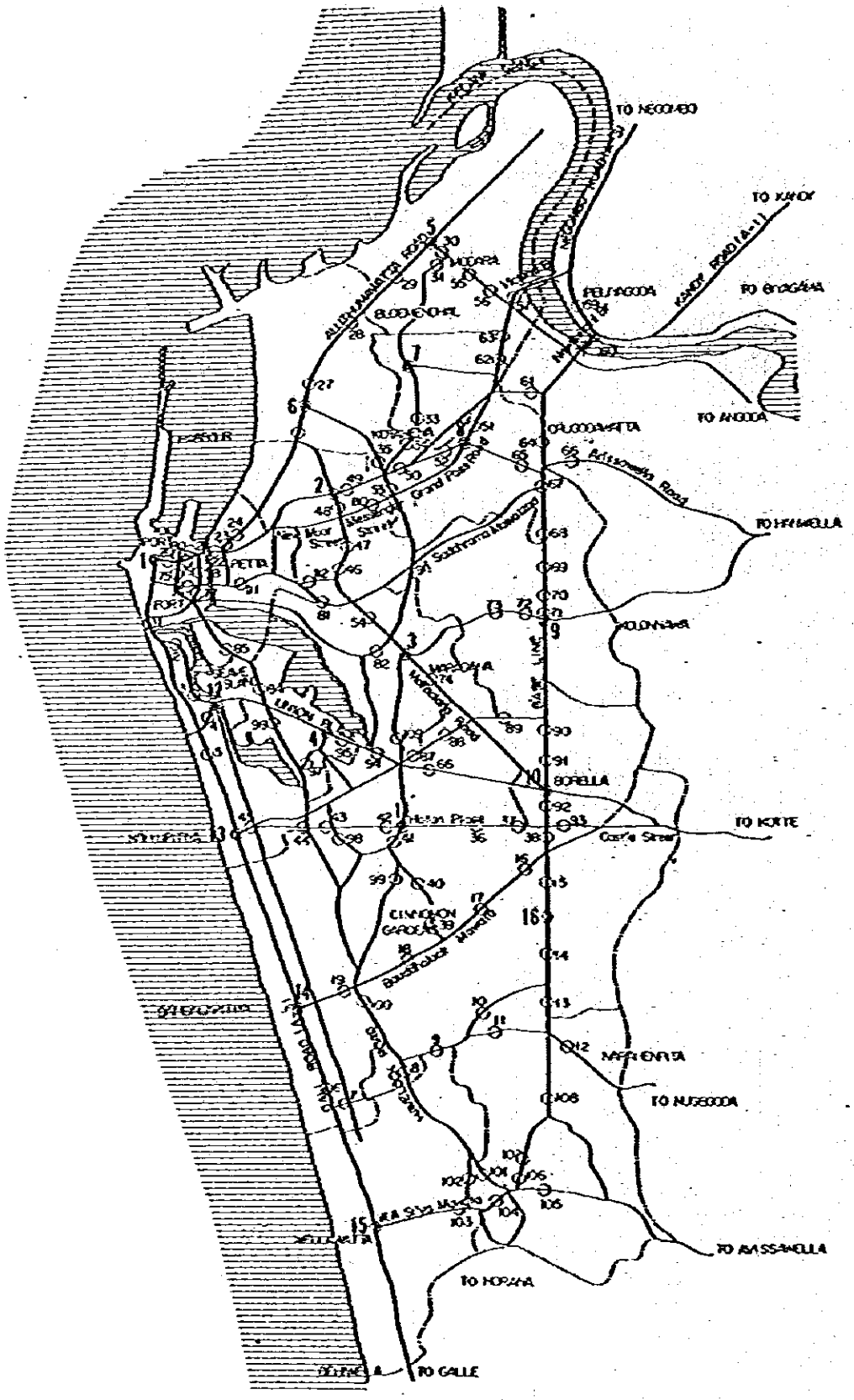


Fig. 1. The Survey Points of the Road Inventory

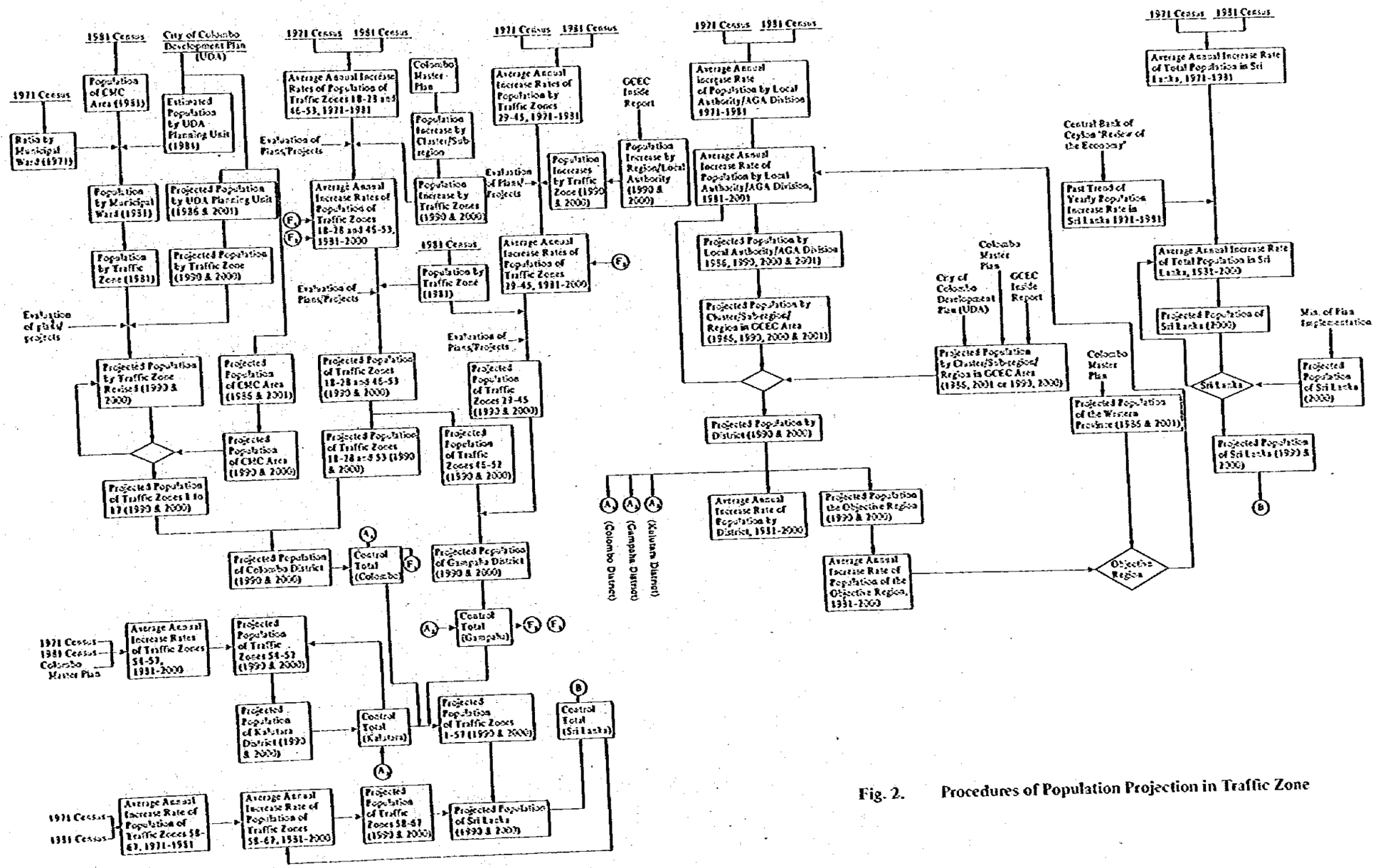


Fig. 2. Procedures of Population Projection in Traffic Zone

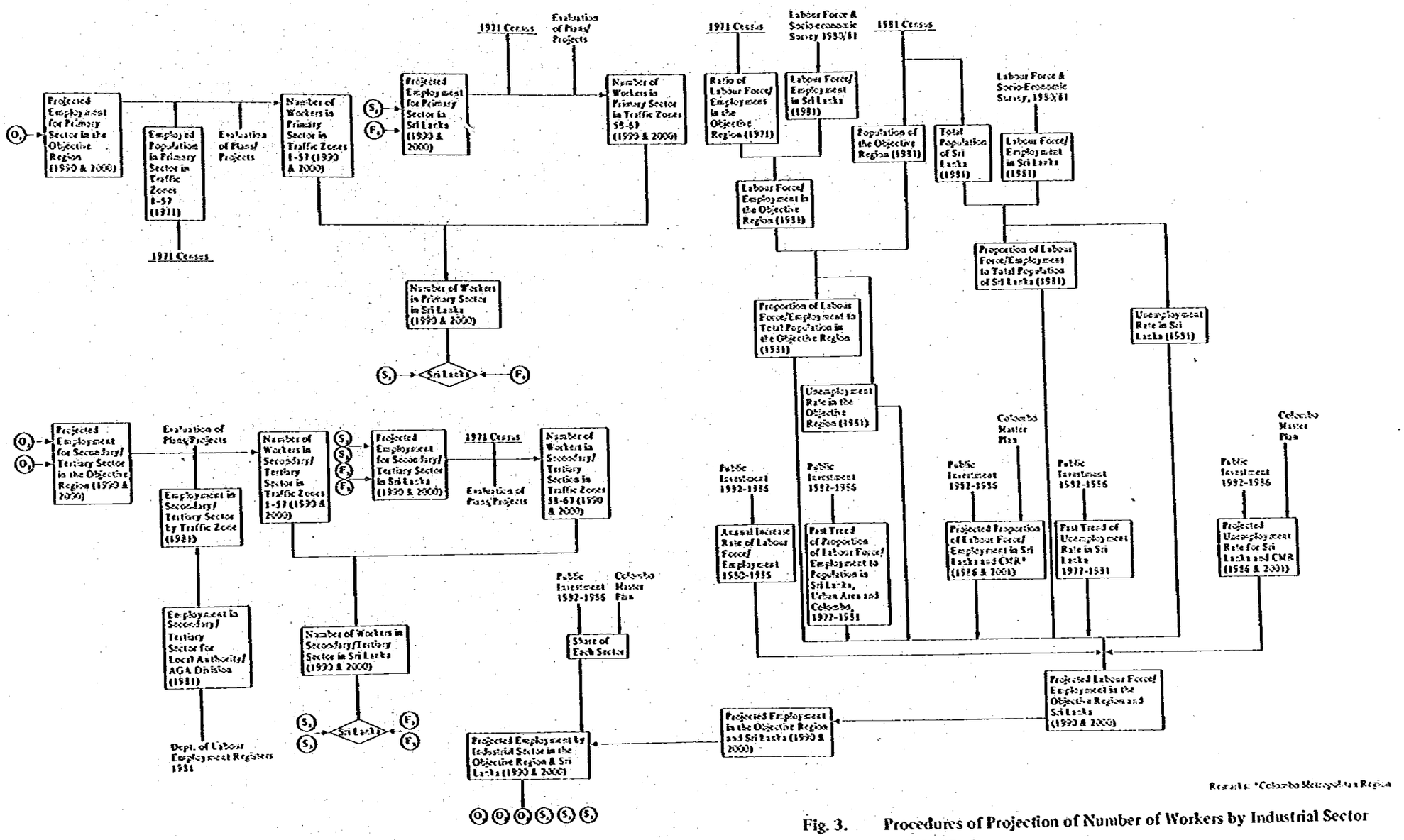


Fig. 3. Procedures of Projection of Number of Workers by Industrial Sector and Traffic Zone

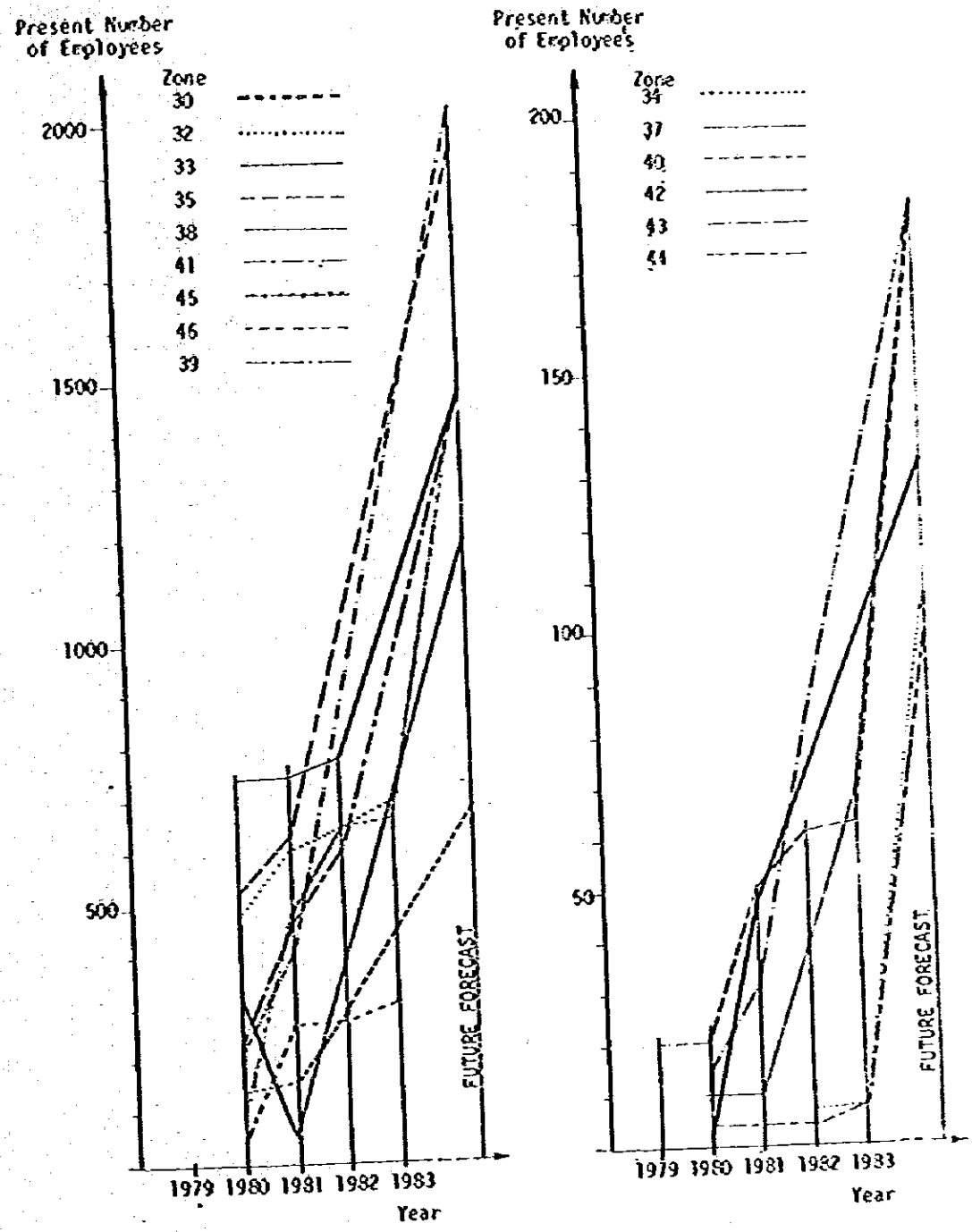


Fig. 4. Number of Private Companies by Zone

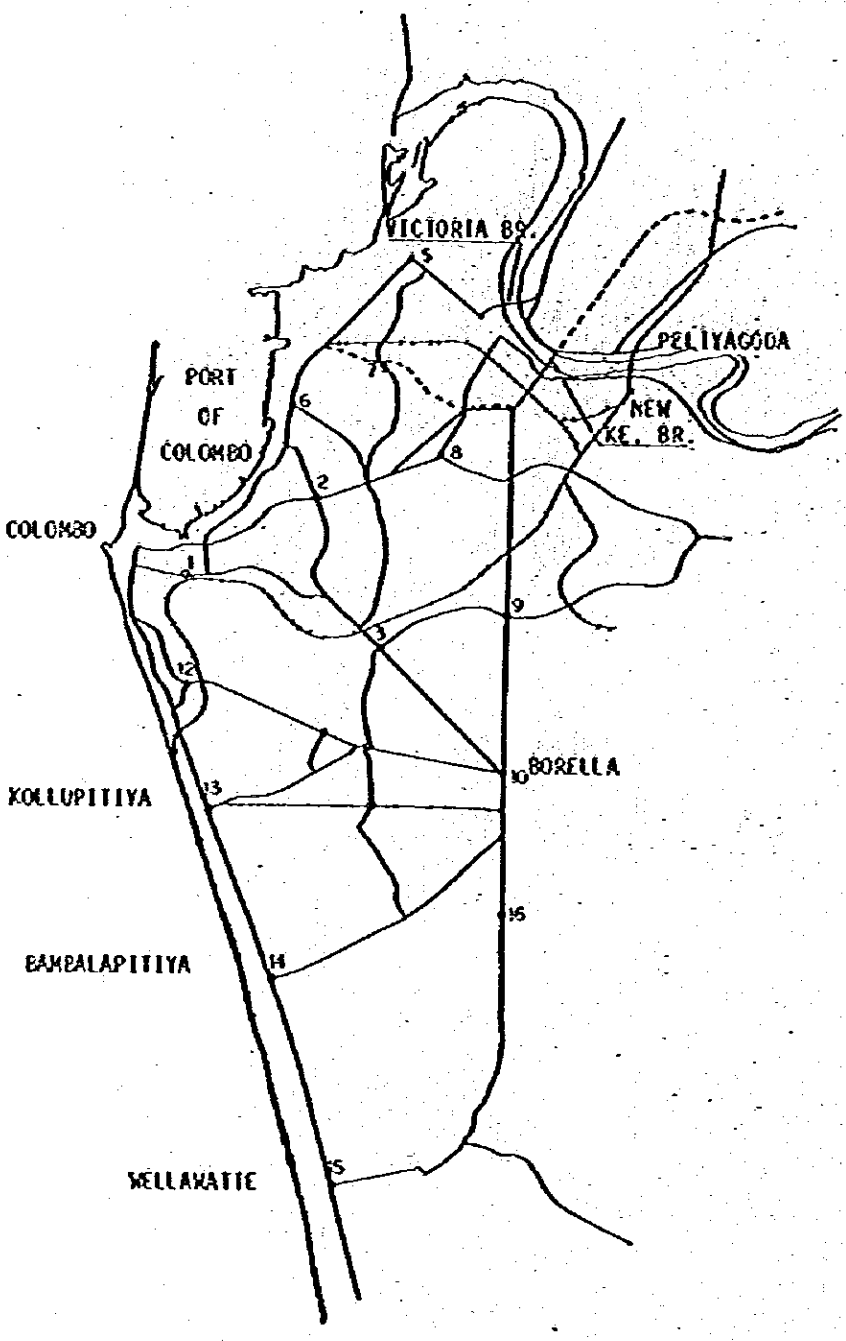


Fig. 5. Road Network for Traffic Assignment within Colombo

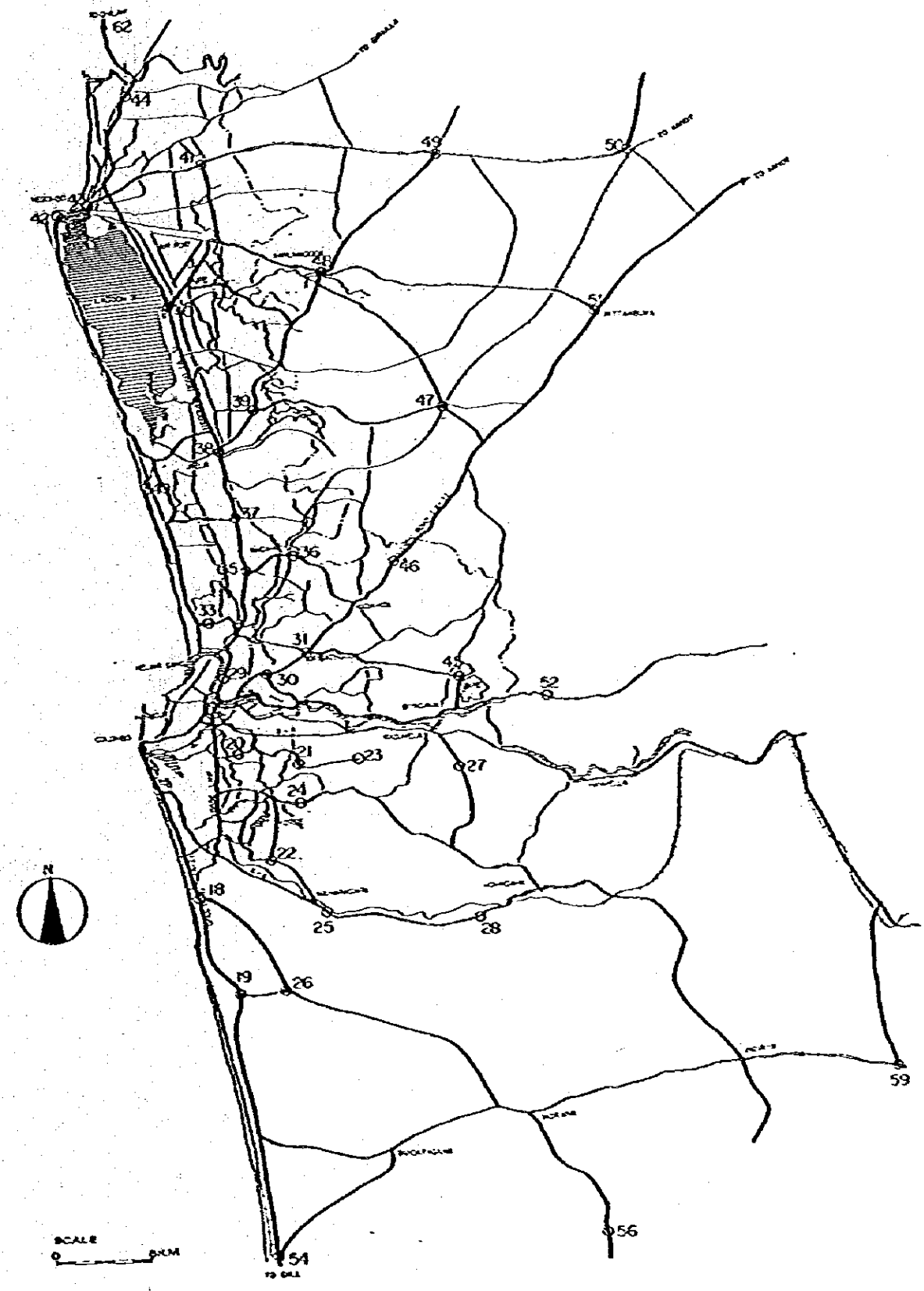


Fig. 6. Road Network for Traffic Assignment – Objective Area –

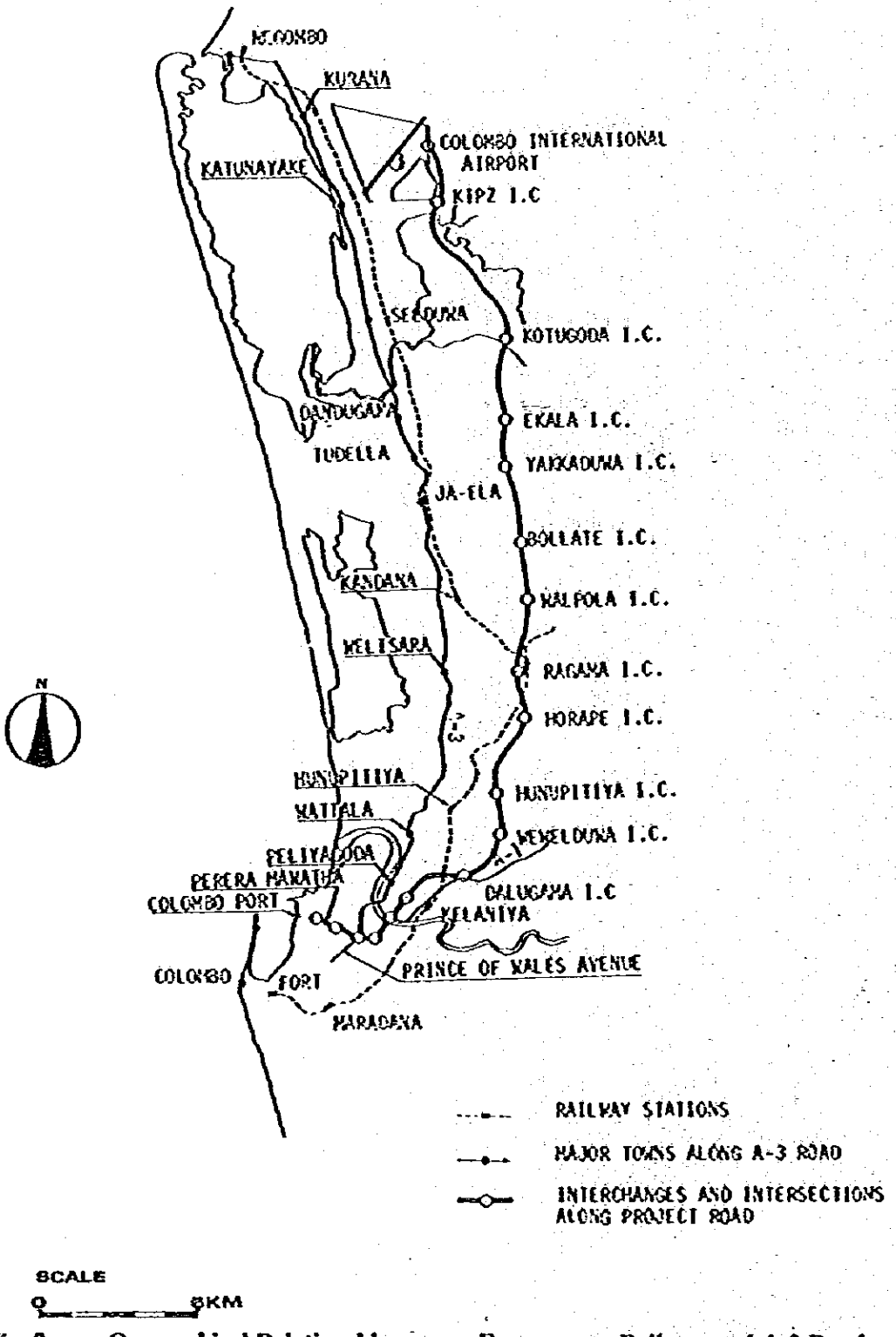


Fig. 7. Geographical Relationship among Expressway, Railway and A-3 Road

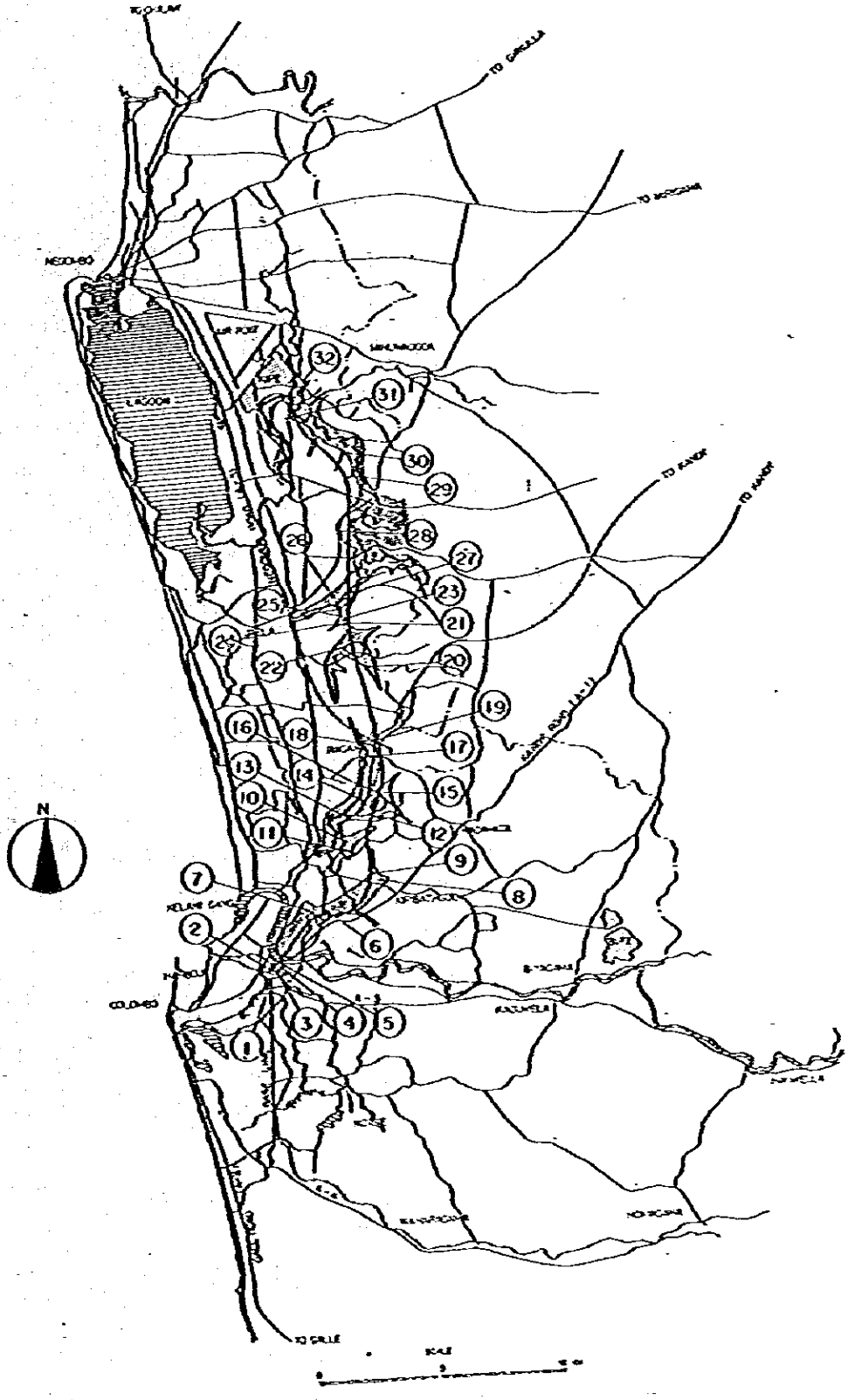


Fig. 8. Location of Existing Flood Relief Drainage Structures

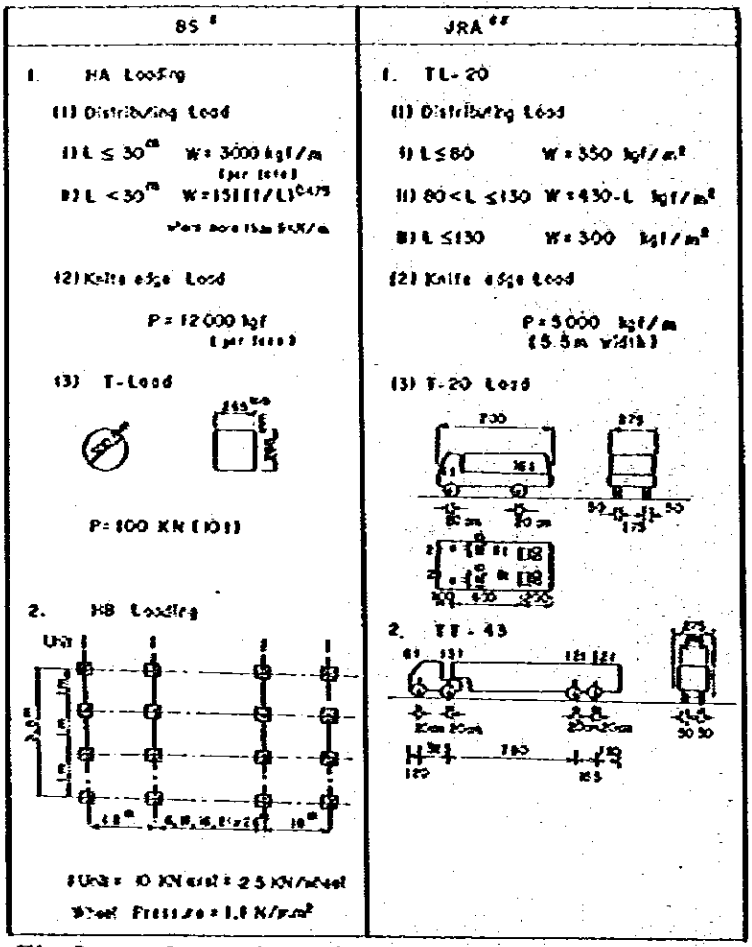
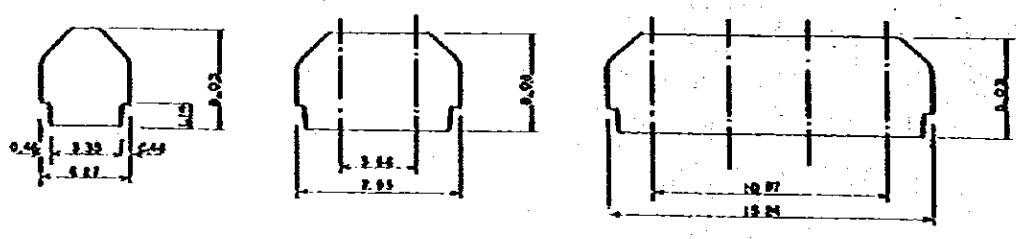


Fig. 9. Comparison of BS and JRA Loads

* Bs : British Standards
** JRA : Japan Road Association



Unit : m

Fig. 10. Standard Gauge of Railway

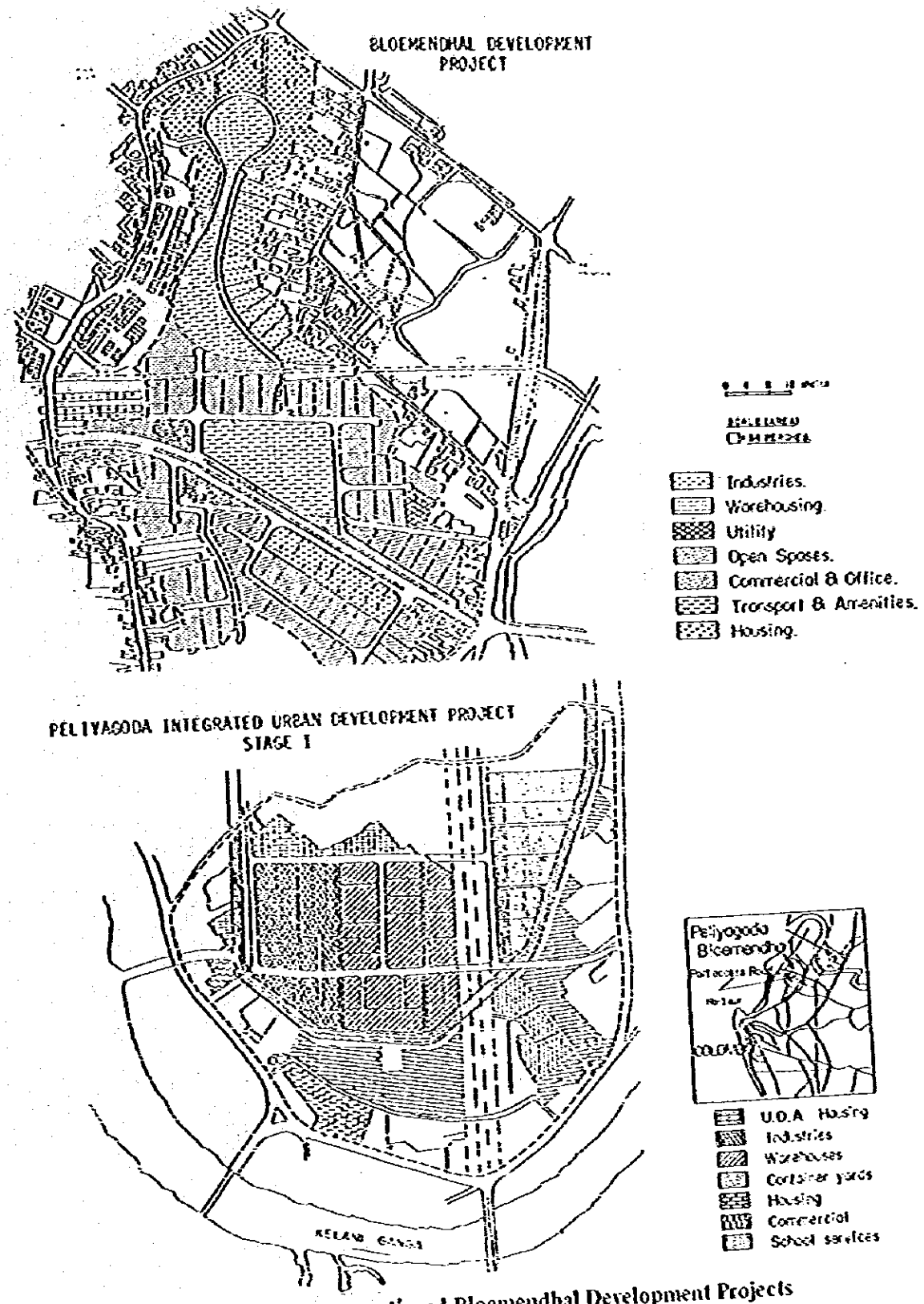


Fig. 11. Peliyagoda and Bloemendhal Development Projects

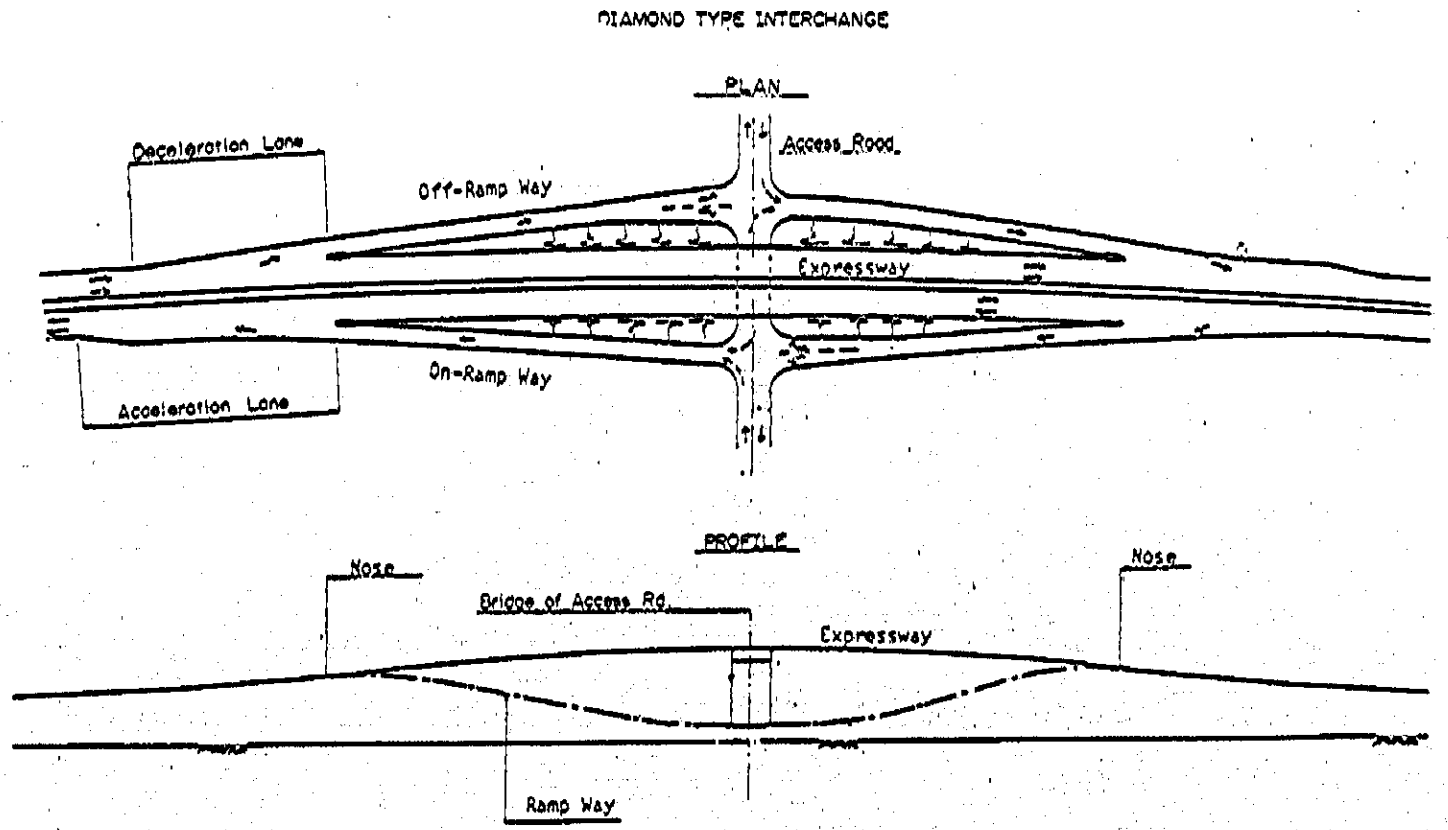


Fig. 12. Standard Plan of Interchange

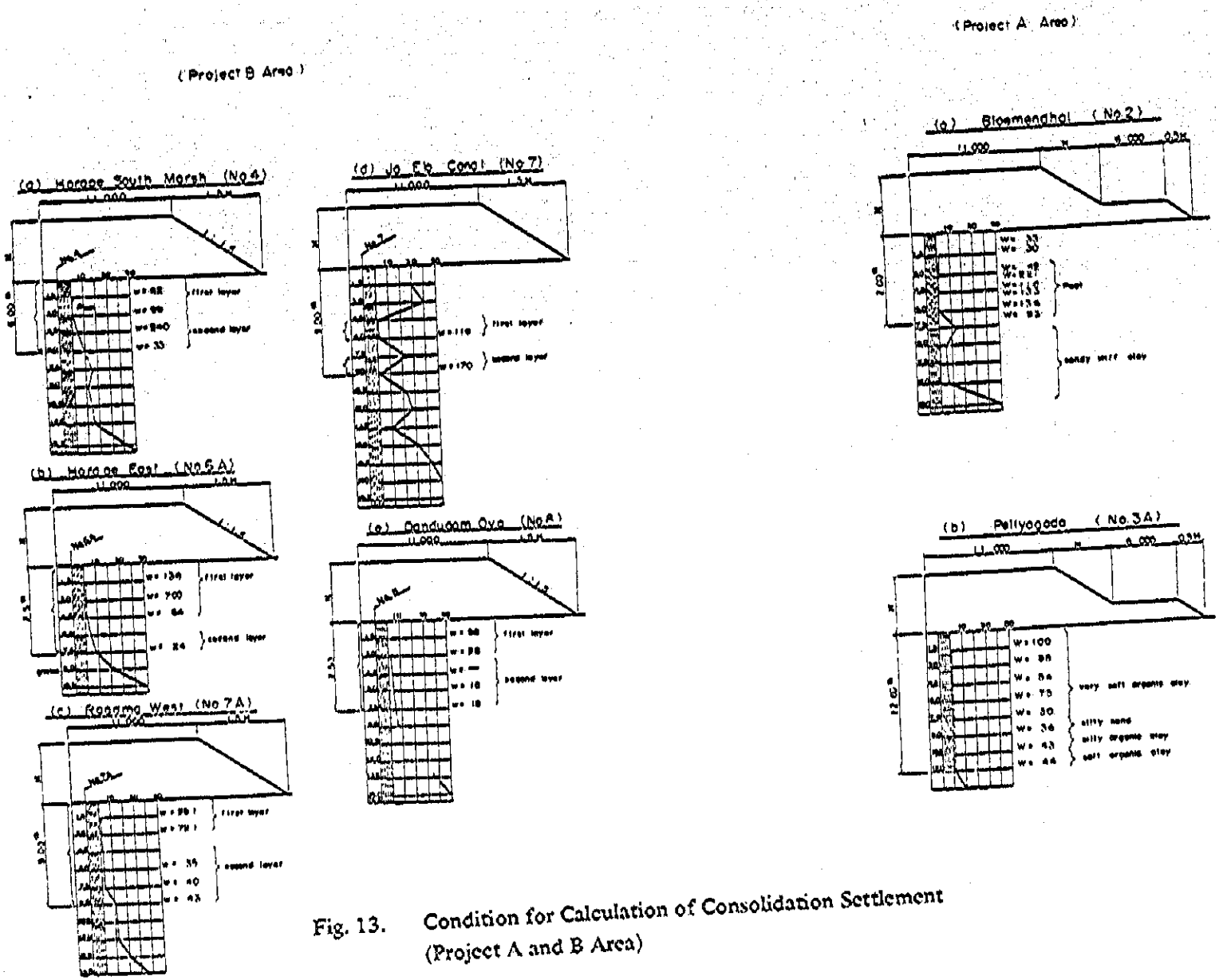


Fig. 13. Condition for Calculation of Consolidation Settlement (Project A and B Area)

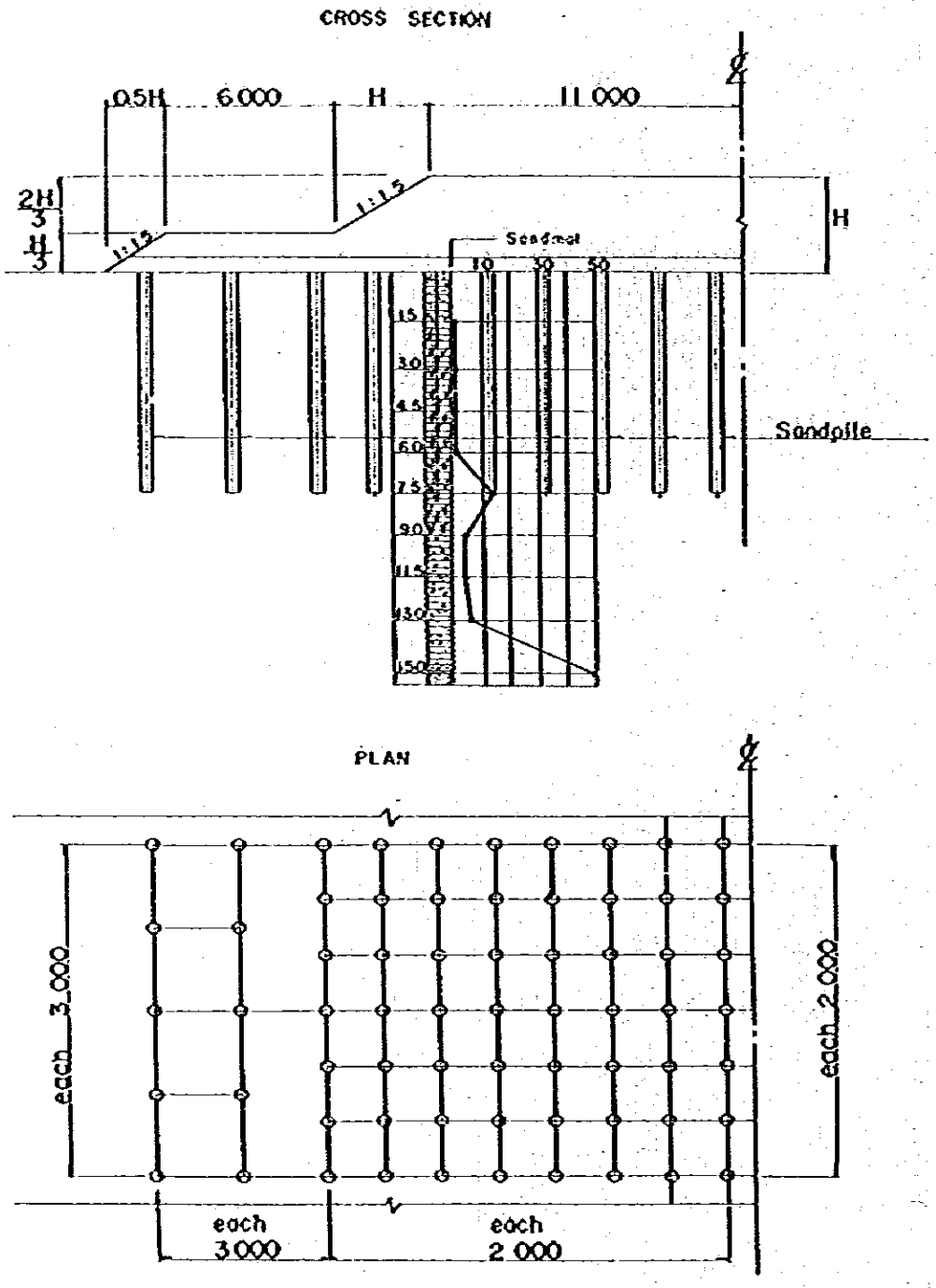


Fig. 14. Sand Pile Arrangement

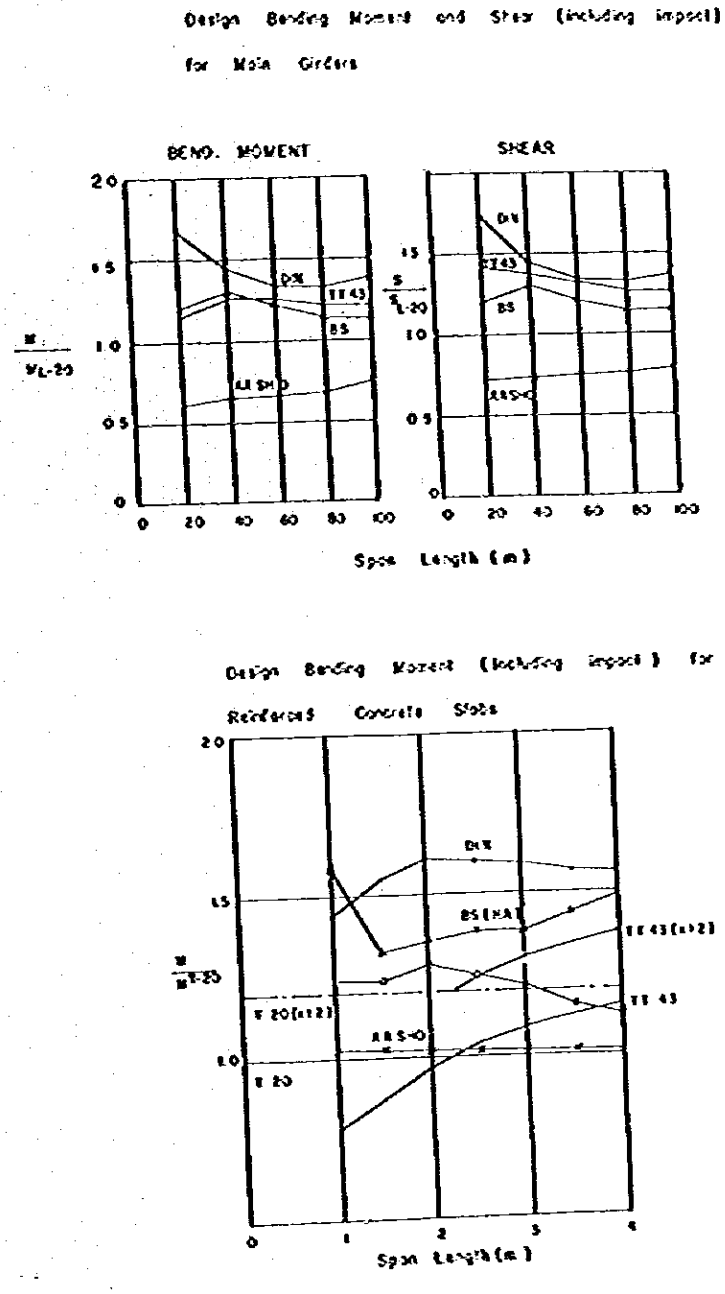
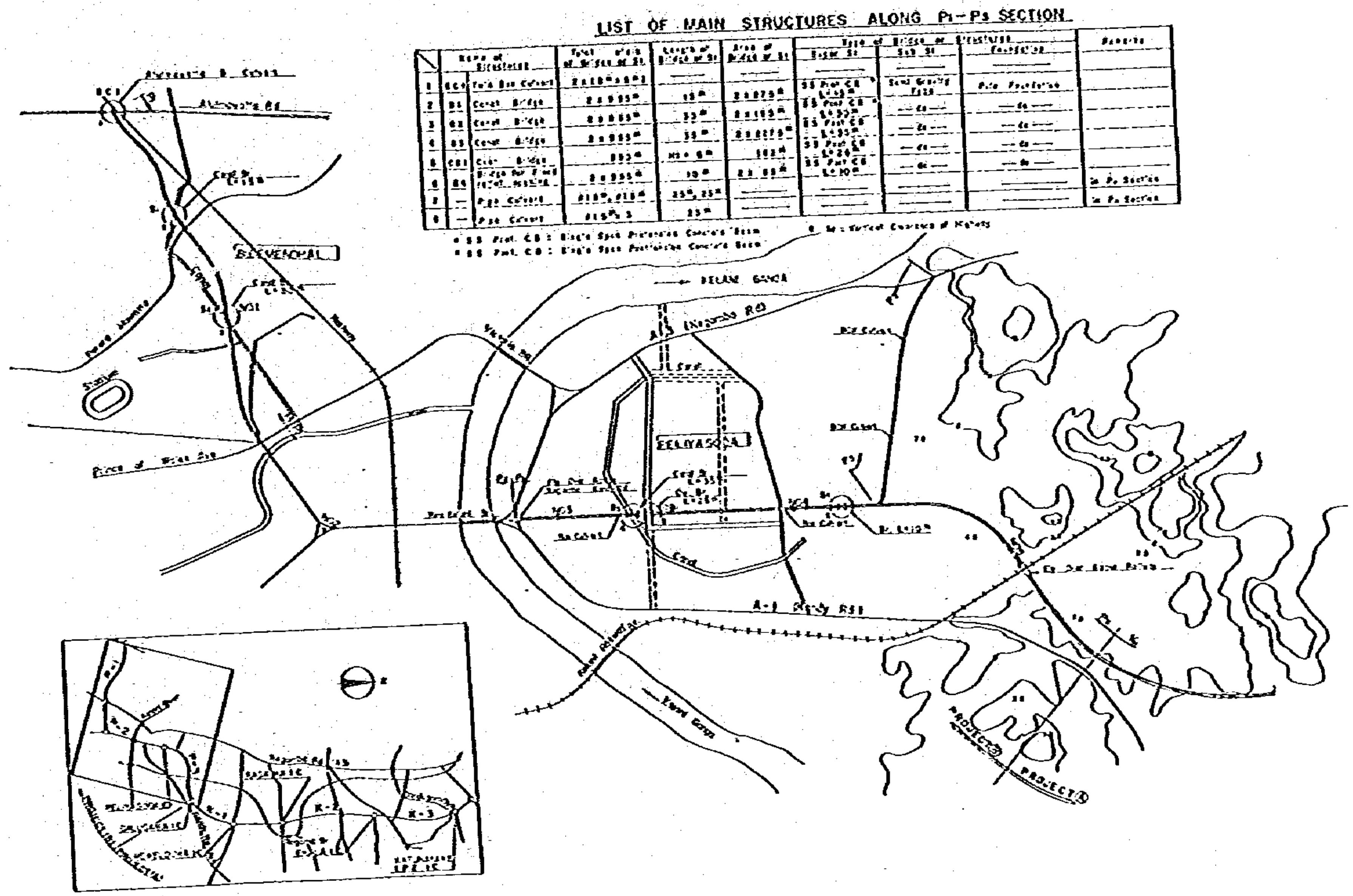


Fig. 15. Design Bending Moment and Shear (Including Impact)



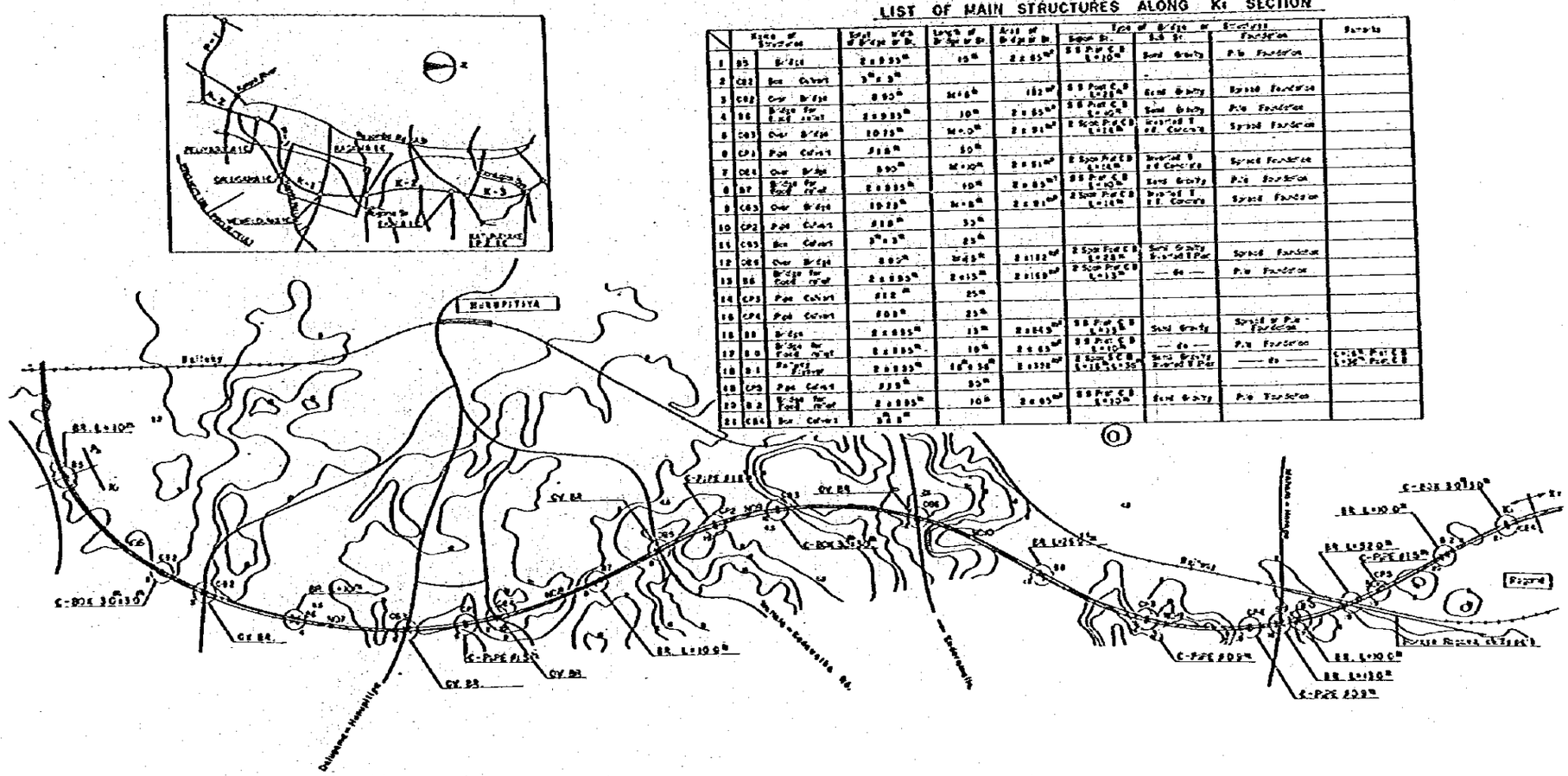
LIST OF MAIN STRUCTURES ALONG P1 – P3 SECTION

	Name of Structure		Total Width of Bridge or St	Length of Bridge or St	Area of Bridge or St	Type of Bridge or Structure: Super St	Sub St	Foundation	Remarks
1	[illegible]	Twin Box Culvert	[illegible]	—	—	SS Prst CB* L=[illegible]	Semi Gravity Type	Pile Foundation	
2	B1	Canal Bridge	[illegible]	15m	[illegible]	SS Prst CB* L=[illegible]	do	do	
3	B2	Canal Bridge	[illegible]	33m	[illegible]	SS Prst CB L=[illegible]	do	do	
4	B3	Canal Bridge	[illegible]	33m	[illegible]	SS Prst CB L=[illegible]	do	do	
5	[illegible]	[illegible] Bridge	[illegible]	[illegible]	[illegible]	SS Prst CB L=10m	do	do	
6	[illegible]	Bridge for [illegible]	[illegible]	10m	[illegible]	—	—	—	in P3 Section
7	—	Pipe Culvert	[illegible]	25m, 25m	—	—	—	—	in P3 Section
8	—	Pipe Culvert	[illegible]	25m	—				

* SS Prst. CB : Single Span Prestressed Concrete Beam

* SS Prst. CB : Single Span Prestressed Concrete Beam

Fig. 16. Location of Structures along P1 ~ P3 Section



LIST OF MAIN STRUCTURES ALONG K1 SECTION

		Kind of Structure	Size of Structure	Length of Structure	Area of Structure	Type of Bridge or Structure: Super Str.	Sub Str.	Foundation	Remarks
1	BS	Bridge	2 x 8.55m	19m	2 x 85m²	8 Span P.C.B L=19m	Steel Gravity	Pile Foundation	
2	CB2	Box Culvert	3m x 3m			-	-	-	
3	CB2	Over Bridge	8.55m	14+6m	182m²	8 Span P.C.B L=19m	R.C.C Gravity	Spread Foundation	
4	BS	Bridge for Road Level	2 x 8.55m	19m	2 x 85m²	8 Span P.C.B L=19m	Steel Gravity	Pile Foundation	
5	CB3	Over Bridge	10.75m	14+0m	2 x 91m²	8 Span P.C.B L=19m	Inverted T of Concrete	Spread Foundation	
6	CP3	Pipe Culvert	3.18m	30m					
7	CB4	Over Bridge	8.55m	14+0m	2 x 91m²	8 Span P.C.B L=19m	Inverted T of Concrete	Spread Foundation	
8	BS	Bridge for Road Level	2 x 8.55m	19m	2 x 85m²	8 Span P.C.B L=19m	Steel Gravity	Pile Foundation	
9	CB5	Over Bridge	10.75m	14+0m	2 x 91m²	8 Span P.C.B L=19m	Inverted T of Concrete	Spread Foundation	
10	CP2	Pipe Culvert	3.18m	33m					
11	CB5	Box Culvert	3m x 3m	23m					
12	CB6	Over Bridge	8.55m	14+5m	2 x 112m²	8 Span P.C.B L=22.5m	Steel Gravity R.C.C with P.Cap	Spread Foundation	
13	BS	Bridge for Road Level	2 x 8.55m	2 x 15m	2 x 159m²	8 Span P.C.B L=19m	— do —	Pile Foundation	
14	CP3	Pipe Culvert	3.18m	25m					
15	CP4	Pipe Culvert	3.18m	23m					
16	BS	Bridge	2 x 8.55m	19m	2 x 85m²	8 Span P.C.B L=19m	Steel Gravity	Spread & Pile Foundation	
17	BS	Bridge for Road Level	2 x 8.55m	19m	2 x 85m²	8 Span P.C.B L=19m	— do —	Pile Foundation	
18	B1	Railway Bridge	2 x 8.55m	18m 3.6m	2 x 332m²	2 Span P.C.B L=18.3m, L=3.6m	Steel Gravity Inverted T of Con.	— do —	Center Pier C.B L=3.6m Pier C.B
19	CP5	Pipe Culvert	3.18m	33m					
20	B2	Bridge for Road Level	2 x 8.55m	19m	2 x 85m²	8 Span P.C.B L=19m	Steel Gravity	Pile Foundation	
21	CB6	Box Culvert	3m x 3m						

Fig. 17. Location of Structures along K-1 Section

LIST OF MAIN STRUCTURES ALONG K-2 SECTION

		Name of Structure	Total width of Bridge in M	Length of Bridge in M	Area of Bridge in M²	Type of Bridge or Structure — Super St.	Sub St.	Foundation	Remarks
1	CB1	Over Bridge	10.75 M	24 × 10 M	2 × 81 M²	2 Span Prst CB L=16 M	Inverted T r.c. Concrete	Spread F.	
2	CB2	Box Culvert for Road Crossing	3 M × 3 M						
3	B/3	Bridge for Road Xing	2 × 6.95 M	10 M	2 × 69.5 M²	2 Span Prst CB L=16.2 M	Semi Gravity	Pile F.	
4	B/4	Bridge for Railway	2 × 8.35 M	13 M	2 × 108.5 M²	2 Span Prst CB L=13 M	do	Spread F.	
5	CB5	Box Culvert	3 M × 3 M						
6	CB7	—do—	3 M × 3 M						
7	CB8	Over Bridge	8.95 M	20 × 8 M	2 × 81 M²	2 Span Prst CB L=16 M	Inverted T r.c. Concrete	Spread F.	
8	CB8	Box Culvert	6 M × 3 M						
9	CB9	Over Bridge	8.82 M	30 × 10 M	2 × 81 M²	2 Span Prst CB L=16 M	Inverted T r.c. Concrete	Spread F.	
10	CP8	Pipe Culvert	12.55 M	23 M					
11	CB10	Over Bridge	10.25 M	30 × 8 M	2 × 81 M²	2 Span Prst CB L=16 M	Inverted T r.c. Concrete	Spread F.	
12	CB11	do	8.82 M	30 × 15 M	2 × 162 M²	2 Span Prst CB L=28 M	Semi Gravity Abut Inverted T Pier	Spread F.	
13	CP13	Pipe Culvert	11.32 M	28 M					

		Name of Structure	Total width of Bridge in M	Length of Bridge in M	Area of Bridge in M²	Type of Bridge or Structure — Super St.	Sub St.	Foundation	Remarks
14	B/5	Bridge for Road Xing	2 × 8.35 M	63 M	2 × 504 M²	5 Span Prst CB L=35 M	Semi Gravity	Pile F.	
15	B/6	Bridge	—do—	15 M	—do—	—do—	—do—	—do—	
16	CB9	Box Culvert	3 M × 3 M						
17	B/7	Bridge for Road Xing	2 × 9.35 M	13 × 2 M	2 × 26 × 8.4 M²	2 Span Prst CB L=13 M	Semi Gravity	Pile F.	
18	CP8	Pipe Culvert	11.32 M	23 M					
19	CB10	Box Culvert	3 M × 3 M						
20	CB11	do	6 M × 3 M						
21	B/8	Bridge for Road Xing	2 × 8.35 M	15 M	2 × 120 M²	5 Span Prst C B L=15 M	Semi Gravity	Pile F.	
22	B/9	Bridge	—do—	15 M	2 × 120 M²	—do—	—do—	Spread F.	
23	B/10	Important Bridge on K-2 Road	—do—	30 M	2 × 195 M²	5 Span Prst C B L=30 M	—do—	Pile F.	
24	CP9	Pipe Culvert	11.32 M	23 M					
25	CB12	Over Bridge	8.82 M	24 × 5 M	2 × 96 M²	2 Span Prst C B L=16 M	Inverted T r.c. Concrete	Spread F.	
26	CP13	Pipe Culvert	11.32 M	23 M					

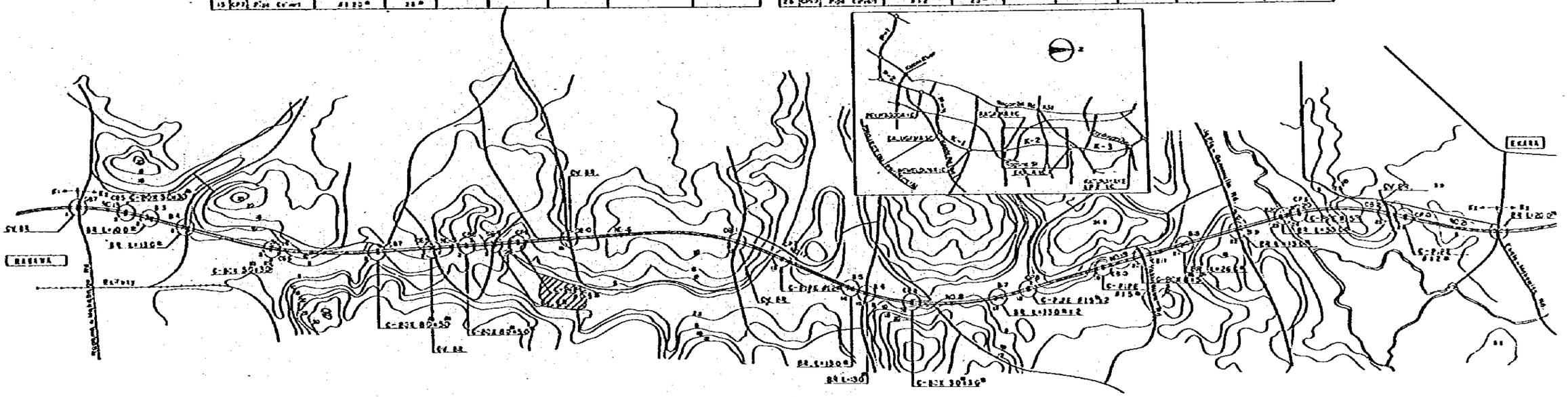
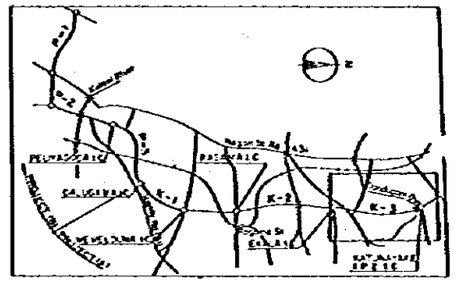


Fig. 18. Location of Structures along K-2 Section

LIST OF MAIN STRUCTURES ALONG K-3 SECTION

	Name of Structure		Total Width of Bridge in M.	Length of Bridge in M.	Area of Bridge in M.	Type of Bridge or Structure: Super St.	Sub St.	Foundation	Remarks
1	B21	Bridge	2 x 9.55 M	60 M	2 x 133 M²	3 Span Pre C.B L=25 M	Solid Gravity	Spread F.	
2	B22	Bridge	2 x 9.55 M	13 M	2 x 24.6 M²	3 Span Pre C.B L=15 M	— do —	— do —	
3	CP21	Pipe Culvert	2 x 1.0 M	25 M					
4	B23	Bridge	2 x 9.55 M	10 M	2 x 88 M²	3 Span Pre C.B L=10 M	Solid Gravity	Spread F.	
5	CP22	Pipe Culvert	2 x 1.0 M	20 M					
6	B24	Bridge	2 x 9.55 M	18 M	2 x 172 M²	3 Span Pre C.B L=18 M	Solid Gravity	Spread F.	
7	OB 3	Over Bridge	8.55 M	30 + 8 M	2 x 81 M²	2 Span Pre C.B L=15 M	Inverted T R.C. Concrete	— do —	
8	B25	3 Span Pre Cast Girder	2 x 9.55 M	78 M	2 x 374 M²	3 Span Pre C.B L=26 M	Solid Gravity	Pile F.	
9	CB 2	Box Culvert	3 M x 3 M						
10	CB 3	— do —	— do —						
11	CB 4	— do —	— do —						
12	CP 23	Pipe Culvert	9.03 M	25 M					

	Name of Structure		Total Width of Bridge in M.	Length of Bridge in M.	Area of Bridge in M.	Type of Bridge or Structure: Super St.	Sub St.	Foundation	Remarks
15	CB 5	Box Culvert	3 M x 3 M						
16	OB 4	Over Bridge	8.55 M	30 + 8 M	2 x 81 M²	2 Span Pre C.B L=15 M			For Sub structural plan
17	CB 6	Box Culvert	3 M x 3 M						
18	CB 7	— do —	— do —						
19	B26	Construction Opt. B-26	2 x 8.55 M	3 Spans 12.25 M	2 x 320 M²	3 Span Pre C.B L=12.25 M	Solid Gravity Narrow Type	Abut + Pile Pier + Cylinder	
20	OB 5	Over Bridge	10.75 M	30 + 8 M	2 x 93 M²	2 Span Pre C.B L=15 M	Inverted T R.C. Concrete	Spread F.	
21	CB 8	Box Culvert	3 M x 3 M						
22	CB 9	— do —	— do —						
23	CB 10	— do —	— do —						



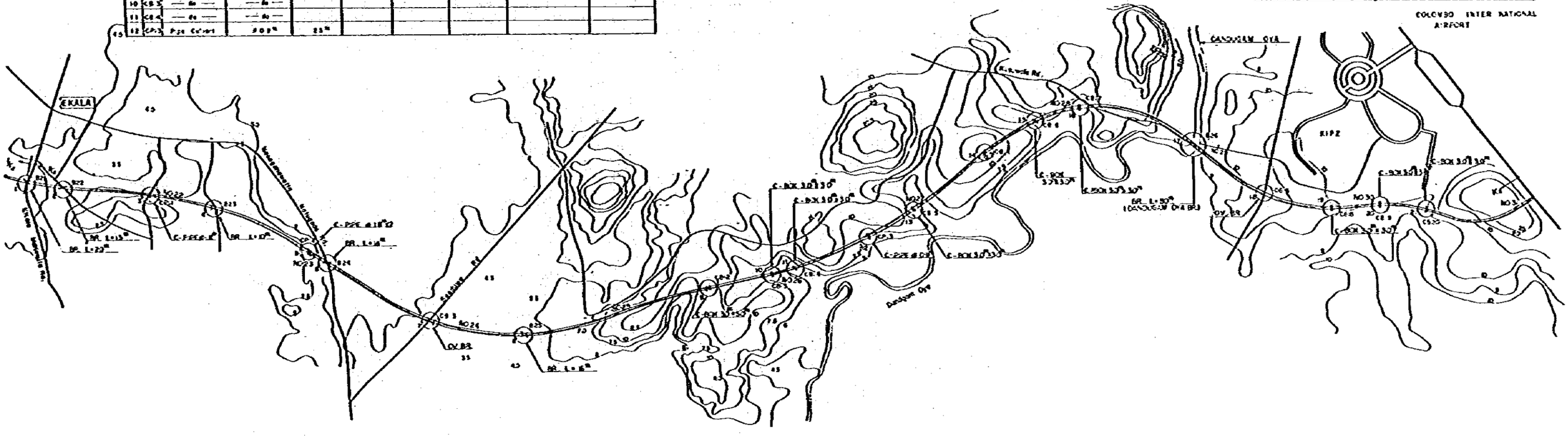
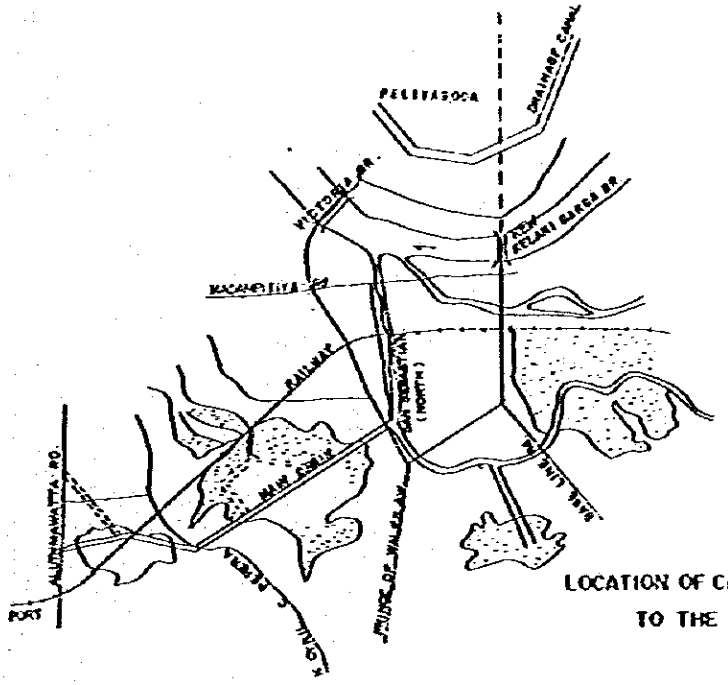


Fig. 19. Location of Structures along K-3 Section



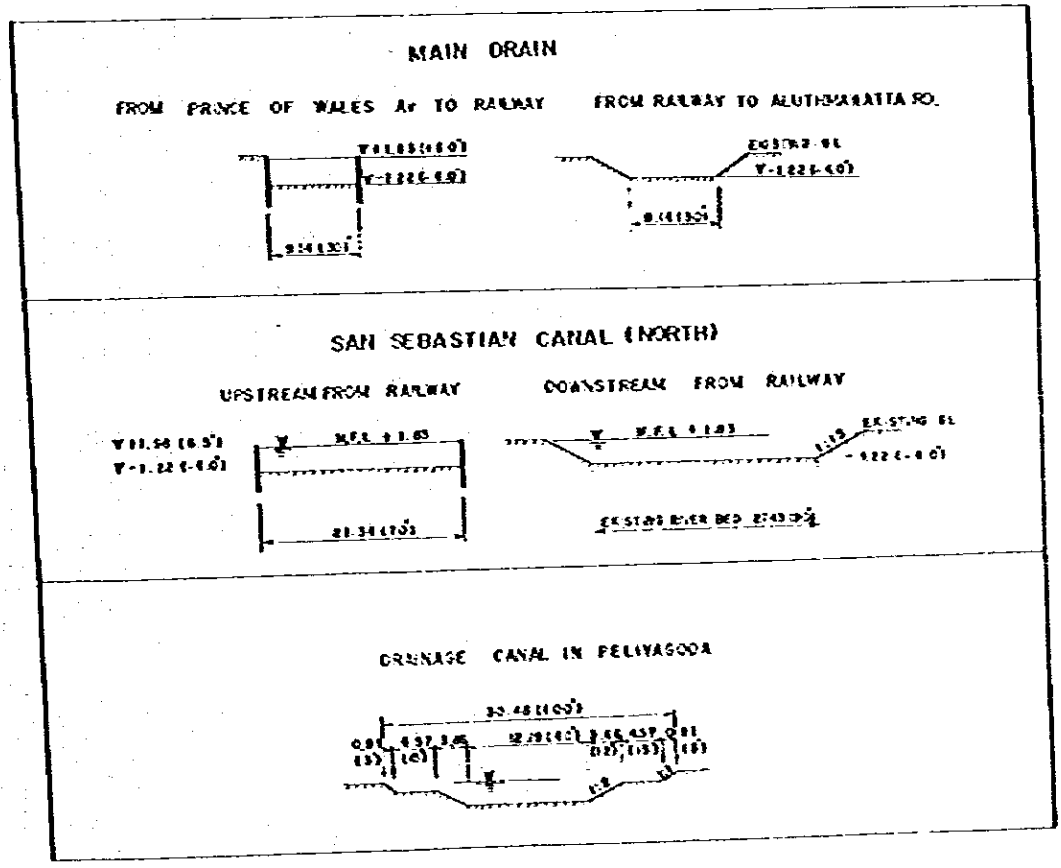
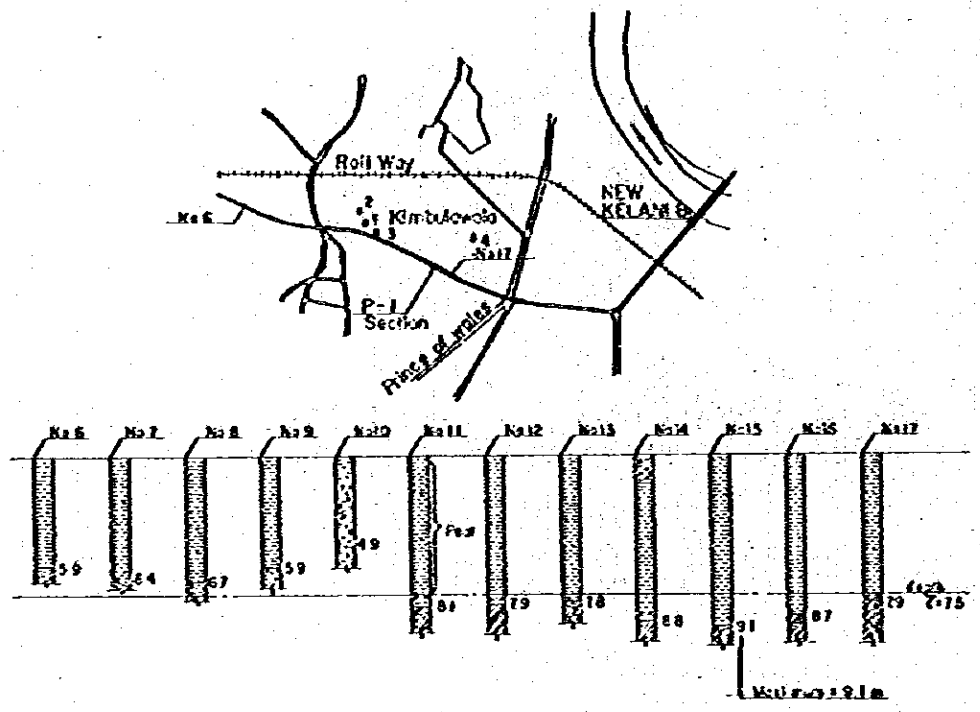


Fig. 20. Typical Cross Sections of Canals



Cone Resistance

Depth (m)	1	2	3	4
0 ~ 1.0				
1.2	1.2			
1.4	1.4			
1.6	1.6			
1.8	1.8			
2.0	2.0			
2.2	2.0			
2.4	2.4			
2.6	2.7			
2.8	2.8			
3.0	3.5			
3.2	3.6			
3.4	3.7			
3.6	3.9			
3.8	3.9			
4.0	4.6	3.5	3.7	
4.2	4.8	3.0	4.2	5.0
4.4	5.0	3.5	3.5	4.5
4.6	5.0	3.5	4.8	5.5
4.8	5.7	3.5	5.0	6.0
5.0	6.2	4.5	8.0	7.5
5.2	7.0	4.5	9.0	9.0
5.4	7.1	4.5	13.5	8.0
5.6	7.7	5.0		8.0
5.8	7.7	5.5		7.0
6.0	8.2	6.0		

Fig. 21. Results of Auger Boring (Existing Data)

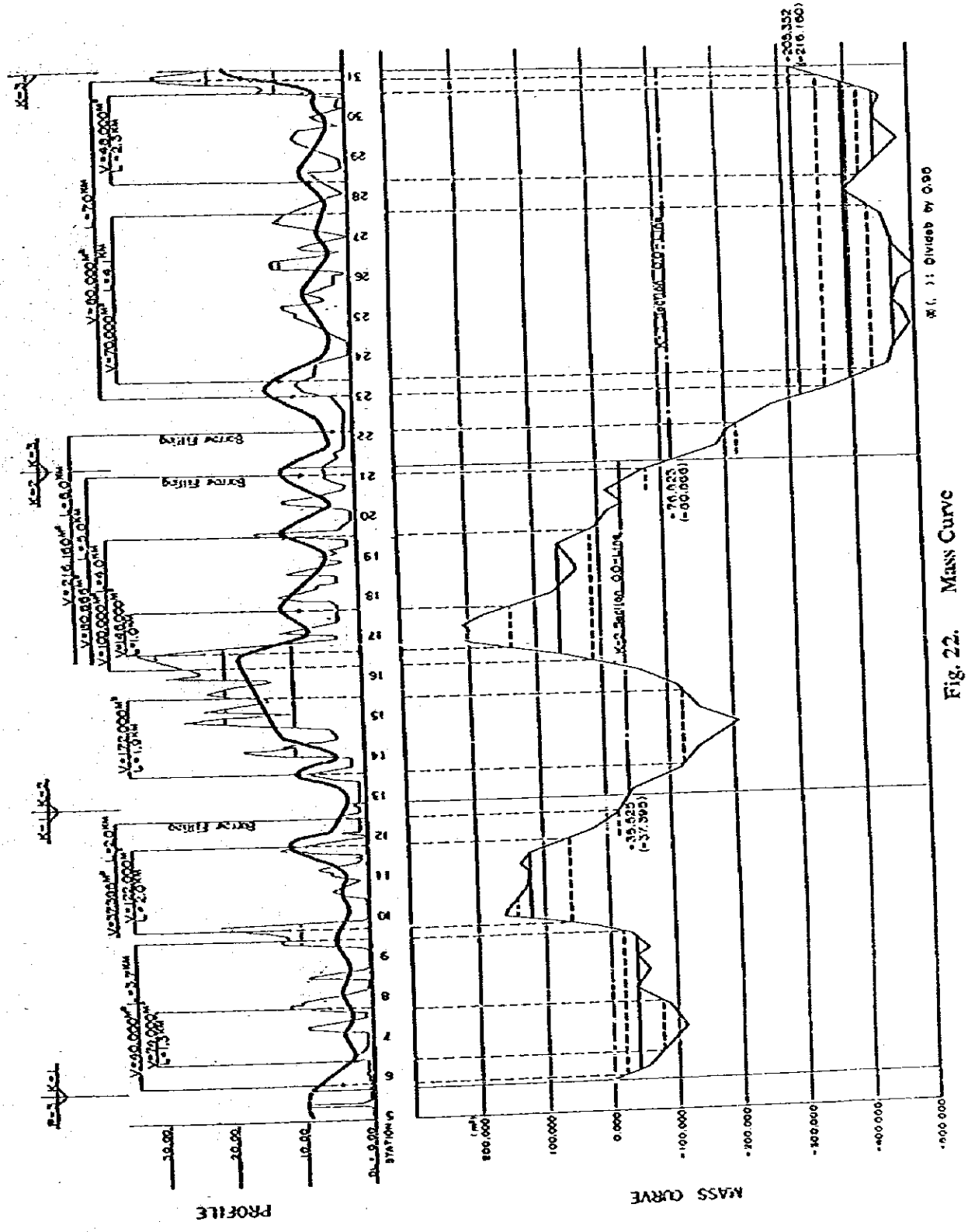


Fig. 22. Mass Curve