8.7 Transportation Cost Estimate

The Vehicle Operating Cost (VOC), Railway Operating Cost (ROC), and Time Value were calculated to obtain the economic benefits of the Masterplan and the projects presented in this Study in terms of transportation costs.

8.7.1 Economic Vehicle Operating Cost

1) Selection of the Representative Models

The models in dominant use at present have been investigated by the following field surveys;

Passenger Car	: Five (5) areas in GCR (CBD, Zamalek, Mohandessin, Attaba Garage, and Giza)
Microbus	: Four (4) microbus terminals in GCR
Medium truck	: Entrance of the Alexandria Agriculture Road
Large truck	: same as above

After the FIAT 128 and FIAT 127, the third most dominantly used passenger car model which can be observed on the roads is the PEUGEOT 504. However, the importation of the model will become difficult because its production in the exporting country will cease. Instead, it is assumed that the higher ranking PEUGEOT 505 will be supplied and that PEUGEOT will maintain the third position in the Egyptian market.

The FIAT 128 which is locally produced and most dominantly used has recently been upgraded mainly in the engine capacity (1100cc to 1300cc) and sold at a higher price than the old model. As for the medium truck with loading capacity around 3 tones, the DAIHATSU is dominant. However, the local production of all models of trucks is being aggressively promoted, and it is therefore safe to assume that there will be difficulty in the importation of this model in the future.

From the above context, it can be pointed out that the trend in the models of the vehicles which are, and will be used seems now to be on a turning point from the phase of utilization of imported vehicles to the phase of diffusion of local made vehicles. The change in the trend has been taken into consideration in the final selection of the representative models in spite of the increasing difficulty in collection of basic data for the estimation of the VOC.

The large bus and minibus services are operated by the CTA, which runs Mercedes minibuses, and mainly Nasr large buses. Therefore these two models were adopted.

The representative models of vehicles which are finally adopted as the basis for calculating the VOC are summarized in the following Table 8.7.1, taking into account the above-mentioned discussion.

Table 8.7.1 Representative Models of Vehicles

Vehicle Type	Representative Model
Passenger Car	FIAT 128, FIAT 127, PEUGEOT 505
Small Bus	MERCEDES (Minibus)
	RAMSES (Microbus)
Large Bus	NASR
Medium Truck	NASR
Large Truck	NASR

2) Usage Conditions by Vehicle Types

(1) Average life time of vehicles

The average life time of vehicles adopted in this Study are shown in Table 8.7.2.

Table 8.7.2 Average Life Time Of Vehicles
(unit: year)

Passenger Car	13
Small Bus	
Minibus	8
Microbus	10
Large Bus	10
Small Truck	11
Medium Truck	11
Large Truck	10

The life time of the passenger vehicles is estimated based mainly on the average car ages at present according to the Study Team's survey. On the other hand, the life time of the freight vehicles is calculated using the annual running distance and the related formula presented in the ENTS in 1984.

(2) Average annual running distance, running speed, and annual running time in GCR

The usage conditions of the different types of vehicles are shown in Table 8.7.3.

Table 8.7.3 Usage Conditions of Vehicles

	Ave. annual running dist. (km/year)	Ave. running speed in GCR (km/hour)	Annual running time (hour/year)
Passenger Car	21,730	34.6	618
Small Bus			
Minibus	38,140	13.0	2,930
Microbus	71,180	22.6	3,150
Large Bus	89,140	13.6	6,580
Small Truck	30,000	34.0	880
Medium Truck	30,000	34.0	880
Large Truck	40,000	34.0	1,180

The passenger car annual running distance and annual running speed in GCR are calculated based on the interview survey on the representative models, using the following weights among the three models:

FIAT 128	34.0%
FIAT 127	18.2%
PEUGEOT 505	47.8%
TOTAL	100.0%

The weights are calculated based on the observed numbers of the models and the weight of the PEUGEOT 505 represents not only itself, but also that of other imported passenger cars.

(3) Average vehicle ages

Synthesizing the related information on the issue, the average vehicle ages which are now used are estimated in the following Table 8.7.4.

Table 8.7.4 Average Vehicle Age

Passenger Car	10 years
Small Bus	
Minibus	3
Microbus	4
Large Bus	6
Small Truck	3
Medium Truck	7
Large Truck	6

As for the passenger car age, the average production year of FIAT 128 is 1976; FIAT 127, 1980; and PEUGEOT 504, 1979, according to the interview survey of 30 passenger cars for each of the three representative models.

3) Purchases Prices of Vehicles in 1987/88

The purchase prices of vehicles at 1987/88 prices are summarized in the following Table 8.7.5.

Table 8.7.5 Estimated Prices of Vehicles
(unit: LE/vehicle at 1987/88 prices)

	Financial Price	Economic Price
Passenger Car	27,680	16,220
Small Bus		
Minibus	36,000	33,260
Microbus	13,060	9,560
Large Bus	113,800	83,300
Small Truck	10,800	7,820
Medium Truck	27,550	19,950
Large Truck	44,500	30,260

In order to obtain the economic purchase prices from the financial prices, the following relevant points were clarified:

a) Import duty by type and model
b) Consumption tax by type and model
c) Ratio of the value of local made portion to the total value of vehicle

For reference, the import duty and consumption tax are summarized as follows:

a) Vehicle import duty

- Buses, microbus	30%
- Passenger cars;	
of 4 cylinders or less	
. 1000cc - 1300cc	85%
. more than 1300cc	110%
of 5 cylinders or more	160%
- For transport of goods and material	20%

b) Vehicle consumption tax (Table 8.7.6)

Table 8.7.6 Vehicle Consumption Tax

	Imported		Locally made	
	unit	tax rate	unit	tax rate
Motor vehicles for transport of persons; combined passenger - cargo cars; jeeps				
- not more than 4 cylinders				
. less than 1000cc	value(1)	5%	value(2)	5%
. 1000 - 1500cc	value	10%	value	10%
. 1500 - 2000cc	value	12.5%	value	20%
Other motor vehicles for transport of persons; combined passenger-cargo cars; jeep cars	value	15%	value	25%

Note : (1) CIF price, (2) Market price
Source: Custom Tariff

The estimated ratios are listed in the following Table 8.7.7.

The above ratios are used for the calculation of the economic prices of the vehicles.

4) Gasoline and Engine Oil Costs

The consumption volumes of gasoline and engine oil have been estimated using the related information in ENTS and the interview survey, and are summarized in Table 8.7.8.

Table 8.7.7 **Ratio of Value Evaluated in Economic Analysis to the Vehicle Total Value(1)**

(unit: %)

	Local made portion	Imported portion	Total(2)
Passenger Car	22	41	63
Small Bus			
Minibus	0	77	77
Microbus	30	36	66
Large Bus	30	36	66
Small Truck	34	32	66
Medium Truck	34	32	66
Large Truck	44	20	64

Notes: (1) At the automobile factory gate financial prices
(2) Deficit from 100% corresponds to taxes (import duty, consumption tax) and financial costs which accrue at the production process

Table 8.7.8 **Consumption Volume of Gasoline and Engine Oil**

(unit: liter/km)

	Gasoline Type	Gasoline Volume	
		Gasoline	Engine Oil
Passenger Car	Gasoline	0.080	0.0024
Small Bus			
Minibus	Diesel	0.210	0.0025
Microbus	Gasoline	0.205	0.0046
Large Bus	Diesel	0.570	0.0050
Small Truck	Diesel	1.120	0.0035
Medium Truck	Diesel	1.300	0.0070
Large Truck	Diesel	1.577	0.0070

The market prices of gasoline and engine oil and consumption taxes on the prices of gasoline in 1987/88 are as shown in Table 8.7.9.

Table 8.7.9 **Market Prices of Gasoline and Engine Oil**

(unit: LE/liter at 1987/88 prices)

	Market Prices	Consumption Taxes
Gasoline		
Regular	0.35	0.089
Super	0.40	0.113
Solar (Diesel)	0.06	
Engine Oil	1.19	

The gasoline and engine oil have to be measured at the international price base. But both financial and economical price levels are the same on the assumption that the international price of crude oil is US$ 18 per barrel.

The formula for the calculation of the domestic economic price of the gasoline based on the international price of crude oil is as follows:

Domestic economic price of gasoline (except diesel oil)
$$= (IP \times EXR/159) \times RC \times SER$$

Where IP: International price of crude oil (US$ 18 per barrel)
EXR: Exchange rate of Egyptian Pound to US$ (2.3 LE = 1.0 US$)
RC: Refinery coefficient (1.10)
SER: Shadow Exchange Rate (1.2)

Through the same kind of formula, the domestic economic price of the engine oil is estimated to be LE 1.19 per liter, and the diesel fuel, LE 0.30 a liter. At the latter estimation, the ratio of the economic price of gasoline to the one of diesel fuel is used, which can be calculated based on the related data in the ENTS in order to supplement the lacking information for estimation.

5) **Tyre Cost**

In the ENTS, it is assumed that the life duration of local made tyre is 50,000 km and the imported tyre, 80,000 km. In case of the passenger car, the duration is calculated as a weighted means of the above two durations, and the weights are calculated based on the shares of tyre used in the observed passenger cars (30 passenger cars for each representative model). In cases of small bus and large bus, the duration is revised based on the related interview surveys. Results are shown in Table 8.7.10.

Table 8.7.10 Duration Period of Tyres

	Tyre type	Number of tyres used	Duration of tyre (km)
Passenger Car	Local/imported	4	68,000
Small Bus			
Minibus	Micheline	6	20,000
Microbus	Imported	4	50,000
Large Bus	Local	6	40,000
Small Truck	Imported	4	80,000
Medium Truck	Imported	6	80,000
Large Truck	Local	6	50,000

The market prices of tyres by vehicle types are shown in Table 8.7.11, estimated based on the price list of tyres which has been compiled by an interview survey.

The domestic economic prices of the tyres are calculated through the following formula:

For local made type:
Domestic economic price of tyre = Market price - Consumption tax

For Imported tyre:
Domestic economic price of tyre =
(Market price - Import duty) x SER

Table 8.7.11 Market and Economic Prices of the Tyres
(unit: LE/tyre at 1987/88 prices)

	Market price	Consumption Tax	Import duty	Economic price
Passenger Car	67	5.4	13.3	58
Small Bus				
Minibus	265	6.5	43.4	258
Microbus	140	6.5	30.8	123
Large Bus	285	8.0	--	277
Small Truck	140	8.0	30.8	122
Medium Truck	180	8.0	39.7	159
Large Truck	230	10.0	--	220

6) Spare Parts Cost

The annual cost of spare parts for the passenger car is the weighted means of the costs of the three representative models (FIAT 128, 170 LE/year; FIAT 127, 120 LE/year; PEUGEOT 505, 230 LE/year). The microbus annual spare parts costs were calculated on the basis of the interview survey. The annual costs for other types of vehicles excluding passenger car and microbus are calculated using the following factors;

a) The purchase prices of the new vehicles in Table 8.7.5, and
b) Percent of annual costs against the purchase prices shown in Table 8.7.12.

The results are shown in Table 8.7.12.

Table 8.7.12 Annual Financial Spare Parts Cost
(unit: LE/year/vehicle at 1987/88 prices)

	Annual cost	% of vehicle purchase price per 1000 km
Passenger Car	190	
Small Bus		
Minibus	1,840	0.14
Microbus	270	
Large Bus	11,030	0.11
Small Truck	340	0.11
Medium Truck	710	0.07
Large Truck	1,210	0.07

The financial annual costs in Table 8.7.12 include the import duty and consumption tax. The cost at domestic economic prices can be calculated using the following formula:

Spare parts cost at domestic economic prices
= FC x (R1 + R2 x SER)

Where FC: Financial/market spare parts cost
R1: Local portion which is assessed in the calculation of the domestic economic cost
R2: Imported portion

R1 and R2 values are summarized in the following Table 8.7.13.

Table 8.7.13 Ratios of Values of Spare Parts Evaluated in the Economic Analysis(1)

(unit: %)

	Local portion	Imported portion
Passenger Car	(2)	(2)
Small Bus		
Minibus	30	50
Microbus	44	40
Large Bus	44	40
Small Truck	55	30
Medium Truck	55	30
Large Truck	65	20

Average import duty rate is 25% of the CIF price and consumption tax is not imposed on spare parts. The above ratios have been estimated based on the relevant data from the interview survey and the World Bank Report.

The estimated spare parts cost at 1987/88 domestic economic prices are shown in Table 8.7.14.

Table 8.7.14 Domestic Economic Spare Parts Cost

(unit: LE/year/vehicle at 1987/88 economic prices)

Passenger Car	173
Small Bus	
Minibus	1,656
Microbus	248
Large Bus	10,148
Small Truck	309
Medium Truck	646
Large Truck	1,077

7) Maintenance Labor Cost

The financial cost can be estimated through the following formula:

Financial maintenance cost =
Hourly wage of staff x hours required for maintenance per running distance

The hourly wage is estimated at 1.27 LE/hour. The hours required for the maintenance per running distance have been quoted from the ENTS and are listed in the following Table 8.7.15.

Table 8.7.15 Maintenance Cost per Running Distance

(unit: LE/km)

Passenger Car	0.0025
Small bus	
Minibus	
Microbus	0.0254
Large Bus	
Small Truck	0.0038
Medium Truck	0.0159
Large Truck	0.0191

CTA has its own organization for the maintenance of buses. Therefore, the maintenance labor costs of the minibus and large bus are considered to be included in the overhead charges which will be discussed later.

Maintenance work requires skilled labor. In Egypt, the opportunity cost of the skilled labor seems to be reflected in the market wage due to the scarcity. As a conclusion, the economic cost of the labor is assumed to be equal to the market wage.

8) Amortization

The calculation formula for the amortization is as follows:

$$\text{Annual amortization} = PV \times \frac{1}{1 - (1 + i)^{-N}}$$

Where PV: Purchase cost of vehicle (Table 8.7.5)
i: Annual interest rate (12%)
N: Life time of the vehicle (Table 8.7.2)

The annual amortization is estimated as follows (Table 8.7.16).

Table 8.7.16 Annual Amortization of Vehicles

(unit: LE/year/vehicle at 1987/88 prices)

	Financial price	Economic price
Passenger Car	4,476	2,489
Small Bus		
Minibus	7,171	6,383
Microbus	2,304	1,605
Large Bus	20,657	14,449
Small Truck	1,801	1,234
Medium Truck	4,655	3,200
Large Truck	7,947	5,122

When considering the amortization causes, the cost can be divided into the running distance portion and the running time portion. The allocation ratios quoted from the World Bank Survey are shown in Table 8.7.17.

Table 8.7.17 Allocation Ratios of Amortization to Running Distance and Time Dependent Portions

(unit: %)

	Distance portion	Time portion
Passenger Car	50	50
Small Bus		
Minibus	85	15
Microbus	85	15
Large Bus	85	15
Small Truck	70	30
Medium Truck	70	30
Large Truck	70	20

9) Crew Cost

The crew number and financial and economic crew costs are summarized in Table 8.7.18.

Table 8.7.18 Annual Crew Cost

(unit: LE/year/vehicle at 1987/88 prices)

	Crew number (persons)	Financial and economic cost
Passenger Car	--	--
Small Bus		
Minibus	1.0	2,160
Microbus	1.0	3,750
Large Bus	5.2	11,230
Small Truck	--	--
Medium Truck	1.0	3,600
Large Truck	1.0	3,600

As to the passenger car and small truck, the owners are assumed to drive the vehicles. The number of crew which is required for two shift operation of large bus is cited as a result of the CTA interview.

As shown in Table 8.7.18, the economic cost of the crew cost is supposed to be equal to the financial cost, assuming that the market wages well reflect the opportunity costs. The annual costs of CTA minibus and large bus are estimated referring to the related data collected through the interview survey and the CTA annual report, and the costs of the medium and large trucks are estimated based on the data in the ENTS.

10) Insurance and Overhead Charges

For the estimation of the annual financial insurances and overhead charges, the following three kinds of data sources are used:

- ENTS survey : Basic information on the insurance, overhead and others, and tax by the vehicle types
- Study Team survey : Firstly on the microbus and secondly insurance which is used for revision of the data from the ENTS survey
- CTA Annual Report : For revision of the data from ENTS concerning the costs relating to CTA minibus and large bus

The economic insurance and overhead charges are calculated using the following formula:

Economic cost =
SWR x (total financial costs - insurance - tax)

The SWR (Shadow Wage Rate) values are:
For CTA minibus and large bus = 0.5
For other types of vehicles = 1.0

The annual insurance and overhead charges are summarized in Table 8.7.19.

Table 8.7.19 Annual Insurance and Overhead Charges
(unit: LE/year/vehicle at 1987/88 prices)

	Financial price	Economic price
Passenger Car	160	
Small Bus		
Minibus	8,090	3,850
Microbus	2,310	1,900
Large Bus	20,760	10,000
Small Truck	640	300
Medium Truck	2,170	1,820
Large Truck	2,180	1,820

11) Vehicle Operating Cost Units

Vehicle Operating Cost consists of the running distance related portion and running time related portion. The estimated vehicle operating cost units are presented in Table 8.7.20.

Table 8.7.20 Economic Vehicle Operating Cost (VOC)

(1) Running Cost (distance related cost) (unit: LE/km at 1987/88 prices)

Cost item \ Type of Vehicle	Passenger Car	Small Bus: Minibus	Small Bus: Microbus	Large Bus	Small Truck	Medium Truck	Large Truck
Financial Cost							
Fuel	0.0280	0.0126	0.0718	0.0342	0.0672	0.0780	0.0946
Lubricant	0.0029	0.0030	0.0055	0.0060	0.0042	0.0083	0.0083
Tyre	0.0039	0.0795	0.0112	0.0428	0.0070	0.0135	0.0276
Spare Parts	0.0089	0.0482	0.0038	0.1237	0.0113	0.0237	0.0303
Maintenance Labor	0.0025	0.0000	0.0254	0.0000	0.0038	0.0159	0.0191
Amortization (distance related)	0.1047	0.1598	0.0275	0.1970	0.0420	0.1086	0.1391
Total	0.1509	0.3031	0.1452	0.4037	0.1355	0.2480	0.3190
Economic Cost							
Fuel	0.0275	0.0630	0.0705	0.1710	0.3360	0.3900	0.4731
Lubricant	0.0029	0.0030	0.0055	0.0060	0.0042	0.0083	0.0083
Tyre	0.0034	0.0775	0.0099	0.0416	0.0061	0.0119	0.0264
Spare Parts	0.0081	0.0434	0.0035	0.1138	0.0103	0.0215	0.0269
Maintenance Labor	0.0025	0.0000	0.0254	0.0000	0.0038	0.0159	0.0191
Amortization (distance related)	0.0582	0.1423	0.0192	0.1378	0.0288	0.0747	0.0896
Total	0.1026	0.3292	0.1340	0.4702	0.3892	0.5223	0.6434

(2) Fixed Cost (time related cost) (unit:, LE/hour at 1987/88 prices)

Cost item \ Type of Vehicle	Passenger Car	Small Bus: Minibus	Small Bus: Microbus	Large Bus	Small Truck	Medium Truck	Large Truck
Financial Cost							
Amortization (time related)	3.6212	0.3671	0.1097	0.4709	0.6138	1.5868	2.0203
Crew	0.0000	0.7372	1.1905	1.7067	0.0000	4.0909	3.0508
Insurance & Overhead	0.2589	2.7611	0.7333	3.1550	0.7273	2.4659	1.8475
Total	3.8801	3.8654	2.0335	5.3326	1.3411	8.1436	6.9186
Economic Cost							
Amortization (time related)	2.0140	0.3268	0.0764	0.3294	0.4208	1.0909	1.3022
Crew	0.0000	0.7372	1.1905	1.7067	0.0000	4.0909	3.0508
Insurance & Overhead	0.0000	1.3140	0.6032	1.5198	0.3409	2.0682	1.5424
Total	2.0140	2.3780	1.8701	3.5559	0.7617	7.2500	5.8954

In this Study, when calculating the saving in VOC of the project, the private car time related portion is not taken into account.

8.7.2 Railway Operating Cost (ROC)

1) Characteristics of ROC in this Study

Generally speaking, ROC must include all the costs that are incurred in order to operate a railway system. But, in order to compare the economic features of the railway system with the road system, cost items of the economic ROC must fit in with those for the economic VOC. In this Study the economic ROC includes the car related costs only. Construction costs and maintenance costs of railway and related electric facilities, etc., are taken into account in the individual project costs.

2) Selection of the Models

Three types of railway systems are operated in GCR, and maintenance, improvement and new construction projects for all three are expected in the future. The three railway systems are:

- Streetcar
- Modernized railway
- Long-established railway (diesel powered)

In order to estimate the ROC of these railway systems, the Heliopolis Metro lines, Regional Metro line, and Al Marg line (before electrification) were chosen to represent streetcars, modernized railway, and long-established railway respectively.

3) Heliopolis Metro Line (Streetcar)

(1) Data provided by HCHD and its modification

Data provided by HCHD and modified by the Study Team are shown in Table 8.7.21.

Table 8.7.21 Annual Operating Cost of the Heliopolis Metro, July 1987 - June 1988

(unit: 1000 LE/year at 1987/88 financial prices)

	HCHD Data	Modified by Study Team
- Spare parts cost	2,903	2,903
- Personnel cost	7,851	7,851
Administration	633	633
Maintenance	2,508	2,508
Service	3,609	3,609
Transformer substation	1,101	1,101
- Power cost	524	524
- Car depreciation	1,741	1,741
- Insurance	1,778	1,778
for machinery	115	115
for employees	1,663	1,663
- Other costs	1,654	1,654
- Car Capital Opportunity Cost	3,869	1,741
Total	20,320	18,192

Some useful comments are presented for forming a better understanding of the table.

- Outline of the activities of the Heliopolis Metro line:
  Line length : 46.3 km
  Car.km/year : 5,027,770 car.km/year
  Number of cars used: 205 cars (Total number of cars at present is 258, Motor coaches; 167, Motor cars; 66, and Trailers; 25)

- Spare parts cost:
  According to the explanation from HCHD staff in charge of costs, the shares of the costs of local made parts and imported parts are 25% and 75% respectively.

  It is expected that roughly up to the year 2000, the share of the local made parts is expected to considerably increase. However, this expectation is not reflected in the estimation of the calculation formula.

- Power cost:
  The purchase price of the electricity is 0.0226 LE/kwh.

- Depreciation cost:
  The total depreciation is 3,628,000 LE, within which 1,741,000 LE is for car depreciation over 20 years.

- Capital Opportunity Cost (COC):
  The financial cost stated by HCHD seems to be the total interest on all kinds of the external loans. Extracting the financial cost which corresponds to the loan for purchase of the cars from the above total financial cost, it can be estimated to be 1,741,000 LE/year, based on the following assumptions;
  . Car depreciation as explained above
  . Average interest rate on loan = 10% (I)
  . Formula;
    Capital Opportunity = (1/2) x V x I
    Cost of car = (1/2) x D x 20 years x I

    Where V = Total purchase prices of cars
    = 1,741,000 LE/year x 20 years = 34,820,000 LE

(2) Arrangement of Data

Data provided by HCHD are arranged as standard cost items and the resulting arrangement is shown in Table 8.7.22.

(3) Financial ROC

Cost items are distributed into rail length oriented cost, car running distance related cost, and number of cars related cost (Table 8.7.23). Thus financial operating cost is obtained from the following formula:

Annual Operating =83,480xline/length+2.1342 x car.km/year
Cost (LE/year) + 17,547 x cars operated

Table 8.7.22 Heliopolis Metro Data Arrangement

(unit: 1000 LE/year at 1988/89 constant prices)

Operating Cost (Comparable)		Modified Operating Cost	
Maintenance Cost		Spare Parts Cost	2,903
Line Maintenance			
- Material Cost	1,103		
- Labor Cost	552		
Electric Facilities Maintenance		Personnel/Maintenance	2,508
- Material Cost	407		
- Labor Cost	702		
- Substation	1,101		
Car Maintenance		Personnel/Substation	1,101
- Material Cost	1,393		
- Labor Cost	1,254		
Operation Cost of Cars			
- Power Cost	524	Power Cost	524
- Labor Cost	3,609	Personnel/Service	3,609
Cost of Car			
- Depreciation	1,741	Depreciation	1,741
- Insurance	115	Insurance on Machinery	115
OverheadCost			
- Personnel	633	Personnel/Administration	633
- Insurance	1,663	Insurance on Employees	1,663
- Other Costs	1,654	Other Costs	1,654
Capital Opportunity Cost	1,741	Capital Opportunity Cost	1,741
TOTAL	18,192		18,192

Note: (1) Allocation ratios estimated on the urban tram-car statistics in the private railway companies in Japan are as follows;
Line maintenance = 38%
Electric facility = 14%
Car maintenance = 48%
(2) Allocation ratios, using the same source data as in note (1), are;
Line maintenance = 22%
Electric facility = 28%
Car maintenance = 50%

(4) Economic ROC

Applying the assumptions described in Table 8.7.24 to the financial cost shown in Table 8.7.23, the financial costs were converted to economic costs (Table 8.7.24).

Table 8.7.23 Inducement of the Formula for Calculating the Financial Operating Cost

Cost Item	Annual operating cost (1000 LE)	Line Length (46.3 km) (LE/km)	Car.km/year (5.03M/year) (LE/car.km)	No. of Cars operated (205) (LE/car)
Maintenance Cost				
- Line	1,655	35,750		
- Electric Facility	2,210	47,730		
- Car	2,647		0.5265	
Car Operation Cost				
- Power	524		0.1042	
- Labor	3,609		0.7178	
Cost of Car	1,856			9,054
Overhead Cost				
- Personnel	633		0.1259	
- Insurance	1,663		0.3308	
- Other costs	1,654		0.3290	
- Capital Opportunity	1,741			8,493
Total	18,192	83,480	2.1342	17,547

Table 8.7.24 Conversion of the Financial Operating Cost into Economic Operating Cost

(unit: 1000 LE/year at 1987/88 financial and economic prices)

	Financial Prices	Economic Prices	Assumptions Introduced
Maintenance Cost			
* Line	(1,655)	(1,627)	
- Materials	1,103	1,268	- 75% import, no import duty - SER: 1.2
- Labor	552	359	- 30% skilled, 70% unskilled - SWR: 0.5 for unskilled
* Electric Facility	(2,210)	(2,166)	
- Materials	407	468	- 75% import, no import duty - SER: 1.2
- Labor	702	597	- 70% skilled, 30% unskilled - SWR: 0.5 for unskilled
- Substation	1,101	1,101	- 100% skilled
* Car Maintenance	(2,647)	(2,856)	
- Materials	1,393	1,602	- 75% import, no import duty - SER: 1.2
- Labor	1,254	1,254	- 100% skilled
Car Operation Cost	(4,133)	(6,192)	
* Power Cost	524	2,583	- 0.1114 LE/KWH
* Labor Cost	3,609	3,609	- 100% skilled
Cost of Car	(1,856)	(2,204)	
* Depreciation	1,741	2,089	- SER: 1.2
* Insurance	115	115	- Non-transfer cost item
Overhead Cost	(5,691)	(5,881)	
* Personnel	633	475	- 50% skilled, 50% unskilled - SWR: 0.5 for unskilled
* Insurance	1,633	1,663	- Non-transfer cost item
* Other Costs	1,654	1,654	
* Capital Opportunity	1,741	2,089	- Capital Opportunity Cost: 12%
Total	18,192	20,926	

Economic ROC is obtained from the economic costs following the same procedure stated in the preceding section (see Table 8.7.25). The result is:

Annual Economic Operating Cost
(LE/year, 1987/88 economic prices)
= 2.5538 x car.km year + 20,940 x cars operated

Table 8.7.25 Inducement of the Formula for Calculating the Economic Operating Cost

Cost Item	Annual operating cost (1000 LE at 1987/88 economic prices)	Car.km/year (5.03M/year) (LE/car.km)	No. of Cars operated (205) (LE/car)
Maintenance Cost			
- Line	1,627		
- Electric Facility	2,166		
- Car	2,856	0.5680	
Car Operation Cost			
- Power cost	2,583	0.5137	
- Labor cost	3,609	0.7178	
Cost of Car	2,204		10,750
Overhead Cost			
- Personnel	475	0.0945	
- Insurance	1,663	0.3308	
- Other costs	1,654	0.3290	
- Capital Opportunity	2,089		10,190
Total	20,926	2.5538	20,940

4) Regional Metro Line (Modernized Railway)

(1) Data provided by ENR and its modification

The data provided by ENR and modified by the Study Team are shown in Table 8.7.26.

Some useful comments are presented for forming a better understanding of the table.

- Number of employees:
  The total number of workers of the two lines are:
  . Administration : 103
  . Maintenance : 1,519
  . Operation and Station: 1,168

  2,790 Registered
  2,512 Actual

  Based on the ENR information the respective shares of each of Helwan line and Al Marg line are 70% and 30% of the total employees stated above.

Table 8.7.26 Annual Operating Cost of the Regional Metro, October 1987 - September 1988

(unit: 1000 LE/year at 1987/88 financial prices)

Subitem Cost	ENR Data	Modified by Study Team
- Spare parts cost total	2,400	2,400
of cars	1,200	1,200
of other facilities	1,200	1,200
- Personnel cost total	NA	3,938
Wages	5,000	3,500
Social Insurance	NA	438
- Maintenance cost contracted	4,000	4,000
of cars	3,500	3,500
of other facilities	500	500
- Power cost	6,155	6,155
- Car depreciation	NA	4,680
- Car Capital Opportunity Cost	NA	7,020
Total		28,193

Note : NA: Not available

- Insurance:
  The insurance is calculated as 12.5% of the wage. This seems to be under estimated.

- Maintenance cost:
  The maintenance of the cars is contracted to a French company, and the maintenance of other facilities to the related Egyptian firms. For the maintenance of cars and other facilities the maintenance materials are provided by ENR, and accordingly the cost comprises the consultation charges and labor cost of the contracted companies.

  It can be assumed that by about the year 2000, taking into account the upgrading of the ENR technical level, that the maintenance amount contracted out to the French company can be saved.

- Power cost:
  The distribution channel of electricity is depicted as follows:

  Electric Power Generation (0.0441 LE/KWH)

  Public Transportation Authority (0.0226 LE/KWH)

  Final Public Users (Heliopolis Metro, etc.)

  From the above it is clear that at least 0.0215 LE/KWH is subsidized. In the case of ENR, the electricity is supplied through Cairo Electricity Distribution Company, but the price is set at 0.0441 LE/KWH.

  The economic cost of the electricity can be calculated as follows:

. Economic cost of electricity = (Pc x Ex x SER x PE)/C
LE/KWH (1987/88 economic prices) = 0.1114 LE/KWH

Where Pc: International price of crude oil (US$ 18/barrel, assuming 1 barrel = 159 liters)

Ex: Exchange rate of Egyptian pound to the US dollar (LE 2.3 = 1 US$)

SER: Shadow exchange rate of Egyptian pound (1.2 assumed)

PE: Production coefficient (1.1 assumed)

C : Consumption value of crude oil per KWH (0.324 liter/KWH)

- Depreciation cost:
The depreciation cost is 2.7 MLE/train at 52 trains for a 30 year period. A train consists of three cars (2 motor cars and 1 car without motor).

  The purchase price of the train imported from France is the latest one, ie. for the Al Marg line which will commence operation in March 1989.

- Capital opportunity cost:
The calculation formula is as follows:
COC of car = (1/2) x V x I
where V: Total purchase price of the cars (2.7 MLE x 52 trains = 140.4 MLE)
I: Estimated interest rate on the loan to ENR (10% per year is adopted).

(2) Arrangement of Data

The data provided by ENR is arranged to the same format as the HCHD data, and finally arranged to standard cost items. The results are shown in Table 8.7.27.

Notes: (1) Allocation ratios estimated on the related data of the private railway companies in big Japanese cities, are as follows: Line maintenance : 67%
Electric facilities : 33%

(2) Based on the composition ratios in employees number of Heliopolis Metro: For facility maintenance : 52%
Car operation : 39%
Administration : 9%

(3) Allocation ratios estimated on the related data of the private railway companies in big Japanese cities, are as follows: Line maintenance : 52%
Electric facility maintenance : 48%

(3) Financial ROC

The results obtained are shown in the following Table 8.7.28.

Table 8.7.27 ENR Data Arrangement

(unit: 1000 LE/year at 1987/88 financial constant prices)

Operating Cost (Comparable)

Maintenance Cost	
Line Maintenance	
- Materials	804
- Labor	491
- Contracted	260 Ⓐ
Electric Facilities	
- Materials	396
- Labor	528
- Contracted	240
Car Maintenance	
- Materials	1,200
- Labor	801
- Contracted	3,500 Ⓑ
Operation Cost of Cars	
Power Cost	6,155
Labor Cost	1,365
Cost of Car Depreciation	4,680
Overhead Cost	
- Personnel	315
- Insurance	438
Capital Opportunity Cost of Car	7,020
Total	28,193

Transformation into HCHD Cost Item Type

Spare Parts	
- Line	804
- Electric	396
- Car	1,200
Labor Cost	
- Mainten.	1,820
- Operation	1,365
- Admin.	315
	Ⓐ
	Ⓑ
Power Cost	6,155
Depreciation	4,680
Insurance	438
Capital Opportunity Cost of Car	7,020
Total	28,193

Modified Operating Cost of Regional Metro

Spare Parts	
- Others	1,200
- Car	1,200
Personnel/Wage	3,500
Maintenance Contracted	
- Others	500
- Car	3,500
Power Cost	6,155
Depreciation	4,680
Personnel/Insurance	438
	7,020
Total	28,193

Table 8.7.28 Inducement of the Formula for Calculating the Financial Operating Cost

Cost Item	Annual operating cost (1000 LE)	Line Length (28 km) (LE/km)	Car.km/year (17.87M/year) (LE/car.km)	No. of Cars operated (156) (LE/car)
Maintenance Cost				
- Line	1,555	55,540		
- Electric Facility	1,164	41,570		
- Car	5,501		0.3078	
Car Operation Cost				
- Power Cost	6,155		0.3443	
- Labor Cost	1,365		0.0764	
Cost of Car	4,680			30,000
Overhead Cost				
- Personnel	315		0.0176	
- Insurance	438		0.0245	
- Capital Opportunity	7,020			45,000
Total	28,193	97,110	0.7706	75,000

The calculation formula for annual operating cost of the Regional Metro is:

Annual Operating Cost (LE/year) = 97,110 x line length + 0.7706 x car.km/year + 75,000 x cars operated

(4) Economic ROC

The same procedures that were applied for calculating the economic ROC of the Heliopolis Metro line are used. Results of the calculation are shown in Tables 8.7.29 and 8.7.30.

The calculation formula for annual economic operating cost of the Regional Metro is:

Annual economic operating cost (LE/year at 1987/88 prices)
= 1.2954 x car.km/year + 90,000 x cars operated

Table 8.7.29 Conversion of the Financial Operating Cost into Economic Operating Cost

(unit: 1000 LE/year at 1987/88 financial and economic prices)

	Financial Prices	Economic Prices	Assumptions Introduced
Maintenance Cost			
* Line Maintenance	(1,555)	(1,453)	
- Materials	804	965	- 100% import, no import duty - SER: 1.2
- Labor	491	319	- 30% skilled, 70% unskilled - SWR : 0.5 for unskilled
- Contracted	260	169	- ditto
* Electric Facility	(1,164)	(1,128)	
- Materials	396	475	- 100% import, no import duty - SER: 1.2
- Labor	528	449	- 70% skilled, 30% unskilled - SWR: 0.5 for unskilled
- Contracted	240	204	- ditto
* Car Maintenance	(5,501)	(5,741)	
- Materials	1,200	1,440	- 100% import, no import duty - SER: 1.2
- Labor	801	801	- 100% skilled
- Contracted	3,500	3,500	- Technology transfer to staff from the French company
Car Operation Cost	(7,520)	(16,739)	
* Power Cost	6,155	15,374	- 0.1114 LE/KWH
* Labor Cost	1,365	1,365	- 100% skilled
Cost of Car	(4,680)	(5,616)	
* Depreciation	4,680	5,616	- SER: 1.2
Overhead Cost	(7,773)	(9,098)	
* Personnel	315	236	- 50% skilled, 50% unskilled - SWR: 0.5 for unskilled
* Insurance	438	438	- Non-transfer cost item
* Capital Opportunity	7,020	8,424	- Capital Opportunity Cost: 12%
Total	28,193	39,755	

Table 8.7.30 Inducement of the Formula for Calculating the Economic Operating Cost

Cost Item	Annual operating cost (1000 LE at 1987/88 economic prices)	Car.km/year (17.87M/year) (LE/car.km)	No. of Cars operated (156) (LE/car)
Maintenance Cost			
- Line	1,453		
- Electric Facility	1,128		
- Car	5,741	0.3212	
Car Operation Cost			
- Power Cost	15,374	0.8601	
- Labor Cost	1,365	0.0764	
Cost of Car	5,616		36,000
Overhead Cost			
- Personnel	236	0.0132	
- Insurance	438	0.0245	
- Capital Opportunity	8,424		54,000
Total	39,775	1.2954	90,000

5) Al Marg Line (Long established line)

(1) Data provided by ENR and its modification

Table 8.7.31 shows the results of the data offered by ENR regarding operating cost and modifications of some of the data by the Study Team. The data shall be used for producing the calculation formula for the future operating cost.

Table 8.7.31 Annual Operating Cost of Existing Al Marg Line
(unit: 1000 LE/year at 1987/88 financial prices)

	Cost
- Spare parts cost total	260,520
of cars	260,520
of other facilities	NA
- Personnel cost total	1,688,000
Wages	1,500,000
Social Insurance	188,000
- Maintenance cost contracted	0
of cars	0
of other facilities	0
- Power cost	114,770
- Car depreciation	1,960,000
- Car Capital Opportunity Cost	2,940,000
Total	6,963,290

Some useful comments are presented for forming a better understanding of the Table.

- Spare parts:
  The total spare parts cost of LE 260,515 is broken down into LE 226,790 for locomotives and LE 33,725 for maintenance equipment.

- Wages:
  Refer to the comments on wages shown in the Regional Metro case.

- Insurance:
  The insurance as estimated by the Study Team is 12.5% of the wages.

- Fuel cost:
  The fuel cost has been estimated under the following conditions:
  - Kind of fuel : "Solar" (diesel, gasoline)
  - Solar price : 3.5 pt/liter
  - Gravity of solar : 0.86
  - Consumption volume per month: 235 tones
  - Economic price of solar : 0.3 LE/liter

The calculations are as follows:

Annual power cost (LE) = 235 x 1000/0.86 x 3.5/100 x 12
= 114,767 LE/year

Economic annual power cost at 1987/88 economic prices
= 235 x 1000/0.86 x 30/100 x 12
= 987,720 LE/year

- Depreciation costs:
  Depreciation can be calculated using the following purchase prices of coaches and diesel locomotives, and the numbers of coaches and locomotives used and adopting the 30 year straight line depreciation method with non residual value:
  Coaches : 70,000 LE/couch
  Diesel locomotive : 3,500,000 LE/locomotive

- Capital opportunity cost:
  The calculation formula is as follows:
  Car Capital Opportunity Cost = 1/2 x V x I
  where V: Total purchase price of the cars (58.8 million LE)
  I: 10%

(2) Arrangement of Data

The results are shown in Table 8.7.32.

Table 8.7.32 Al Marg Line Data Arrangement

(unit: LE/year at 1988/89 financial prices)

Operating Cost (Comparable)		Modified Operating Cost
Maintenance Cost		Personnel/Wages
* Line		1,500,000
- Material	NA	
- Labor	296,400	
* Electric Facility		Personnel/Maintenance
- Material	-	
- Labor	-	
* Car		Spare parts cost
- Material	260,520	260,520
- Labor	483,600	
Car Operation Cost		Power cost
* Power Cost	114,770	114,770
* Labor Cost	585,000	
Cost of Car		Depreciation
* Depreciation	1,960,000	1,960,000
* Insurance		
Overhead Cost		
* Personnel	135,000	
* Insurance and other costs	188,000	Insurance on employees 188,000
Car Capital Opportunity Cost	2,940,000	Capital Opportunity Cost 2,940,000
Total	6,963,290	6,963,290

Note: (1) The personnel/wages are allocated according to the following ratios:
Facility maintenance = 52%
Train operation = 39%
Administration = 9%
(2) The facility maintenance are allocated according to the following ratios:
Line maintenance = 38%
Car maintenance = 62%

(3) Financial ROC

The results obtained are shown in the following Table 8.7.33.

Table 8.7.33 Inducement of the Formula for Calculating the Financial Operating Cost

Cost Item	Annual operating cost (LE)	Line Length (15km) (LE/km)	Car.km/year (6.11M/year) (LE/car.km)	No. of Cars operated (90) (LE/car)
Maintenance Cost				
- Line	296,400	19,760		
- Electric Facility				
- Car	744,120		0.1218	
Car Operation Cost				
- Power	114,770		0.0188	
- Labor	585,000		0.0957	
Cost of Car	1,960,000			21,780
Overhead Cost				
- Personnel	135,000		0.0221	
- Insurance and others	188,000		0.0308	
- Capital Opportunity	2,940,000			32,670
Total	6,963,290	19,760	0.2892	54,450

The calculation formula for annual operating cost of the Al Marg line is:

Annual Operating = 19,760 x line length + 0.2892 x car.km/year
Cost (LE/year) + 54,459 x cars operated

(4) Economic ROC

The financial costs are converted into economic costs using assumptions listed in Table 8.7.34. The calculation formula is obtained using figures of Table 8.7.35.

The calculation formula for annual economic operating cost of the Regional Metro is:
Annual economic operating cost (LE/year at 1987/88 prices)
= 0.4351 x car.km/year + 65,330 x cars operated

8.7.3 Time Value

1) Adopted Time Value

In the economic evaluation of the Masterplan as a whole and the selected projects, the following time values are used:

Vehicle owners : 1.10 LE/hr
Non-vehicle owners : 0.41 LE/hr

The above values are basically calculated based on the Logit Model presented in the following section, and represent the willingness to pay on the part of the passengers and the users of the vehicles due to the saved traveling time. Therefore the time values are independently of their trip purposes.

2) Estimation Method

The Logit Model, which is induced from the results of the Regional Metro and competitive bus lines survey, is as follows;

$$P = 1/(1 + Exp(0.127 - 0.041dT - 0.060dC))$$

where P : Share of railway passengers
dT : Time difference (travel time on bus minus travel time on railway in minutes)
dC : Cost difference (bus fare minus railway fare in piasters)

The model explains the selection behavior of the passengers between the public transport means (bus and railway). Assuming that the high income household members possess and daily use their vehicles, and that low income household members use the public transportation, it can be considered relevant that the time value calculated based on the Model represents the willingness to pay of the members of low income households due to the time saving in transportation.

The time value of the non-vehicle owners can be calculated from the parameters of the Model.

$$\text{Time value} = \frac{(\text{Parameters of the dT} \times 60 \text{ minutes})}{(\text{Parameters of the dC} \times 100 \text{ piasters})} = (0.041 \times 60)/(0.060 \times 100) = 0.41$$

According to the Person Trip survey conducted by the Study Team in 1987, the average household income of the vehicle owner is 1.68 times higher than that of the non-vehicle owner. The time value of the vehicle owner is estimated by multiplying that of the non-vehicle owner by the magnitude.

9. Masterplan

9.1 Subjects of Masterplan and Policy Alternative

In general, the main purpose of a transportation Masterplan is to compose a well-balanced network to meet the future demand and to avoid inefficient, double and over-investment by taking into consideration long-term perspectives and employing a comprehensive planning method. A Masterplan is basically a guide line plan in its nature, rather than an action plan like a five year plan. Therefore, it is essential to set up a basic policy for transportation infrastructure development, prior to discussing each project individually. And to set the basic policy, future issues must be clarified. In this section, issues to be solved and the subject of the Masterplan are explained.

1) Analysis on "Do Nothing" Case

Objectives of a masterplan will vary according to cities and countries. However, one of the most universal and essential objective is undoubtedly to develop transportation facilities to cope with future demand. The most direct way to determine the future issues is to analyze the issue of "what will happen by the year 2000" under the present network and facilities of transportation without the implementation of any new policies or investment. This analysis can be called the "Do Nothing" case.

The "Do Nothing" case is defined more precisely as follows;

a. The infrastructure of highway and railway networks will remain as they are. Maintenance work will be done with the aim of keeping the present capacity, and not to raise it.

b. The bus fleet and railway rolling stock will be strengthened according to demand increase.

c. The people's motivation to select a transportation mode will not change drastically in the future and there will be no relative change in vehicle operating cost and public transportation fares.

Figs. 9.1.1 to 9.1.3 show the "Do Nothing" assignment results of the year 2000 demand as stated in Chapter 8. Fig. 9.1.1 illustrates the demand pattern in the form of a spider network which is an imaginary network composed by linking the centroids of adjacent zones. An outstanding demand increase is observed in the north-east corridor (CBD - Mataria/Ain Shams), the south-west corridor (CBD - Giza/Ahram) and the southern corridor (CBD - Maadi/Helwan). Comparing the trip patterns of private mode (car and taxi) and public mode (bus and rail transit), the former mode shows a remarkable increase in most links, while the latter increases only slightly from the present pattern.

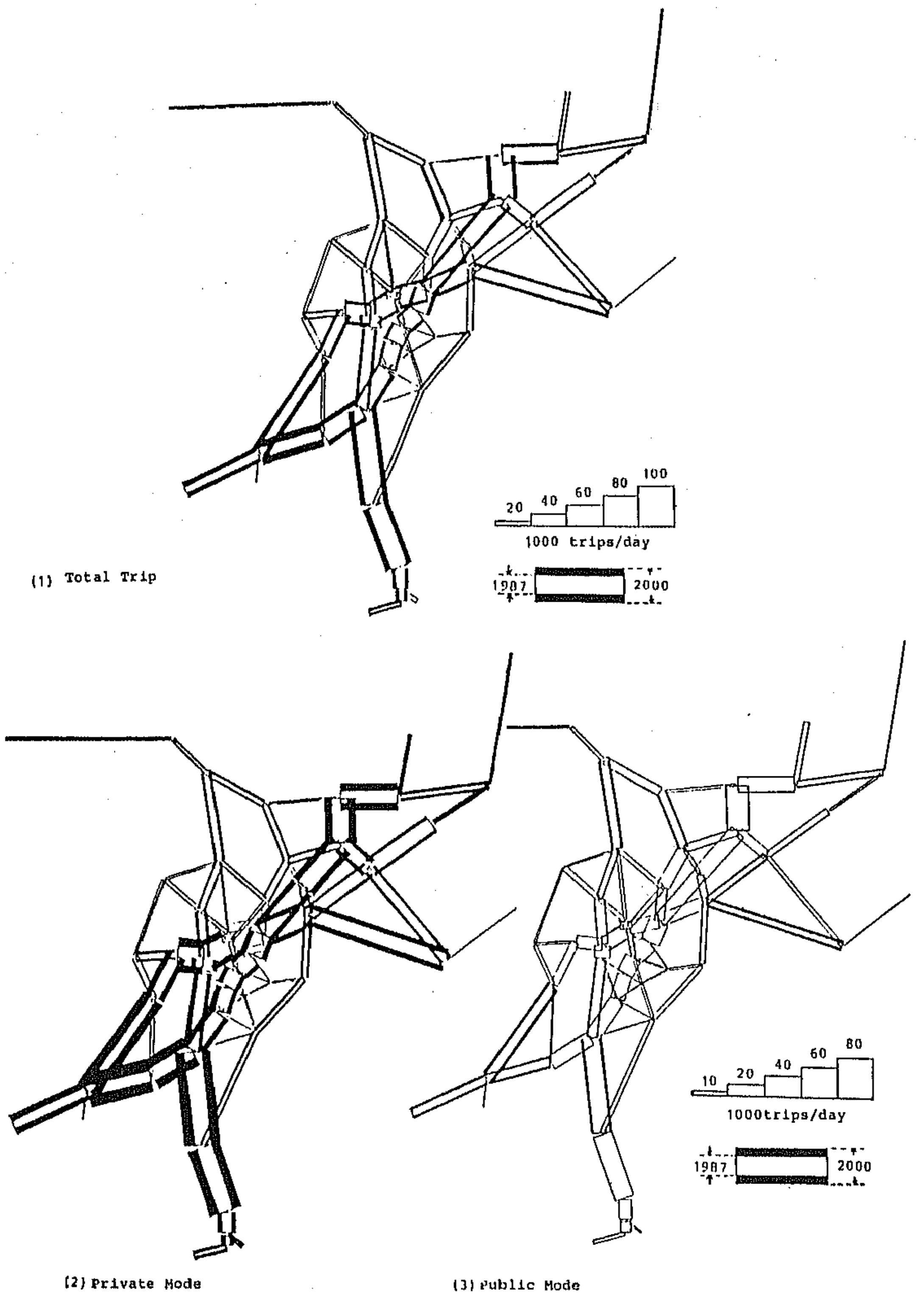


Fig. 9.1.1 Future Modal Share Based on the Trend shown in the Spider Network

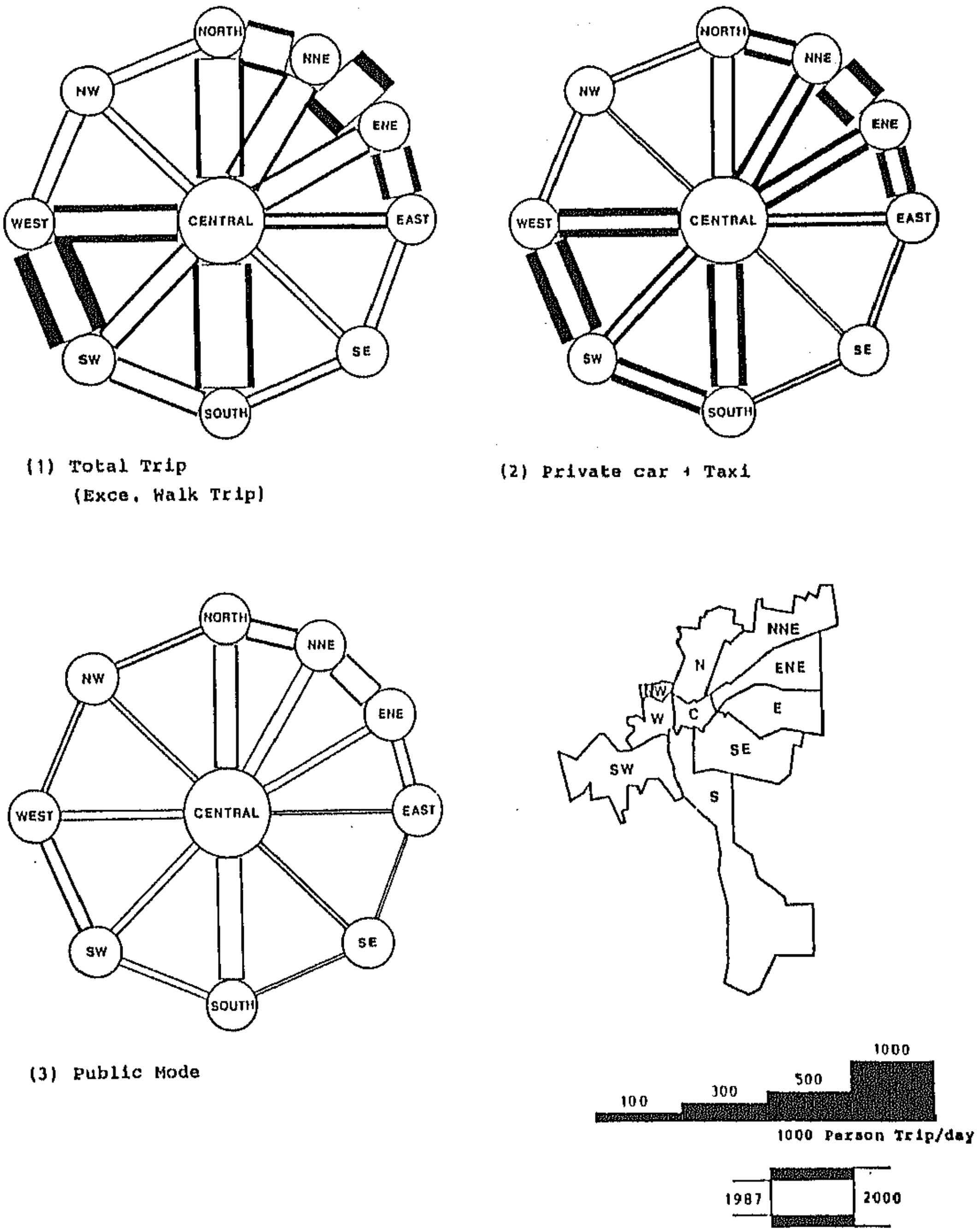


Fig. 9.1.2 Directional Person Trip in 1987 and 2000

In order to observe the demand change in the future more clearly, another schematic network was prepared by integrating zones in radial directions from CBD. Present and future trips assigned on the simplified network are illustrated in Fig. 9.1.2, where large increases are shown in the following integrated zone pairs:

West	-	SW	77% increase
NNE	-	ENE	47%
ENE	-	East	64%
Central	-	South	28%
Central	-	NNE	16%
Central	-	ENE	14%
Central	-	West	60%

Fig. 9.1.3 shows the assigned trips in the actual present network which has arterial roads totaling 3,216 km and railways of 119 km. More than one third of the total road length will be congested in the year 2000, at a traffic volume/road capacity rate (hereinafter referred to as V/C rate) of over 1.0. In particular, the streets of Ramses, Salah Salem, Corniche, Ahram, Sudan and Port Said will suffer unbearable congestion with V/C rates of over 1.5. The total length of road links with over a 1.5 V/C rate will be 223 km, or about 7% of the whole network.

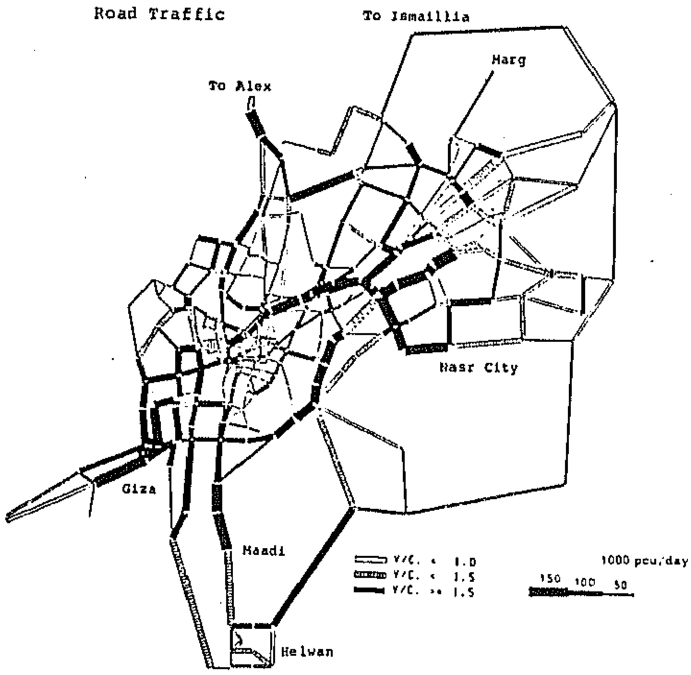


Fig. 9.1.3 Traffic Volume in Year 2000 Under "Do Nothing" Condition

The overall V/C rate of the network will rise from 0.462 in the year 1987 to 0.767 in 2000 and aggregated average speed will decline from 7.3 km/h to 4.4 km/h in the same period.

In Table 9.1.1, future modal shares are compared to present ones under various terms. Roughly speaking, the present transport demand is shared equally by the private mode and the public mode. In the year 2000 under the "Do Nothing" condition, the share of the private mode will be almost double that of the public mode. This means that as the total demand, excluding trips on foot and by two wheelers, increases by 1.6 times, the same volume as increased demand will be absorbed in the private mode traffic. This will result in a heavier burden on the road network.

Table 9.1.1 Future Modal Share by "Do Nothing" Assignment

Year	Item	Car, Taxi	Bus	Railway
1987	Passenger (1000)	3,970	2,909	685
	(%)	(52.5)	(38.5)	(9.0)
	Passenger.Km (1000)	46,702	32,156	4,292
	(%)	(56.2)	(38.6)	(5.2)
	Passenger.hr (1000)	6,369	6,389	210
	(%)	(49.1)	(49.3)	(1.6)
2000	Passenger (1000)	6,862	3,156	710
	(%)	(64.0)	(29.4)	(6.6)
	Passenger.Km (1000)	95,361	37,109	4,851
	(%)	(69.4)	(27.0)	(3.6)
	Passenger.hr (1000)	21,505	10,795	228
	(%)	(66.1)	(33.2)	(0.7)

Note: Intra-Zonal trips are not included

2) Demand Shift from Private Mode to Public Mode

(1) Necessity and Difficulty

To cope with the future increase of road traffic, the network capacity must be raised by 25 to 30% which would only be maintaining the present level of service. However, it will be almost impossible to sufficiently develop new arterials or widen existing arterials to achieve the needed capacity increase and meet the future demand within a decade. Moreover, it will not be justified from the economic viewpoint to depend heavily on the private mode. Accordingly, one of the most basic and essential subjects of the Masterplan is to find an appropriate answer to the question of how to lessen peoples' dependence on private mode and convert private car users to public mode.

In order to encourage more people to use public transport, its service must be improved and reinforced both in quality and quantity. However, better transport service may not always attract more private car users to public transport modes. This may be explained by the fact that urban residents generally have a strong preference for using private cars; this is particularly so for residents in the GCMR.

Through an exhaustive effort to develop a modal split model for GCMR, it was revealed that GCMR residents' motivation for selecting either private car or a public mode could not be explained by either the travel time difference or the cost gap between those two modes. Present modal shares are influenced by neither the trip distance nor the trip purpose. The only factor affecting the modal shares is the car ownership rate of the origin zone. This fact suggests that people tend to make a trip using a passenger car whenever it is available and depend on public transportation only when no car is available.

In February 1988, four months after the Regional Metro started its operation between Mubarak and Helwan stations an interview survey was made to about 1,000 passengers at Mubarak sta. and Sadat sta.; one of the interview items was their former means of transportation for the same trip. The result shows a very low conversion rate of below 4% from private car to the Metro. This is further evidence that public transportation in a higher service level may not necessarily attract the private mode passengers.

Generally, when a car owner makes a modal choice he is not so strongly conscious of vehicle operating cost. Even when he does mind cost, he will consider only fuel cost which is the most direct expense and will not pay attention to such costs as tire cost, depreciation and interest.

The fuel prices in Egypt are 40 piasters/liter for super gasoline and 35 piasters/liter for regular as of September, 1988; these may be one of the lowest rates in the world.

A comparison of the fuel cost of a passenger car to fares of various public modes assuming an average fuel consumption rate, reveals that the fuel cost is about 10 piasters for each 5.3 km which is the average trip length excluding walk trips. This cost corresponds to the fare of CTA bus which is the cheapest public transit mode together with CTA tram (Fig. 9.1.4). This low cost may be one reason why car owners prefer using their cars to taking a public mode.

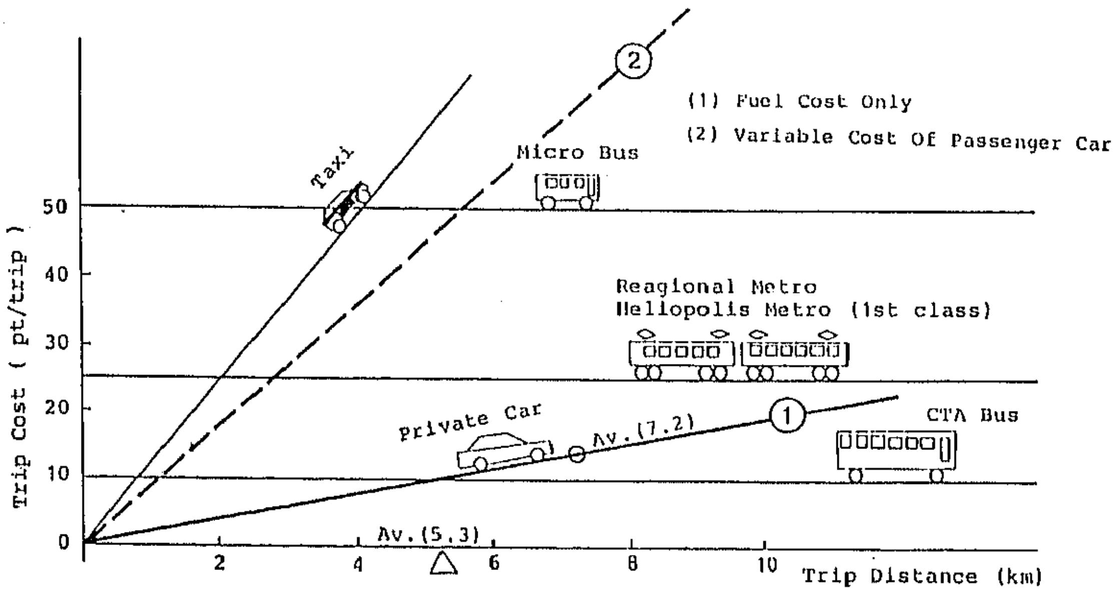


Fig. 9.1.4 Trip Cost by Transportation Mode

(2) Target of Trip Conversion

Because of the GCMR residents' strong preference for the private mode, some intensive policy measures will be required to shift the demand to public mode, as well as providing better public transport service. A series of simulation work has been done to set up a target number of private mode trips necessary to be converted, taking into account the physical constraints of existing road network capacity and parking capacity in CBD.

a. Constraint of Road Network Capacity

It would be very difficult to develop the many needed new arterials in the built-up area. Even if it were possible, it would take a long time. Therefore, road network capacity will be one of the severe constraints which will determine the necessary volume of conversion.

Traffic assignment work is done in a repetitive way by dividing an O-D traffic volume into several groups (five groups in this Study) and assigning the traffic of each group one by one to the shortest-time route which is investigated every time.

Here, one scenario is introduced; traffic congestion above a certain level would force car users to change their mode to public transport. Practically it is assumed that, in a certain time of assignment, if more than one third of the shortest-time route is congested by the traffic already assigned in the previous times, a traffic volume/road capacity rate over 1.5 where average speed is less than 5 km/h, the car traffic shall convert to bus or rail transit. However, if the total trip length is less than 1.0 km, this conversion will not occur regardless of degree of congestion. Under these conditions, O-D traffic in 2000 was assigned to the present road network with the result that about 1,600,000 trips (16% of trips using a car) were shifted to public transportation.

It should be noted that the said conversion of 1.6 million trips ought to be regarded as a target figure and that the conversion would not necessarily occur automatically by road congestion only. Policy measures needed to encourage this conversion will be discussed in section 9.2.

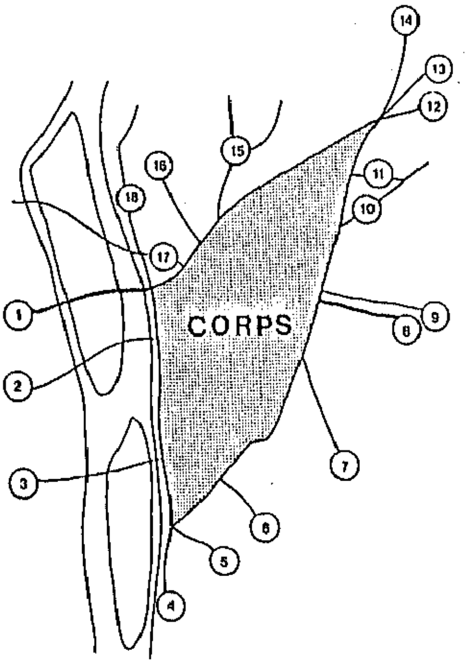
b. Constraint of Parking Capacity in CBD

At present eighteen roads connect with CORPS having a total capacity of about 880,000 pcu/day, and the daily traffic coming to and going out of CORPS comprises 810,000 pcu of cars and taxis and 120,000 pcu of buses, totaling 930,000 pcu (including through traffic) and aggregate V/C rate (traffic volume/road capacity rate is 1.06 (Table 9.1.2).

According to the "Do Nothing" analysis discussed in the previous section, traffic to and from CORPS in 2000 will be

1,250,000 pcu of cars and taxis and 130,000 pcu of buses. The V/C rate will reach 1.56, a level at which the congestion rate would become serious. To ease the congestion down to the present level, 4 to 5 new (4 lane) arterials will be required to serve CORPS.

Table 9.1.2 Capacity of Roads Linking to CORPS



	Road	Daily Capacity
1	6th Oct. Br.	171000
2	Qasr Al Nile Br.	34000
3	Gamaa Br.	61200
4	Corniche Al Nile St.	53400
5	Magra Al Eion St.	80100
6	Magra Al Eion St. - Al Sad Al Barrani St.	7400
7	Qalaa St.	8700
8	Azhar Br.	68400
9	Azhar St.	44400
10	Gueish St.	34200
11	Gueish St. - Port Said St.	7400
12	Ramses St.	52200
13	Sekket Al Hadid St.	51300
14	Port Said St.	40800
15	Shubra St.	45600
16	Sabteyah St.	40800
17	26th July St.	34800
18	Corniche St.	40800
	Total	876500

In CORPS/CBD, there is another critical constraint which is the shortage of parking space. Based on the PT survey and the parking survey, daily parking demand is estimated at about 150,000 pcu in CORPS, of which 61,000 pcu is in CBD. The demand in CORPS will increase by 1.7 times to 260,000 pcu.

On the other hand, parking capacities (including on- and off-street) in CORPS and CBD are about 150,000 pcu and 60,000 pcu respectively. In the future, plans for enforcing parking control (as explained in Chapter 12) will decrease the on-street parking capacity to two-thirds the present capacity (Table 9.1.3).

Table 9.1.3 Parking Capacity in CORPS/CBD

		On-Street		Off-Street		Total	
		1987	2000	1987	2000	1987	2000
CORPS	Parking Lots	25,828	20,000	18,648	31,000	44,476	51,000
	Daily Capacity	90,398	80,000	56,052	99,200	146,450	179,200
CBD	Parking Lots	6,414	4,140	11,000	20,860	17,414	25,000
	Daily Capacity	22,449	16,560	33,000	83,440	55,449	100,000

In the parking plan, 12,000 lots for CORPS of which 10,000 lots for CBD are set up as goals of off-street parking development. When these conditions are realized, total daily parking capacity will be 180,000 cars in CORPS of which 100,000 cars in CBD. If demand exceeds these capacities, drivers will no longer be able to find a parking lot. Therefore, use of a car to and in CORPS/CBD should be restricted as much as possible with some proper policy measures.

If car traffic to CORPS is limited to 180,000 pcu/day, about 180,000 car users (80,000 cars) will have to change their mode to public transportation.

Thus conversion rate would total 1,780,000 trips, of which 1,600,000 trips are induced by road network capacity constraints and 180,000 trips by CORPS parking capacity constraints.

3) Comparative Analysis of Policy Alternatives

In this section, two alternative networks will be tested for their efficiency to obtain the basic information to compose a masterplan network. One alternative corresponds to a road plan which shall be developed to the maximum extent without any railway projects, and the other alternative corresponds to a railway plan which shall be likewise developed excluding road projects. This analysis is an experiment through computer simulation to know the characteristics of each mode. Therefore, either of the two alone, even the best one, can not be the Masterplan network as it is.

(1) Alternatives and Simulation Conditions

Each alternative network plan intends to cope with future demand by developing a single mode or one kind of infrastructure: one being by road, the other by railway.

a) Alternative 1: Road Oriented Plan

In this alternative, as many roads as possible will be developed. In Table 9.3.1 of Chapter 9.3, three elevated roads called Metropolitan Expressway (Expwy) and 29 surface roads have been identified as long-list projects. Their total cost is estimated to be 3,312 million LE which may exceed the available financial capacity. However, all the projects are assumed in this case.

b) Alternative 2 : Railway Oriented Plan

This alternative assumes all the railway projects proposed in Table 9.3.1, including Urban Metro Line No. 1, No. 2, and Regional Metro Giza Branch Line shall be developed. Their total cost, estimated to be 3,222 million LE, is almost the same as the cost of Alternative 1.

Future OD trips are assigned to each alternative network and the results will be compared to that of "Do Nothing" assignment. There are two OD matrices for year 2000; one is the original OD matrix forecast in Chapter 8, and the other is the OD matrix after the target conversion explained in the previous section is realized by some policy measures. (Hereinafter referred to as "without policy case" for the former and "with policy case" for the latter, respectively).

Alternative 1 aims at facilitating private car use to the maximum extent. The OD matrix "without policy" will be applied to Alternative 1 and to the other, Alternative 2, OD matrix "with policy" will be applied.

After traffic assignment, the total annual transportation cost (TATC) in GCMR will be used as an evaluation indicator. TATC consists of travel time cost, vehicle operating cost and rail transit operating cost. Details are explained in Chapter 9.5.

(2) Evaluation

Results of the traffic assignment and estimated total annual transport costs (TATC) are shown in Table 9.1.4 and Fig. 9.1.5 where the following is observed;

Table 9.1.4 Transportation Demand and Cost Under Alternative Policy Conditions

	Do Nothing	Road Only	Rail Only R-1	Rail Only R-2
1 Model Share (million/day)				
(1) Passenger.km				
Car	88.3	62.9	66.9	64.2
Taxi	7.0	6.1	6.7	6.4
Bus	37.1	51.8	52.4	54.0
Rail	4.6	9.2	12.7	21.1
(2) Passenger.hr				
Car	19.7	5.8	12.8	11.4
Taxi	1.8	0.6	1.5	0.1
Bus	10.8	5.4	11.1	11.0
Rail	0.2	0.3	0.4	0.7
2. Transportation Cost (million LE/year)				
(1) Veh./Rail Operating Cost				
Car	1217	867.3	922.7	884.6
Taxi	1444	675.4	1272.2	1132.5
Bus	730	569.5	841.1	843.7
Rail	48.4	80.7	112.6	117.8
(2) Travel Time Cost	8050.8	2750.3	5929.1	5453.9
(3) Total Cost	11490.2	4943.2	9077.7	8432.5

Note R1 : Under free modal choice
R2 : Assuming 10% of car passenger demand to be converted to railway

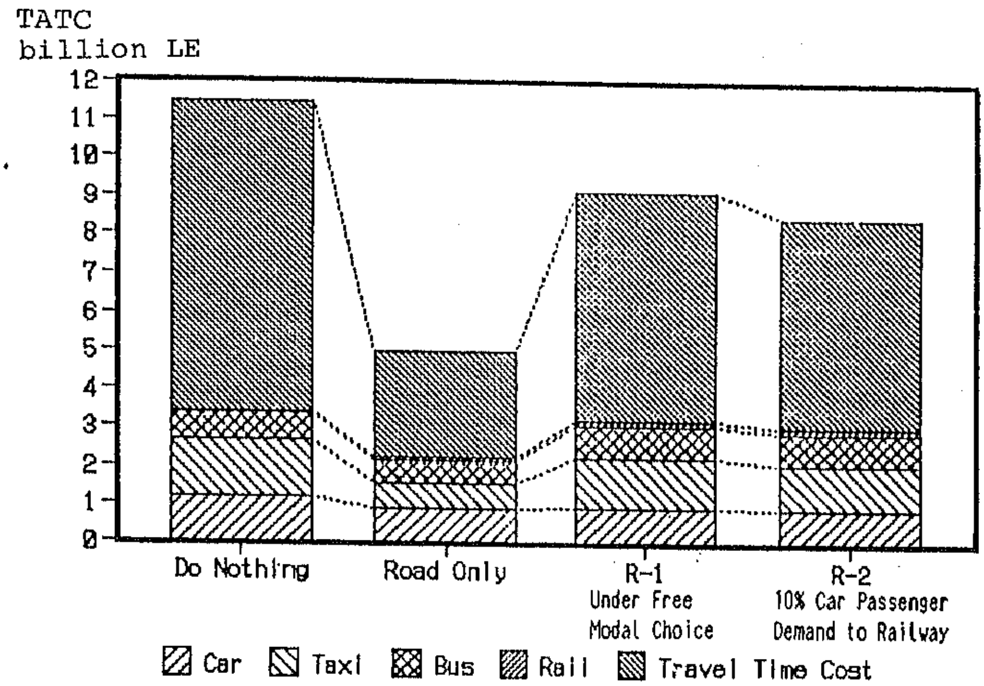


Fig. 9.1.5 Annual Transportation Cost Under Alternative Policy in Year 2000

a. TATC will reach 11.5 billion LE in 2000 under the "Do Nothing" case without policy. This amount accounts for about 13% of GDP in 2000. The average speed of road traffic will be 4.5 km/h in this case.

b. Alternative 1 will reduce TATC to 4.9 billion LE, resulting in a 6.6 billion LE reduction. Most benefits accrue from time saving of vehicles and passengers. Average speed will improve to 10.8 km/h.

c. In case of Alternative 2, railway passengers will increase by 2.7 times of that under the "Do Nothing" case in terms of passenger.km, keeping an average high speed of 31.7 km/h. On the other hand, there will be no significant improvement in road traffic, when compared with the "Do Nothing" case. Total saving in TATC is about 2.4 billion LE.

d. For alternative 2, another case (R-2) is tested where a 10% share of car passengers, with OD where railway service is available, is shifted from the private mode to public transportation. Even in this case, total saving is 3.1 billion LE, about half of alternative 1.

e. In conclusion, the following should be taken into careful consideration when developing the Masterplan strategy and network.

   a) A shift from private mode to public mode will generate sizable benefit, comparing R-2 with R-1. Therefore the conversion target should be accomplished by all means.

b) Road projects are more effective than railway projects to raise the average road traffic speed and reduce the total transportation cost.

c) Even in Alternative 2 (Railway oriented plan), railway can only account for less than 20% in total passenger•km of public mode. Therefore the majority of public transport demand will depend on bus in the future.

(3) Necessity of Rail Network Development

As discussed above, railway network is not so effective against expectation as far as saving in vehicle and railway operating costs are concerned. However, the development of an urban railway system cannot be immediately rejected because of economic reasons only.

In urbanized areas, especially such as the CBD and its surroundings, there is very little possibility for new road construction. During this Study every effort was made to search for such possibility and as a result only a few road projects in the built-up area such as widening of Kamel Sidky and Shubra streets, and the construction of Ahmed Said st. extension were identified.

Discussing only from the economic viewpoint, with the same amount of investment needed to develop a new urban rail system, wide arterials could be constructed through the destruction of existing buildings and structures. This alternative may even prove to be a more economical method by which to cope with the increasing demand. However such large scale demolition would actually be impossible because of the strong negative impact it would have on the inhabitants and workers in the effected area.

There is no reason to believe that in the future a different situation would arise where new arterials could be freely constructed in the built up area without creating negative social impact. Therefore, it must be recognized that the increase of road capacity is severely limited which in turn restricts the continuous increase in road traffic. As a result, the majority of passengers will come to depend on a railway system in the long run.

The main reason why the railway cannot be the major mode in terms of passenger share in the analysis of policy alternatives is that the railway network density is not high enough to transport passengers from their origin point to the final destination without transferring to buses. Such transfer forces passengers to pay higher tariff. Consequently the urban railway system must be further expanded to create a more dense network so as to provide service competitive to the bus service.

As long as the railway network density remains low, investment in any railway project will show a relatively low economic efficiency. Should decision makers continue to depend on economic feasibility only to formulate their decisions, then a railway network which can bear the dominant role in public transportation will never be realized and passengers will have to continue to depend on road transportation which would become gradually unreliable from the point of view of punctuality, and with no possibility in the future for significant improvement because of difficulty of new road construction.

9.2 Basic Strategy for Masterplan Development

1) Objectives and Targets

Through the analysis of the present transport conditions and the forecast of future demand for, and issues in urban transportation, the following objectives and targets are set up for the Masterplan:

(1) Objectives

a. To support and promote the socio-economic development of the Greater Cairo Metropolitan Region.
b. To guide the urban growth in the planned direction and realize orderly urban development.
c. To improve transportation service in newly urbanized areas.
d. To provide a variety of transportation services to meet every kind of demand.
e. To pursue transport efficiency and economy.

(2) Targets

a. Satisfy future transport needs.
b. Assure people equal accessibility to transport service.
c. Improve traffic safety.
d. Minimize Total Transport Cost.
e. Improve urban environment and conservation of historical places.

2) Basic Strategy

(1) To use existing facilities effectively

The financial resources are limited when compared to the investments required for the transportation projects in GCMR. Therefore, existing facilities should be effectively utilized in order to economize these resources.

(2) To shift the demand from private mode to public mode

In order not only to reduce transportation cost but also to mitigate the burden on transport facilities, this shift must be promoted by all means. On the one hand, public transport service should be improved to attract passenger car users and on the other hand, owning and using a private car should be discouraged by such policy measures as increasing import duties on vehicles, gasoline tax and charging for on-street parking.

(3) To limit private car use in CBD

Most of current traffic issues are found in CORPS/CBD. Above all, the shortage of parking facilities is serious and the road capacity is substantially decreased by cars parking on the road. If passenger cars continue to concentrate to CBD and park on the streets there, the space for carriageway will disappear. Therefore, some strong measures are required to restrict private car use in CBD.

(4) To introduce toll roads and bridges

The development of roads and bridges is definitely regarded as public natured works. On the other hand, when it is possible to identify the direct beneficiaries of a project then it would appear to be a sound idea to have them bear the project cost to some extent. With this point in mind, toll roads and bridges should be studied for their viability.

3) Constraints

(1) Financial Constraints

One of the most difficult constraints may be the financial one. Should a masterplan be developed neglecting to consider the limit of available funds, it will become merely a dream.

Table 9.2.1 shows an estimate of the plausible investment amount for the transportation sector in GCR. The estimation is based on the projection of GDP (the accumulated total from 1988 to 2000 will reach 1,012 billion LE at 1987 price) and the regional or sectoral shares of investment in the first and second five year plans. The total investment funds available for new transportation projects in GCMR during this 13 year period will be about 6.4 billion LE (at 1987 prices). This accounts for 2.5% of the national investment total; this figure is based on the first 5 year plan which gives priority to infrastructure development. However, if the second 5 year plan, which emphasizes the production sectors, is the basis for estimating transportation investments, then the total will fall to 2.8 billion LE.

Table 9.2.1 Projection of Transportation Investment in GCR until the Year 2000

(unit: million LE at 1987 price)

		Base Case (based on 2nd 5 year plan)	High Case (based on 1st 5 year plan)
(1)	GDP (1988-2001)	1,012,262	1,012,262
(2)	Total Investment in Egypt	214,684	259,136
(3)	From above, in Transport Sector	16,721	26,358
(4)	From above, in GCR	5,200	10,544
(5)	From above, to new Projects	2,842	6,355

Accordingly it may be considered reasonable that the total investment of the Masterplan should fall in the range of 3.0 to 6.0 billion LE.

(2) Social Constraints

Infrastructure development in urban areas will often require the demolition of existing buildings. In the case of residential buildings, some negative impact will accrue. Even though compensation is possible, it will take a long time to remove all the buildings. The existence of historical buildings will force the suspension of the project or altering the project plans. Therefore, the Masterplan should be prepared keeping the extent of demolition of existing buildings and facilities to a minimum.

4) Investment Policy

Not only for the present, but in the future the majority of public transport will depend on buses and taxis, both of which use road facilities. In this respect, the road network must be expanded to improve public transportation service. On the other hand, and as pointed out in the previous section, railway network development is important in the long-term perspective.

Here, an investment amount necessary to develop a railway network with adequate density, will be estimated as a rule of thumb.

If the density of a railway network which can be competitive against the bus network is assumed to be 0.5 km/km2, meaning that average interval of railway lines is 4.0 km, GCMR with an area of 360 sq.km will require a railway system of 180 km total extension. At present there are only 121 km of railway system (44 km of Regional Metro line, 47 km of HCHD metro lines, and 30 km of CTA tram lines - excluding lines proposed to be abolished in the future), and therefore an additional 60 km of new lines will be needed. It will require several decades to achieve a railway network of such density.

The total investment required to construct 60 km of railways will reach 5,000 million LE including rolling stock if one third of the extension is under ground, at 150 million LE/km, and the rest at ground surface with 50 million LE/km. With the aim to develop this network by the year 2050, 6 decades from now, 800 million LE should be allocated in the first decade.

As a conclusion, when formulating the Masterplan for the year 2000, although investment for road projects are larger, an investment amount of at least 800 million LE for railway development shall be included.

9.3 Masterplan Network

1) Method of Planning

The Masterplan network was prepared following the procedure shown in Fig. 9.3.1. A detailed examination of the "Do Nothing" analysis made it possible to foresee future transportation problems. In order to solve or avoid such problems, various projects and countermeasures were developed and tested for their demand and effects through computer simulation.

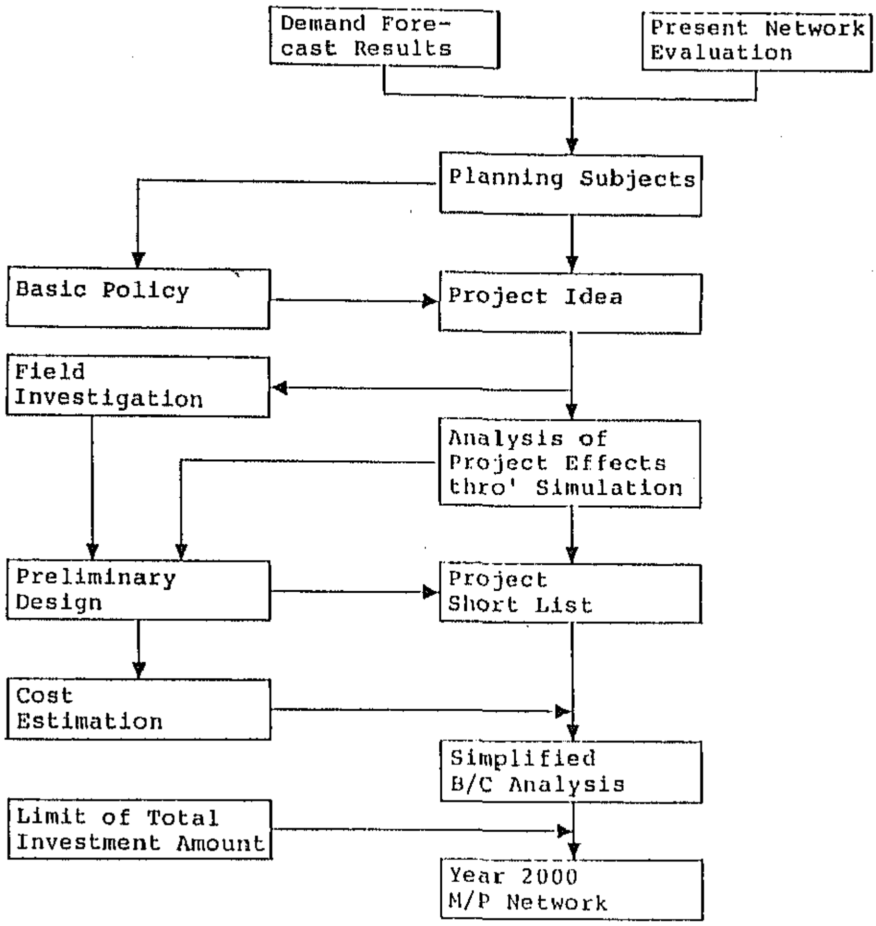


Fig. 9.3.1 **Masterplan Network Formulation Procedure**

At the same time, field investigation was made at each project site to check the actual situational and technical aspects; based on this information the preliminary design and cost estimation works were undertaken. In this manner the project long list was prepared.

A large number of projects are required in order to cope with present and future issues and to pursue the previously stated objectives. This resulted in the total cost exceeding the plausible range of future investment funding. Therefore, a simplified B/C analysis through comparing a single year's cost and benefit was made for each project in order to determine its priority. This finally led to the establishment of the Masterplan network for the year 2000.

2) Frame of Masterplan

Figs. 9.3.2 and 9.3.3 illustrate the Masterplan networks for road and railway respectively. Features of the Masterplan are summarized below.

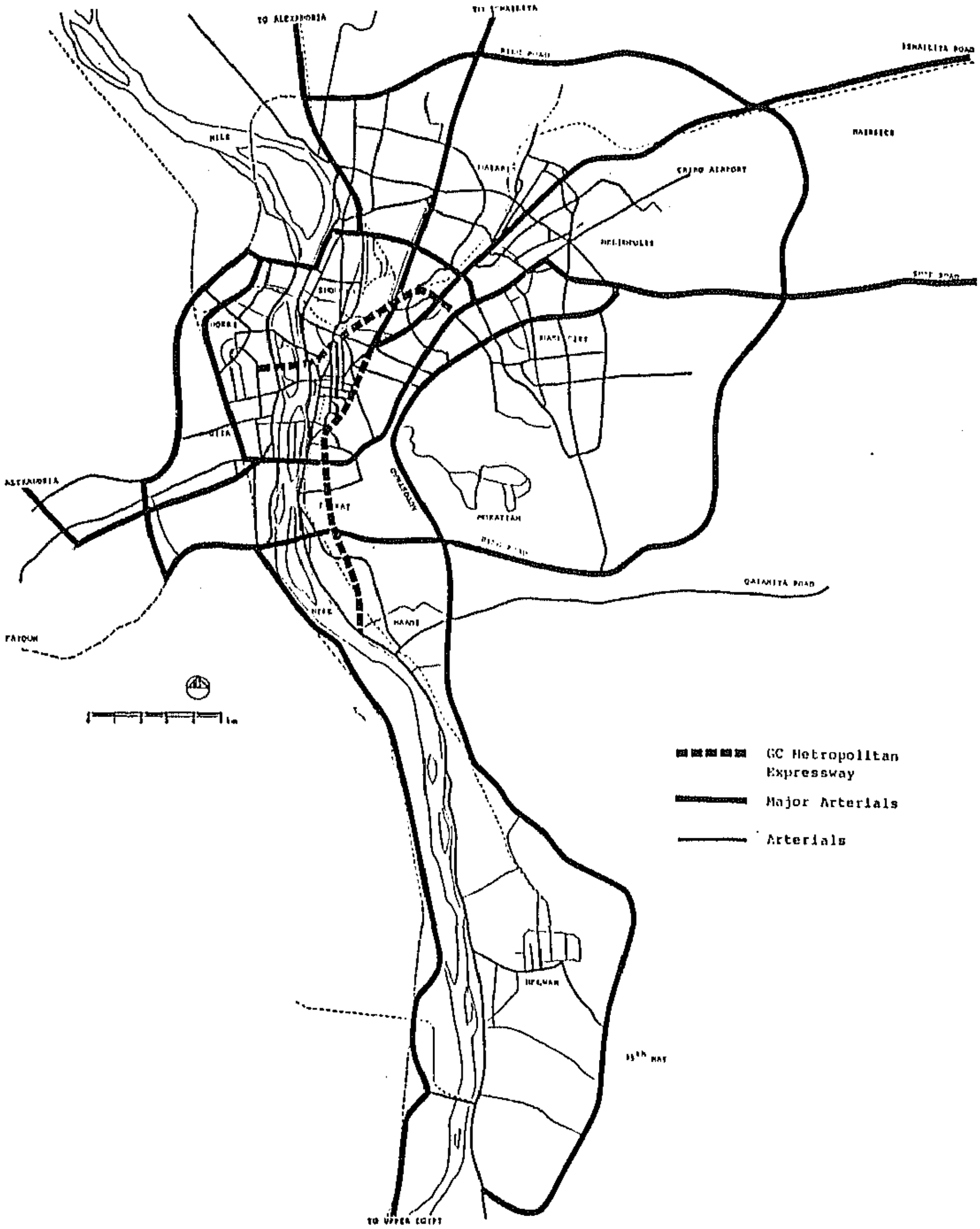


Fig. 9.3.2 Masterplan Road Network in Year 2000

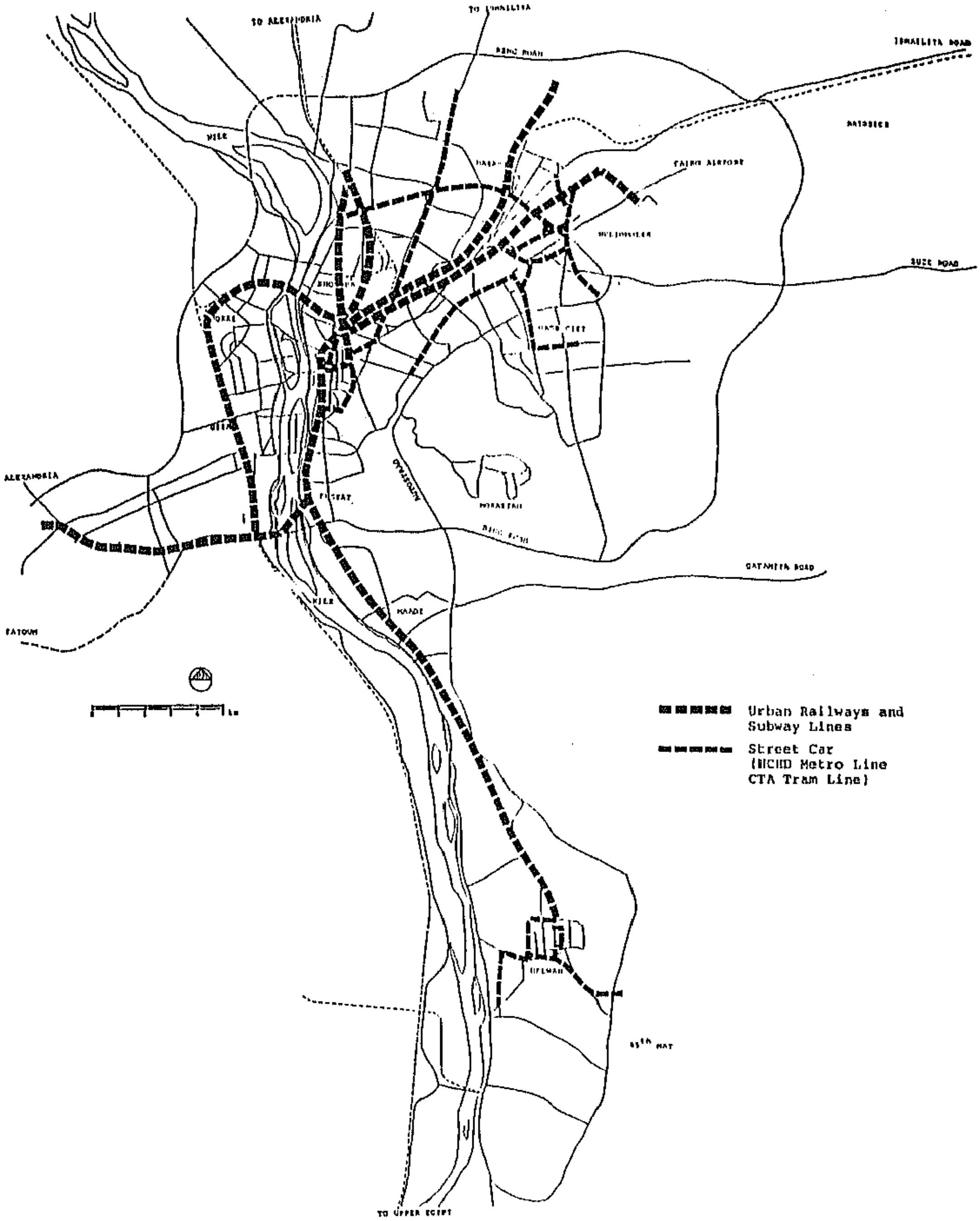


Fig. 9.3.3 Masterplan Railway Network in Year 2000

(1) Frame of Masterplan Road Network

- Road projects such as Sekket Al Wayli st. and Rod Al Farag br. Western Approach are planned to form the Inner Ring Road together with the existing Salah Salem st. and Sudan st. The Inner Ring Road will connect the existing sub-centers of Heliopolis, Nasr City, Masr Al Qadima, Giza, Dokki, Embaba and Shubra and is expected to divert traffic between those sub-centers from radial arterials.

- Main radial arterials are planned to have their starting points on the Inner Ring Road and to be connected with highways in the National Network.

- Since it is considered difficult to increase traffic capacity inside the Inner Ring Road without the removal of buildings, an elevated road network, which utilizes the existing road spaces in the form of multi-level structures, is planned. This network will be connected to the Inner Ring Road for traffic from outside the Inner Ring Road.

- The Outer Ring Road will be completed except for the North Nile River br. section.

- At grade streets are planned mainly between the Inner Ring Road and the Outer Ring Road where rapid housing development is under way, mostly following right-of-way ordinances determined by the cities of Cairo, Giza and Qaliubiah.

(2) Frame of Masterplan Railway Network

- An urban metro network should be developed in the long term. Priority will be attached to the phase 1 section of the Urban Line 1 from Shubra Al Kheima sta. to Tahrir sq. from the viewpoint of demand and impact. Prior to the construction of phase 1, Shubra st. needs to be widened to reduce phase 1 construction costs.

- To fully utilize of the capacity of the Regional Metro line, a Giza branch line should be constructed from Mary Gergis sta. to the planned Ahram intercity bus terminal location.

- HCHD Ramses-Nozha line should be improved to enable the operation of frequent rapid trains. Other tram lines are to be segregated completely, or else removed in the long run. The CTA Helwan line should be extended to the Helwan Regional Metro sta. and to 15th May City.

- ENR should provide urban train service between Shubra Al Kheima sta. and Giza sta. Prior to this service, the improvement of Cairo Central sta. is needed. In the future, the ENR terminals should be decentralized to Shubra Al Kheima City for Delta trains and Giza City for Upper Egypt trains.

(3) **Frame of Masterplan Bus Network**

- As bus passengers will increase by 1.28 times the present number in the year 2000, the bus fleet should be reinforced in number and in quality. 250 to 350 buses should be introduced annually to replace old buses and increase the fleet.

- Exclusive bus lanes are to be introduced along the streets of Ramses, Galaa, Giza Corniche, and Pyramid, and conditionally along Qasr Al Aini, Corniche, Gueish and Ahmed Helmi streets. Before introduction, comprehensive research and planning is necessary.

- To promote the conversion from private car use to public bus use, it is recommended that a new deluxe bus service with a higher fare be introduced.

- Bus terminals at Attaba and Giza squares should be expanded and improved. As the railway network is developed, bus terminals will be needed at the main stations. At planned intercity bus terminals, urban bus terminals are also to be located for transfer convenience.

(4) **Frame of CBD Traffic Plan**

- Based on the proposals in the Second Urban Development Project, CBD Components, introduction of CBD ATC, intersection remodeling, installation of bus bays and parking restriction plan are selected as urgent projects.

- On-street parking will be restricted on CBD arterials to increase traffic capacity. An on-street parking charge is planned on semi-arterials by selling parking tickets to eliminate long time parking. Multi-storey garages with total capacity of 9,860 lots, together with on street parking shall be established.

- To decrease private mode use in CBD, consideration is being given to improvement of bus services and pedestrian conditions, and hierarchical arrangement of streets. 2.7 km of bus arterials are planned in a cross shape to eliminate through traffic except on 26th July st. Only CBD buses will be allowed to operate within CBD, and at Tahrir, Ramses, Attaba and Sayedah Zeinab squares on the fringe of CBD, bus terminals of 0.3 ha total area are planned to transfer from outside buses. These proposals will be implemented in stages.

- An Attaba-Azbakiah transport complex is proposed to mitigate traffic congestion, coordinate the tram, bus, mini-bus and urban metro, provide underground parking space, and beautify the park. This complex includes CBD and CTA bus terminals, CBD bus arterial, shopping complex, elevated garden, and 1,600 lot underground public garage.

- A total area of 206 ha in CORPS is in need of redevelopment in order to upgrade urban conditions and develop the road network. Widening of Kamel Sidky st. and realignment of Azhar st. are to be accomplished together with urban redevelopment.

(5) **Project Formulation**

A project is defined as a minimum unit of the Masterplan component, which can function independently of other projects. The Masterplan as explained in this chapter, identifies 57 projects: 32 road projects, 14 railway projects, 3 bus projects, and 8 CBD projects.

All the projects are shown in Table 9.3.1 with estimated costs divided into foreign currency and local currency portions. The location of each project is shown in Figs. 9.3.4 and 9.3.5.

The total Masterplan projects cost 6,769 million LE, broken down as follows; 3,313 million LE for road projects, 3,222 million LE for railway projects, 172 million LE for bus projects, and 62 million LE for CBD projects. The total amount is slightly above the upper limit of the financial capacity.

Table 9.3.1 Masterplan Project List

Project No.	Project Name	Description	Total Cost (M.LE)
H001	Expwy No. 1	6th Oct. Br. extension project from Ghamra Br. to Salah Salem st. 2.3Km, 4 lane road. Interchanges at Ghamra Br. and Abbasseya sq.	74.1
H002	Expwy No. 2	New viaduct construction from Ring Road in Fustat area to Bab Al Shaaria sq. 8.0 Km, 4 lane double deck type viaduct on Port Said st. with junction in Fustat and interchanges on Fustat Road, Salah Salem st., Sayedah Zeinab sq. and Qalaa st.	333.8
H003	Expwy No. 3	New viaduct construction from Bab Al Shaaria sq. to Ismailia Desert Road. 7.3 Km, 4 lane viaduct on Gueish st., Abbasseya st., Khalifah Al Mamoun st. and Gisr Al Suez Road with interchanges on Bab Al Shaaria sq., Gueish sq., Kobri Kobba and Kobba st. One junction with Expwy No.1 (6 Oct. Br. Extension) on Abbasseya sq.	287.8
H101	Ring Road Southern section in Giza	Ring Road between Giza north-south route and Nile south bridge. 4.1 Km, 8 lane with 50m ROW. Main structure: 200m Tersa Canal Br.	74.8
H102	Ring Road Southern section (Nile River Br.)	Main span : 65m + 2 x 115m + 65m = 360m, PC cantilever Type. 8 lane. 1100m west approach viaduct on Upper Egypt Highway, ENR and Zomor Canal, and 550m east approach viaduct on Corniche st. and Maadi Agriculture Road. Interchanges with Upper Egypt Highway and Maadi Agriculture road. Total section length : 2.5Km.	290.8
H103	Ring Road Southern section (Fustat Area)	Ring Road between Maadi Agriculture Road and Autostrade. 3.8 Km, 6 lane with 40m ROW. 250m viaduct between Maadi Agriculture Road and Fustat hill area. Part of the section is under construction.	71.2
H104	Ring Road Giza North-South link	Ring Road between southern section and western arc through Giza built up area. 3.8 Km 6 lane with 40m ROW road construction.	51.8
H105	Ring Road Western Arc	Ring Road between Alexandria Desert Road and Giza North-South Link. 5.5 Km 4 lane with 40m ROW road construction.	62.3
H106	Ring Road Western Arc	Ring Road between Giza North-South Link and Sarwat st. Extension. 2.1 Km 6 lane with 40m ROW road construction.	54.3
H107	Ring Road Western Arc	Ring Road between Sarwat st. Extension and 26 July st. Extension. 4.3 Km 6 lane with 40m ROW road construction.	71.2
H108	Ring Road Western Arc	Ring Road between 26 July st. Extension and Rod Al Farag western approach extension. 4.3 Km 6 lane with 40m ROW road construction. 300m Viaduct on ENR line.	114.8
H109	Ring Road Western Arc (North Nile Rv. Br.)	Ring Road between Rod Al Farag Br. western approach extension and Alexandria Agriculture Road. 8.3 Km 4 lane with 40m ROW road construction. Main span of north Nile River Br.: 85m + 2 x 125m + 85m = 420m and 70m + 4 x 125m + 70m = 640m, PC cantilever type. 600m viaduct for west 1200m viaduct for east approaches.	296.0
H110	Ring Road Northern Arc (Qaliubiah)	Ring Road between Alexandria Agriculture Road and Ismailia Canal. 7.8 Km 4 lane with 40m ROW road construction.	126.4
H111	Ring Road Northern Arc (Al Marg)	Ring Road between Ismailia Canal and Ismailia Desert Road. 12.7 Km 4 lane with 40m ROW road construction. Ismailia Canal Br. has been completed.	205.0
H201	Salah Salem - Sayedah Road	New road construction between Salah Salem and Sayedah Zeinab sq. 3.0 Km 4 lane road with 20m ROW.	39.4
H202	Kamel Sidky st.	Widening of existing 20m (0.4 Km) and 12m (0.7 Km) Kamel Sidky st. to 4 lane 40m ROW from Ramses sq. to Gueish st. and 2.8Km new road construction on the successive section along Old Cairo Wall from Gueish st. to Autostrade.	174.9
H203	Rod Al Farag st.	Improvement of existing 18m - 20m, 1.7 Km Rod Al Farag st. to 4 lane 20m ROW, and 3.6 Km new road construction on the successive section up to Ramses st. in Abbasseya sq.	106.4
H204	Shubra st.	Widening of existing 25m, 1.7 Km Shubra st. (2 lane one-way with single track tram line at the center) from Rod Al Farag st. to North Entrance of Cairo Central Station to 6 lane 40m st. ROW has been secured. No. of buildings to be demolished : 26 bldgs.	24.0
H205	Ahmed Helmi st.	Improvement of existing 4.1 Km Ahmed Helmi st. (25m ROW, 4 lane with segregated tram line at the center) to 6 lane st. from Ismailia Canal Road to North Entrance of Cairo Central Station.	10.9

Table 9.3.1 (cont...)

Project No.	Project Name	Description	Total Cost (M.LE)
H206	Ahmed Said st.	Widening of existing 2.7 Km, 18m ROW, 2 lane Ahmed Said st. from Ramses st. to Sekket Al Wayli st. to 36m ROW, 6 lane st. and 2.8 Km new road construction on the successive section from Sekket Al Wayli st. to Mataria st.	76.5
H207	Sekket Al Wayli st.	Improvement of 1.7Km, 20m ROW, 2 lane Mamalik School road and 2.5 Km, 30m ROW, 4 lane Sekket Al Wayli st. to 30m ROW, 6 lane st. and 1.7 Km new road construction between Ahmed Helmi st. and Port Said st. including a 200m bridge over ENR line.	72.4
H208	Ahmed Said st. Extension	Extension of 6 lane 36m ROW Ahmed Said st. from Mataria st. to Ismailia Desert Road in Ain Shams area by widening of existing 20m ROW Nezoul st. for 1.2 Km, and 20m - 40m ROW Ibrahim st. for 1.8 Km and construction of new road for 3.3 Km.	73.2
H209	Azhar st. Extension	Extension ot existing 4 lane Azhar st. from Salah Salem st. to Autostrade for 0.4 Km. ROW : 40m	3.7
H301	Giza North-South Street	4.2 Km, 4 lane with 40m ROW new road construction between Ring Road southern section in Giza and Sarwat st. extension.	89.5
H302	Sarwat st. Extension	Extension of existing 6 lane 40m ROW Sarwat st. from ENR line to Ring Road western arc for 2.3 Km.	99.2
H303	26 July st. Extension	Extension of existing 6 lane 45m 26 July st. from ENR Line to Ring Road western arc for 3.0 Km. 350m Viaduct over ENR line.	39.5
H304	Ahmed Orabi st. Extension	Extension of existing 6 lane 50m ROW Ahmed Orabi st. from ENR Line to Ring Road western arc for 1.6 Km. 350m viaduct over ENR line.	103.8
H305	Rod Al Farag Br. West Approach	4.3 Km, 4 lane, 40m ROW Road improvement from Rod Al Farag Br. to Sudan st. via Wehda st. and Bouhi st. or ENR freight line. 350m viaduct over ENR line.	33.3
H306	Rod Al Farag Br. West Approach Extension	1.3 Km, 4 lane, 40m ROW road construction from Rod Al Farag Br. west approach to Ring Road western arc. 350m viaduct over ENR line.	67.6
H401	Shubra Al Kheima North-South Road (1)	1.3 Km, 4 lane, 40m ROW road construction from Ismailia Canal Road to Shubra Al Kheima East-West Road. 400m new bridge over Ismailia Canal.	31.7
H402	Shubra Al Kheima East- West Road	1.3 Km, 4 lane, 50m ROW road construction from existing Shubra Al Kheima East-West Road to Ismailia Canal west road.	69.9
H403	Shubra Al Kheima North-South Road (2)	1.9 Km, 4 lane, 40m ROW road construction from existing Shubra Al Kheima East-west road to Ring Road Northern Arc.	82.4
		Total	3,312.6
R001	Urban Metro No.1 Phase I	10.2 Km Urban Metro construction from ENR Shubra sta. to Tahrir sq. via Ramses sq. and 12 stations including stations at both ends. Connection with Regional Metro at Tahrir sq. (Sadat sta.).	887.5
R002	Urban Metro No.1 Phase II	4.9 Km Urban Metro Extension up to Boulaq in Giza from Tahrir sq. via Nile Rv., Mesaha st., Abdel Salam st., Cairo University and ENR Boulaq sta.	537.3
R003	Urban Metro No.2	16.5 Km, East-West Urban Metro Construction from ENR Embaba sta. up to Nasr City via Ahmed Orabi st., 26 July st., Azbakiah park, Kamel Sidky st., Salah Salem st. and Autostrade.	897.7
R004	Regional Metro Giza	11.8 Km Regional Metro branch line construction from existing Mary Gergis sta. on the regional metro up to the planned long distance bus terminal in Pyramid area via Dahab Island, Nile Rv. and Ring Road southern section. Connecting station with ENR Giza line.	361.9
R005	Urban Rail Operation (Cairo Central Sta. - Shubra sta.)	Introduction of urban rail operation for 6.5 Km ENR Minouf line from Cairo Central Sta. to Shubra sta. Construction of 3 intermediate stations and improvement of both terminal stations. Single track operation in case of no improvement at Cairo Central Station.	13.9

Table 9.3.1 (cont...)

Project No.	Project Name	Description	Total Cost (M.LE)
R006	Urban Rail Operation (Cairo Central Sta. - New Giza Sta.)	Introduction of urban rail operation for 15.7 Km ENR Giza line from Cairo Central sta. up to new Giza sta. (2.3 Km southwards from present sta.). Construction of 3 intermediate stations and a new Giza station, and improvement of Cairo Central station. The project will allow, together with R006 project, the operation between new Giza sta. to Shubra sta.	13.7
R101	HCHD Metro Ramses - Nozha	Introduction of Urban Rail Operation for 15.4 Km HCHD Metro line from Ramses sta. to Nozha sta. via Roxi sq. by rail improvement and introduction of high speed and scheduled operation. Construction of 4.5 Km viaduct between Roxi sq. and Hegaz sq. Improvement of existing Roxi sta. and installation of automatic signal system.	163.2
R102	HCHD Nozha - Airport Extension	4.3 Km extension of R101 HCHD Metro line from Nozha sta. to Cairo international Airport for air passengers, well-wisher and airport employees. Construction of underground stations below Airport terminal No.1 and 2.	284.1
R103	HCHD Al Gehaz Al Markazi	Construction of 530m viaduct of HCHD Metro and a station on viaduct at Al Gehaz Al Markazi intersection with Salah Salem.	7.7
R104	Connection of CTA Tram and HCHD Metro	Connection of HCHD Metro Mataria line and CTA Tram Mataria line to allow continuous tram operation between Kobri Al Suez and Al Raii. Installation of 300m rail and trolley.	0.5
R105	Extension of CTA Port Said Line	Extension of CTA Port Said Tram Line to Sayedah Zeinab Regional Metro station via Sad Al Barrani st. Construction of 900m rail and trolley.	1.6
R106	Extension of CTA Helwan Line	Extension of CTA Helwan Tram Line to 15th of May City beyond Autostrade and to Regional Metro Helwan station. Construction of 1.7 Km Rail and trolley and a viaduct over Autostrade.	3.1
R107	Small Scale Improvement of CTA Tram Lines	Small scale improvement of CTA tram lines of Ramses st. - Abdel Moneim Riad and Raii - Mataria. Installation of railway crossing signals and fence to promote segregation.	21.2
R108	Small Scale Improvement of HCDC Metro Lines	Small scale improvement of HCHD Metro lines. Installation of railway crossing signals and fence to promote segregation.	29.0
		Total	3,222.4
B001	Increase of Bus Fleet	To meet the future demand, about 1000 buses should be introduced additionally by the year 1999.	115.8
B002	Deluxe Bus	To encourage car users to use bus service, deluxe bus service is introduced, charging higher tariff and prohibiting standing passengers. Initially 200 buses are introduced as a pilot project.	56.0
B003	Bus Exclusive lane	Introduction of exclusive bus-lanes in Ramses st., Galaa st., Al Qasr Al Aini st., and Corniche st. to Maadi and also in Gueish st. and Ahmed Helmi st. after removal of tram line.	0.0
		Total	171.8
C101	Bus Exclusive Road	Introduction of 2.7 Km, 7.0m carriageway, 2 lane (both direction) bus exclusive roads on Emad Al Dine st., Qasr Al Aini st., Sherif st. and Adly st. Installation of bus bays.	13.6
C102	Bus Rerouting	Bus routes rerouting on CBD bus exclusive roads and CBD peripheral streets of Ramses, Galaa, Tahrir, Boustan and Clot Bey.	0.0
C103	Bus Terminal	Construction of 3 bus transfer terminals (total floor area : 0.25 Ha.) at Ramses sq., Tahrir sq. and Attaba st.	5.4
C104	Exclusive Pedestrian Arterials	Introduction of 2.7 Km exclusive pedestrian arterials in CBD along bus exclusive roads, equipped with lighting, vegetation, street furnitures such as benches. Width : 4.5m at both sides of bus lane.	0.2
C105	Exclusive Pedestrian Streets	Introduction of 1.7 Km exclusive pedestrian streets connecting with exclusive pedestrian arterials, equipped with lighting, vegetation, street furnitures such as benches and small parks. Standard width : 6.0m.	1.6
C106	On-street Parking	Establishment of 16.3 Km, 4,140 lots on-street parking spaces on one side of distributors and collectors in CBD. Introduction of parking ticket system for the collection of parking charge.	0.3

Table 9.3.1 (cont...)

C107	Off-street Parking	Construction of a total of 9,860 lots, 24 Ha. floor area multi-storey garages in CBD.	40.1
C108	Traffic Regulations	Establishment of 16.3 Km one way system on collectors and no-parking regulation on 8.7 Km distributors in CBD.	0.5
		Total	61.7
GRAND TOTAL			6768.5

Note: Project Code: X a b c

- b c — Serial number
- a — Governorate
  - 0 Not defined or Located in two or three governorates
  - 1 Cairo Governorate
  - 2 Giza Governorate
  - 3 Qaliubiah Governorate
- X — Project category
  - H : Road
  - R : Railway project
  - B : Bus project
  - C : CBD project

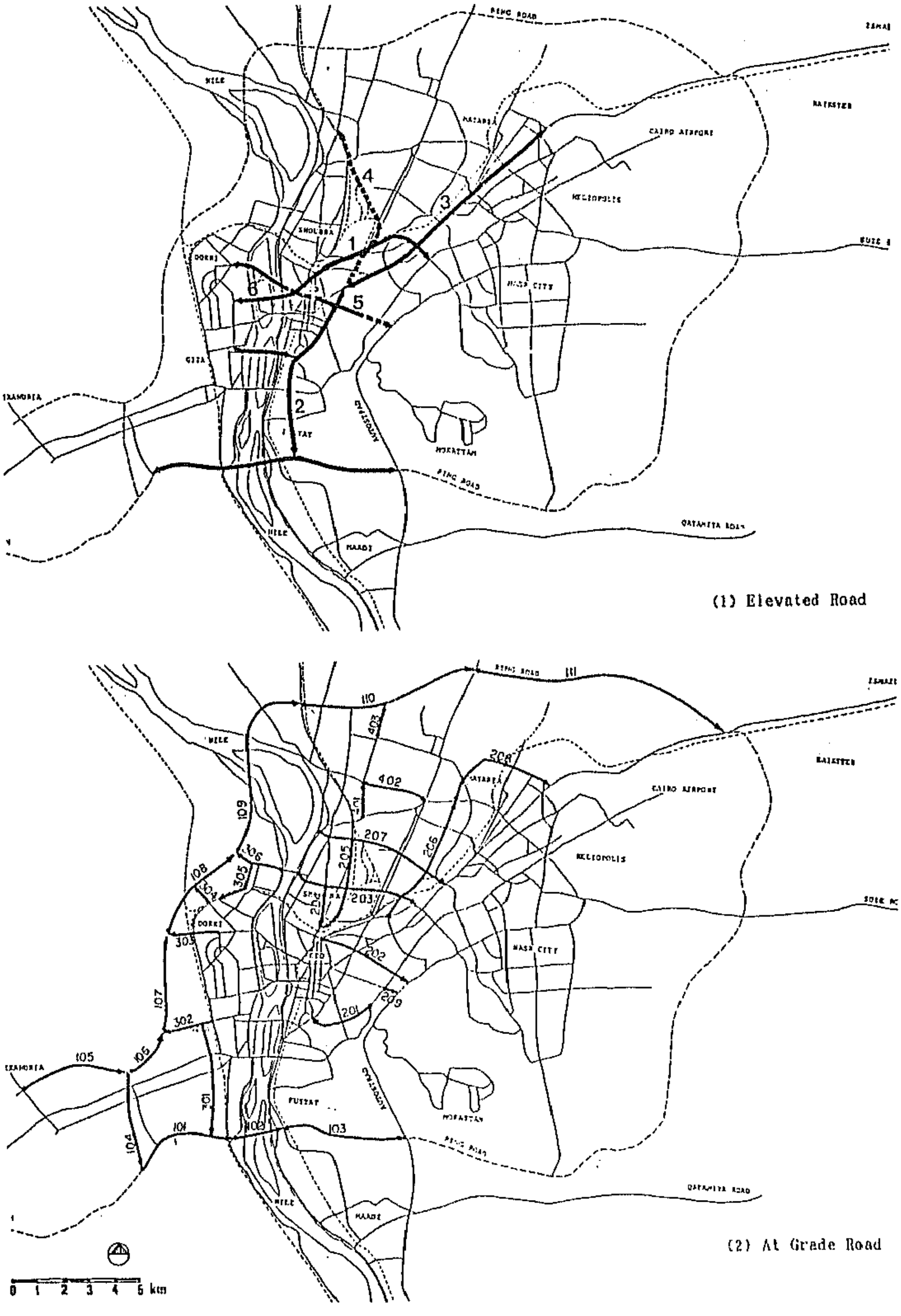


Fig. 9.3.4 Location Map of Road Projects

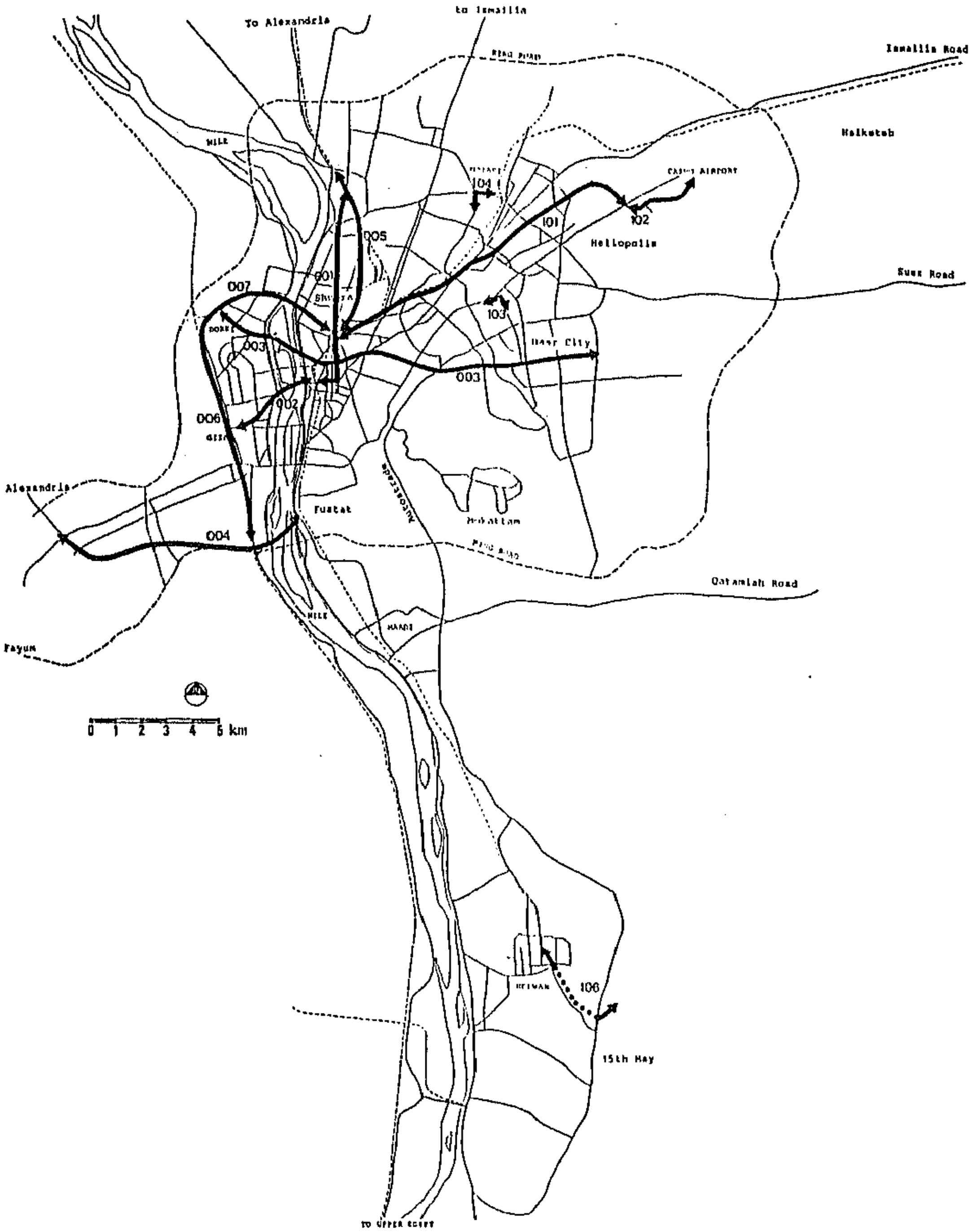


Fig. 9.3.5 Location Map of Railway Projects

Classifying each project according to the supposed organization responsible for construction of the project, investment amount by each organization is as shown in Table 9.3.2.

Table 9.3.2 Masterplan Project by Related Organization

(unit: million LE)

	No. of Project	Project Code	Invest-ment	(%)
MODANC	13	H101 H102 H103 H104 H105 H106 H107 H108 H109 H110 H111 H303 H304	1561.9	23.1
NAT	4	R001 R002 R003 R004	2684.4	39.7
Cairo Gov.	17	H001 H002 H003 H201 H202 H203 H204 H205 H206 H207 H208 H209 C104 C105 C106 C107 C108	1319.8	19.5
Giza Gov.	4	H301 H302 H305 H306	289.6	4.3
Qaliubiah Gov.	3	H401 H402 H403	184.0	2.7
ENR	2	R005 R006	27.6	0.4
HCHD	4	R101 R102 R103 R108	484.0	7.2
CTA	10	R104 R105 R106 R107 B001 B002 B003 C101 C102 C103	217.3	3.2
Total	57		6768.6	100.0

9.4 Project Priority and Setting

1) Priority Setting

Prior to planning the investment schedule, every component project of the Masterplan was examined as to its relative importance form various viewpoints, such as demand volume, economic efficiency, engineering issues, social impact, etc., and classified by its overall score into one of three groups; high, medium and low priority group. Details of the evaluation criteria and ranking results are explained in Chapter 10 for road projects and Chapter 11 for public transport projects.

Ranking was done separately for each of road and public transport sectors, because road projects and public transport projects differ in various aspects of their function, beneficiaries, scale of investment and executing agencies. Therefore it is considered reasonable that the priority and share of investment should be discussed from the higher standpoint of policy and strategy. A guideline is suggested in Section 9.2, of this chapter concerning the budget allocation between road and railway sector.

In the economic evaluation of each component, a simplified method was employed, which is the so-called single year cost/benefit comparison. The benefit expected to be brought about by a project in the year 2000 is compared to the sum of the project cost divided by the project life and capital opportunity cost of the year. The benefit of a project is calculated as an increment of the total operating cost of vehicles and railways when the project is eliminated from the Masterplan network.

Besides the economic evaluation indices such as B/C ratio and B-C, the current progress (or the maturity) and the negative social impact of a project are considered as additional criteria for the road projects. In the case of public transport projects the following various factors are taken into account:

a. Cost performance of projects from the economic viewpoint
b. Fundamental element of public transport structures
c. Convenience for public transport mode users
d. Affordable financially to the executing body
e. Contribution to the community
f. Project consensus
g. Project magnitude
h. Ease of implementation

The results of priority ranking are as shown in Table 9.4.1 where 33 projects out of 46 are ranked in the high priority group, and 11 projects in the medium priority group. When ranking each project, it was also kept in mind whether the project had enough possibility to be completed before the year 2000 with respect to the financial constraint stated in the previous section (Chapter 9.2). The Urban Metro No. 2 (R003) and HCHD Metro Airport Extension (R102) were ranked in the low priority group mainly due to this point.

Table 9.4.1 Priority and Cost of Masterplan Component Projects

Priority / Cost Scale	(1) High		(2) Medium		(3) Low
Large (over 200 M.LE)	H002 H102 H111		H003 H109	R001 R002 R004	R003 R102
	829.6		2,370.5		1,181.8
Medium (100-200 M.LE)	H108 H110 H202 H304	R101	H203		
	683.1		106.4		0.0
Small (Less than 100 M.LE)	H001 H101 H103 H104 H105 H106 H107 H204 H205 H207 H209 H302 H305	H306 H401 H402 H403 R005 R006 R103 R104 R105 R106 R107 R108	H201 H206 H208 H301 H303		
	1,045.5		318.1		0.0
Total	2,558.2		2,795.0		1,181.8

Note: Road and Railway projects only

Total cost of the high priority ranked projects is estimated to be 2,558.2 million LE (at 1987/88 constant price) which is less than the plausible investment amount during the 1990s which falls between 3 to 6 billion LE. However, when the project costs of the medium priority ranked groups are added, the total exceeds the said amount. Therefore the main issue involved in of project scheduling will be how to plan the implementation schedule of medium priority ranked projects.

2) Investment Schedule

In order to plan a well balanced investment schedule by aligning the Masterplan component projects on the time axis, several conditions must be considered simultaneously. Here, an appropriate schedule was looked for through trial and error, keeping in mind the following conditions:

a. The investment should be planned in such a manner that annual investment amount is almost constant, because a sudden rise or fall of this amount will not only be unrealistic but also cause various financial and administrative issues.

b. Careful attention must be paid to the inter-relationship among projects, especially between projects in different sectors.

c. Priority should be given to projects which aim at solving problems considered very serious at present.

In this Study, CBD projects which are mainly concerned with traffic management are not specifically scheduled because they should be implemented on occasion and when needed, due to their symptomatic treatment nature. Among CBD projects, construction of off-street parking facilities should be implemented continuously because the supply of parking space in CBD can hardly catch up with the demand notwithstanding all the efforts.

Table 9.4.2 shows the recommended investment schedule. The main points of the investment schedule are described by sector hereinafter.

(1) Road

a. The period of 1990 to 1992 will be for the preparatory works to develop the Metropolitan Expressway system. Afterward implementation shall be continued without interval in the order if H001, H002 and H003.

b. Ring Road south bridge (H102) is envisaged to be completed in 1994 and prior to this approach roads along both sides (H101, H103) should be constructed. Also Expwy 2 (H102) should commence its service from the Ring Road to Sayedah Zeinab at the same time of the opening of the bridge to improve the accessibility to CBD.

c. Most of the other Ring Road sections should be completed during 1990 to 1995 and only the north bridge will still be under construction in 2000.

d. As for Kamel Sidky st. Widening Project (H202), four to five years will be required to prepare the urban redevelopment plan along the road and to form a consensus amongst the inhabitants. Land acquisition shall start in 1995 and be completed in 1999.

e. Sekket Al Wayli st. (H207) should be completed by the mid-90s.

f. Shubra st. (H204) should be widened by 1996 before the construction of Urban Metro No. 1 (R001) starts.

Table 9.4.2 Investment Schedule of Masterplan Project

	Project	Cost (MLE)	Rank	Implementation Schedule 90 91 92 93 94 95 96 97 98 99 0 1 2 3 4 5
H001	Expwy No. 1	74.1	A	---- ****
H002	Expwy No. 2	333.8	A	--------************
H003	Expwy No. 3	287.8	B	-------- ****************
H101	R. Road South in Giza	74.8	A	--------****
H102	R. Road South br.	290.8	A	----************
H103	R. Road South Fustat	71.2	A	--------****
H104	R. Road North South	51.8	A	----------------****
H105	R. Road Western Arc.	62.3	A	--------****
H106	R. Road Western Arc.	54.3	A	----------------****
H107	R. Road Western Arc.	71.2	A	----------------****
H108	R. Road Western Arc.	114.8	A	----------------****
H109	R. Road North Nile br.	296.0	B	----------------****************
H110	R. Road Qaliubiah	126.4	A	------------********
H111	R. Road Al Marg	205.0	A	----------------********
H201	Salah Salem-Sayedah	39.4	B	----------------****
H202	Kamel Sidky st.	174.9	A	----------------****
H203	Rod Al Farag st.	106.4	B	----------------****
H204	Shubra st.	24.0	A	----------------****
H205	Ahmed Helmi st.	10.9	A	------------****
H206	Ahmed Said st.	76.5	B	----------------****
H207	Sekket Al Wayli st.	72.4	A	------------********
H208	Ahmed Said st. Ext.	73.2	B	----------------****
H209	Azhar st. Ext.	3.7	A	--------****
H301	Giza North-South st.	89.5	B	----------------****
H302	Sarwat st. Ext.	99.2	A	----------------****
H303	26th July st. Ext.	39.5	B	----------------****
H304	Ahmed Orabi st. Ext.	103.8	A	--------****
H305	Rod Al Farag west App.	33.3	A	------------****
H306	Rod Al Farag west Ext.	67.6	A	--------****
H401	Shubra Al Kheima N-S 1	31.7	A	------------****
H402	Shubra Al Kheima E-W	69.9	A	--------****
H403	Shubra Al Kheima N-S 2	82.4	A	--------****
R001	Urban Metro #1, Ph.1	887.5	B	------------************************
R002	Urban Metro #1, Ph.2	537.3	B	----------------************
R003	Urban Metro #2	897.7	C	--------
R004	Regional Metro Giza	361.9	B	------------ ************
R005	ENR (Cairo C.- Shubra)	13.9	A	----****
R006	ENR (Cairo C.- Giza)	13.7	A	----****
R101	HCHD Ramses-Nozha Imp.	163.2	A	----****************
R102	HCHD Airport Ext.	284.1	C	--------
R103	HCHD Gehaz Al Markazi	7.7	A	----****
R104	CTA & HCHD Connection	0.5	A	----****
R105	CTA Tram to S.Zeinab	1.6	A	--------****
R106	CTA Tram Ext. Helwan	3.1	A	----****
R107	CTA Tram Improvement	21.2	A	----************
R108	HCHD Metro Improve.	29.0	A	----************
B001	Bus Fleet Increase	115.8	A	**
B002	Deluxe Bus	56.0	A	****
B003	Exclusive Bus Lane	0.0	A	******** ************
C101	Exclusive Bus Road	13.6	A	(Not Scheduled)
C102	Bus Rerouting	0.0	A	
C103	Bus Terminal	5.4	A	
C104	Excl. Pede. Arterial	0.2	C	
C105	Excl. Pede. Street	1.6	C	
C106	On-St. Parking System	0.3	A	
C107	Off-St. Parking Bldg.	40.1	A	
C108	Traffic Regulation	0.5	A	
	Total	6768.6		-- 1849.4 -- -- 1968.8 -- -- 2950.4

Note : ---- Design and Land Acquisition
**** Construction and Rolling Stock

g. Connections to the Ring Road (H302, H303, H304, H306, H403) are to be completed in accordance with the construction of each respective Ring Road section.

h. Urban streets in Shubra Al Kheima (H401, H402, H403) should be developed at an early stage as the urbanization progress in the area will make their implementation more difficult.

(2) Railway

a. HCHD Metro Ramses-Nozha line (R101) should be upgraded in the early 1990s because of its high cost performance and comparatively low lost.

b. Urban Metro No. 1, phase 1 (R001) will require a couple of years for detail design work and another three to four years for fund procurement and contract. Construction shall start in 1996 and be completed by 2001.

c. During the construction of phase 1, preparatory works (design, fund procurement, land acquisition and contract) for phase 2 (R002) shall be done and construction should immediately follow completion of phase 1.

d. Right of way for Regional Metro Giza branch (R004) should be secured at the same time of land acquisition for the Ring Road (H101, H102) and implementation to be started in the late 90s. If the area along the route is rapidly urbanized, this project should be implemented earlier.

e. Small Scale railway projects (R005, R006, R103 to R108) should be carried out in the early 90s.

(3) Bus

a. Bus Fleet (B001) should be increased continuously year by year by about 100 buses a year. This figure does not include new buses for replacement of the old ones.

b. Deluxe buses (B002) are to be introduced in 1995 after trials.

c. Careful check of road capacity is needed before implementing exclusive bus lanes (B003). For the first stage, it should be tested in Ramses st. and Galaa st. after extension of Expwy 1 to Ghamra Bridge. Introduction in Corniche, Gueish st. and Ahmed Helmi st. must be coordinated with Expwys 2 and 3 construction and abolition of tramways.

The Masterplan has been developed with the original intention of coping with the transportation demand in 2000 and under favorable financial conditions all its component projects should have been accomplished by 2000. However, some projects had to be postponed mainly because of financial constraint. In this respect, projects have been classified into the following three groups:

Group A: Projects to be completed before 2000
Group B: Projects to be in the construction phase in 2000
Group C: Projects to be started after 2000

The schedule was basically planned so as to incorporate all the high priority ranked projects in Table 9.4.1 into Group A, projects with medium priority into Group B, and low priority projects into Group C respectively.

Table 9.4.3 shows the investment amounts from 1990 to 2005 calculated based on the schedule. Up to the year 1999, most of the amounts for each year are in the range from 350 to 500 million LE, and their total amounts to 3,756.6 million LE of which almost half is for the first five years (1990 - 1994).

Table 9.4.3 Investment Schedule

(unit: million LE at 1987/88)

Year	Project A (complete by 2000)	Project B (under construction in 2000)	Project C (start after 2000)	Total
1990	40.4	9.8	-	50.2
1991	339.2	17.1	-	356.3
1992	452.3	17.1	-	469.4
1993	408.0	24.7	-	432.7
1994	485.2	24.7	-	509.9
1995	331.6	24.4	-	356.0
1996	307.5	125.9	-	433.4
1997	209.9	212.3	-	422.2
1998	119.7	239.7	-	359.4
1999	36.4	330.7	-	367.1
2000	-	528.0	-	528.0
2001	-	490.2	-	490.2
2002	-	239.0	-	239.0
2003	-	255.8	-	255.8
2004	-	255.5	18.1	273.6
2005	-	-	18.1	18.1
2006-	-	-	1145.5	1145.5
Total	2730.2	2794.9	1181.7	6706.8

Note: Including bus projects and excluding CBD projects

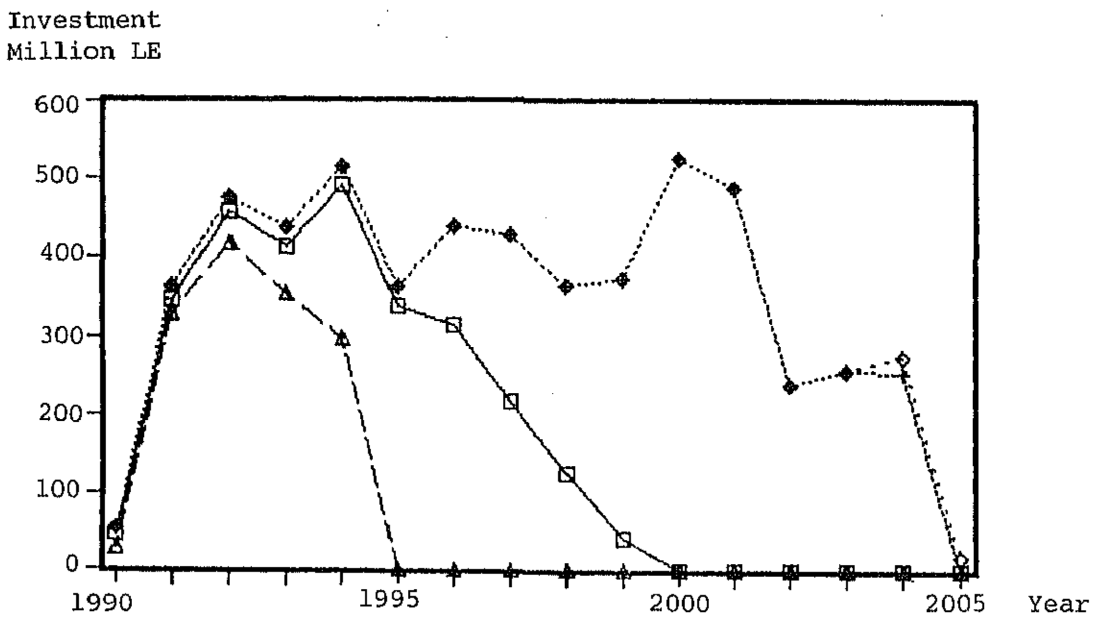
The said amount for the first ten years (1990 - 1999) is the sum of the total cost of Group A projects and a part of Group B projects. The cost of road projects accounts for 75%, railway projects 20%, and bus projects 5%.

Aggregating the project costs based on the recommended schedule, total project cost of each group is as shown in Table 9.4.4 and Fig. 9.4.1, where concerning the share of the foreign portion, an increasing tendency can be observed, which is; 39%, 58%, and 69% for Groups A, B, and C respectively. This is because the large-scale projects with larger foreign portion are designated in Groups B and C.

Table 9.4.4 Project Cost by Ranked Group

Ranked Group	Foreign (M.US$)	Local (M.LE)	Total
A	474.2	1701.1	2791.9
B	710.1	1161.7	2794.9
C	355.1	365.0	1181.7
Total	1539.4	3227.8	6768.5

Note: 1 US$ = 2.30 LE



Notes: □ Annual investment cost of Group A projects
\+ Annual investment cost of Groups A and B projects
◇ Annual investment cost of all projects
△ Annual investment cost of projects to be completed by 1994

Fig. 9.4.1 Annual Investment Amount of Masterplan

9.5 Economic Appraisal on the Masterplan as a Whole

9.5.1 Economic Evaluation Method

Benefits shall be conceived of as the differences arrived at by deducting the total transport cost (vehicle operating cost, rail operating cost,time value, etc.) if the projects are all implemented (with-project case) from the total transport cost, should none of the projects be implemented (without-project case) during the period of analysis, 1989 through the year 2000. This is the usual method of feasibility studies. However, the Masterplan used a different method: while benefit from all the projects as a whole was calculated in the same way as stated here, the benefits expected from individual projects were conceived of as the difference arrived at by deducting the total transport cost in "with-project" case from the total transport cost, should a given project not be implemented (Fig. 9.5.1). In this Report, Masterplan type evaluation is adopted in Part II, while the Feasibility Study type evaluation method is used in Part III, in accordance with the nature of each study. Thus it should be noted that the evaluation results in Part II and Part III will not be directly comparable.

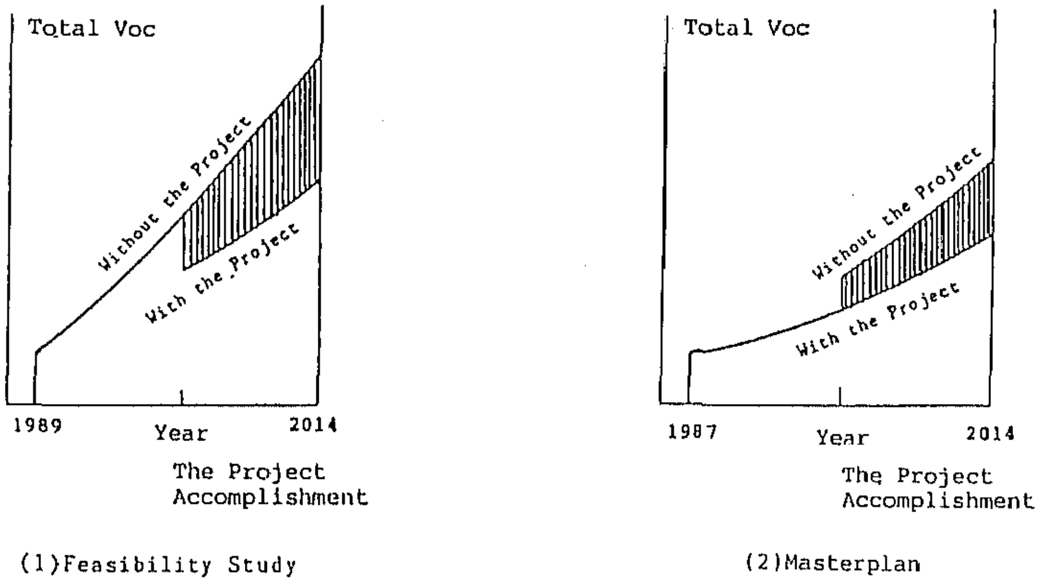


Fig. 9.5.1 Benefit of a Project

The time that the cost is incurred and the time that the benefit is accrued do not coincide, and therefore they must be converted into present values by appropriate discount rates before they may be compared. Internal rate of return shall be used as the evaluation index, with additional consideration for net present value and benefit/cost ratio.

The estimation of future socio-economic and demographic indicators for the region have been carried out up to the year 2000 only. Consequently, the OD table in the Study has also been prepared until the year 2000.

In the Feasibility Study type evaluation method, the benefits of the subsequent period to the year 2000 will be calculated by the extrapolation method, employing the growth rate between the OD table of the years 1986 and 2000, for the period of 25 years up from the target year of Stage I (Year 1992).

While the stream of benefits shall be cut off in the year 2014 for the purpose of discounted cash flow analysis, the residual value, as of the year 2014, of the road, which will continue to exist as assets beyond the year 2014 shall be accounted for as negative cost in the year 2014. In other words, of the total investment, depreciation only up to year 2014 shall be accounted for in the cost stream.

9.5.2 Economic Appraisal on the Masterplan

1) Investment efficiency of the Masterplan Projects

The construction costs of each of the Group A projects are shown in Table 9.5.1, while the annual investments are given in Table 9.5.2. The appraisal indices of the Group A projects and the Group A projects whose implementation would be completed by 1994 (hereinafter referred to as Sub-Group A projects), are summarized in Table 9.5.3.

In the table two cases are shown: Without and With Time Value cases. The Without Time Value case adopts only the saving in the operating cost of vehicles and railway as the benefit and forms the base case of the economic appraisal, while the With Time case which is added for reference, includes the saving in the travel time of the passengers in addition to the operating cost.

The Economic Internal Rate of Return (EIRR) of the Group A projects is calculated at 17.3% (Base Case) and the EIRR of the Sub-Group A projects is estimated at 10.0% (Base Case). It can be pointed out that the Group A projects, the projects which would be completed up to the end of year 1999 and operated at by the year 2000, are economically viable because the EIRR exceeds the Capital Opportunity Cost rate (COC) of 12% adopted in Egypt. In short, Group A projects are recommendable to be implemented from the view points of Egyptian economy and national society.

The EIRR of Sub-Group A projects (10.0%) is fairly below the EIRR of Group A projects. This fact implies that the Sub-Group A projects which are composed of relatively small scale projects can not cope with the future traffic demand in GCMR, though their investment share is more than half (56%) of the total investment of the Group A projects.

A 10% change in the investment brings about 1.6-1.8% points in the EIRR of Group A projects and 1.4-1.5% points in the EIRR of Sub-Group A projects. However, as shown in the ratios of the range to the EIRRs of the standard cases, the 10% change has a bigger influence on the investment efficiency in case of the Sub-Group A projects than the Group A projects.

For reference, the EIRRs of With Time value case count for about 50%, which is a very high level of EIRR.

Table 9.5.1 Construction Cost of the Component Projects to be accomplished by 2000 (Group A)

(unit: Million LE at 1987/88 price)

Project Code	Title	Financial Cost	Economic Cost
H001	Expwy No. 1	74.1	80.0
H002	Expwy No. 2	333.8	359.0
H101	R. Road South in Giza	74.8	76.7
H102	R. Road South br.	290.8	309.2
H103	R. Road South Fustat	71.2	72.9
H104	R. Road North South	51.8	52.5
H105	R. Road Western Arc.	62.3	62.6
H106	R. Road Western Arc.	54.3	57.0
H107	R. Road Western Arc.	71.2	73.4
H108	R. Road Western Arc.	114.8	120.4
H110	R. Road Qaliubiah	126.4	130.0
H111	R. Road Al Marg	205.0	210.7
H202	Kamel Sidky st.	174.9	176.0
H204	Shubra st.	24.0	24.0
H205	Ahmed Helmi st.	10.9	11.4
H207	Sekket Al Wayli st.	72.4	76.3
H209	Azhar st. Ext.	3.7	3.8
H302	Sarwat st. Ext.	99.2	99.5
H304	Ahmed Orabi st. Ext.	103.8	124.0
H305	Rod Al Farag west App.	33.3	36.2
H306	Rod Al Farag west Ext.	67.6	68.6
H401	Shubra Al Kheima N-S 1	31.7	32.7
H402	Shubra Al Kheima E-W	69.9	69.8
H403	Shubra Al Kheima N-S 2	82.4	82.4
R005	ENR (Cairo C. - Shubra)	13.9	13.6
R006	ENR (Cairo C. - Giza)	13.7	13.5
R101	HCHD Ramses-Nozha Imp.	163.2	170.5
R103	HCHD Gehaz Al Markazi	7.7	8.5
R104	CTA & HCHD Connection	0.5	0.6
R105	CTA Tram to S.Zeinab	1.6	1.7
R106	CTA Tram Ext. Helwan	3.1	3.2
R107	CTA Tram Improvement	21.2	21.9
R108	HCHD Metro Improve.	29.0	29.7
Total		2558.3	2672.3

Table 9.5.2 Annual Investment for the Group A Projects Excluding Bus Fleet

(unit: Million LE at 1987/88 price)

Year	Financial Cost	Economic Cost
1990	28.8	30.4
1991	327.6	333.1
1992	440.7	453.6
1993	396.4	432.0
1994	473.6	499.2
1995	264.1	276.6
1996	295.8	306.6
1997	198.4	204.0
1998	108.0	110.9
1999	24.8	25.9
Total	2558.2	2672.3

Table 9.5.3 Economic Evaluation Indices

	Group A Projects as a whole		Sub-Group A Projects	
	Without Time Value (Base Case)	With Time Value	Without Time Value (Base Case)	With Time Value
EIRR (%) (Standard Case)	17.30	53.60	10.00	47.60
Cost 10% up	15.80	50.50	8.70	44.40
Cost 10% down	19.20	57.20	11.60	51.40
B/C (1)	1.39	5.68	0.88	4.20
NPV (1)(M.LE)	715.30	8551.20	-144.80	3795.40
Total Investment (M.LE)	2672.3		1447.6	
Residual Value (2) (M.LE)	2017.9		763.9	

Note (1): Discount rate of 12%
(2): At the end of year 2005

2) Source of the Benefit

Table 9.5.4 shows that the benefit in year 2000 accrued from the Group A projects is estimated at 758.4 million LE at 1987/88 economic prices, and 204.3 million LE from the Sub-Group A projects. About 60% of the benefit comes from the saving in Taxi Time related vehicle operating cost (VOC) and about 35% from the saving in Bus Time related VOC. Non-count of the private car time related VOC makes the above shares mainly higher than the actual level. On the contrary, in case of taking into consideration the saving in the travel time of the passengers in addition to the VOC as the benefit, the private car provides about 45% of the benefit, followed by Bus with 34% and Taxi 21%.

Table 9.5.4 Benefit in Year 2000

(unit: Million LE at 1987/88 economic prices)

	Group A Projects		Sub-Group A Projects	
Without Time Value Case				
Total benefit	758.4	100.0%	204.3	100.0%
Taxi Time Related VOC	430.2	56.7%	137.2	67.2%
Bus Time Related VOC	235.2	31.0%	84.9	41.6%
(For reference)				
With Time Value Case				
Total Benefit	3,297.8	100.0%	1,146.7	100.0%
Car	1,493.5	45.3%	547.0	47.7%
Bus	1,114.2	33.8%	395.6	34.5%
Taxi	689.1	20.9%	211.1	18.4%

As shown in Table 9.5.5, the decreasing trend in the vehicle running speed in Do-Nothing case and the increasing trend in case of the Group A projects bring about the increase in the saving of the time related VOC, resulting in expansion of the benefit over time.

Table 9.5.5 Average Vehicle Running Speed

(unit: km/h)

Case	1987	1995	2000
Do-Nothing Case	7.08	5.67	5.03
Group A Projects Case		7.09	8.28
Sub-Group A Projects Case		7.09	6.01

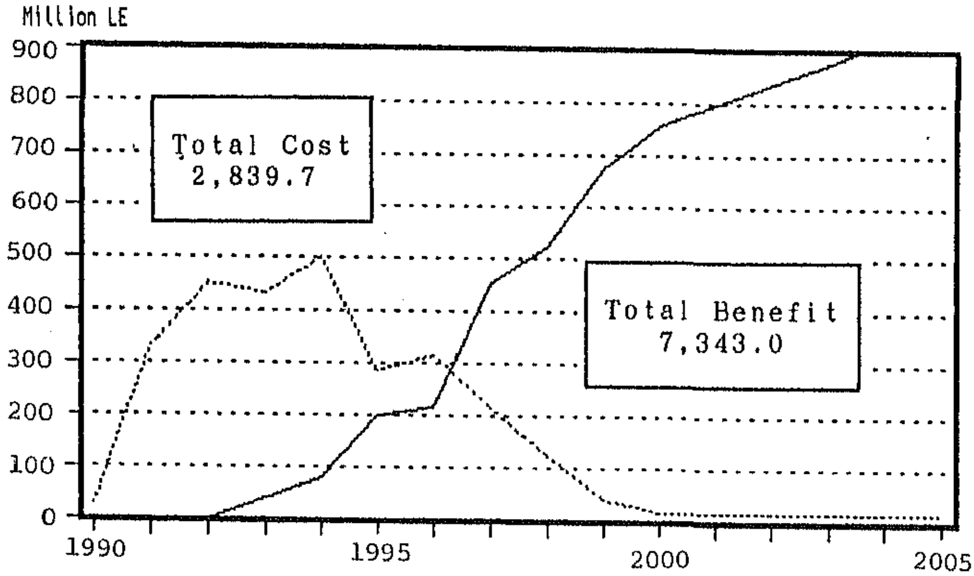
In case of the Sub-Group A projects, the vehicle is compelled to slow down from 7.09 km/hr in year 1995 to 6.01 km/hr in year 2000 which implies that the facilities planned in the Sub-Group A projects are relatively insufficient to accommodate the traffic demand in year 2000. This situation is reflected in the stagnant benefit and finally in the EIRR in Table 9.5.3.

The flow of costs and benefit of the two cases are tabulated in Table 9.5.6 and depicted in Fig. 9.5.2.

Table 9.5.6 Flow of Cost and Benefit

(unit: million LE at 1987/88 domestic economic prices)

Year	Group A Projects as a Whole		Sub-Group A Projects	
	Cost	Benefit	Cost	Benefit
1990	30.4		30.4	
1991	333.1		333.1	
1992	453.6		430.3	
1993	434.1	39.3	390.0	39.3
1994	503.2	78.7	318.6	78.7
1995	285.6	198.9	9.0	198.9
1996	315.8	216.9	9.0	200.0
1997	216.7	452.6	9.0	201.1
1998	124.3	525.3	9.0	202.1
1999	41.5	672.9	9.0	203.2
2000	16.9	758.4	9.0	204.3
2001	16.9	796.3	9.0	224.7
2002	16.9	836.1	9.0	247.2
2003	16.9	877.9	9.0	271.9
2004	16.9	921.8	9.0	299.1
2005	-2,001.0	967.9	-754.9	329.0
Total	821.8	7343	837.5	2699.5



Note; Including maintenance cost (167.4 MLE)

Fig. 9.5.2 Cost and Benefit (excl. TTC Saving) Flow of Masterplan (Group A Project Only)

9.6 Impact by New Town and Settlement Development

As described in Chapter 7, MODANC and GOPP have plans to develop three new towns (15th of May, 6th October and Al Obour) and ten new settlements in desert areas north-east, east and west of GCMR in order to mitigate pressure of urbanization, especially by informal housing development. In every analysis of the future transportation demand in the previous chapters, the demand generated in and attracted to those new towns and settlements has been ignored because of their uncertainty. This section analyzes their impact on the road and railway transportation demand.

1) Demand Structure

According to GOPP's Master Scheme, each new town is envisaged to have 150,000 to 500,000 population and a new settlement, 250,000 each in the final stage. Total capacity will reach 3,390,000 (Table 9.6.1). As of 1988, 10 years after its commencement, the population of 15th of May is approximately 30,000, and 6th October, has 75 enterprises and 4,300 workers. Others have not started yet. Although the pace of the new settlements development will be more rapid than that of the new cities mentioned above because the private sector's vitality is planned to be utilized, it may be difficult for all the new settlements to be completed and inhabited to their full capacities by the year 2000. Therefore this Study assumes about one third of the planned population, ie. 1,152,000 for 2000, as shown in Table 9.6.1.

Table 9.6.1 Future Population of New Town and Settlement

Zone	New Town New Settlement	Population	
		Planned Capacity	Year 2000
34	15th May	150,000	102,000
	NS8	250,000	50,000
36	NS9	250,000	-
44	Al Obour	240,000	100,000
	NS10	250,000	-
45	NS1	250,000	250,000
	NS2	250,000	100,000
	NS4	250,000	150,000
46	NS3	250,000	100,000
	NS5	250,000	100,000
47	6th October	500,000	100,000
	NS6	250,000	50,000
	NS7	250,000	50,000
Total		3,390,000	1,152,000

Source: Master Scheme, GOPP, 1983.
Population in 2000 is assumed by Study Team.

Future transportation demand generated in the new towns and settlements is forecast as described below, where only zones 44 to 47 are analyzed. Included in GCMR are zones 34 and 36 for which demand has been forecast in Chapter 8.

Of the one million population, 750,000 are aged 6 or older. Assuming the car owning family rate at 31%, as high as the GCMR average, the daily trip production rate will be 2.1 trips per person. Thus, 1,575,000 trips will be generated in 2000 from the new town and settlements. About 26%, ie. 414,600 will be trips using vehicles or trains. Applying the models developed in Chapter 8, inter-zonal trips are estimated at about one million per day (Table 9.6.2).

Table 9.6.2 Generated Trip in New Town and New Settlement in Year 2000 (excl. walking Trip)

(unit: trip/day)

Mode	Intra-Zonal	Inter-Zonal	Total
Car	83,800	403,500	487,300
Taxi	4,500	31,300	35,800
Public Mode	81,100	561,200	642,300
Total	169,400	996,000	1,165,400

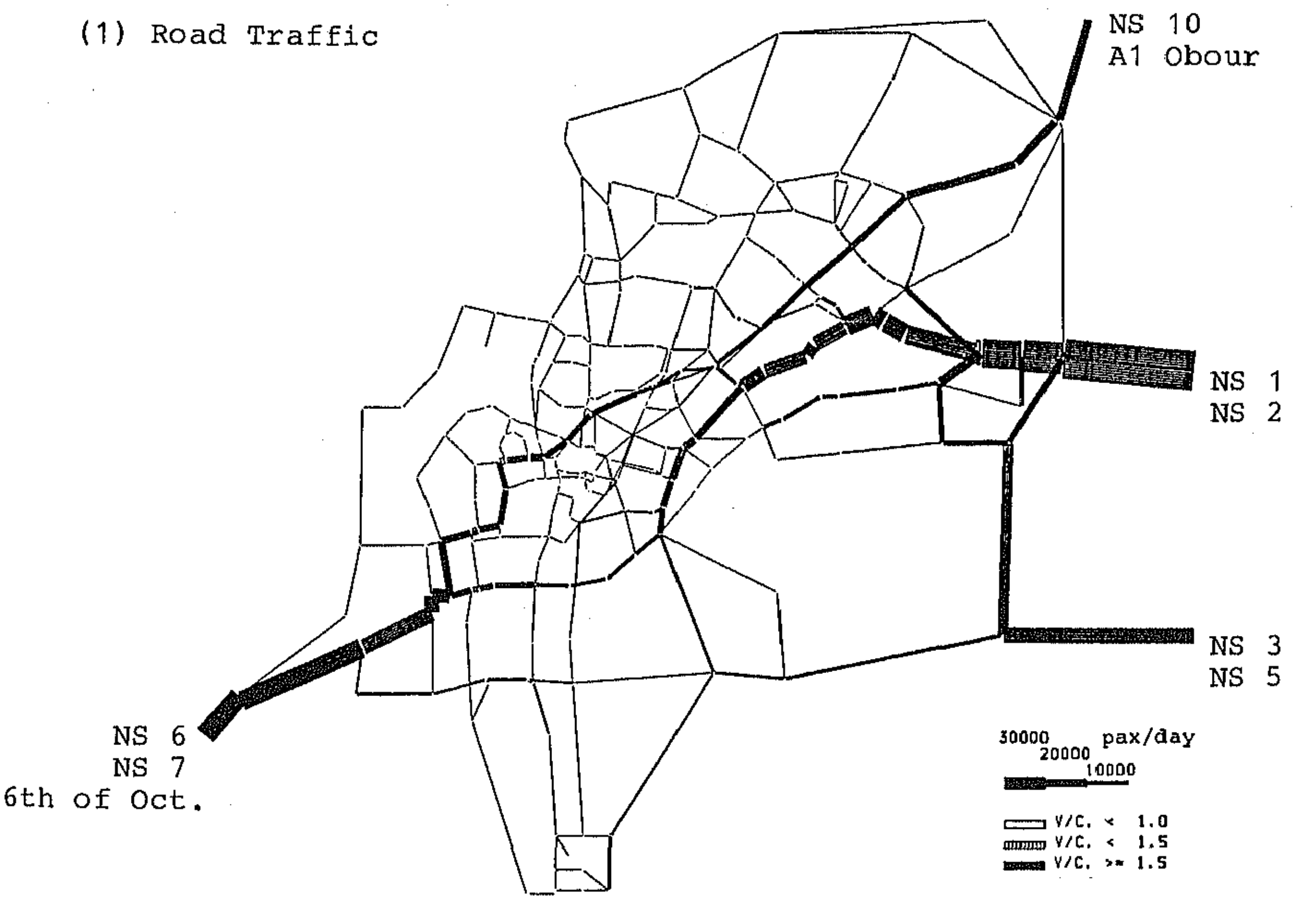
When distributing the inter-zonal trips using the same gravity model as in Chapter 8.4, 29% of trips are attracted to Masr Al Gadida, 15% to the Central area, and 18% to Ahram and Agouza.

2) Increase of Traffic

Adding to the Masterplan network one railway line (extension of HCHD Al Mataria line along the Suez road and then to the south so as to serve new settlements Nos. 1, 2 and 4), a new network was prepared. Fig. 9.6.1 shows the results of traffic assignment of the inter-zonal trips from the new towns and settlements to the new network.

Road traffic shows a large increase by 80,000 to 100,000 pcu/day in the Suez road, about 50,000 pcu in Ahram st., and 35,000 pcu in the Ring Road. Salah Salem st., Ramses st. and Sarwat st. will also have an increase of 15,000 to 20,000 pcu while in CBD area, road traffic will not be much affected because the traffic inflow will be scattered to many arteries.

The railway will also have a large increase of 60,000 to 100,000 passengers/day along the corridor of eastern new settlements - Heliopolis - Ramses - Ahram. HCHD Roxi - Nozha line will have 43,000 passengers and Al Mataria line 20,000 additional passengers.



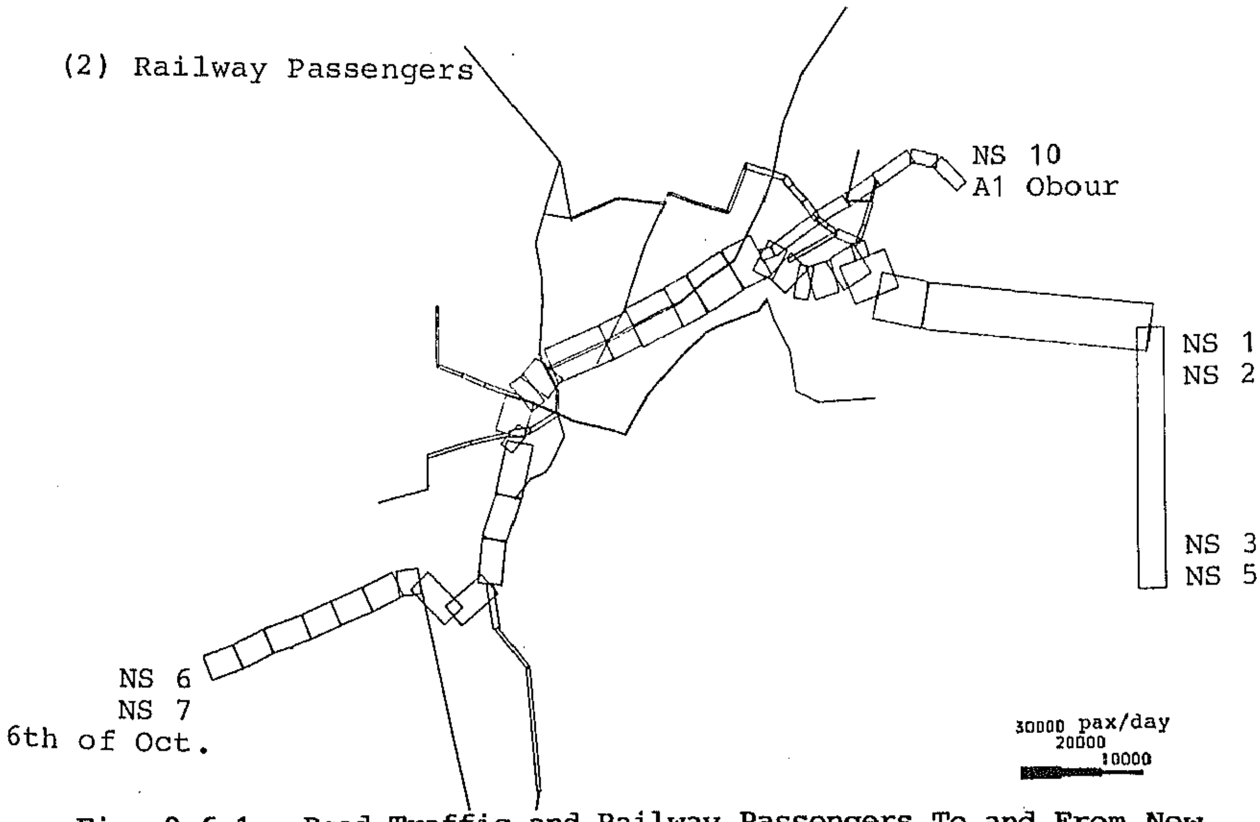


Fig. 9.6.1 Road Traffic and Railway Passengers To and From New Settlements

3) Guideline to cope with traffic increase by new town and settlement development

As stated above, an additional heavy burden will be placed on roads and railways in the urbanized area in GCMR by the new agglomeration of new towns and settlements. To lessen this burden, every effort should be made to raise the inter-zonal trip rate (assumed at 37% in this analysis) as high as possible. GOPP has a plan to develop several industrial estates adjacent to the new settlements. In addition, it will be necessary to foster inside each settlement the service sector and arrange educational, medical and cultural facilities, in order to raise their self sufficiency.

As the new settlements are developed, the Ring Road will have an important rôle to distribute traffic to and from them. Construction of roads connecting the Ring Road and the urban cores such as CBD, Heliopolis and central Giza will be required to make the Ring Road function effectively.

It is also advisable to construct, in the early stage, a railway line to the new settlements Nos. 1 to 5 in order to promote their development. Main lines of HCHD metro are to be underground railway when passengers between Heliopolis and the new settlements reach 100,000 per day. Along the Ahram corridor, the Regional Metro Giza branch line should be constructed, otherwise Urban Metro Line 1 should be extended to the west.

10. Road Network Improvement Plan

10.1 Considerations

1) Future Network Pattern

At present radial roads in the Greater Cairo Region consist of the following:

a. Alexandria Agriculture Road
b. Ismailia Agriculture Road
c. Ismailia Desert Road
d. Suez Desert Road
e. Autostrade
f. Corniche Al Nile
g. Upper Egypt Highway
h. Pyramid st.
i. Warraq Road

In addition, the following ring roads are currently being constructed in recognition of the fact that service in a circular direction is at present inadequate:

a. Outer Ring Road
b. Intermediate Ring Road

However, it should be noted that the major present direction of traffic demand is radial and is expected to remain so in the future. While ring roads are important as a means of easing the load on radial roads, the main issue with which Greater Cairo must grapple in the future is the improvement of roads in a radial direction. Fig. 10.1.1 shows this pattern of road systems. The main axes are:

a. Alexandria Agriculture Road direction
b. Ismailia Agriculture Road direction
c. Suez Desert Road direction
d. Maadi Agriculture Road direction
e. Giza City direction
f. Northern Giza City direction

Traffic increase is anticipated along axes b. and c. in conjunction with the establishment of New Settlements in the desert region. Increased traffic demand is also projected along axes e. and f., where private sector-led urban development projects are being actively pursued on arable land. Although these lands are being protected by the government, their proximity to central Cairo encourages such development. Axes a. and d. link Lower Egypt with Upper Egypt.

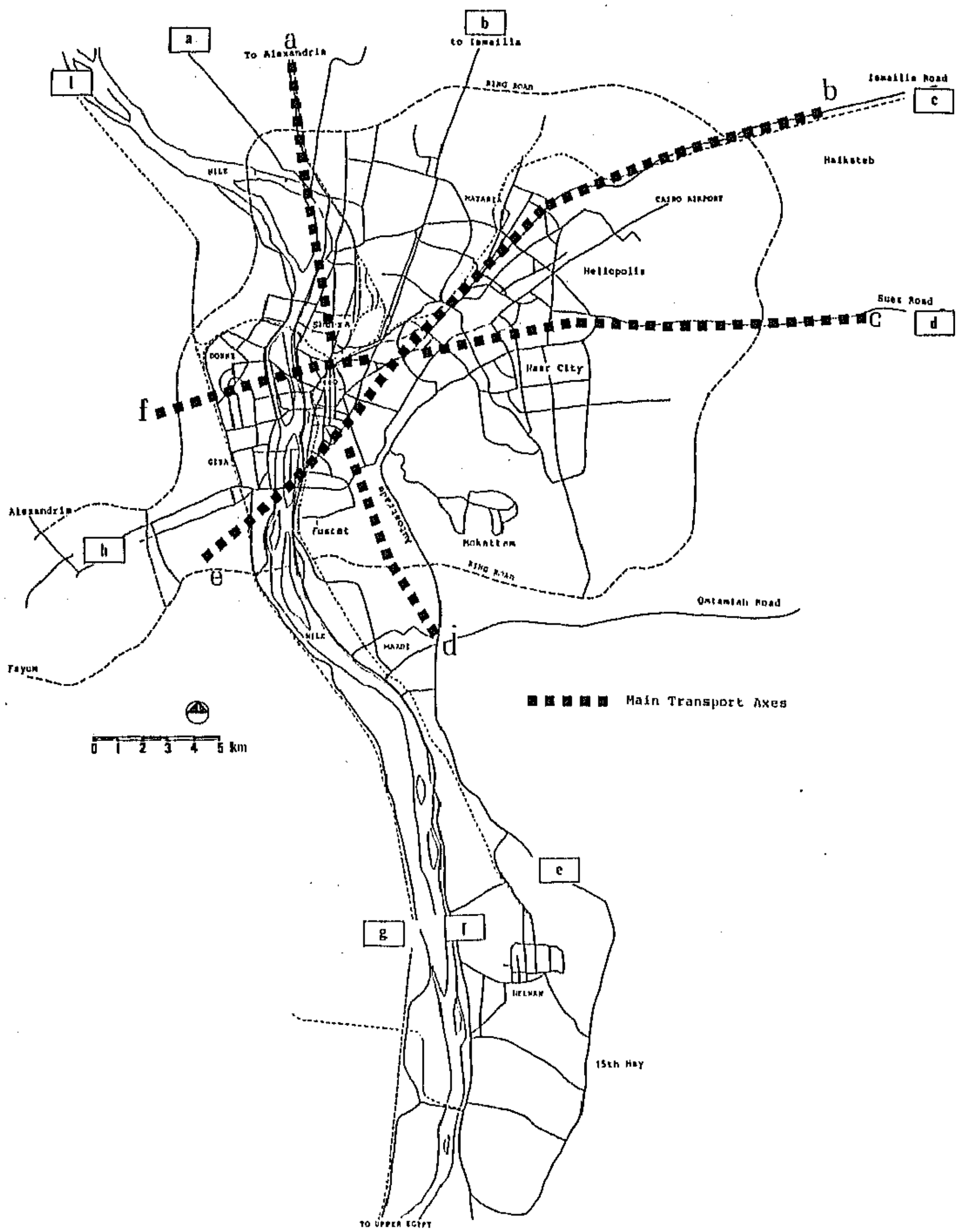


Fig. 10.1.1 Road Network Scheme

2) Demand-Capacity Balance Across the Nile River

The traffic capacity of trans-Nile River roads at present is 423,600 pcu per day (1987) as shown in Table 10.1.1. Two new bridges are expected to be built over the Nile River by the year 2000: the Rod Al Farag br. (eight lanes) currently under construction in the north of Cairo, and another bridge (eight lanes) in the south, plans for which are being pursued in conjunction with the Ring Road plan. The addition of these two bridges will raise traffic capacity across the Nile by 1.6 times the existing level to 697,200 pcu per day. This will be sufficient for meeting the forecast traffic demand across the Nile River of 624,900 pcu per day for the year 2000 with a congestion rate of 0.90. Thus, there appears to be no need to plan for additional bridges against further increase traffic demand over the Nile River up to the year 2000.

Table 10.1.1 Nile Screen Capacity and Demand Balance (2000)

(unit: 1000 pcu/d)

Br. Name	Capacity	Demand	Remarks
1 Rod Al Farag (u/c)	136.8	10.4	(8 Lanes)
2 Embaba	17.4	47.1	
3 26th July	68.4	48.1	
4 6th Oct.	171.0	230.4	
5 Tahrir	52.2	96.8	
6 Gamaa	61.2	84.7	
7 Giza	53.4	107.4	
8 Ring Road (u/p)	136.8		(8 Lanes)
Total	697.2	624.9	
Demand - Capacity		-72.3	
Ave. Cong. Rate		0.9	

Note: u/c: Under Construction, u/p: Under Planning

There are also plans to build another bridge over the Nile as part of the Ring Road route linking Qaliubiah with Giza. The trans-Nile capacity is thus judged to be adequate for the foreseeable future.

3) Demand-Capacity Balance for Intermediate Ring Road Cross Sections

Fig. 10.1.2 shows the forecast demand-capacity balance in the sections fanning out in a radial direction from the Intermediate Ring Road, for the year 2000. Demand/capacity gap in Cross Section A (Heliopolis direction) is forecast to reach 301,000 pcu per day in 2000, or about two times the present capacity. In terms of number of lanes, this means that roughly 25 additional lanes will be required to meet this demand. Likewise, the gap is expected to reach 284,000 pcu in Cross Section D (Giza direction) for a capacity shortfall corresponding to 24 lanes, and 204,000 pcu in Cross Section C (Maadi direction) for a deficiency corresponding to 17 lanes.

The construction of new arterials to satisfy the entire requirement for additional lanes is unfeasible owing to space limitations. Therefore, the number of lanes that is needed to secure a demand-capacity ratio of maximum 1.5 times (congestion ratio of at most 1.5, which is the point at which traveling speed is thought to decline to less than 5 km/hour) is calculated as shown in Table 10.1.2.

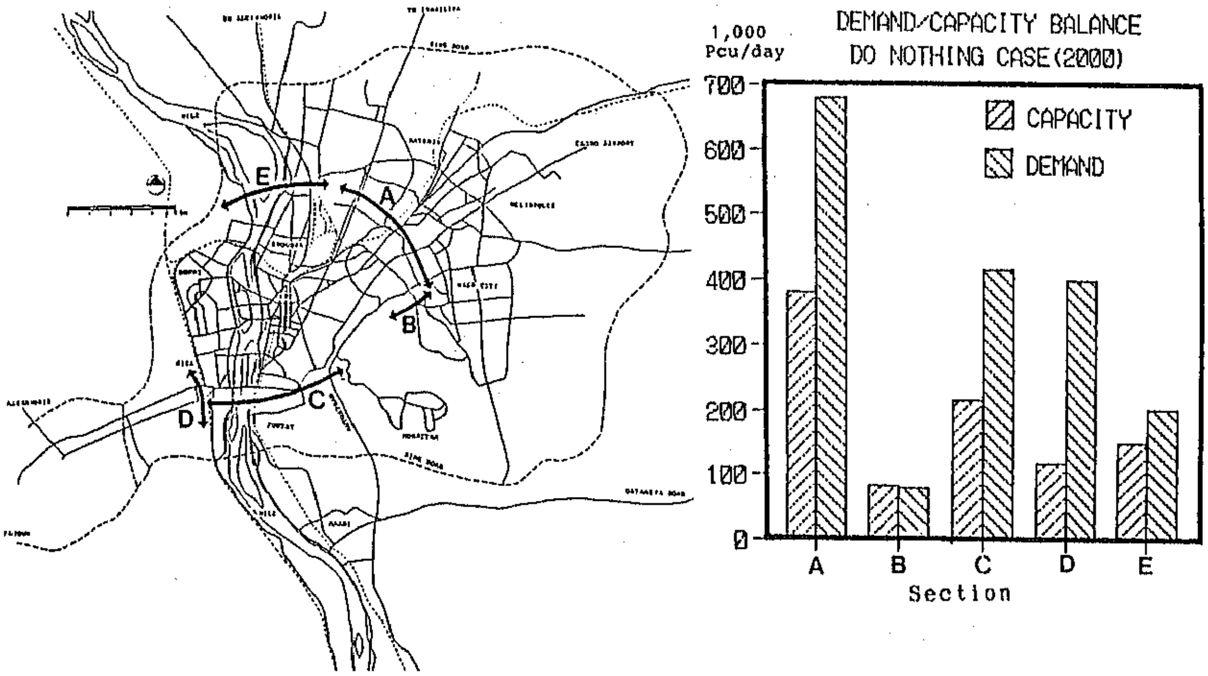


Fig. 10.1.2 Demand/Capacity Balance in the Year 2000

Table 10.1.2 Section Demand and Capacity (2000)

(unit: 1000 pcu/day)

Section	Capacity	Demand	Requirement				Remarks
			V/C=1.0		V/C=1.5		
			DEF.	Lane No.	DEF.	Lane No.	
A	380	681	-301	25	-111	6	- Expwy 4 - Ahmed Said +2
B	78	74	-				
C	212	416	-204	17	-98	5	- Expwy 4
D	113	397	-284	24	-228	13	- Ring Road 8 - Sarwat Ext. 6
E	148	198	-50	4			

The cross section requiring the greatest number of lane additions is Cross Section D (Giza direction), where 13 additional lanes are needed even if the congestion rate is allowed to rise to 1.5. This is because, while the agricultural land to the west of the ENR tracks in the Giza district is being developed rapidly by private individuals and firms, no sufficient consideration has been given to the provision of new roads. Arterial road service between this area and the area to the east of the tracks is fulfilled only by the following two routes:

a. Ahram st.
b. King Faisal st.

To correct the deficiency, at least six arterial road lanes connecting the east and west sides of the ENR tracks are required, in addition to the construction of the Ring Road (eight lanes). At the same time, it may be necessary to provide a north-south route between Ahram and King Faisal streets.

The cross sections with the next largest forecast demand are A (Heliopolis direction), where six additional lanes are required, and C (Maadi direction), where five more lanes are needed.

4) Current Road Network vs. Future Demand

Figures 10.1.3 and 10.1.4 show the assignments of current (1987) and future (2000) traffic on the current (1987) road network. At present, the total length of sections where traffic demand exceeds capacity by 1.5 times (congestion rate of 1.5 or more) is about 73 km. This is forecast to increase to 180 km, or 2.5 times the current value, in the year 2000. In addition, the average congestion rate (traffic volume/traffic capacity) on arterial roads is expected to rise from 0.43 in 1987 to 0.72 in the year 2000. One of the objectives of the Road Network Improvement Plan is to prevent any further increase in the length of sections with a congestion rate of more than 1.5 (and if possible to achieve a congestion rate of less than 1.5 in all sections), as well as to prevent the average congestion rate on arterial roads from rising further.

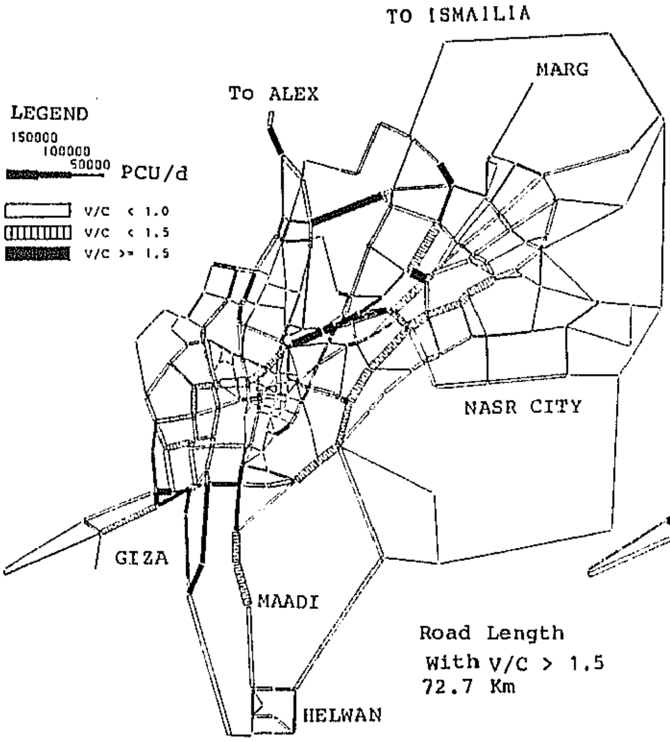


Fig. 10.1.3 Present Traffic Volume on Present Road Network

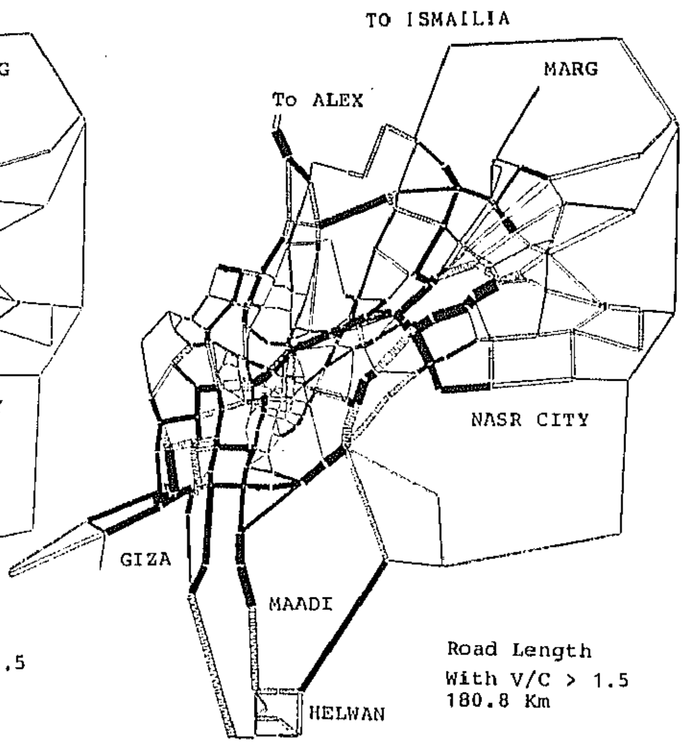


Fig. 10.1.4 Future Traffic Volume in the Year 2000 on Present Road Network

10.2 Policies on Road Network Development

1) Association with Existing Projects

The Road Network Improvement Plan takes into consideration the following on-going projects:

(1) Outer Ring Road (Ring Road)

The progress of the Ring Road construction by EAGCR under the Ministry of Development is shown in Fig. 10.2.1, and is described below:

a.	The desert section between Ismailia Desert Road and Autostrade	: completed
b.	Autostrade to Nile br.	: under construction
c.	Nile br. section	: preparing tender call
d.	Zomor Canal in Giza to Fayum	: under construction
e.	Western arc, Giza to Alexandria Agriculture Road	: center line has been set
f.	Northern arc, Alexandria Agriculture road to Ismailia Desert Road	: under construction

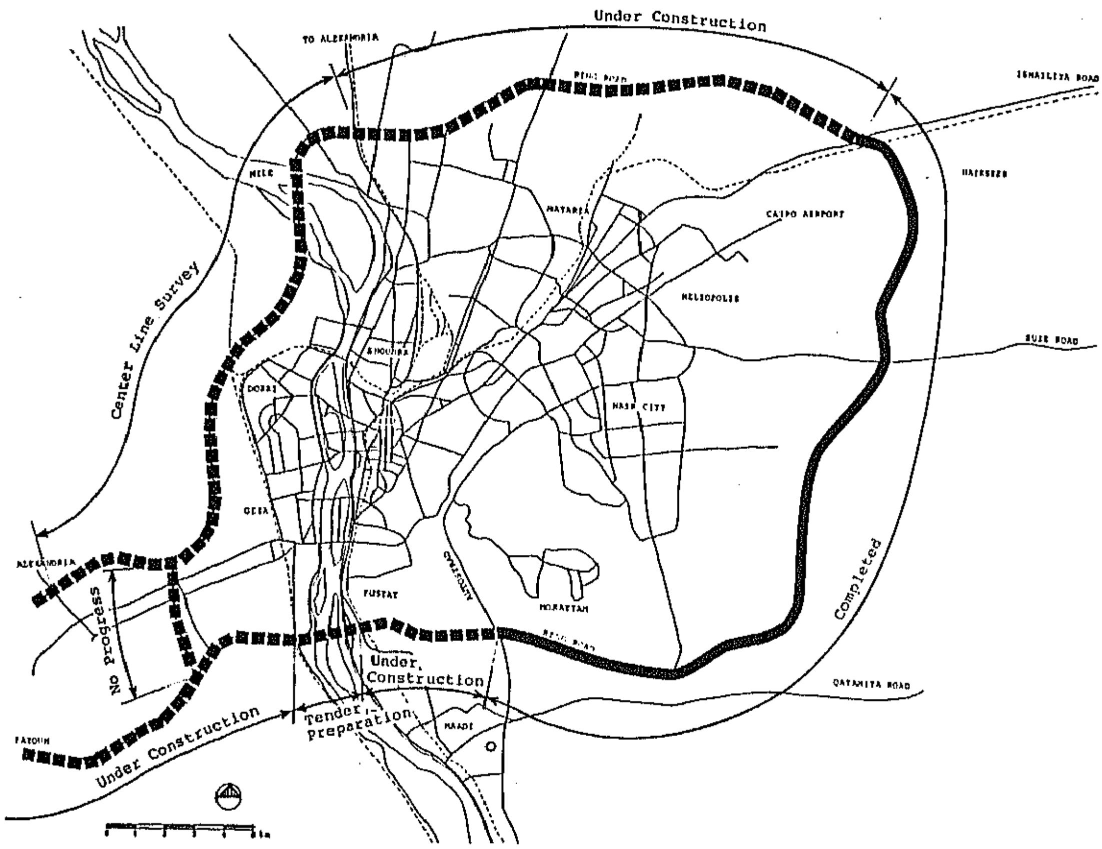


Fig. 10.2.1 Progress of Ring Road (Sept. 1988)

The Ring Road sections already constructed and at present under construction have four lanes. Although the project in its complete stage calls for an eight lane road, the Road Network Improvement Plan takes the four lane Ring Road into account.

(2) 6th October Br. Extension

While the 6th Oct. br. is being extended at present from Ramses sq. to Ghamra br. (Port Said st. intersection), plans for further extension, from Ghamra br. to Salah Salem st. via Abbasseya sq., are in progress. The Heliopolis Metro and Al Marg lines and the ENR Quarry line run through the planned section in a position parallel to Mahatet Sekket Al Hadid st. The first half of the planned extension will run between existing buildings and the north side of these railroad tracks (Fig. 10.2.2), and the second half will be built above the Quarry line.

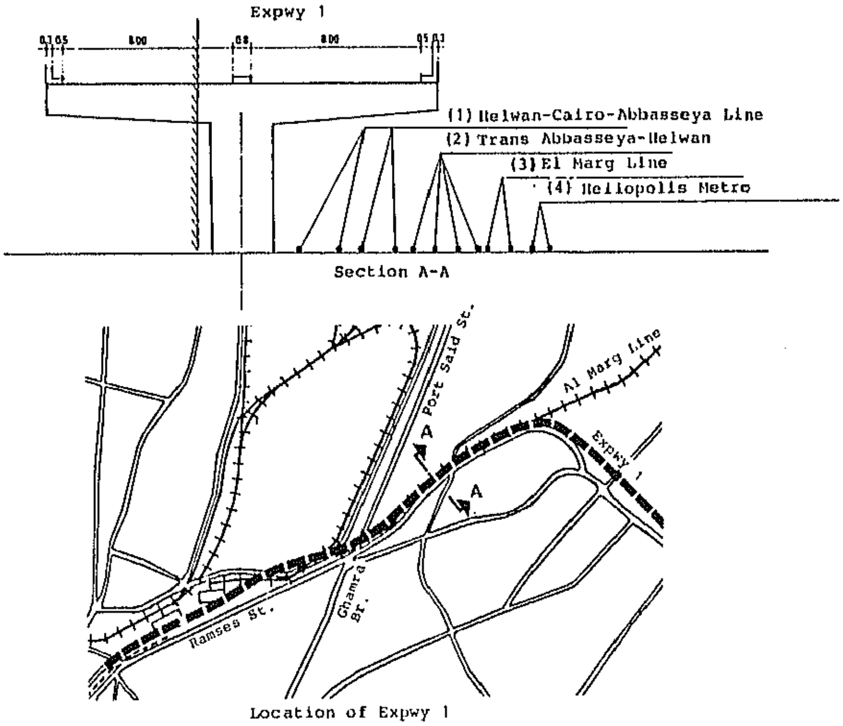


Fig. 10.2.2 Cross Section of 6th October br. Extension

The extension is designed as a four-lane road with a total width of 17.8 m, with an interchange above the Ghamra br. and on/off ramps between Ahmed Said st. and the Al Marg line, and between the Al Marg and Heliopolis Metro lines.

(3) Sekket Al Wayli Road

Since a feasibility study on this project was conducted in 1987 with the assistance of the World Bank (see Fig. 10.2.3 for the proposed typical cross section), the results of the survey are incorporated into the Road Network Improvement Plan. However, certain matters, such as the method of crossing ENR marshaling yard area, require further study.

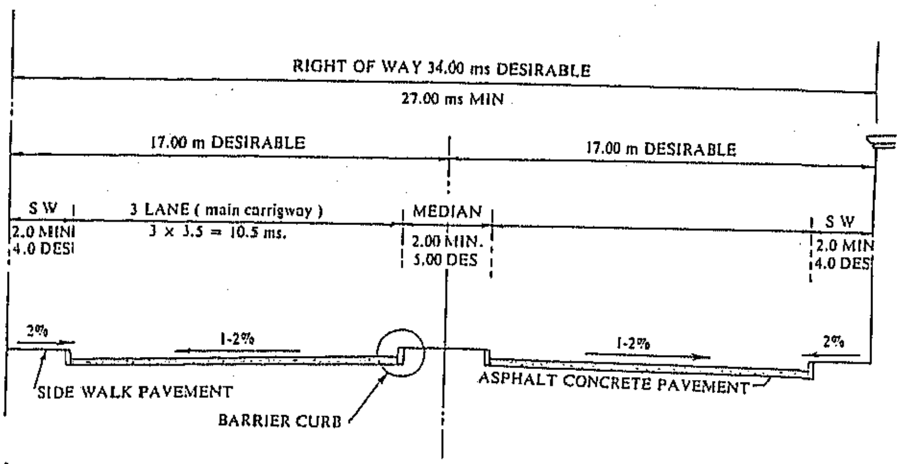


Fig. 10.2.3 Typical Cross Section of Sekket Al Wayli

(4) West Approach to Rod Al Farag Br.

A new Rod Al Farag br. over the Nile River is under construction at present (Fig. 10.2.4), with approaches on Corniche st. on both banks of the river. The original plan called for the continued use of Rod Al Farag st. for the eastern approach. However, as the street is narrow and its widening would require extensive compensation to building owners, the Sekket Al Wayli Road has been adopted as the alternative. The road is to be widened and improved in a circular direction from Mamalik School Road, partially using Corniche st. in a north-south direction. On the western side, a new approach will be built from the bridge to Sudan st., by-passing the dense residential area of Embaba in between.

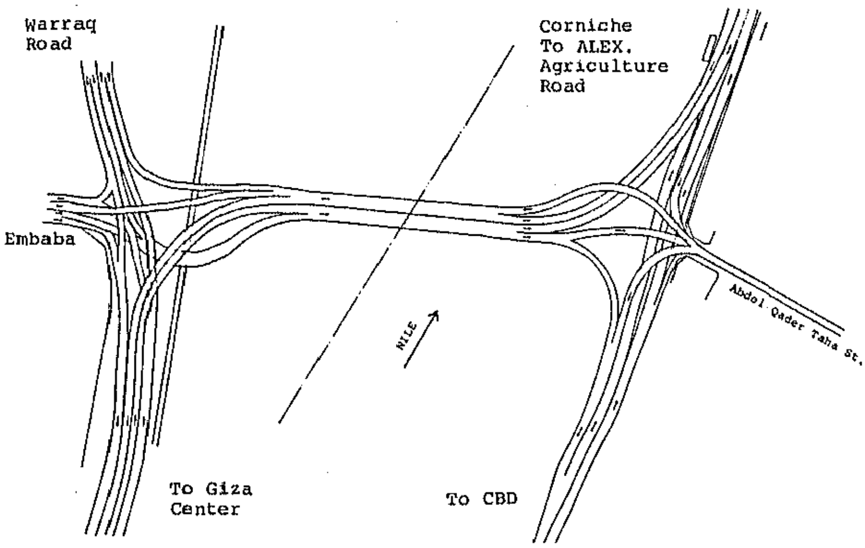


Fig. 10.2.4 Plan of Rod Al Farag br.

(5) City ROW Ordinances for Roads in Cairo's Built-Up Area

Since 1971, the Cairo Governorate has established ROW Ordinances for roads to be constructed in the built-up area of Cairo. Land for the planned roads is being secured by obliging abutting buildings, either newly-constructed or renovated, to be set back whenever necessary, under the supervision of Cairo's City Planning Section. However, only a small portion of the required land has been secured so far. The Road Improvement Network Plan actively incorporates those arterials whose plans are close to completion. An example is Shubra st. (Rod Al Farag st. - Cairo Central station's north square).

(6) City ROW Ordinances for Roads in Giza and Qaliubiah

ROW Ordinances for roads in Giza city have been planned to deal with the rapid development of residential areas on both sides of King Faisal and Ahram streets. In addition, in Shubra Al Kheima city, where industrialization has progressed in recent years, roads are expected to be built on the agricultural lands along the Ismailia Canal within the inner area of the Ring Road, where ROW has been secured by ordinances, to divide the area reserved for a large-scale industrial park into blocks.

2) Use of Existing Space

Most buildings in the Greater Cairo Region are three- or four-story multi-family housing units. Although past experience shows that it is not impossible to remove these buildings for road construction, it would require the payment of compensation to a large number of inhabitants, and, if any problems arise, delays to the project and a certain amount of social disturbance would be unavoidable. Therefore, in order to propose projects with a high probability of being implemented before the year 2000, the Road Network Improvement Plan recommends the construction of elevated roads that make use of existing space thereby avoiding the problems resulting from land acquisition.

The spaces within the built-up area that are adjacent to CBD and available in sizable stretches include the following:

a. The banks of the Nile River
b. Port Said st.
c. Gueish st./Khalifah Al Mamoun st.
d. Shubra st.
e. Ahmed Helmi st. along the ENR tracks
f. Along the Heliopolis Metro and Al Marg line tracks

It is important to note, however, that the banks of the Nile River, along which the two Corniche streets run, are currently valuable recreation area where people can enjoy the river scenery; nothing should disturb this use.

3) Improvement of Service to Inferior Traffic Sections in the Built-Up Area

The Islamic district between Port Said and Salah Salem streets is crowded with old buildings, and the two arterials are connected only by a few streets, such as Azhar st. The high concentration of buildings in the district not only obstructs traffic between the two arterials, but also is the cause of inferior traffic service to the inhabitants. The dearth of public space, moreover, prevents the provision of adequate public services, such as sewerage, parks and green space; it also hinders fire fighting and other disaster prevention activities.

The district contains many buildings of historical and religious significance, and every effort must be expended to preserve these buildings. At the same time, however, it would be desirable to build new roads and secure greater public space in order to improve the district's living environment.

4) Improvement of Access to New Residential Areas

Government-led urban development projects are being implemented in new residential areas in the desert region, such as in Nasr City to the east of the Greater Cairo Region. Concurrently, plans for population distribution, access means and public transportation systems are being pursued systematically. Meanwhile, the agricultural area on the Giza side, between the Ring Road's Western Arc and the ENR tracks, has been actively developed for residential purposes by private efforts, despite the government's policy of agricultural land preservation. The construction of sewerage and other public service facilities is being carried out on the heels of such housing development.

While the area is expected to become increasingly residential hereafter, the laying of roads subsequent to development will create various social problems, including those related to compensation payments; moreover, this will entail increases in construction costs and delays due to land acquisition requirements. Therefore, it is important to assign roads in advance and procure the necessary land for future road construction. Concerning the width of arterial roads for the area, 40-50 m would be desirable so as to be able to respond flexibly to future demand.

5) Disposition of New Settlement-Related Roads

Roads that are planned in conjunction with the New Settlements can function only after the settlements are completed. Although these roads certainly cannot be ignored in view of the size of population forecast for the New Settlements, in the Road Network Improvement Plan, the base case assumes that the settlements are not established, as their time frame and other matters remain uncertain.