10.3 Construction of Metropolitan Expressway

1) Candidate Routes

Fig. 10.3.1 shows the candidate routes for the elevated Metropolitan Expressway (hereinafter referred to as Expwy). These routes correspond to major traffic corridors and were chosen in accordance with the following standpoints:

Expwy 1: To be built along the route of the existing arterial road which runs from the Dokki district in Giza city to Salah Salem st. via Ramses sq. and 6th Oct. br. Extension.

Expwy 2: Connects with the Ring Road and serves traffic traveling between Maadi direction or Giza and CBD direction. To be built over Port Said st.

Expwy 3: Serves traffic traveling between Heliopolis and CBD direction. To be built over Gueish, Khalifah Al Mamoun and Gisr Al Suez streets.

Expwy 4: Serves traffic between Alexandria Agriculture Road and CBD direction.

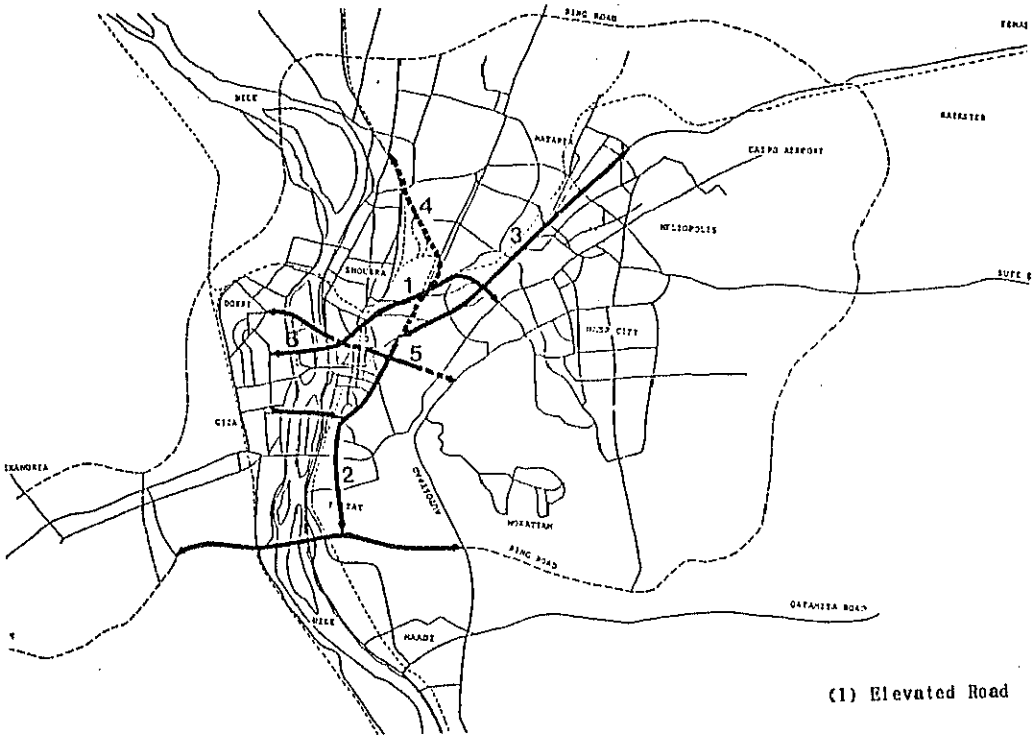


Fig. 10.3.1 Metropolitan Expressway Network

Expwy 5: Links together the existing 26th July br. and Azhar br. The section in the CBD to be built over 26th July st.

Expwy 6: Branches out from Expwy 2 at Sayedah Zeinab sq. and serves to divide traffic between Giza and Heliopolis direction. To be built over Gamaa br.

Table 10.3.1 gives the volume of traffic forecast for the year 2000 where only the above elevated roads are built, by case and by road. For reference, the volume of traffic that can be expected if a toll of 1.0 LE per ride is charged, is also given for each route (Expwy 1, however, will be toll free in view of present situation where most of it is in operation, one part under construction and the third section under design). The cases for which traffic forecasts are given in the table are described below; the extension section comprising Expwy 1 is assumed to be constructed in all four cases. In addition, the Ring Road Nile River bridge is assumed to be constructed by the year 2000, as Expwy 2 is connected with the Autostrade - Giza North-South Road section of the Ring Road.

Case 1: Construction of Expwys 2 and 3
Case 2: Construction of Expwys 2 and 4
Case 3: Construction of Expwy 5
Case 4: Construction of Expwys 2, 3 and 6

Table 10.3.1 Traffic Volume of Expwys (2000)

(unit: 1000 pcu/day)

		Case 1		Case 2		Case 3		Case 4	
		Free	Toll	Free	Toll	Free	Toll	Free	Toll
Expwy No. 1		105.3	110.1	100.4	100.9	99.6	101.4	99.9	106.7
Expwy No. 2		80.0	74.0	84.3	55.5			82.5	68.3
Expwy No. 3		76.5	65.2					78.9	63.9
Expwy No. 4				75.7	30.8				
Expwy No. 5	Whole sec.					90.4	56.3		
	New sec.					58.7	27.8		
Expwy No. 6								70.2	36.0

Traffic flow on Expwys 2 and 3 in Cases 1 and 4 is heavy regardless of whether tolls are charged. In contrast, the volume of traffic differs by close to two times when tolls are charged on Expwy 4 in Case 2, on Expwy 5 in Case 3, and on Expwy 6 in Case 4. On Expwy 5, the overall average indicates a comparatively large flow of traffic, but the volume in the new section to be constructed between the existing 26th July br. and the existing Azhar br. is expected to be about half the overall average on this route.

Part of Expwy 4 coincides with the Ghamra br. (Fig. 10.3.2) located at the intersection of Port Said st. and Ramses st. The road width for Ghamra br. is 36 m, while the bridge part is 29 m

wide (a two-way, four-lane road with about 6 m for exclusive tramway tracks). For Expwy 4 to pass over this bridge in elevated style there would be two problems:

(1) It would have to be built at a higher level than the 6th Oct. br. (Expwy 1: double-deck structure), which is to pass over the Ghamra br. transversely; and

(2) There is no space for providing new piers on either side of the Ghamra br.

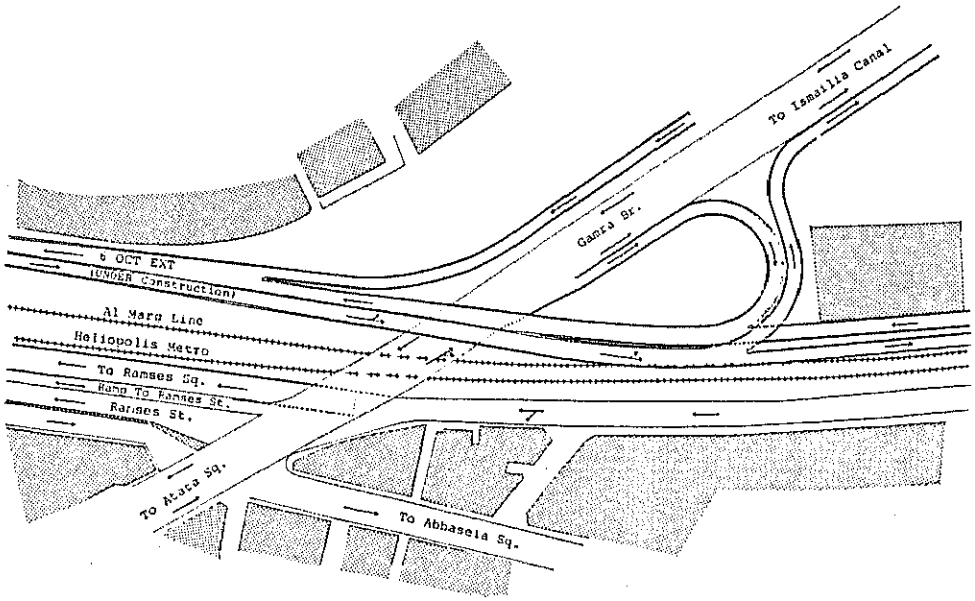


Fig. 10.3.2 Ghamra Bridge

Expwy 4 would thus have to share the Ghamra br. surface with the non-elevated road that currently passes through the bridge. For this reason, the feasibility of introducing a toll system on Expwy 4 in the future appears to be low.

The low volume of traffic in the new section on Expwy 5 in Case 3 is due to the fact that the majority of motorists using the 26th July or Azhar bridges would continue to exit from the Azbakiah Park ramp or the Abou Al Ella ramp at the entrance to the CBD, even if the two bridges are connected by Expwy 5. Therefore, there is no need to affect the esthetic appearance of the CBD by building Expwy 5, at least up to the year 2000 (26th July st. within the CBD will require a double-deck structure for Expwy 5 in view of the existing street width).

Expwy 6 is a short road and is positioned as a branch line of Expwy 2. There are a number of difficult problems that must be solved before the route can be established, such as how to pass through the Sayedah Zeinab sq. - Corniche st. section and how to cross the Nile River.

Taking into consideration the foregoing, Expwys 1, 2 and 3 are recommended for construction towards achieving the Masterplan for the year 2000.

2) Impact of Metropolitan Expwy

Fig. 10.3.3 shows the results of the trip assignment (toll-free case) made for the year 2000 with only Expwys 1, 2 and 3 added to the current road network, in comparison with the Do Nothing Case. Table 10.3.2 shows the forecast traffic volume of the three Expwys. Expwy 1 has the heaviest volume of traffic: 124,700 pcu per day in the busiest section and an overall average of 80,400 pcu per day. This is followed by Expwy 3 with a maximum of 102,200 pcu per day and an average of 68,000 pcu. The demand-capacity ratio (congestion rate) on both roads is 1.0 or more if they are provided with four lanes, indicating that a considerable portion of traffic would use Expwys to avoid congestion on non-elevated roads. Thus, as far as traffic demand is concerned, sufficient grounds exist for constructing the Expwys.

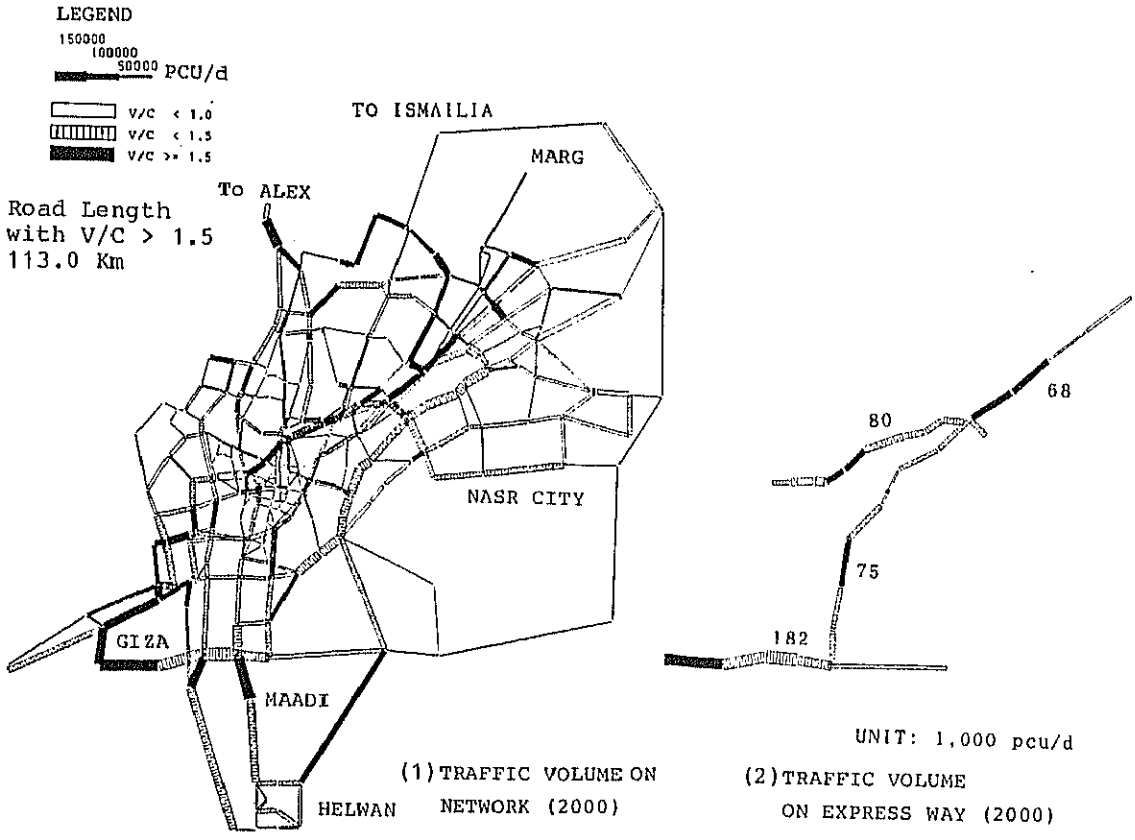


Fig. 10.3.3 Future Traffic Volume in the Year 2000 on Road Network with Expwys 1, 2, and 3

Table 10.3.2 Traffic Volume on Expwys 1,2, and 3 (2000)

Expwy	Traffic Vol. (1000 pcu/d)		Average V/C
	Max.	Ave.	
1	124.7	80.4	1.18
2	96.7	75.4	1.10
3	102.2	68.0	0.99

Note: Toll-Free case

In Table 10.3.3, the traffic indices for the overall road network, including non-elevated roads, show that the length of sections with a congestion rate of 1.5 or more in the year 2000 would drop from 180 km in the Do Nothing Case to 113 km if the three Expwys are built; however the congestion rate on most arterials will still remain above 1.5. Moreover, the average congestion rate for the network as a whole would improve only slightly from 0.72 in the Do Nothing Case to 0.70 with the three Expwys. In other words, the provision of Expwys alone will not be enough to deal with the expected 2.5-fold increase in traffic demand in the Greater Cairo Region even to the extent of maintaining the present (1987) service levels where average congestion rate: 0.43, and sections with more than 1.5 congestion rate: 73 km.

Table 10.3.3 Traffic Indices of Road Network with Expwys 1, 2, and 3

	Indices	Do Nothing Case (2000)	With Expwys 1, 2, & 3 (2000)
1	Section Length (km) with V/C more than 1.5 (%)	180.8 5.6	113.0 3.5
2	Ave. V/C	0.721	0.696
3	Million veh.km	35.14	34.12
4	Million veh.hr	7.16	5.50

10.4 Improvement of Non-Elevated Road Network

1) Impact of Ongoing Road Projects

Fig. 10.4.1 shows the results of the traffic assignment made for the year 2000 on the elevated roads and the following roads (Fig. 10.4.2), which are currently under planning and which are thought to have a high probability of being implemented:

a. Ring Road (Giza North-South Road - Autostrade)
b. Ring Road (Alexandria Agriculture Road - Ismailia Desert Road)
c. Sekket Al Wayli Road
d. West approach to Rod al Farag br.

In the southern portion of the Ring Road (sections 101, 102 and 103 in Fig. 10.4.3), traffic is forecast to be as heavy as 195,000 pcu per day in the year 2000 in the section that crosses the Nile River (102) if the road is connected with Expwy 2. In the northern portion of the Ring Road (sections 110 and 111), section 110 in Qaliubiah is predicted to process 47,000 pcu of traffic per day. In addition, daily traffic is expected to reach 57,000 pcu on Sekket Al Wayli Road (section 207) and 56,000 pcu on the Rod Al Farag Bridge's western approach (section 305). All these sections are fully worthy of construction in view of the high level of traffic expected.

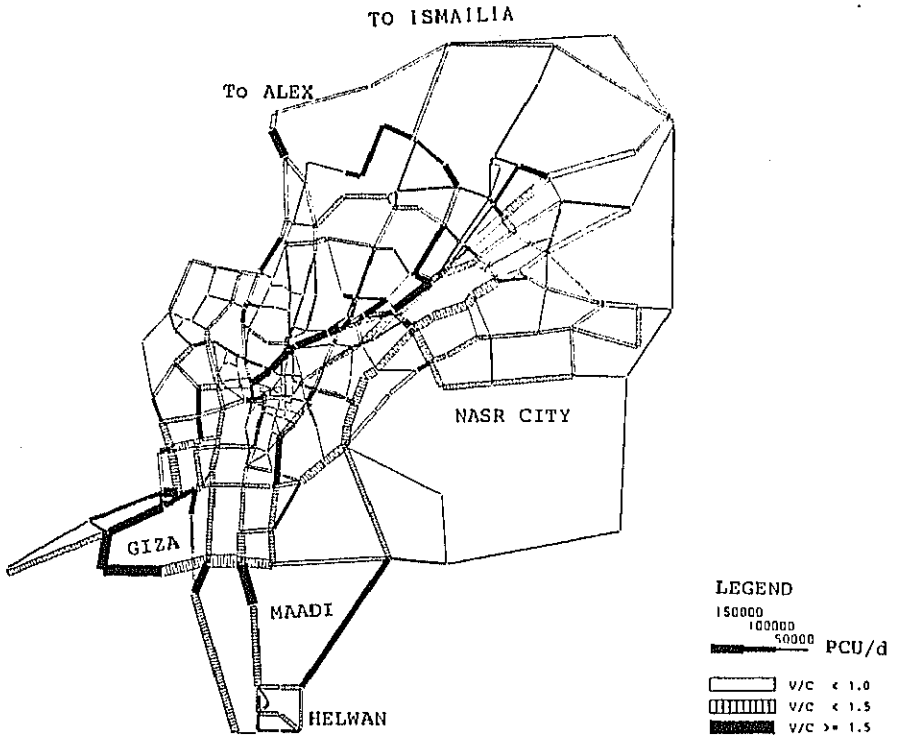


Fig. 10.4.1 Future Traffic Volume on Road Network with Expwys 1, 2, and 3 and On-going Projects (2000)

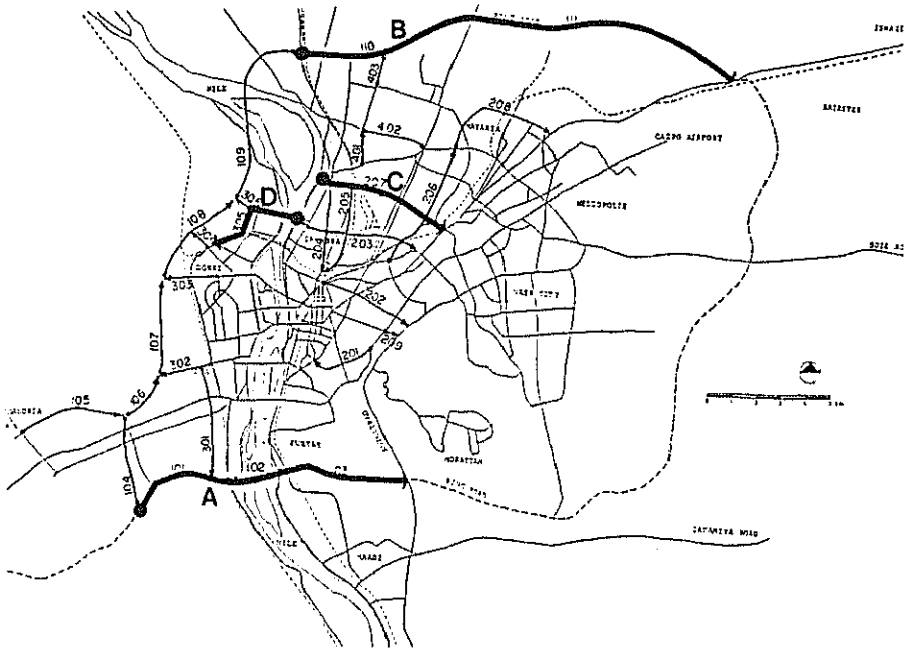


Fig. 10.4.2 Locations of On-going Projects

The Sekket Al Wayli feasibility study conducted with the assistance of the World Bank projects that hourly traffic on Sekket Al Wayli Road will reach 7,100 pcu in the year 2003 and daily traffic, 59,000 pcu (peak hour coefficient, 10%; round-trip ratio, 60%). These figures more or less correspond to the one given above.

If the above four roads, together with Expwys, are added to the existing road network, the extension of sections with more than 1.5 congestion rate would fall to 100 km from 113 km under the Expwy-only case, and the average congestion rate would decline from 0.70 to 0.69 (Table 10.4.1). This, however, is still unsatisfactory.

Table 10.4.1 Traffic Indices of Road Network with Expwys 1, 2, and 3 and On-going Projects

	Indices	Do Nothing Case (2000)	With Expwys 1, 2, & 3 and On-going Projects
1	Section Length (km) with V/C more than 1.5 (%)	180.8 5.6	99.8 3.1
2	Ave. V/C	0.721	0.694
3	Million veh.km	35.14	34.76
4	Million veh.hr	7.16	5.21

2) Ideal Road Network

Fig. 10.4.3 shows the network of non-elevated roads that should be improved or constructed. In the figure, sections numbered in the 100's comprise the Ring Road, those numbered in the 200's are roads in the Cairo Governorate, those in the 300's are Giza Governorate roads and those in the 400's are Qaliubiah Governorate roads. The total extension of roads subject to construction or improvement is 134.4 km, which breaks down to the following:

a. Elevated roads : 21.9 km
b. Ring Road : 60.3 km
c. Non-elevated roads : 56.5 km

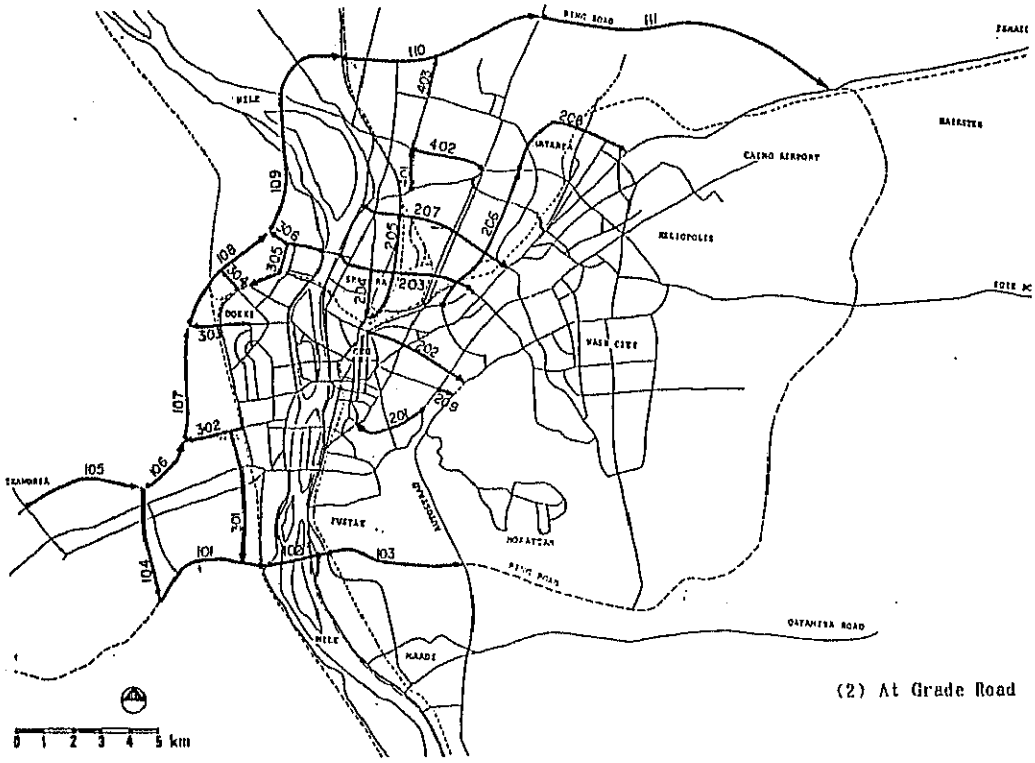


Fig. 9.3.4 Location Map of Road Projects

These roads are described hereinafter.

(1) Ongoing Projects

Sekket Al Wayli (207), western approach to the Rod Al Farag br. (305)

(2) City Roads having ROW Ordinances

Shubra st. (204), Sarwat st. extension (304), Shubra Al Kheima Roads North-South Road No. 1 (401), Shubra Al Kheima East-West Road (402), Shubra Al Kheima North-South Road No. 2 (403)

(3) Roads to inferior traffic sections in built-up area

Salah Salem st. - Sayedah Zeinab sq. Road (201), Kamel Sidky st. (202)

(4) Roads to new residential areas

Giza North-South Road (301), 26th July extension (303), Ahmed Orabi st. extension (304), Rod Al Farag br. western approach extension (306)

(5) Demand-oriented roads

Rod Al Farag st. (203), Ahmed Helmi st. (205), Ahmed Said st. (206), Ahmed Said st. extension (208)

Fig. 10.4.4 shows the results of the traffic assignment made for the year 2000 with all the above roads added to the current

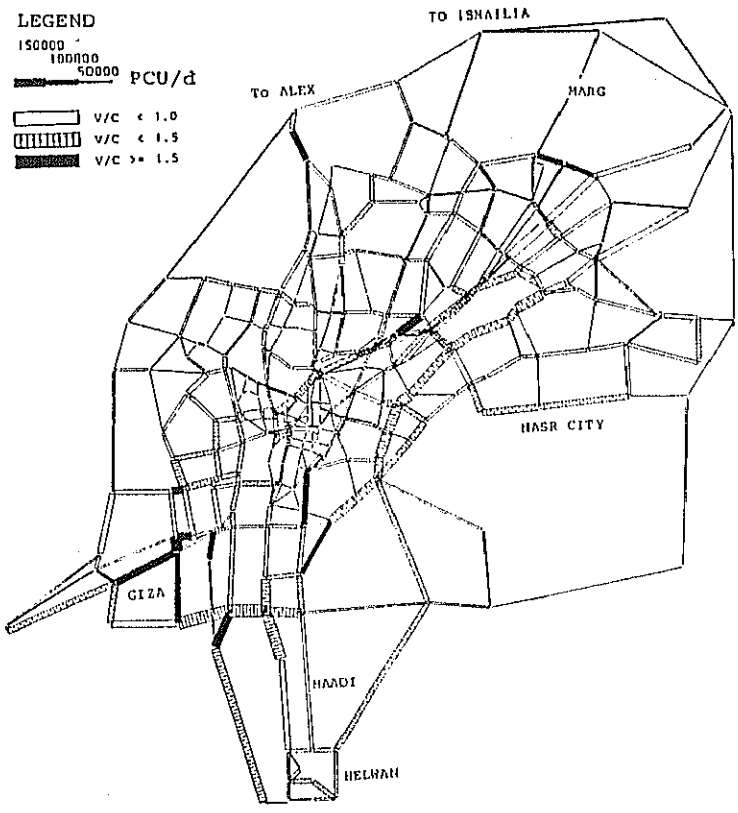


Fig. 10.4.4 Future Traffic Volume in the Year 2000 on the Ideal Road Network

road network. The congestion rate falls within the 1.0-1.5 range on nearly all arterials.

Traffic conditions on some roads to be constructed or improved, other than those discussed earlier, are described below.

The flow of traffic on Ahmed Said st. between the Hadaek Al Kobba district and Mahatet Sekket Al Hadid st. is expected to be heavy at 125,000 pcu per day. This is because the improved Ahmed Said st. will function as an arterial that links CBD to the relatively densely populated districts of Hadaek Al Kobba (net population density in the year 2000: 651 persons per hectare), Al Zeitoun (529 persons per hectare), Al Mataria (1,018 persons per hectare), and Ain Shams (824 persons per hectare). At present trips between these districts and CBD are taken via the Port Said or Khalifah Al Mamoun streets that border the districts. Traffic demand on these two arterials, however, is forecast to exceed capacity in the year 2000. Accordingly, Ahmed Said st. (currently a two-lane street operated one way) shall be widened to six lanes.

Kamel Sidky st. (202), the section between Ramses sq., a major transportation node in the CBD, and the Autostrade is expected to process 66,000 pcu of traffic per day, thus lightening the current load of CBD-destined traffic on the Ramses st. - Mahatet Al Sekket Al Hadid st. section and on the 6th Oct. br. extension.

Likewise, the Salah Salem st.- Sayedah Zeinab sq. Road (201), where 52,000 pcu of daily traffic is expected, will facilitate movement between CBD and Salah Salem st. and lighten the load on Port Said st. in the CBD and surrounding areas.

On the Giza North-South Road (301), the section between King Faisal st. and Ahram st. will process 162,000 pcu of daily traffic. Most of the traffic will move toward the Ring Road's Nile River bridge and the Sarwat st. extension, both of which are to be constructed, in order to escape the bottleneck at Giza sq.

With the addition of all the roads listed above to the current road network, the extension of sections with a congestion rate of a minimum 1.5 will drop to 42.4 km from the 1987 level of 73 km. The average congestion rate, however, will be 0.66, higher than the 1987 level of 0.43, indicating that congestion will be more widespread, though less severe. On the whole, the present level of service will be maintained (Table 10.4.2). The average traffic volume in the year 2000, the length and the lane numbers of the project roads are summarized in Table 10.5.6.

3) Outline of Surface Road Projects

(1) Salah Salem - Sayedah Zeinab Square Road (201)

The existing street between Abdel Maguid Al Labbani and Qaraat Bab Al Wazir streets is only 10 m wide at certain points,

Table 10.4.2 Traffic Indices of Ideal Road Network

	Indices	Do Nothing Case (2000)	Ideal Road Network (2000)
1	Section Length (km) with V/C more than 1.5 (%)	180.8 5.6	40.5 1.2
2	Ave. V/C	0.721	0.656
3	Million veh.km	35.14	33.08
4	Million veh.hr	7.16	3.25

while buildings of historical and religious significance line the street on both sides. Since this makes it difficult to widen and improve the street, the plan proposed here calls for the construction of a new four-lane road between Salah Salem st. and Sayedah Zeinab sq. in a position parallel to the street. The road will have a total extension of 3.0 km and ROW width of 20 m.

The Salah Salem - Sayedah Zeinab sq. Road will start from Bab Al Wazir to the west of the Citadel in Salah Salem st. A ramp over Salah Salem st. will be provided on the Heliopolis side to improve access. The road will intersect Qalaa st. at Salah Al Din sq. and then pass along the south of Ibn Tulun Mosque to reach Sayedah Zeinab sq.

Although the historical and religious buildings mentioned above will be by-passed, it will still be necessary to remove existing buildings along most of the route. As many as 50 buildings will be subject to land acquisition and compensation payments in the Qalaa st. - Sayedah Zeinab sq. section (1.6 km) alone.

(2) Kamel Sidky St. (202)

The Kamel Sidky st. starts from Ramses sq., runs along the Old Cairo Wall built in the 7th Century, and ends at the Autostrade, with a total length of 5.2 km.

Measures to preserve the Old Cairo Wall are at present taken only along the Gueish st. - Manssoureya st. section. Between Ramses sq. and Gueish st., broken sections of the wall are found intermittently among the buildings lining the Kamel Sidky st. While the proposed improvement calls for the widening of Kamel Sidky st. into six lanes with a ROW width of 40 m to meet traffic demand, it would be desirable, if possible, to secure an additional 60 m or so south of the street for the streetside green space which would incorporate the Old Cairo Wall, thus serving to preserve this historical structure.

As many as 31 buildings will be subject to compensation payments along the 1.3 km section between Ramses sq. and Gueish st. It may therefore be necessary to review the possibility of adopting the land acquisition method used in urban redevelopment projects when carrying out the improvement work. In addition, the Gueish st. - Manssoureya st. section (about 600 m) and the Salah Salem st. - Autostrade section (about 700 m) pass through

cemeteries where lower income people have staked out their homes. It may be necessary to relocate these people before the improvement work can be implemented.

(3) Rod Al Farag St. (203)

The plan proposed here calls for the establishment of a four-lane road running from Abbasseya sq. to the eastern bank of the Rod Al Farag br., which is currently under construction. The road will have a ROW width of 20 m and total extension of 5.3 km.

The existing Rod Al Farag st. will be used for the section (about 1.7 km) between Corniche st. along the Nile River and Teraat Al Boulaqiya st., then south via Abdel Qader Taha st. While the current width of Rod Al Farag st. is 18 - 20 m, since the City Planning Department of Cairo Governorate has established 20 m as the ROW width, the same width is taken up in this plan.

For the 1.8 km section between Teraat Al Boulaqiya st., the terminal point of the existing Rod Al Farag st., and Sharikat st., which runs parallel to Port Said st., the following problems must be resolved:

a. The route and method of passing through the residential area in the Teraat Al Boulaqiya st. - Ahmed Helmi st. section.
b. The method of crossing Ahmed Helmi st. and the ENR tracks (Alexandria line and freight line).
c. The route and method of passing through the residential area between the ENR tracks and Sharikat st.

In the Sharikat st. - Ahmed Said st. section that follows, the proposed route will follow that of a 20 m road currently running through the section.

Between Ahmed Said st. and Abbasseya sq., it will be necessary to fly over the tracks of the Al Marg, Quarry and Heliopolis Metro lines, as well as the extension of the 6th Oct. br. (Expwy 1). It will also be necessary to pass through the premises of the Ain Shams University's Medical Department.

Although Cairo Governorate had been considering this same route as an alternative to the Intermediate Ring Road since the beginning of the construction of the Rod Al Farag br., this route was laid aside owing to the problems cited above. However, as the following benefits can be expected, the route is now included as part of the road network to be achieved by the year 2000.

a. The route will maximize the functions of the Rod Al Farag br.
b. The route will improve service to the Shubra and Sharabiya districts, where the improvement of roads running in a circular direction is lagging behind.
c. As an Intermediate Ring Road, it will divert some of the traffic concentrating on the 6th October br. (Expwy 1).

An overpass with a total length of 600 m will be provided where the proposed route crosses Ahmed Helmi st. and the ENR tracks, and a 540 m overpass will be built where this route crosses the Al Marg line and the 6th October br. The proposed route will also run between some existing buildings of Ain Shams University and connect with the Abbasseya sq. portion of Ramses st.

(4) Shubra St. (204)

Shubra st. from Ismailia Canal to Rod Al Farag st. (2.9 km) is a four-lane thoroughfare with a separated tram line down its center. From Rod Al Farag st. to the Cairo Central sta. (1.7 km), the two lane one-way street is only 25 m wide with a single-track tram line down its center.

Cairo Governorate has established a ROW width of 40 m for the Rod Al Farag st. - Cairo Central sta. section, and all but 26 buildings along the street have been set back (Fig. 10.4.5). Another consideration to take into account is that there are plans to build the Urban Metro No. 1 line along this section. The choice between the cut-and-cover construction method and the shield drive method seems to favor the former, which involves the widening of the street, as being more advantageous in terms of cost. Therefore, the proposed improvement work calls for the section to be widened to 40 m under the assumption that the Urban

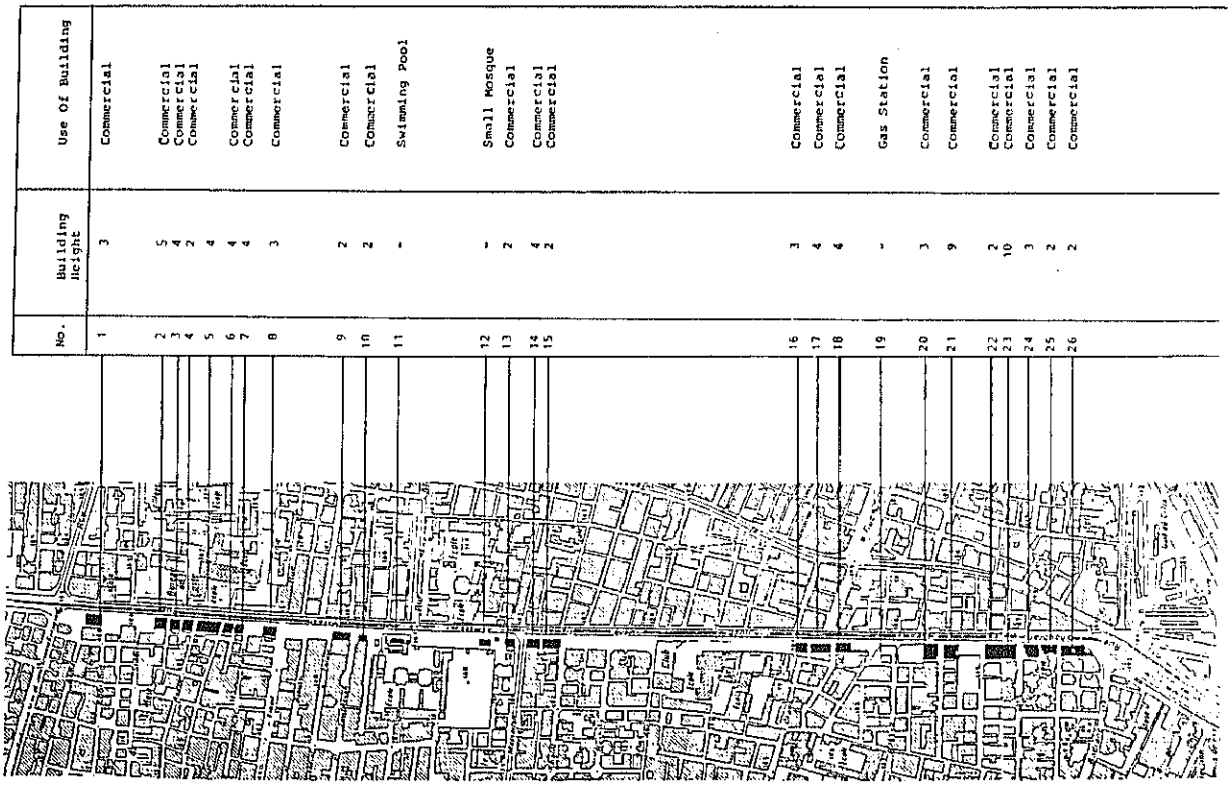


Fig. 10.4.5 Buildings within 40 m ROW of Shubra St.

Metro No. 1 line would be constructed. Under the further assumption that the tram line would be removed in conjunction with the construction of the Urban Metro line, the entire length of Shubra st. will be provided with six lanes.

(5) Ahmed Helmi St. (205)

Ahmed Helmi st. is an arterial linking the Alexandria Agriculture Road and the northern exit of Cairo Central sta. The 4.1 km section from Ismailia Canal to the grade-separated intersection with Ahmed Badawi st. is a four-lane thoroughfare with a separated tram line down the center. The section (about 0.7 km) from Ahmed Badawi st. to the Shubra st. intersection, where Ahmed Helmi st. terminates, is a four-lane street with a median. Near the northern exit of Cairo Central sta., where there is a long distance bus terminal, the vague boundary between the bus terminal and the street is a factor causing traffic congestion.

Should the ENR commence urban transport services in the future, the tram line will become redundant. For this reason, the proposed improvement of Ahmed Helmi st. calls for the removal of the tram line in order to secure two additional lanes, for a total of six lanes. The overall width of the street is 25 m and will thus require no compensation payments.

Concerning the area where Ahmed Helmi st. conflicts with the long-distance bus terminal at the northern exit of Cairo Central sta., the plan proposed here generally conforms to the 1986 improvement plan formulated for the bus terminal (Fig. 10.4.6), with a few modifications, such as the intersection with Shubra st.

(6) Ahmed Said St. (206 and 208)

At present there is a grade-separated intersection where Ahmed Said st. crosses Ramses st. (one-way in Heliopolis direction) and an interchange where the street passes through a culvert below Mahatet Sekket Al Hadid st. (one-way in Ramses sq. direction).

In the 2.6 km section of Ahmed Said st. which passes through the Sharabiya district from the Ramses st. intersection to the Sekket Al Wayli st. intersection, the proposed plan calls for the widening of the current two lane one-way operated street to six lanes with a total width of 36 m. Since the Sharabiya district is densely populated, 82 buildings will be subject to compensation payments in this section.

Between Sekket Al Wayli st. and Kablat st. (2.9 km), Ahmed Said st. runs along Mataria Canal. A ROW width of 40 m has been established in advance by the City Planning Department of Cairo Governorate for the section, although a few structures do not conform to this stipulation.

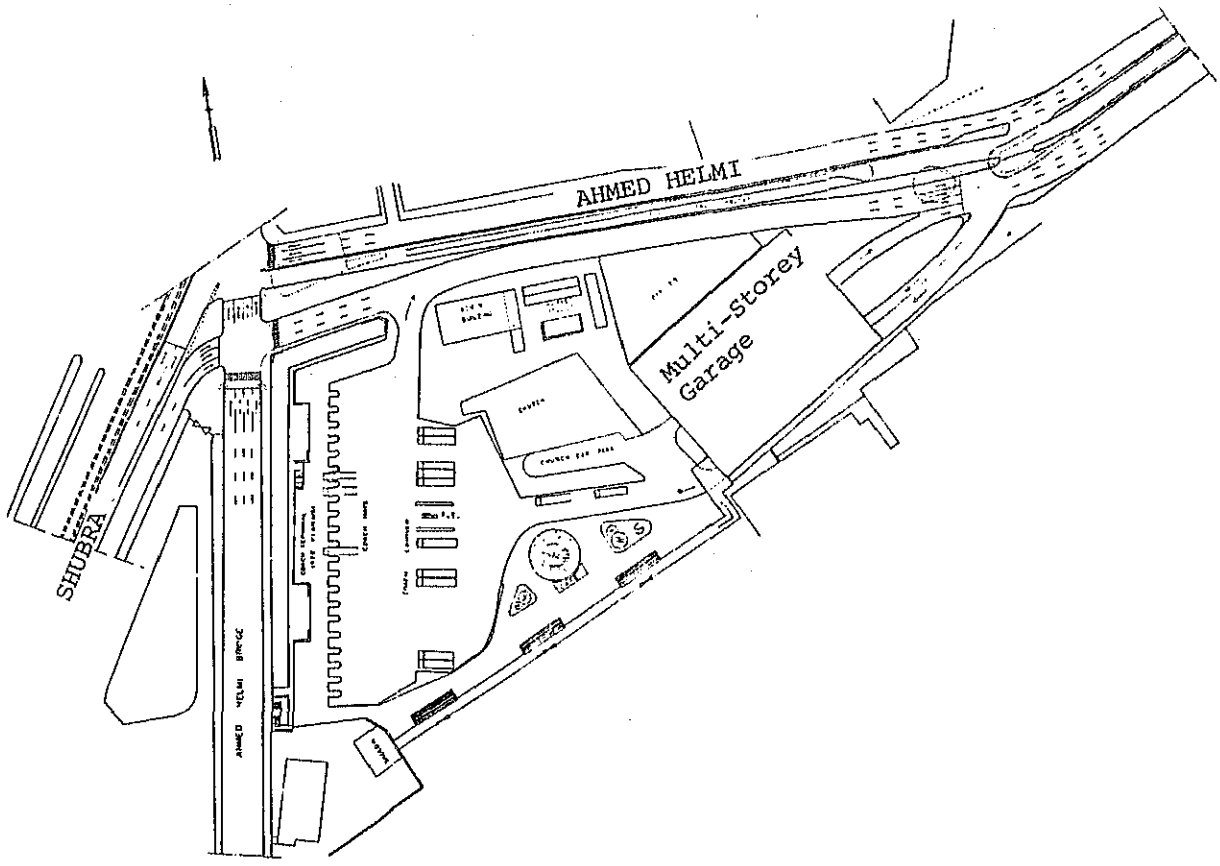


Fig. 10.4.6 Improvement Plan of Long Distance Bus Terminal at the end of Ahmed Helmi St.

At present the Ain Shams district is served by only two arterials: Gisr Al Suez st. (Ismailia Desert Road), which runs along the south side of the district, and Ain Shams st. (two lanes operated as a pair of one-way streets), which passes through the district up to Al Marg. In order to guide traffic from this district to the CBD, Ahmed Said st. will be extended from Kabrat st. to the intersection with Nozzle st. Subsequent to this, the Nozzle st., which crosses Ahmed Said st. diagonally, will be widened and Ahmed Said st. will be extended past the Al Marg line to Ibrahim st. (width: 20 - 40 m) in the Ain Shams district.

(7) Sekket Al Wayli St. (207)

In 1984, a feasibility study on the best route for linking the Rod Al Farag br., currently under construction, with Salah Salem st. in the Heliopolis district was conducted under the sponsorship of the World Bank. The study proposed that Sekket Al Wayli st. be extended and upgraded into a six-lane thoroughfare under the judgment that the improvement of Rod Al Farag st. discussed in (3) above would be difficult to implement.

The route proposed by the feasibility study runs north along Corniche st., turns onto Mamalik School Road at the Dawlatan st. intersection, and crosses Ahmed Helmi st., ENR Alexandria line and the ENR marshaling yard via an underpass tunnel (length: 97 m). The route then follows the existing Sekket Al Wayli st., which is to be upgraded and improved, and intersects with the Al Marg line and Khalifah Al Mamoun st., where another underpass is to be provided, to reach Salah Salem st. However, a flyover bridge over the Al Marg line is under construction by NAT in the Kobri Al Kobba area as a part of the Regional Metro project to segregate any road crossings and speed up the railway operation (Fig. 10.4.7).

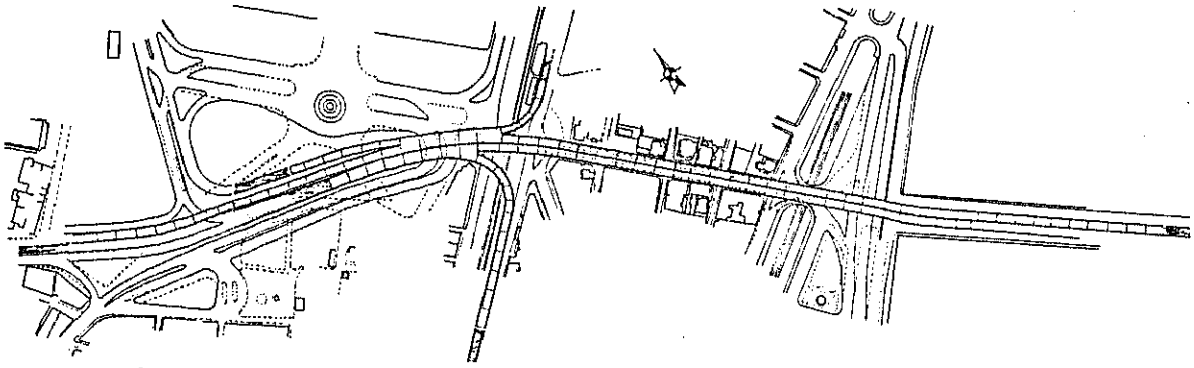


Fig. 10.4.7 Regional Metro Flyover on Sekket Al Wayli

The total length of this proposed route is 9 km. The feasibility study gives the following standards for the improvement of Sekket Al Wayli st.:

a. High traffic capacity (1,200 vehicles/lane/hour)
b. Limited or no parking on main carriageway
c. Full segregation of road and rail traffic
d. Proper segregation of pedestrian/vehicle traffic
e. Traffic flow conditions at level of service C or D as defined by the Highway Capacity Manual.

The improvement plan proposed here follows the one described above. However, it is possible to consider a 200 m-long overpass as an alternative to the underpass at the ENR line crossing.

(8) Azhar St. Extension (209)

The current Azhar st. (four lanes), which terminates in Salah Salem st., is to be extended 0.6 km to the Autostrade under this plan. The area between Salah Salem st. and the Autostrade is a cemetery and, as with Kamel Sidky st. discussed in (2) above, there is the problem of relocating the people who have settled on the cemetery premises.

(9) Giza North-South Road (301)

In order to deal with the recent development of residential areas, Giza City has formulated various improvement plans for

streets (such as Tersa st.) running east to west in a position parallel to the existing Ahram and King Faisal streets. However, as there is no arterial linking all these east-west streets together, the construction of the Giza North-South Road, which will run from the Sarwat st. extension to the Ring Road, is proposed here in order to disperse traffic on the east-west streets.

Existing north-south roads in Giza City consist only of Salah Salem st. and Corniche st. (which connects with the Upper Egypt Highway) on the eastern side of the ENR line. On the western side of the ENR line, the Zomor Canal road provides north-south service to traffic on the southern portion of Ahram st. and only a 10 m wide street at the end of the King Faisal br. functions as a north-south arterial linking King Faisal st. with Ahram st. All these roads will be upgraded into a four-lane thoroughfare with a ROW width of 40 m.

(10) Sarwat St., 26th July St., Ahmed Orabi St., and Rod Al Farag Br. West Approach Extensions (302, 303, 304 and 306)

The extensions of the above streets are proposed here with the intention of providing access between the ENR line, which serves as the western boundary of the current Giza urban area, and the Ring Road, which will serve as the new western boundary of the future Giza urban area. As all these streets have an adequate ROW width of 40 - 50 m, the extensions are designed so as to maintain the same width as the streets. At the ENR line crossing, all the extensions will be provided with viaducts except for Sarwat st., which already has a viaduct.

(11) Rod Al Farag Br. Western Approach (305)

The main western approach to the Rod Al Farag br. currently under construction is provided on Corniche st. There are also plans to divert some of the main stream of approaching traffic to Wehda st., which is an arterial road serving the northern part of the Embaba district. Wehda st. is at present being repaved under the financing of the World Bank.

The proposed route will incorporate the improved Wehda st. and will be connected with Sudan st. to form a four-lane Intermediate Ring Road using Bouhi st., which runs north to south along the western periphery of the Embaba district, and the ENR Silo line land.

(12) Roads in Shubra Al Kheima (401, 402 and 403)

In the Shubra Al Kheima district, a residential area is developing in the area within the inner curve of the Ring Road, and plans to construct wide roads with a ROW width of 40 - 50 m are being carried out. The plan proposed here calls for the inclusion of the majority of those roads as arterial roads in the future road network of the GCR.

The main north-south arterial will be the road that starts from the intersection between the existing Ahmed Helmi st. and Ismailia Canal Road, spans the Ismailia Canal and provides a link with the center of the Shubra Al Kheima district and further on to the Ring Road.

For the east-west arterial, the road that spans the Ismailia Canal and connects with Mataria st. has already been constructed. In addition, the construction of a new east west arterial is proposed here to the end of the newly constructed Ismailia Canal br. at the Port Said st. extension.

10.5 Estimation of Road Construction Costs

1) Estimation Method

(1) General Approach

As in ordinary construction works, to arrive at the estimated construction cost, the costs for labor, equipment and materials are added up for each cost item.

In works involving the use of large machinery, machinery operating expense accounts for a considerable proportion of each construction cost item. Machinery operating expense is determined by the number of days the equipment will be used, which in turn depends primarily on the combination of equipment used and on the resulting level of equipment performance, although the working rate in the region or country is also a factor. Therefore, the most typical combination of equipment for a given cost item was assumed, and the performance level to be achieved by this combination of equipment was used to determine the number of operating days.

To the construction cost thus estimated, the indirect cost of construction which includes expenses for temporary facilities, field supervision, and general administration are added the design cost, and the contingency fund, as well as the separately-calculated land acquisition and compensation costs, to arrive at the project cost.

(2) Foreign Exchange Rate

The foreign currency exchange rate was set at 1 US$ = 2.3 LE as of July, 1988. The costs are given by foreign currency portion in terms of US$ and local currency portion in terms of LE and the total financial costs are shown in terms of LE applying the foreign currency exchange rate.

(3) Calculation of Economic Cost

The financial costs were converted into the economic costs by taking the following procedures:

a. Deduction of transfer costs such as import tax and duties or sales taxes from material costs.
b. Conversion of the unskilled labor wage into economic terms by using a shadow wage rate of 60% of the financial rate.
c. Conversion of the official foreign currency exchange rate into economic terms by using a shadow exchange rate of 1.2 times the official rate.

The economic costs are shown in terms of LE as the total of the foreign currency and the local currency portions.

2) Labor Cost

Labor cost is calculated by first obtaining the average annual wage from the average hourly wage and from the various allowances (social insurance, welfare, etc.) and then dividing the annual wage by the estimated number of working days in a year.

Social insurance is calculated in accordance with Law No. 79 (1984), which provides for the payment of life insurance against old-age and death, workmen's compensation insurance, medical insurance, and unemployment insurance. The amount of payment and the proportion of payment to be covered by the employer and employee differ according to the size of income, as shown in Table 10.5.1.

Table 10.5.1 Share of Social Charge Payment

(unit: %)

Classification	Employer	Employee	Total
Permanent Staff			
.Less than 250 LE/M	26	14	40
. 251 - 625 LE/M	24	11	35
.More than 625 LE/M	0	35	35
Temporary Staff	18	10	28

Annual working hours are given as 2,257 hours. This is based on the estimation that non-working days, which are the sum of weekend holidays, national holidays, and paid leaves, total 87 days and that overtime work amounts to 40 hours per month (Table 10.5.2).

Table 10.5.2 Annual Non-Working Days

Item	No. of Days
Friday	52
Holiday	14
Paid Vacation	21
Total	87

The above expenses are added to the basic wage to arrive at the labor cost. Table 10.5.3 shows the costs of labor by worker category (unskilled workers are classified as temporary employees when determining social charge).

3) Equipment Cost

The hourly cost of machinery and equipment is estimated from the expenses for depreciation, repairs, maintenance, and operation. Other construction projects in Egypt were referred to when

Table 10.5.3 Labor Cost

		Driver	Operator	Foreman	Skilled Labor	Unskilled Labor
Basic Daily Salary	LE/d	9.92	9.22	11.52	12.16	6.27
Social Charge	(%)	35.00	35.00	35.00	35.00	28.00
Monthly Salary	LE/M	310.69	288.77	360.80	380.85	186.16
Overtime Charge	LE/h	2.33	2.16	2.52	2.85	1.47
Overtime Hour	H/M	40.00	40.00	40.00	11.50	40.00
Annual Salary	LE/Y	4,846.68	4,502.04	5,539.20	4,951.05	2,939.52

determining equipment operational life, average working hours, repair expenses, and annual maintenance expenses. The accounting of depreciation is assumed to be by the 90% straight-line method. At the same time, a comparison was made with the costs of leasing construction equipment in Egypt (July 1988). The costs of major equipment thus estimated are shown in Table 10.5.4.

4) Materials Cost

Of the materials to be supplied domestically, cement and steel frames, which are the main construction materials, are not being manufactured in sufficient supply. In the case of cement, the Egyptian Cement Sales Company buys up all cement manufactured domestically and adjusts its price to that of imported cement. Thus the cost of domestic material is considered to contain the foreign currency portion. Table 10.5.5 gives the percentage of the domestic cost of materials that will be paid for in foreign currency.

The prices of imported materials are converted into domestic prices with the addition of duties and fees to the materials' CIF prices in Egypt.

5) Indirect Cost

Expenses for temporary facilities, which are included in the indirect cost of construction, include expenditures for transporting, preparing and removing common-use heavy machinery, expenditures for the construction of plant and electric power facilities, expenditures incurred in the provision of preventive measures (sound-proofing, groundwater blockage, etc.) and safety precautions, expenditures for utilities, and expenditures for field supervision and general administration. Field supervision expenditures include personnel and office expenses incurred at the field office. General administrative expenditures include expenses incurred at the head office.

Since indirect cost, unlike direct construction cost, differs greatly according to the contractor that actually undertakes the work, it is difficult to obtain workable estimates of all the above expenses. Therefore, in this estimation indirect cost is assumed to be 35% of direct cost, in accordance with other projects in Egypt. Domestic and foreign currencies are assumed to account each for half of the total.

Table 10.5.4 Equipment Cost

	Equipment	Basic Price (US$)	Operational life (Year)	Residual Value (%)	Annual Operating Hours (Hour)	Maintenance Rate (%)	Annual Management Rate (%)	Fuel Consumption (l/h)	Electricity Consumption (Kw)	Lubricant Consumption (%)	Financial Cost		Economic Cost	
											Foreign (US$/h)	Local (LE/h)	Foreign (US$/h)	Local (LE/h)
1	Aggregate Spreader 2.3m	1,500	3	10	530	40.0	5.0	0.48	0.00	30.0	1.29	0.13	1.29	0.09
2	Apron Feeder 30t	44,600	9	10	1000	45.0	5.0	0.53	0.00	30.0	8.47	0.30	8.47	0.1
3	Asphalt Plant 30t	155,000	6	10	1000	50.0	7.0	300.00	100.00	30.0	44.43	92.11	44.43	91.0
4	Asphalt Plant 60t	520,000	6	10	1000	50.0	7.0	575.00	201.00	30.0	149.07	181.18	149.07	177.45
5	Asphalt Finisher 3m	117,950	7	10	550	50.0	7.0	4.48	0.00	30.0	54.84	2.19	54.84	0.87
6	Asphalt Finisher 5m	147,500	6	10	550	50.0	7.0	6.47	0.00	30.0	76.88	3.18	76.88	1.26
7	Batching Plant	480,000	7	10	950	60.0	7.0	20.80	78.00	30.0	134.98	34.01	134.98	30.28
8	Belt Conveyer 0.35*10m	15,000	2	10	3000	10.0	6.5	1.37	0.00	30.0	2.78	0.29	2.78	0.27
9	Belt Conveyer 0.6*15m	19,600	2	10	3000	10.0	6.5	1.50	0.00	30.0	3.63	0.32	3.63	0.29
10	Breaker 800kg	35,800	2	10	600	35.0	5.0	0.00	0.00	30.0	38.19	0.90	38.19	0.0
11	Bulldozer 11t	108,000	6	10	12001	5.0	6.5	8.50	0.00	30.0	31.95	3.01	31.95	1.66
12	Bulldozer 21t	220,900	6	10	12001	5.0	6.5	15.70	0.00	30.0	65.35	5.83	65.35	3.06
13	Casing Tube D1.2m	16,700	2	10	500	70.0	5.0	0.00	0.00	0.0	26.05	1.01	26.05	0.0
14	Casing Tube D1.5m	20,500	2	10	500	70.0	5.0	0.00	0.00	0.0	31.98	1.23	31.98	0.0
15	Clamshell 0.3m3	115,200	5	10	1200	75.0	6.5	8.99	0.00	0.0	35.04	2.59	35.04	1.35
16	Compressor 4.6m3	33,200	5	10	1000	50.0	5.0	6.00	0.00	30.0	10.29	1.46	10.29	1.17
17	Compressor 9.6m3	42,810	5	10	1000	50.0	5.0	10.17	0.00	30.0	13.27	2.35	13.27	1.98
18	Concrete Cutter 0.3m	6,000	3	10	800	25.0	5.0	0.48	0.00	30.0	3.13	0.15	3.13	0.09
19	Concrete Breaker 30kg	4,000	2	10	1000	20.0	5.0	0.00	0.00	30.0	2.32	0.03	2.32	0.0
20	Concrete Bucket	1,800	5	10	500	55.0	5.0	0.00	0.00	30.0	1.14	0.03	1.14	0.0
21	Concrete Finisher 5.5m	103,000	7	10	500	35.0	7.0	3.10	0.00	30.0	49.15	1.49	49.15	0.6
22	Concrete Pump Car 85m3	233,000	4	10	12001	5.0	6.5	13.49	0.00	30.0	97.08	7.01	97.08	2.63
23	Concrete Spreader 2.3m	124,000	7	10	500	35.0	7.0	13.49	0.00	30.0	59.17	3.70	59.17	2.63
24	Crawler Crane 22.5t	193,900	5	10	1000	85.0	7.0	5.56	0.00	30.0	74.85	3.92	74.85	1.08
25	Crawler Crane 35t	261,000	5	10	1000	85.0	7.0	6.50	0.00	30.0	100.75	5.08	100.75	1.27
26	Delivery Hose D0.2m	1,470	1	10	500	70.0	6.5	0.00	0.00	0.0	4.48	0.18	4.48	0.0
27	Diesel Hammer 1.25t	44,000	4	10	1200	90.0	6.5	9.00	0.00	30.0	17.23	2.46	17.23	1.76
28	Diesel Hammer 2.5t	65,000	4	10	1200	90.0	6.5	15.00	0.00	30.0	25.46	3.97	25.46	2.93
29	Distributor 4kl	25,000	6	10	530	40.0	7.0	0.67	0.00	30.0	12.89	0.40	12.89	0.13
30	Drill Pipe D0.2m	1,470	1	10	500	75.0	6.5	0.00	0.00	0.0	4.60	0.19	4.60	0.0
31	Dump Truck 11t	92,000	4	10	1500	60.0	10.0	6.30	0.00	30.0	27.29	2.02	27.29	1.23
32	Dump Truck 2t	23,000	4	10	1500	55.0	10.0	6.36	0.00	30.0	6.67	1.42	6.67	1.24
33	Dump Truck 6t	62,000	4	10	1500	60.0	10.0	5.00	0.00	30.0	18.39	1.51	18.39	0.98
34	Earth Auger D0.45m	50,000	4	10	1000	35.0	7.0	2.11	0.00	30.0	18.25	0.79	18.25	0.41
35	Engine Pump 4 inch	1,730	6	10	7501	10.0	5.0	0.70	0.00	30.0	0.80	0.17	0.80	0.14
36	Generator 75KVA	40,000	6	10	800	39.0	5.0	30.50	0.00	30.0	12.60	6.23	12.60	5.95
37	Generator 100KVA	41,500	6	10	800	39.0	5.0	36.00	0.00	30.0	13.07	7.31	13.07	7.02
38	Generator 125KVA	46,200	6	10	800	39.0	5.0	47.74	0.00	30.0	14.55	9.63	14.55	9.31
39	Grout Mixer	3,400	6	10	600	55.0	7.0	0.00	4.40	30.0	1.66	1.47	1.66	1.43
40	Grout Pump	4,000	6	10	600	55.0	7.0	0.00	3.20	30.0	1.96	1.09	1.96	1.04
41	Hand Hammer 1.1m3	1,200	2	10	1000	35.0	5.0	0.00	0.00	30.0	0.77	0.02	0.77	0.0
42	Hammer Grab D1.2m	24,600	1	10	500	70.0	6.5	0.00	0.00	0.0	75.03	2.96	75.03	0.0
43	Hammer Grab D1.5m	42,100	1	10	500	70.0	6.5	0.00	0.00	0.0	128.41	5.07	128.41	0.0
44	Hammer Crown	5,600	1	10	500	70.0	6.5	0.00	0.00	0.0	17.08	0.67	17.08	0.0
45	Hydro-Shovel 0.6m3	155,000	5	10	1200	75.0	6.5	4.10	0.00	30.0	47.15	2.47	47.15	0.8
46	Line Marker 90kg	4,600	4	10	1200	60.0	6.5	3.88	0.00	30.0	1.57	0.81	1.57	0.76
47	Macadam Roller 12t	50,000	7	10	750	50.0	7.0	5.40	0.00	30.0	17.05	1.46	17.05	1.05
48	Motor Grader 3.1m	119,870	7	10	850	50.0	7.0	7.80	0.00	30.0	36.06	2.39	36.06	1.52
49	Reverse Circulation Drill	253,800	5	10	1000	75.0	6.5	0.00	0.00	0.0	92.64	3.27	92.64	0.0
50	PC Jack	10,500	5	10	2000	75.0	10.0	0.00	0.00	30.0	2.10	0.07	2.10	0.0
51	Road Sweeper 1.8m	171,000	5	10	950	50.0	7.0	8.70	0.00	30.0	59.40	3.24	59.40	1.7
52	Soil Compactor 0.05t	1,800	3	10	800	45.0	5.0	0.30	0.00	30.0	1.06	0.09	1.06	0.06
53	Soil Compactor 0.2t	2,900	2	10	800	45.0	5.0	0.48	0.00	30.0	2.47	0.16	2.47	0.09
54	Soil Mixing Plant 15m3	157,000	6	10	1200	50.0	7.0	0.00	43.00	30.0	37.51	14.91	37.51	13.98
55	Spray Gun	25,500	5	10	1440	85.0	7.0	0.96	0.00	30.0	6.84	0.45	6.84	0.19
56	Sprayer 0.3Kl	2,200	3	10	1360	25.0	5.0	0.34	0.00	30.0	0.67	0.08	0.67	0.07
57	Stand Pipe D1.2m	3,390	2	10	500	75.0	6.5	0.00	0.00	0.0	5.53	0.22	5.53	0.0
58	Suction Pipe D0.2m	2,240	2	10	500	75.0	6.5	0.00	0.00	0.0	3.65	0.14	3.65	0.0
59	Surface Vibrator 1.5m	1,800	4	10	530	65.0	5.0	0.43	0.00	30.0	1.38	0.13	1.38	0.08
60	Submerged Pump D0.10m	2,292	5	10	7201	20.0	5.0	0.00	2.20	30.0	1.34	0.78	1.34	0.72
61	Submerged Pump D0.15m	5,219	5	10	7201	20.0	5.0	0.00	0.00	0.0	3.06	0.15	3.06	0.0
62	Tamper 100kg	1,920	4	10	1000	70.0	5.0	0.14	0.00	30.0	0.80	0.06	0.80	0.03
63	Tandem Roller 10t	48,000	7	10	650	45.0	7.0	5.57	0.00	30.0	18.46	1.59	18.46	1.18
64	Tire Roller 15t	56,000	7	10	750	50.0	7.0	5.58	0.00	30.0	19.09	1.55	19.09	1.09
65	Tremie Pipe D0.25m	420	2	10	500	45.0	5.0	0.00	0.00	0.0	0.57	0.02	0.57	0.0
66	Truck 5t	26,000	4	10	1100	70.0	10.0	4.50	0.00	30.0	10.99	1.23	10.99	0.88
67	Truck 8t	39,000	4	10	1100	70.0	10.0	6.00	0.00	30.0	16.49	1.70	16.49	1.17
68	Truck Crane 5t	67,000	7	10	900	50.0	6.5	2.30	0.00	30.0	18.66	0.91	18.66	0.45
69	Truck Crane 11t	140,700	7	10	900	50.0	6.5	3.00	0.00	30.0	39.20	1.55	39.20	0.59
70	Truck Crane 16t	159,500	7	10	1000	50.0	6.5	5.00	0.00	30.0	39.99	1.95	39.99	0.98
71	Truck Crane 40t	365,600	7	10	1000	50.0	6.5	6.17	0.00	30.0	91.66	3.45	91.66	1.2
72	Truck Crane 70t	577,500	7	10	1000	50.0	6.5	10.80	0.00	30.0	144.79	5.65	144.79	2.11
73	Truck Crane 90t	718,800	7	10	1000	50.0	6.5	13.80	0.00	30.0	180.21	7.11	180.21	2.69
74	Truck Mixer 3m	47,000	5	10	950	45.0	7.0	8.40	0.00	30.0	15.93	2.02	15.93	1.64
75	Vibrator	960	3	10	700	35.0	5.0	0.00	0.30	30.0	0.61	0.11	0.61	0.1
76	Vibro Hammer 45kw	58,690	4	10	1000	100.0	6.5	0.00	12.20	0.0	28.76	4.31	28.76	3.05
77	Vibro Hammer 60kw	81,200	3	10	1000	100.0	6.5	0.00	18.30	0.0	51.29	6.90	51.29	4.58
78	Vibrating Roller 3.5t	70,535	5	10	800	85.0	6.5	1.70	0.00	30.0	33.59	1.62	33.59	0.33
79	Watering Cart 5.5Kl	40,000	5	10	1000	50.0	7.0	5.00	0.00	30.0	13.20	1.32	13.20	0.98
80	Welder 250A	6,700	7	10	500	70.0	5.0	3.52	2.00	30.0	3.46	1.45	3.46	1.34
81	Wheel Loader 1.4m3	83,540	7	10	1200	60.0	7.0	8.45	0.00	30.0	18.60	2.16	18.60	1.65

Table 10.5.5 Foreign Currency Percentage in Local Materials

(unit: %)

Material	Foreign	Local
Cement	50.0	50.0
Reinforcement	50.0	50.0
PC Steel	100.0	0.0
Asphalt	10.0	90.0
Crusher	30.0	70.0

6) Engineering and Supervision Cost

The design cost is calculated under the assumption that international open bidding will be placed. Applying the ratio indicated by other projects in Egypt, the design cost is assumed to be 10% of the sum of the direct cost and indirect cost. Domestic and foreign currencies are each assumed to account for half of the total.

7) Contingency Fund

The contingency fund is generally divided into physical contingency and price contingency. The former is reserved for physical factors, such as discovery of unexpected obstacles or occurrence of unusual conditions that disrupt work. Price contingency is reserved for inflation during the construction period. In this estimation only physical contingency is taken into account, as price contingency is discussed in the financial analysis.

Referring to other projects in Egypt, and also taking into account the fact that the project has a high likelihood of encountering more than the usual number of problems owing to its implementation in an urban area, physical contingency is given as 10% of the sum of the direct cost, indirect cost and design cost.

8) Land Acquisition and Compensation Costs

For information on the unit cost of land and buildings, assessed values for tax purposes determined by the Egyptian Ministry of Finance and market values indicated by real estate advertisements are available. Although the assessed value is supposed to be reviewed every time a project is to be implemented, it is generally lower than the market value. Therefore, in this estimation, market values are used to calculate the costs of land acquisition and compensation payable to building owners.

9) Result of Cost Estimate

(1) Financial Cost

The total construction cost including land and building compensation costs are estimated at 3,312.6 million LE (Table 10.5.6), of which 39.6% or 571.0 million US$ is the foreign currency portion and 60.4% or 1,999.3 million LE is the local currency portion.

Table 10.5.6 Summary of Road Projects Costs

Project No.	Length (Km)	ROW (m)	Lane No.	AADT(2000) (pcu/d)	Financial Cost			Economic Cost		
					Foreign M.US$	Local M.LE	Total M.LE	Foreign M.US$	Local M.LE	Total M.LE
H001	2.30		4	86,246	22.0	23.5	74.1	22.0	19.3	80.0
H002	8.00		4	65,332	96.8	111.2	333.8	96.8	91.8	359.0
H003	7.30		4	76,600	84.5	93.5	287.9	84.5	77.1	310.3
Sub. Total	17.60				203.3	228.2	695.8	203.3	188.2	749.3
H101	4.10	50	8	124,925	9.0	54.1	74.8	9.0	51.9	76.7
H102	2.50		8	176,950	84.5	96.5	290.9	84.5	76.0	309.2
H103	4.90	40	6	53,530	8.5	51.6	71.2	8.5	49.4	72.9
H104	3.80	40	6	74,166	3.8	43.1	51.8	3.8	42.0	52.5
H105	5.50	40	4	39,924	4.5	51.9	62.3	4.5	50.2	62.6
H106	2.10	40	6	94,452	10.7	29.7	54.3	10.7	27.5	57.0
H107	4.30	40	6	47,927	10.1	48.0	71.2	10.1	45.5	73.4
H108	4.30	40	6	21,596	23.0	61.9	114.8	23.0	56.9	120.4
H109	8.30	40	4	26,922	65.7	144.9	296.0	65.7	128.5	309.8
H110	7.75	40	4	33,118	17.8	85.5	126.4	17.8	80.9	130.0
H111	12.70	40	4	16,381	28.5	139.4	205.0	28.5	132.0	210.7
Sub. Total	60.25				266.1	806.6	1,418.6	266.1	740.8	1,475.2
H201	3.00	20	4	51,072	4.6	28.8	39.4	4.6	27.8	40.5
H202	5.21	40	6	72,455	6.6	159.7	174.9	6.6	157.8	176.0
H203	5.30	20	4	60,437	18.4	64.1	106.4	18.4	60.4	111.2
H204	1.74	36	4	56,681	1.3	21.0	24.0	1.3	20.4	24.0
H205	4.10	26	4	40,149	2.7	4.7	10.9	2.7	3.9	11.4
H206	5.57	36	6	77,723	6.5	61.5	76.5	6.5	59.6	77.5
H207	4.02	30	6	49,005	17.9	31.2	72.4	17.9	26.9	76.3
H208	5.30	36	4	73,038	3.9	64.2	73.2	3.9	62.6	73.4
H209	0.60	20	4	25,481	0.3	3.0	3.7	0.3	3.0	3.8
Sub. Total	34.84				62.2	438.2	581.3	62.2	422.4	594.1
H301	4.20	40	4	87,099	3.4	81.7	89.5	3.4	80.4	89.8
H302	2.25	40	6	69,564	2.3	93.9	99.2	2.3	93.2	99.5
H303	3.00	45	6	28,369	8.1	20.9	39.5	8.1	19.0	41.4
H304	1.60	50	6	18,497	6.7	88.4	103.8	6.7	105.5	124.0
H305	4.96	40	4	49,291	6.8	17.7	33.3	6.8	17.4	36.2
H306	1.30	40	4	14,267	4.4	57.5	67.6	4.4	56.5	68.6
Sub. Total	17.31				31.7	360.1	433.0	31.7	372.0	459.5
H401	1.30	40	4	53,469	4.9	20.4	31.7	4.9	19.2	32.7
H402	1.30	50	4	46,698	1.2	67.1	69.9	1.2	66.5	69.8
H403	1.90	40	4	45,424	1.6	78.7	82.4	1.6	78.0	82.4
Sub. Total	4.50				7.7	166.2	183.9	7.7	163.6	184.9
TOTAL	134.50				571.0	1,999.3	3,312.6	571.0	1,887.0	3,463.0

Note: 1 US$ = 2.3 LE

The cost of the Expwys is 695.8 million LE or 21.0% of the total construction cost. The cost of Ring Road is 1,418.6 million LE or 42.8%, of which 290.8 million LE or 20.4% is for the Nile River Bridges in the south. The remaining costs are for the construction of surface roads in Cairo (581.3 million LE or 17.5% of the total), Giza (433.0 million LE or 13.1%) and Qaliubiah (183.9 million LE or 5.6%) Governorates.

The land and building compensation cost reaches 68.2% of the total construction cost in the case of the surface roads, excluding the Ring Road which passes through agriculture area.

(2) Economic Cost

The total economic cost is estimated at 3,463.0 million LE, which is 4.5% higher than the total financial cost, because of the shadow exchange rate.

10.6 Priority of Road Projects

1) Procedure of Priority Ranking

The priority of projects should be studied taking into consideration the following elements:

a. Effect on decreasing traffic congestion in entire road network
b. Cost performance of projects from the economic standpoint
c. Convenience for road users
d. Financial influence for the executing agency
e. Influence to communities
f. Project consensus
g. Fitness with policy
h. Ease of implementation
etc.

Some of these elements can be quantified while for others it is difficult. Therefore the Study focused mainly on the cost performance and benefit scale of projects. A project is considered to have high priority when it has good benefit scale and cost performance; otherwise, the project should be studied in further detail taking the other elements into consideration. A detailed explanation of benefit and cost is given below.

2) Factors for Calculation

(1) Annual Benefit of Project

The benefit of road projects is defined as the vehicle operating cost (VOC) saving in terms of economic price. The VOC saving could be calculated as either:

a. the difference between the total VOC in the Do Nothing Case and of that in the case where a project is executed, or

b. the difference between the total VOC in the case where a project in the Masterplan network will not be executed and the total VOC in the Masterplan network.

The VOC saved is expressed as the total VOC decrease in case a. above and the total VOC increase in the case b. The study aims to measure the influence of a project to the Masterplan network, therefore the latter method is adopted to calculate the benefit.

To compare the benefits of the projects, the benefits of each project in one year, the year 2000, are calculated so as to eliminate the influence by the variance of the implementation schedule.

(2) Project Cost

The construction cost of a project should be expressed on an annual base to calculate B/C of a project in the year 2000. For this purpose, the formula to make annual repayment of principal and interest in one rate for 25 years, at an annual interest rate of 12% is applied. The annual repayment rate is calculated at 0.1275 times the principal. Residual values of the road at the 25th year are neglected.

(3) Cost Benefit Ratio (B/C)

The cost benefit ratio was selected to represent the cost performance of a project. The benefit in the year 2000 and the cost in the same year calculated following the procedure given above was applied to obtain the B/C ratio. The economic cost of the project was applied for the calculation.

3) Project Grouping

The scatter graph in Fig. 10.6.1 shows the relationship between B/C and B-C of the projects. The projects can be classified into four groups based on Fig. 10.6.1:

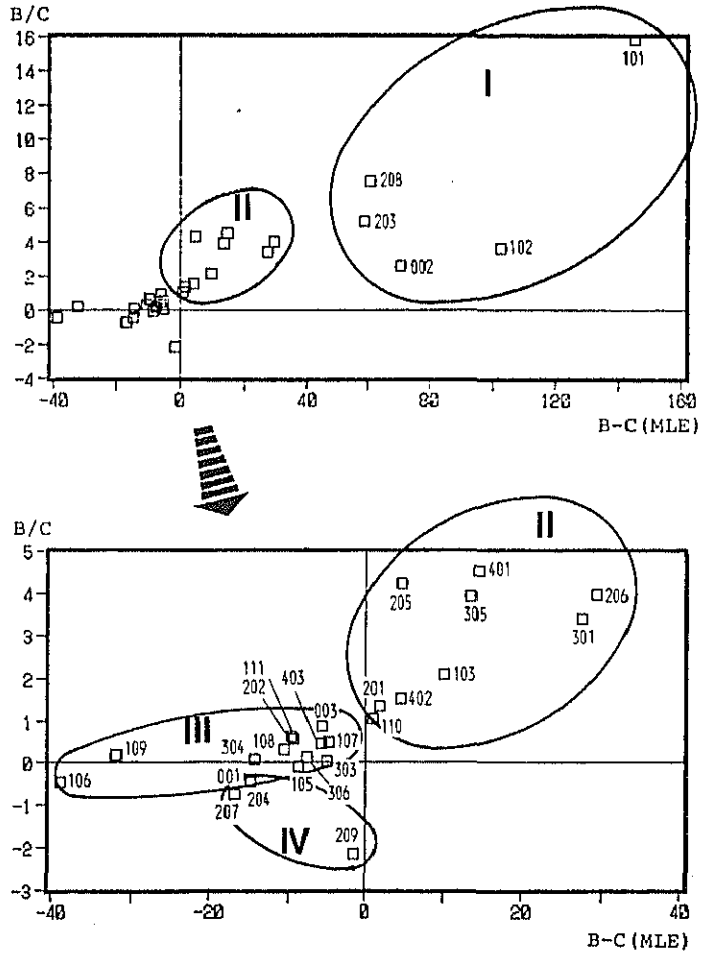


Fig. 10.6.1 Project Groups (Benefit by VOC)

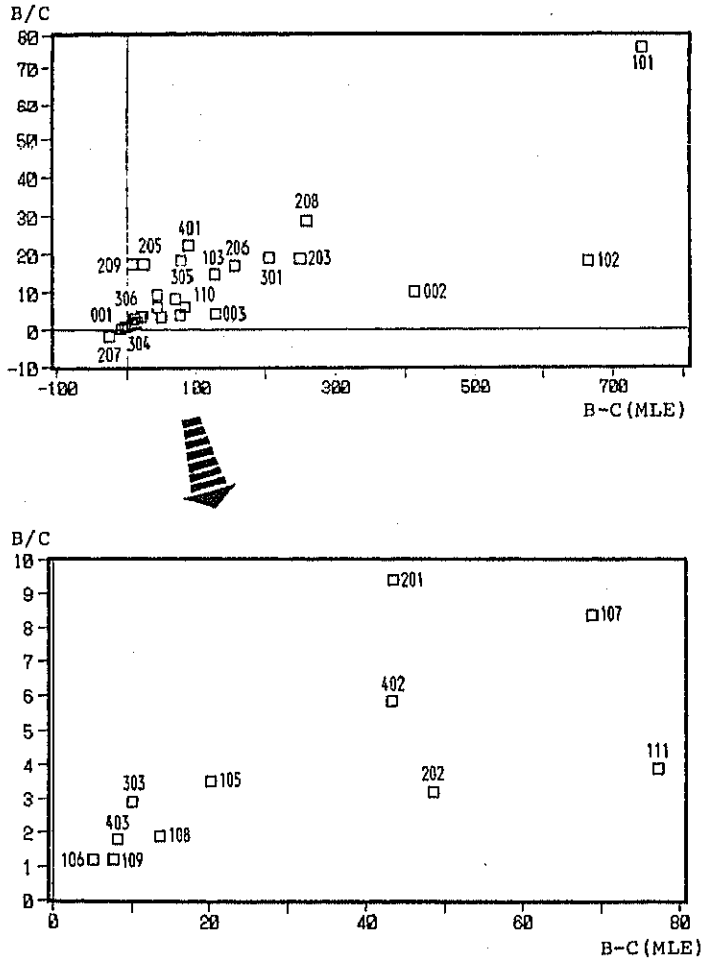


Fig. 10.6.2 Project Groups (Benefit by VOC and Passenger Time Saving)

I. the group with high B-C value and B/C ratio
II. the group with low B-C value and B/C ratio
III. the group with negative B-C value and low B/C ratio
IV. the group with negative B-C value and B/C ratio

In the case of groups III and IV, the project scales are smaller than the others, so the benefit from these projects tends to be influenced by the condition of other project links.

The benefit in Fig. 10.6.1 is derived from the VOC saving of the vehicles only, however the benefit which includes the passenger time saving of the vehicles is shown in Fig. 10.6.2, where almost all the projects show high B-C and B/C values.

It is noted that the benefit in this calculation is derived from VOC increase by the canceling of the project from Masterplan network, and the benefit derived from VOC decrease by the adding of the project to Do Nothing case will show a different value.

Therefore Sekket Al Wayli project (No. 207) shows a negative B/C ratio in the graph, because in the Masterplan network, an alternative circular route connected directly to Rod Al Farag br. exists (Rod Al Farag st. improvement and construction, No. 204) and logically, this route provides a more convenient route than Sekket Al Wayli st. However, if only Sekket Al Wayli st. is constructed (this case would be more practical), much traffic will turn into Sekket Al Wayli st. and this project will have more benefit.

Group I, which shows a high benefit scale and cost performance, contains the southern route of the Ring Road (101) including the Nile river bridge (102), Expwy 2 (002), Rod Al Farag st. improvement and construction (203), and Ahmed Said st. extension in the Ain Shams area (208).

Group II, which shows a low benefit scale and low cost performance, contains:

a. Ring road south Nile bridge to Autostrade (103) and section in Shubra Al Kheima (110)
b. Giza North - South road (301)
c. Rod Al Farag st. western approach (305)
d. Salah Salem - Sayedah Zeinab sq. street (201)
e. Ahmed Said st. improvement and its extension into Ain Shams area (206, 208)
f. Ahmed Helmi st. improvement (205)
g. Shubra Al Kheima North-South and East-West streets construction (401 and 402)

Expwy 3 (003), and Kamel Sidky st. (202) were classified in Group III. Most of the access streets from Sudan st. to the Ring Road's western arc passing over the ENR line (303, 304, 306) were classified in this group because of the existence of the Giza North-South road in the Masterplan network.

4) Priority Ranking

The priority ranking of the projects was made by taking the project's present status and its social aspects into consideration, in addition to the priority ranking by the benefit scale and cost performance.

(1) Present Project Status

The present project status was classified into four categories:

a. The project is on-going
b. Preparatory works have been done
c. The project has been planned
d. No action has been taken

The projects for the southern and northern sections of the Ring Road were classified as "on-going" projects. The western arc of the Ring Road was classified at the "preparatory works" level.

(2) Social Aspects

Concerning social aspects, the extent of demolition of houses and buildings was used to judge the projects priority. Projects were classified into the following three categories:

a. There is no problem
b. There is a problem which can be solved
c. The problem is serious

Most of the new streets projects within the built-up area of Cairo governorate were classified into the "serious problem" category. The elevated road projects were classified into the "solvable problem" category.

(3) Comprehensive Priority Ranking

The comprehensive priority ranking was made by assigning scores according to the categories in each aspect, and after totaling the scores, the comprehensive priority ranking was calculated. Table 10.6.1 shows the priority ranking of the projects. The comprehensive priority ranking was given in the range of one to five, with one showing the highest priority and five showing the lowest.

Shubra st. (204) was classified into category five from the view point of the road network. However the widening of Shubra st. will allow the construction of Urban Metro No. 1 by the cut-and-cover method; this will reduce the construction cost of the metro originally planned by shield driving method due to the narrow width of the street. Moreover, if the metro is not introduced by the year 2000, the improvement of tram line will be required on the street with the inevitable widening of the street.

On the contrary, Ahmed Helmi st. (205) was classified into category two, however the improvement of the street requires the removal of the existing tram line, which is one of the proposals in the Study only under the condition that the urban commuter service on ENR line will substitute the function of the existing tram line on Ahmed Helmi st. Therefore, the improvement of Ahmed Helmi st. can be recommended only after the introduction of the urban commuter service into ENR line. The improvement of Ahmed Helmi st. requires the improvement of the long distance bus terminal as well.

Fig. 10.6.3 shows the accumulated cost of the projects following the order of the priority ranking in terms of financial price. The total project cost up to the priority ranking three is 2,030 million LE or 61% of the entire total. Therefore, if the budget is limited to 2/3rd the total, the project to be canceled

should be discussed among those in the four or five category ranking. These projects are marked by asterisk marks in Table 10.6.1. Kamel Sidky st. (202) and Shubra st. (204) remain in the projects group to be executed, despite of their ranking of five, in view of their relationship with other projects such as Urban Redevelopment Project and Urban Metro No. 1.

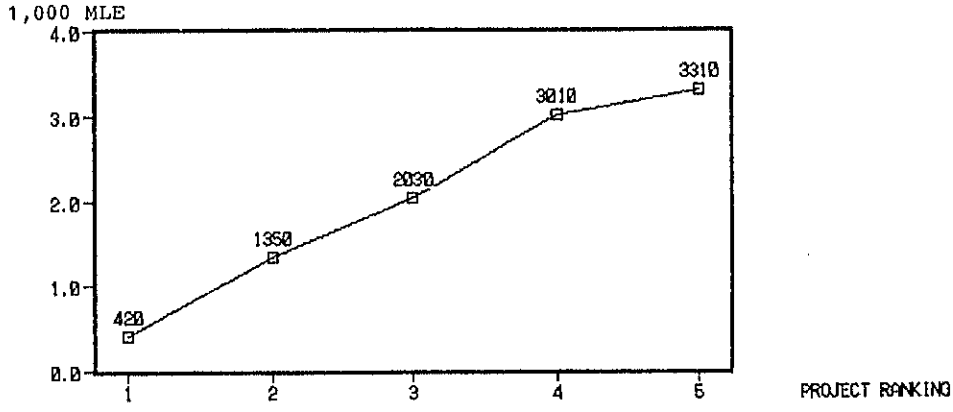


Fig. 10.6.3 Accumulated Cost of the Projects

Table 10.6.1 Comprehensive Priority Ranking

Case	Financial Cost M.LE	Ranking B-C & B/C	Project Status	Social Aspect	Compre-hensive	Masterplan (Yr 2000)
H001	74.1	4	2	1	3	
H002	333.8	1	4	2	3	
H003	287.9	3	4	2	4	*
H101	74.8	1	1	2	2	
H102	290.9	1	1	1	1	
H103	71.2	2	1	2	2	
H105	62.3	3	2	1	2	
H107	71.2	3	2	1	2	
H108	114.8	3	2	1	2	
H109	296.0	3	3	2	4	*
H110	126.4	2	1	1	1	
H111	205.0	3	1	1	2	
H201	39.4	2	4	3	5	*
H202	174.9	3	3	3	5	
H203	106.4	1	4	3	4	*
H204	24.0	4	3	2	4	
H205	10.9	2	3	1	2	
H206	76.5	2	3	3	4	*
H207	72.4	4	2	2	4	
H208	73.2	1	4	3	4	*
H209	3.7	4	4	2	5	
H301	89.5	2	4	3	5	*
H303	39.5	3	2	3	4	*
H304	103.8	3	2	1	2	
H305	33.3	2	2	2	3	
H306	67.6	3	2	1	2	
H401	31.7	2	2	2	3	
H402	69.9	2	2	1	2	
H403	82.4	3	2	1	2	
H601	205.3	3	2	2	3	
TOTAL	3312.8					2304.4

Note: Project Status
1 On-going
2 Preparation
3 Planned
4 No Action

Social Aspect
1 No Problem
2 To be solved
3 Difficult

11 Public Transportation Plan

11.1 Demand Structure

1) Total Demand

The public transport demand in 1987 and future demand in the year 2000 are shown in Fig. 11.1.1, in the form of assigned passenger demand on spider networks. The total public transport demand in the year 1987 was 4 million trips per day and is estimated to increase by 1.6 times to 6.5 million trips per day in the year 2000. The characteristics of the different demand structures by direction are described below.

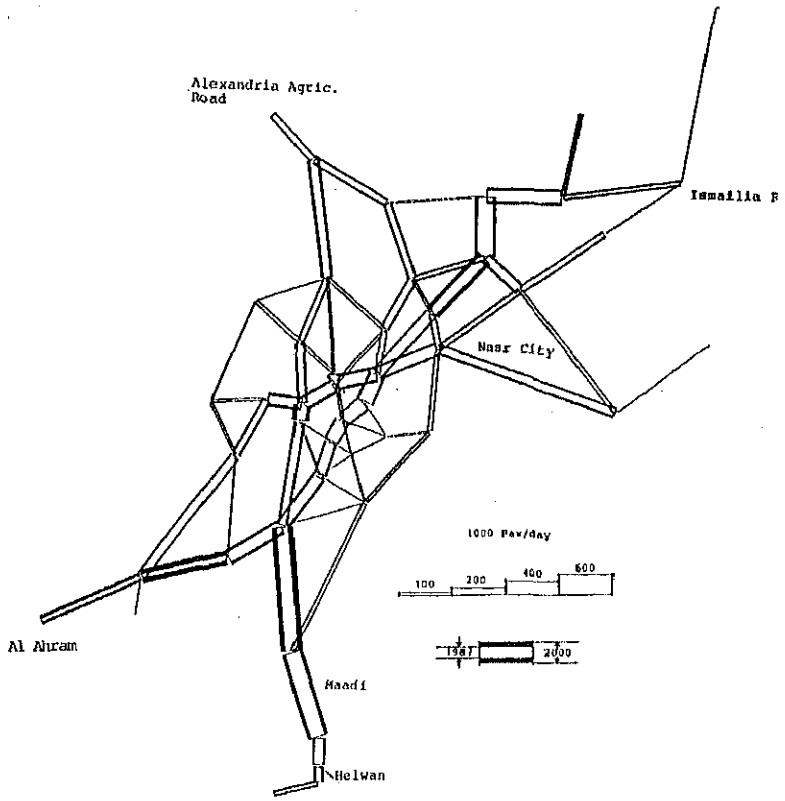


Fig. 11.1.1 Public Transportation Demand in 1987 and 2000 assigned to Spider Network

2) Demand Structure at Intermediate Ring Road Sections (1987)

Fig. 11.1.2 shows the 1987 public transport volume by mode fanning out in a radial direction from the intermediate Ring Road. The largest traffic (612 thousand person trips) was at cross section A (Heliopolis direction). Regular size buses carried the major burden, followed by taxi. The fact that a large volume was transported by taxi indicates a high standard of living in the Heliopolis area. The Regional Metro line (Al Marg line) and Heliopolis Metro line transported around 60 thousand passengers each. The small volume transported by microbus shows

the existence of sufficient CTA bus service network. CTA Tramway (Port Said line) transported 24 thousand person trips.

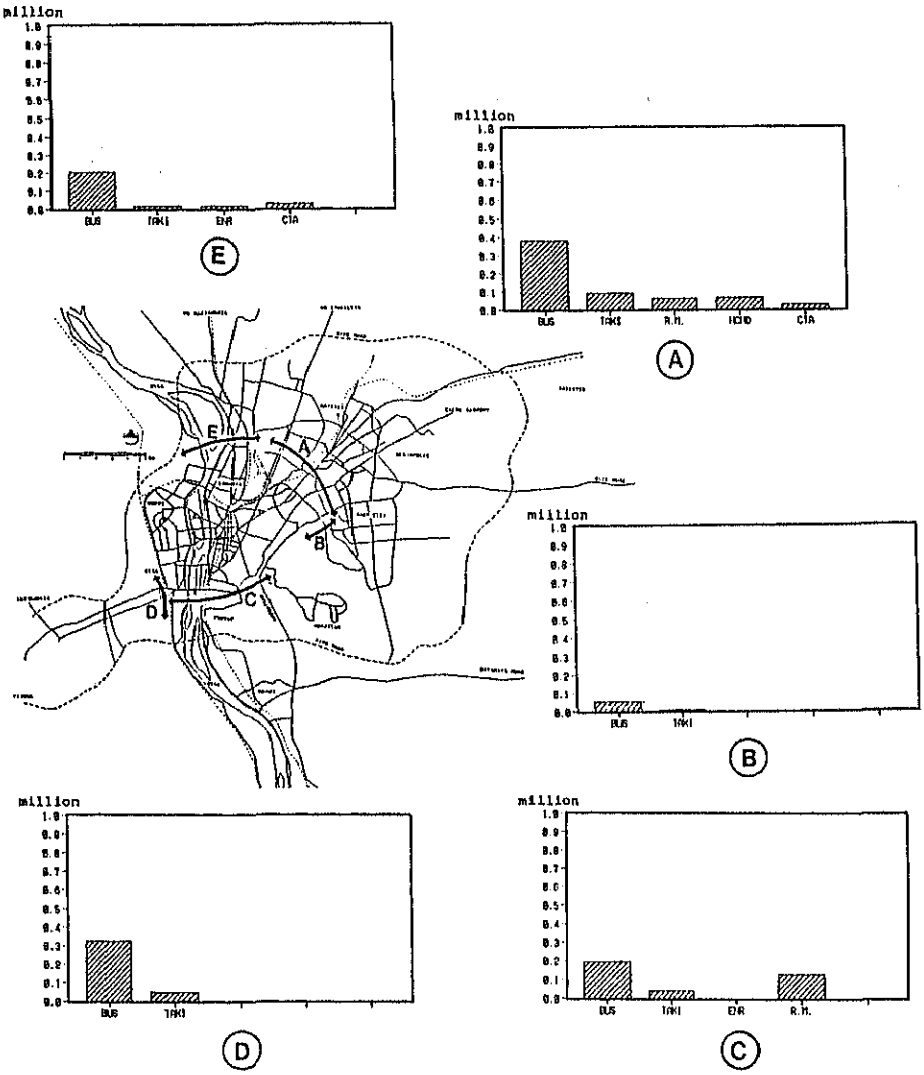


Fig. 11.1.2 **Public Transportation Demand in 1987 at Cross Sections**

The second largest traffic volume of 369 thousand was recorded at cross section D (Giza direction). Although CTA buses transported 60% of the traffic, the 37% share of microbus and taxi reflects a poor CTA bus network.

Traffic along cross section C (south bound to Maadi, Helwan) closely followed cross section D with 360 thousand. At that section the Regional Metro line transported 127 thousand passengers, which was almost equivalent to the number of passengers transported by the CTA buses.

Cross section E (north bound to Shubra Al Kheima) had a relatively small traffic of 259 thousand persons. Because of

insufficient CTA bus network, microbuses and taxis transported 75 thousand passengers compared to 141 thousand by CTA buses. Share of microbus transport was significant at cross sections D and E.

Cross section B recorded a very small traffic volume and is well served by the CTA bus network.

3) Demand Structure at Intermediate Ring Road Section (2000)

Fig. 11.1.3 shows the projected transport volume (person base) in the Do-Nothing case up to the year 2000. Regular size buses shall be burdened by the increase in passengers. Meanwhile, the Regional Metro is not expected to efficiently cope with the increase in demand at cross sections A and C. The reasons for this shall be examined in section 11.10 of this chapter.

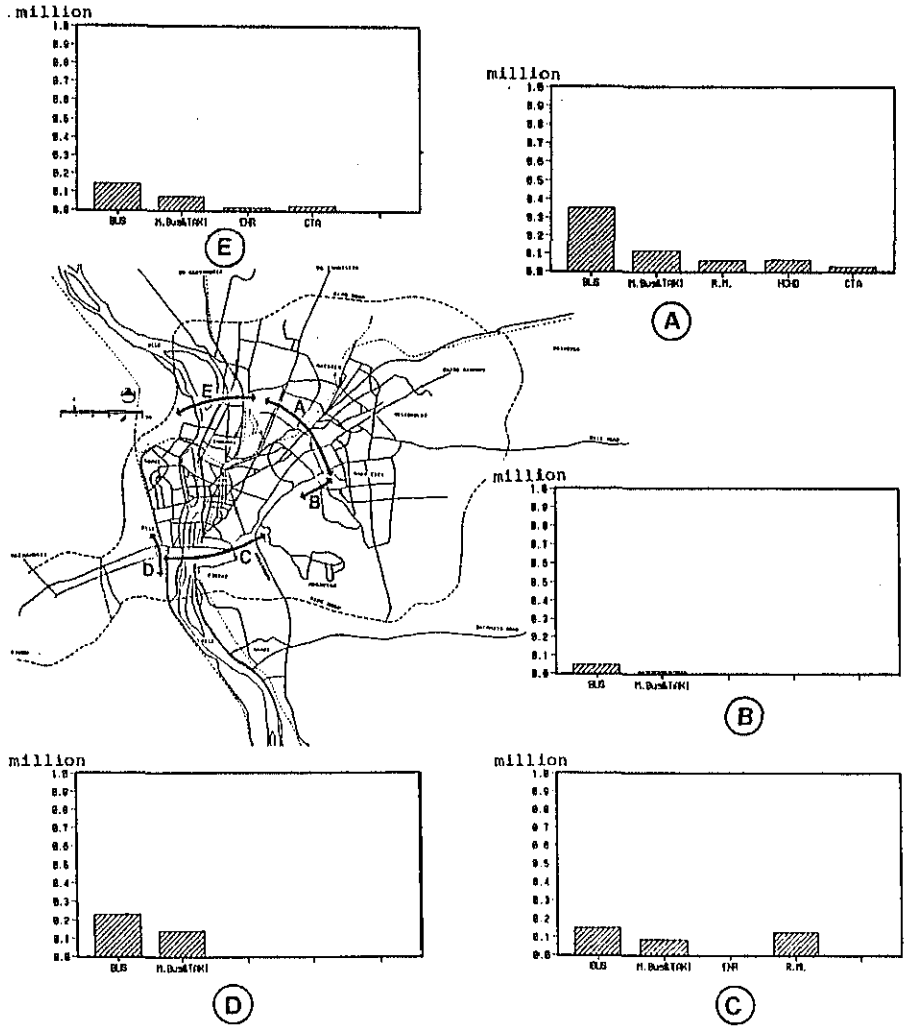


Fig. 11.1.3 Public Transportation Demand in 2000 at Cross Sections (Do Nothing Case)

11.2 Fundamental Countermeasures

1) Demand at Cross Section A and Alternative to be Adopted

Demand at cross section A shall be 1,243 thousand persons (Table 11.2.1). Passenger capacity of regular size buses running on 6 main roads is 960 thousand. One practical problem is that the 6 main roads at cross section A decrease in number towards the central area of Cairo. This means that at most only 4 roads can be selected for bus transport. Meanwhile three rail systems exist at this cross section; the Regional Metro line (Al Marg line at present), Heliopolis Metro line and Port Said line (CTA tramway).

Table 11.2.1 Selected Policy

(unit: 1000 passengers/day)

Cross Section	Demand 2000	Transport Capacity							
		Bus and Taxi (1) 1987	Increase of Bus	New Rail	ENR	Regional Metro	Heliopolis Metro	CTA Tram	Balance
A	1243	455	0	0	0	666	180	120	178
B	140	59	81	0	0	0	0	0	0
C	847	231	0	0	2	666	0	0	52
D	581	368	80	343	0	0	0	0	210
E	564	218	0	343	1	0	0	12	10

Note (1): Bus includes regular, mini, and micro sizes

The road Masterplan proposed the construction of one elevated expressway from Heliopolis via Khalifah Al Mamoun st., Abbasseya sq., Gueish st., Port Said st., and passing over old Cairo area to Giza (Chapter 10). This is the only new road proposed in the area.

Such circumstances suggest the need for adopting the combined policy of improving both bus and rail systems.

No new road development is proposed in this cross section in the Masterplan, therefore it is assumed that bus and taxi transport capacities shall not increase in the future. Subsequently, bus and taxi transport capacities are fixed at the 1987 levels and the burden of increased demand must be placed on the Regional Metro line, Heliopolis Metro line and Port Said line (CTA tram). The maximum planned transport capacity of the Regional Metro line is 60 thousand/hour/direction while the peak hour rate was measured as 0.18 from the home interview PT survey. Therefore the planned daily transport capacity is considered as 666 thousand. At present Heliopolis Metro lines are operating as tramways. The modernization of a principal line (Ramses-Roxi-Nozha) shall give a capability of 4 minutes headway operation with 6-car train formation. A train can transport 1,080 passen-

gers at section, with a total of 180,000 passengers transported daily. Port Said line shall continue to operate as a tramway but some modernization of tracks, fences to segregate tracks from other traffic, and signalization to give priority to the tramway shall be implemented. As a result of such improvements, a transport capability of 120 thousand passengers shall become available with 4-car train formation (loaded 720 passengers) and 4 minutes headway operation.

Balance of demand and supply by the said proposal shows a supply surplus of 178 thousand. This surplus may be adjusted through changes in headways of the three rail systems corresponding to transport demand along the line.

2) Demand at other Cross Sections and Alternatives to be Selected

Increase of traffic demand at cross section B shall be 81 thousand persons. This increment shall be easily handled by addition of buses to bus fleet.

Cross section C requires a transport capacity of 847 thousand persons in the year 2000. Transport capacity of buses and taxis at present is 231 thousand. Of the four main roads; Corniche east, Corniche west, Salah Salem, and Autostrade Road, only the Autostrade can accommodate more bus traffic however it is not connected with Cairo CBD. Increase of bus transportation along the Autostrade might not be a good solution for "To Work" trips. As mentioned before, the newly developed Regional Metro line can accommodate 666 thousand trips, therefore the difference in demand in 2000 and transport capacity of buses and taxis of 616 thousand may be accommodated by the Regional Metro line.

There are only two main roads in cross section D; King Faisal and Ahram roads. Due to the road network improvement plan, one more trunk line, composed of Ring Road (Project 106) and Sarwat st. extension (Project 302) shall become available for bus transport use in 2000. A bus transport capacity increase of 80 thousand passengers can be expected assuming 80 passengers /bus with headway of 40 seconds and peak hour rate 0.18. Accordingly, total bus transport capacity is estimated as 448 thousand. Although this capacity is remarkably large there is still a shortage of 133 thousand. Proposed is the Regional Metro Giza branch plan which branches from Mary Gergis sta. of the Regional Metro line to the Giza Pyramids direction along the Ring Road proposed right of way. The track is at some distance from the built-up area at present but is located in an area where the population is likely to rapidly increase in the near future. This rail system has enough capacity to cover the shortage in capacity mentioned above.

Corniche, Shubra, and Ahmed Helmi roads are located in cross section E, and no additional development of road network is proposed there in this Masterplan. Therefore it is assumed that

there will be no increase of road use type transportation capacity. Demand in 2000 is projected to become 564 thousand of which 218 thousand shall be transported by buses and taxis. The remaining 346 thousand can only be accommodated by rail systems.

The Urban Metro No. 1 line has enough transport capability to meet the deficit in demand.

3) Fundamental Countermeasures

It is clear from the discussions introduced in the preceding two sections that the following fundamental countermeasures are needed to cope with the demand in 2000:

a. More effective use of the Regional Metro line
b. Upgrading of Heliopolis Metro line; Ramses-Roxi-Nozha section
c. Construction of Urban Metro No. 1
d. Construction of Regional Metro Giza branch

These countermeasures are conceived from the physical point of view to accommodate demand in 2000. Their justification shall be examined from the economic point of view in the following sections.

11.3 Basic Requirements of the Public Transport Services in GCMR

The requirements for improving the quality of the public transport service at present in GCMR and the guidelines to formulate the public transport structure are described hereinafter.

1) Software

(1) Increase Speed of Public Transport

Increasing the speed of the tramway transit mode can be achieved by:

a. Classifying the existing railways into trunk lines and feeder lines.
b. Securing the exclusive right-of-way for trunk lines.

Increasing the speed of the bus transit mode can be achieved by;

a. Defining trunk bus routes among the existing routes.
b. Introducing exclusive bus lanes for the trunk bus routes.

(2) Upgrade Service Level

a. Increase of Transport Capacity

From the viewpoint of passenger convenience, a transit mode with high speed, less headway, and high capacity can provide high quality service.

b. Improvement of Punctuality

For most work and business trips, punctual operation would be one of the most attractive factors. Although it would be difficult to require punctual operation for all public transport, at least the trunk line transit could provide punctual and scheduled operation if given exclusive right-of-way.

c. Improvement of Feeder Service

Microbuses and taxis provide relatively cheap feeder service at present. Therefore the continuation of such services is recommended, together with the rerouting of CTA bus routes in order to provide dense feeder services to public transport trunk lines and encourage their utilization.

d. Upgrade Interior Quality and Service

The introduction of deluxe buses with secured seating and air-conditioning would be another solution for those passengers who do not worry about travel time. The maintenance of clean lines and pleasant conditions inside the vehicles through daily short-time maintenance and cleaning works before the vehicle is returned to the depot, would also ensure passenger attraction.

(3) Restrain Additional Cost

According to the PT survey, the percentage of Regional Metro users who did not have to transfer to other transport modes to reach their destination was the lowest compared to other modes, at 59%. The figures for other transport modes were; bus (89%), minibus (89%), microbus (99%), tram (87%) and Heliopolis metro (73%).

Transferring to other modes requires additional payment and waiting time, and the introduction of trunk line services into the public transport system would require more transferring. Therefore, convenient and easy transferring with no additional cost, and a minimum waiting time at suitable facilities would be required.

To avoid the cost increase when transferring and consequently to encourage the utilization of the trunk line transit, the introduction of a discounted continuous ticket system between the different lines and modes shall be proposed.

2) Hardware

The proposals described above mostly contain that of software and can be implemented through day-to-day operation without a large amount of investment; however the Masterplan focuses mainly on the improvement of hardware on the trunk line transit so as to create the possibility of improving software at any time.

(1) Association with Existing Projects

The existing public transport projects are;

a. Regional Metro Phase II (Mubarak sta. - Al Marg sta.)
b. Urban Metro No. 1 (Shubra - Boulaq)
c. Urban Metro No. 2 (Darassah - Embaba)

The 2nd phase of the Regional Metro is underway at present and will be completed by March 1989; therefore, this project is considered as an existing line.

NAT is preparing a tender call for an engineering study for Urban Metro No. 1 project. The Masterplan will follow the idea of NAT in general but with slight modifications on the route or on the implementation schedule when needed.

Regarding Urban Metro No. 2 project, difficulties exist such as the method of passing under the narrow Azhar st., and under 26th July br. Some route modification shall be considered.

Other than the abovementioned projects, current small scale projects are not included in the "existing projects" since they hardly influence the Masterplan.

(2) Maximum Use of Existing Facilities

Much investment has been spent on the urban transport facilities in GCR, some of which are in a state of deterioration, however most can be rehabilitated for use with additional investment. But it is feared that new investment for transportation facilities, especially in the already built-up CBD area will be difficult.

Therefore, emphasis should be put on the maximum utilization of the existing public transportation facilities. The important existing facilities are the rail transit facilities including ENR, CTA tram lines, Heliopolis Metro lines and Regional Metro line.

11.4 Subway Plan (Regional Metro and Urban Lines)

1) Planning Policy

As outlined in sec. 11.2 of this chapter, the framework for the public transport plan is the Regional Metro, Urban Metro No. 1, Regional Metro Giza branch, and upgraded Heliopolis Metro lines. NAT's planned route for Urban Metro No. 1 line starts at Shubra Al Kheima, passing through Ramses sq., Attaba sq., and Tahrir sq., crossing the Nile river, and arrives at Boulaq Al Dakrour finally terminating at ENR Giza sta. The line has been planned to be constructed in two stages:

1st stage : Shubra Al Kheima to Tahrir sq.
2nd stage : Tahrir sq. to Giza sta.

This alignment serves major traffic between the north of Cairo, through the CBD, to Giza, and thus the major activity centers in GCMR will be directly connected with each other.

The Regional Metro Giza branch also serves traffic between Giza and Cairo CBD, with its route branching from the Regional Metro line at Mary Gergis sta. and extending to the Pyramids area along the Ring Road. The route is at some distance from King Faisal and Ahram roads, but the area along the route is being rapidly developed for residential use.

2) Urban Metro Line No. 1 (R001 and R002)

(1) Concept

The Urban Metro Line No. 1 will be constructed as a solution to the congested traffic conditions on Shubra st. and in the CBD, and to the shortage of public transportation systems crossing the Nile river. The line is planned to have a maximum capacity of 343 thousand passengers/day or 62 thousand passengers/peak hour.

a. Route Location

The starting point of Urban Metro No. 1 is located east of the existing ENR Shubra sta., facing Shubra Al Kheima sq. and is a major inter-modal point with a bus terminal. Land for car depot has been secured nearby (Fig. 11.4.1).

After crossing the Nile river, the route is planned to go straight in the west direction along Tahrir st. up to Boulaq Al Dakrour sta. of ENR. Recently NAT decided to extend this line as far as ENR Giza sta. along Sudan st.

Considering this extension, this line could be planned to go south-westward, instead of southward, crossing ENR line and in parallel with King Faisal st. and Ahram st. in order to serve the expanding public transport demand along the Ahram corridor. In this case, the line had better take its route, after crossing the

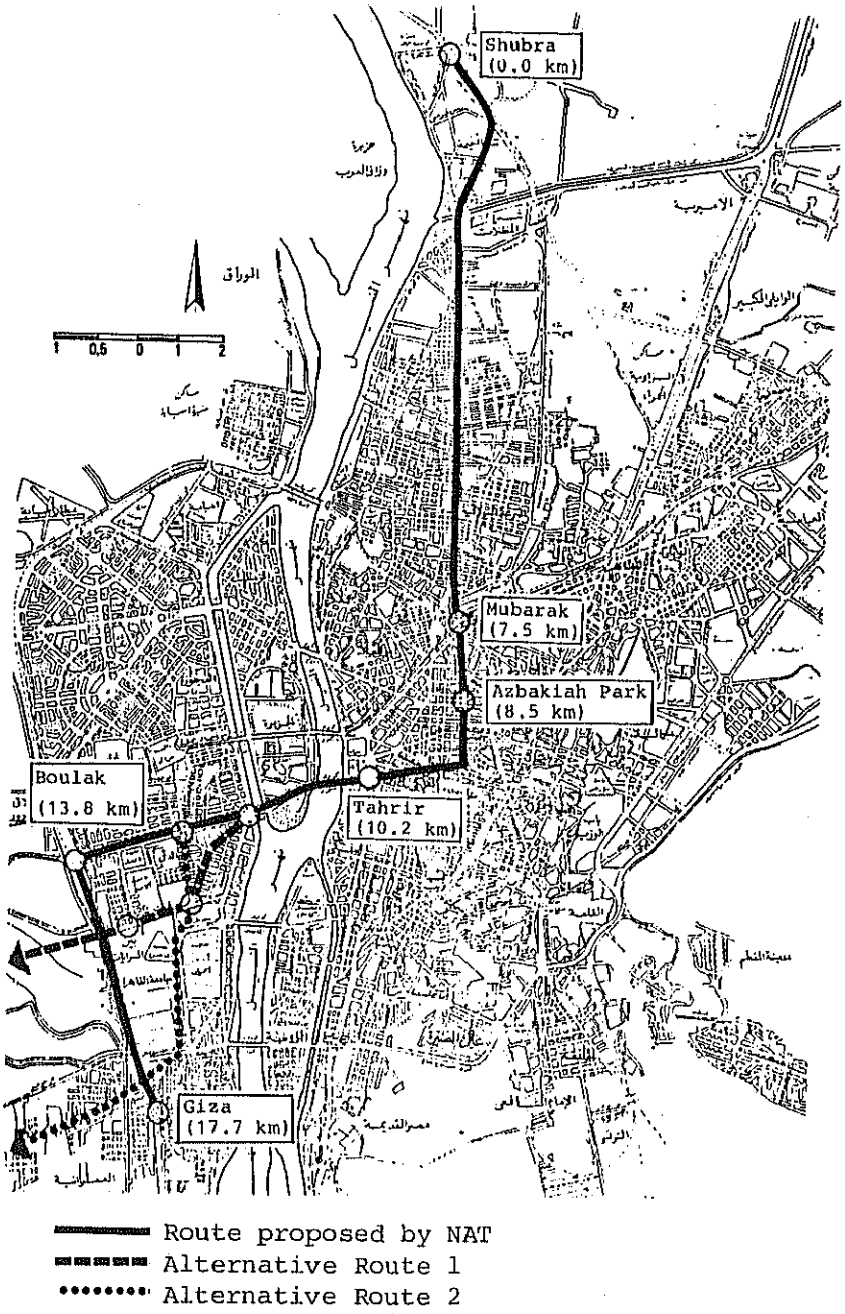


Fig. 11.4.1 Route of Urban Metro No. 1

river, along Mesaha st. and Abdel Salam Aaref st. for two reasons; to serve the trips to and from Cairo University where more than 80,000 students are studying, and secondly to economize the construction cost by crossing ENR line at about one kilometer south of Boulaq Al Dakrour sta. where the right-of-way of ENR becomes narrower.

From the viewpoint of maximizing the demand for this line, another alternative route is suggested; running under Tahrir st., turning south at Dokki sq., taking Dokki st., Gamaat Al Qahera

st. passing in front of Cairo University and along Ahram st. down to its end. This route may be the most favorable in terms of demand but its cost will also be the highest among the alternatives.

As explained above, many alternative routes can be considered for phase 2 of Urban Metro No. 1. In this Study the line will be tentatively terminated at Cairo University sta. and further extension will not be discussed.

Locations of major stations are:

(a) The Regional Metro's Mubarak (Ramses sq.) and Sadat (Tahrir sq.) stations, both of which have been built to accommodate Urban Metro No. 1 line.
(b) Azbakiah Park in the CBD, where a station can be easily built.
(c) Cairo University, where passenger attraction, including university students, will be high.
(d) Giza ENR station, which is the center of Giza city and a point where traffic concentrates.
(e) West side of ENR line, where new residential area is being developed, and a large volume of passengers can be expected.

b. Planned Transport Capacity and Opening Schedule

The maximum planned transport capacity is set at 343 thousand passenger/day or 62 thousand passenger/peak hour from cross section analysis. Because this line is considered as a fundamental countermeasure to accommodate the traffic demands to both Shubra and Giza directions, it would be desirable to open the entire route at once. However, if the considerable size of investment required makes it unfeasible to do so, the partial opening, starting from the Shubra end where land for the car depot has been secured, is proposed. In this case, the route will pass through the CBD and terminate at Sadat sta., which is convenient for linkage with other transportation systems.

(2) Operation Plan

The operation plan outlined in Table 11.4.1 is established on the basis of the peak-hour demand given in section 1) Concept, and on the train configurations given in Table 11.4.2. The layout of the tracks based on this operation plan is shown in Fig. 11.4.2.

One-way maximum transport demand per peak hour by section in the year 2000 is estimated at 31 thousand passenger/hr. The number of trains required is 11. At a pitch of 4 min., it takes 20 minutes to travel the 10.2 km from Shubra to Sadat stations. The number of cars required for this is 8 per train, plus one reserve, or a total of 96 cars (partial opening case).

Table 11.4.1 Operation Plan of Urban Metro No. 1

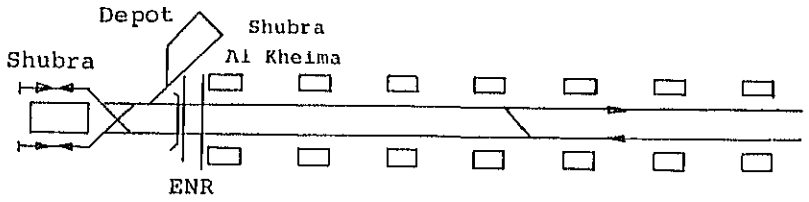
	Item	Unit	Plan
1	Max. Speed	km/h	80
2	Scheduled Speed	km/h	30
3	Min. Headway	min	2.5
4	Train Formation	cars	8
5	Max. Passenger	pax/train	2,050
6	Service		local

Source: Ministry of Transport

Table 11.4.2 Configuration of Urban Metro No. 1

No.	Description	Unit
1	Electric Power Supply	DC Aerial
2	Train Formation	8 cars
3	Max. Speed (with full load-km/h)	80 km/h
4	Tare Weight (t)	270 t
5	No. of Passengers	
	Seated	304 persons
	Standing	1752 persons
6	Dimensions of Car Body (LxW)	
	Driving Car	17.3m x 2.69m
	Middle Car	17.3m x 2.69m
	Height of Floor Level	1100 mm
7	Acceleration and Deceleration	
	Acceleration (maximum)	0.9 m/s
	Deceleration (normal)	0.9 m/s
	Deceleration (emergency)	1.1 m/s
8	Train Length	138 m
9	Total Train Weight	2283 t
10	Commercial Speed	30 km/h

Source: Ministry of Transport



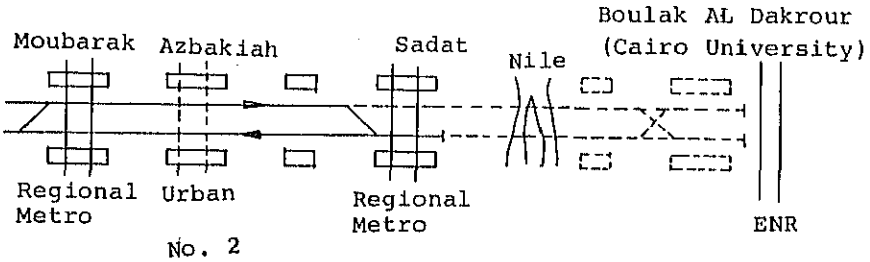


Fig. 11.4.2 Track Layout Sketch

The same calculation for the full opening case (Shubra-Cairo Univ.) requires 15 trains plus two reserve, or a total of 136 cars.

(3) Construction Works

a. Engineering Works

In the area where heavy traffic is expected, the construction method shall be selected with the first consideration towards minimizing interruption to the traffic flow, and then to economy. Therefore, the double-track shielding method (Fig. 11.4.3) was adopted within CBD to maintain the present traffic flow and the environment in the commercial area.

The cut and cover method (Fig. 11.4.4) was adopted in the southern section from Rod Al Farag st. to Shubra st. where 40 m ROW has been established by the city ordinance and widening is underway.

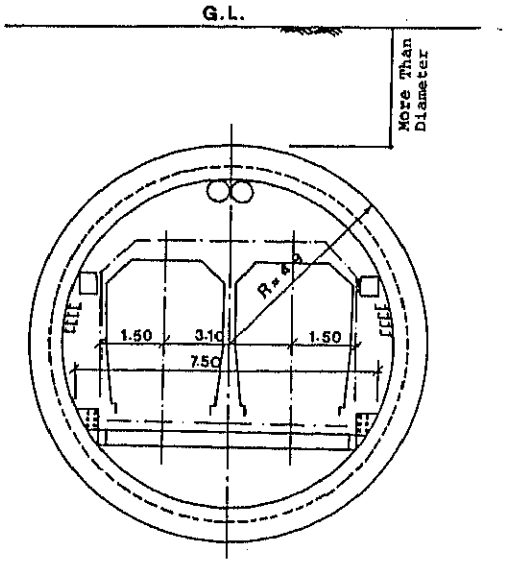


Fig. 11.4.3 Standard Cross Section (Shield Tunnel)

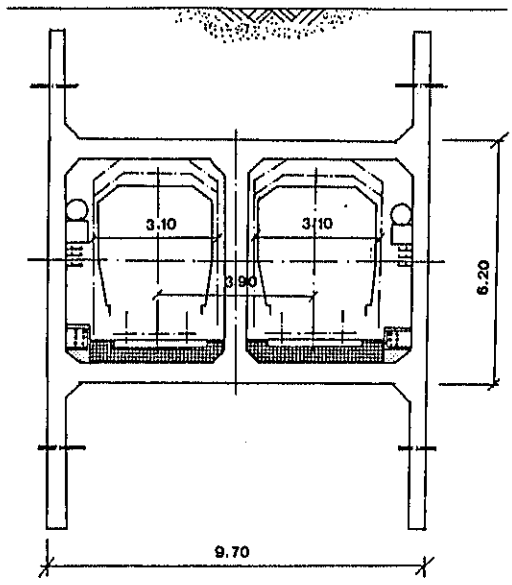
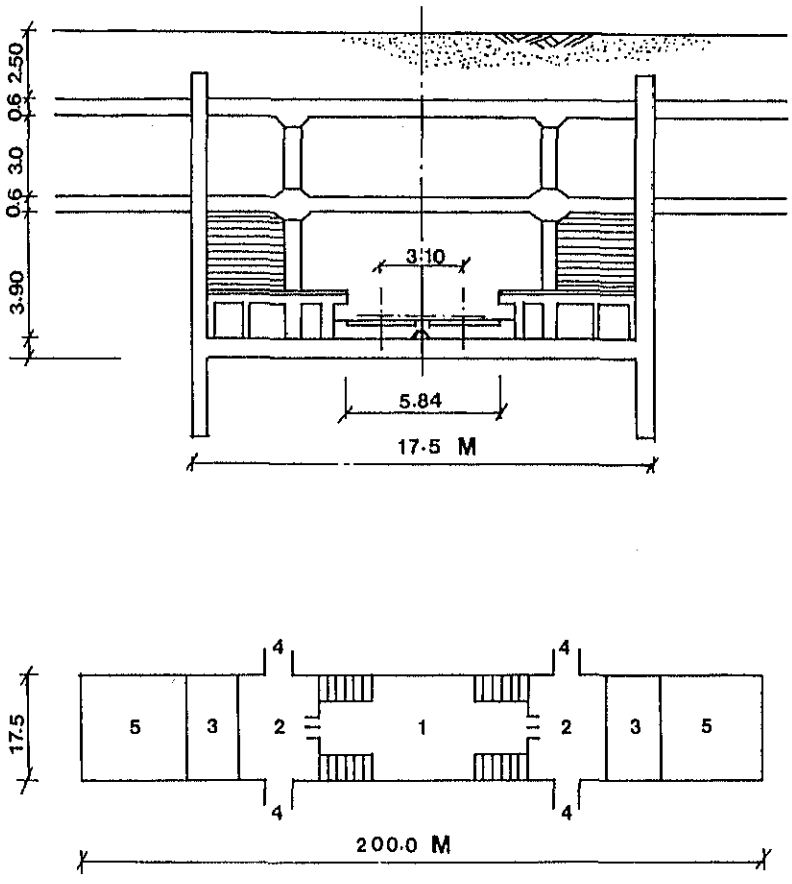


Fig. 11.4.4 Standard Cross Section (Cut & Cover)

The cut and cover method was also adopted to construct underground stations (Fig. 11.4.5) applying a continuous in-situ wall. The preliminary profile of Urban Metro No. 1 is shown in Fig. 11.4.6. The shielding method is adopted for the section from Mubarak sta. (Ramses sq.) to Mesaha sta. in Giza. The maximum. gradient is 4% at the section from Sadat sta. (Tahrir sq.) to the Nile River crossing. Azbakiah sta. can be used for the shielding base. In the partial opening stage, only one platform will be used for passengers, to avoid any disturbance for the future construction of shielding under the Nile River.



Outline of the Station Plan

1. Concourse in the barrier
2. Concourse out of the barrier
3. Ticket office, Station master
4. Connection Path
5. Refrigeration room, Power distribution room

Fig. 11.4.5 Outline of the Station

b. Electrical Works

The signal system will be the car-mounted speed control system. Headway will be controlled by the Automatic Traffic Controller (ATC). A Centralized Traffic Controller (CTC) system will also be applied. In case of emergency, the manual system will be applied when approaching to stations. Catenary will be of rigid contact line. Ventilation inside tunnels will be a compulsory and closed system.

c. Car Depot

The Shubra car depot will house 136 cars for full operation or 96 cars in case of partial opening (Fig. 11.4.7).

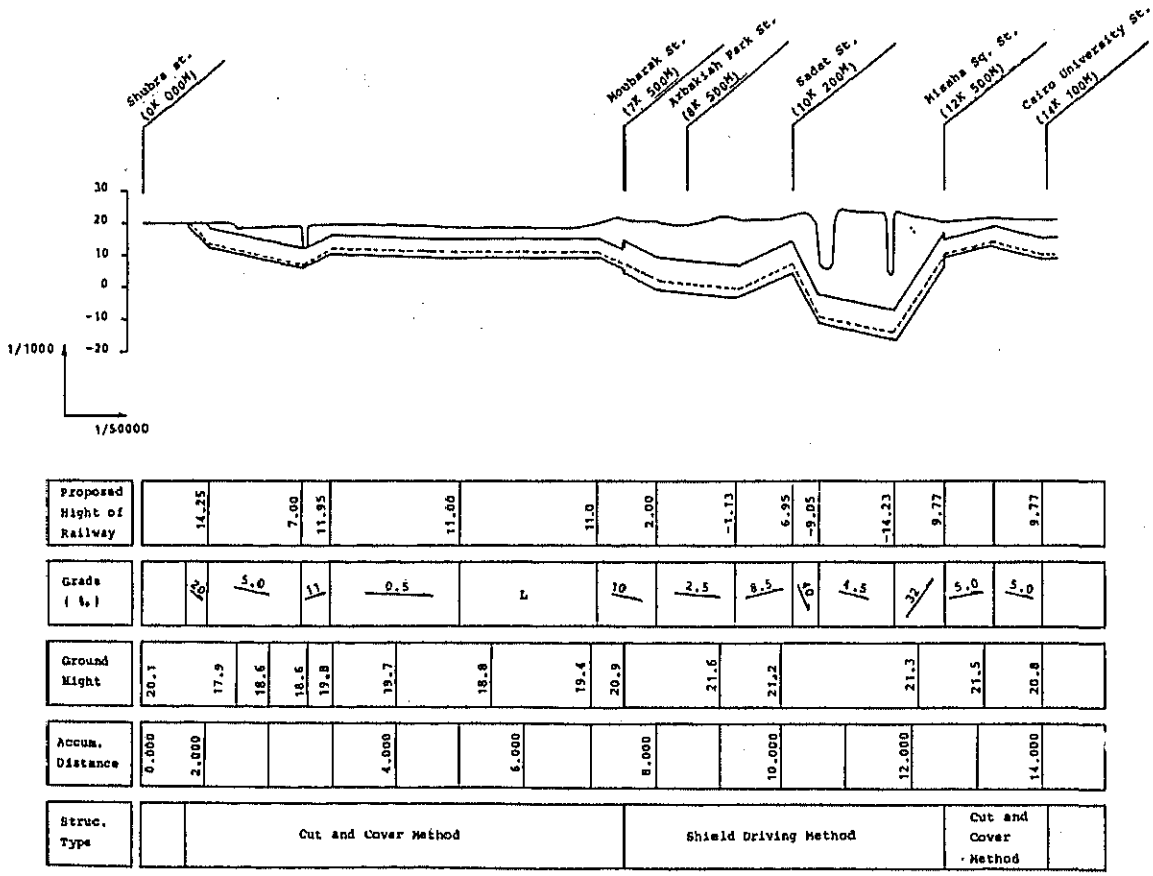


Fig. 11.4.6 Preliminary Profile of Urban Metro No. 1

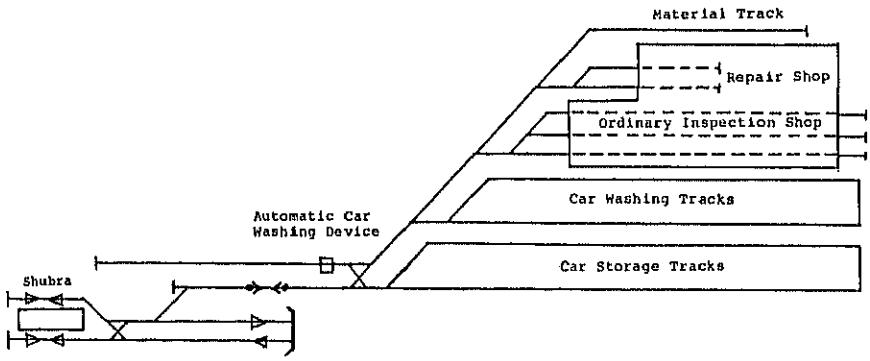


Fig. 11.4.7 Layout of Car Depot

3) Urban Metro No. 2 (R003)

(1) Concept

The route planned for Urban Metro line No. 2 connects Al Darassah - Attaba sq. - Isaaf sq. (Nasser Regional Metro sta.) to terminate at Embaba ENR sta. The line connects with Heliopolis Metro Darassah line at Darassah sta. and can attract transfer passengers originating from Nasr City and the Heliopolis area.

Urban Metro line No. 2, together with Urban Metro line No. 1 and the Regional Metro form a dense subway network in the Cairo CBD (Fig. 11.4.8). Upon the completion of the three lines, the entire CBD area shall be covered by subway stations within walking distance. In addition, six subway legs shall radiate in all directions from the Cairo CBD and can widely serve the traffic demands.

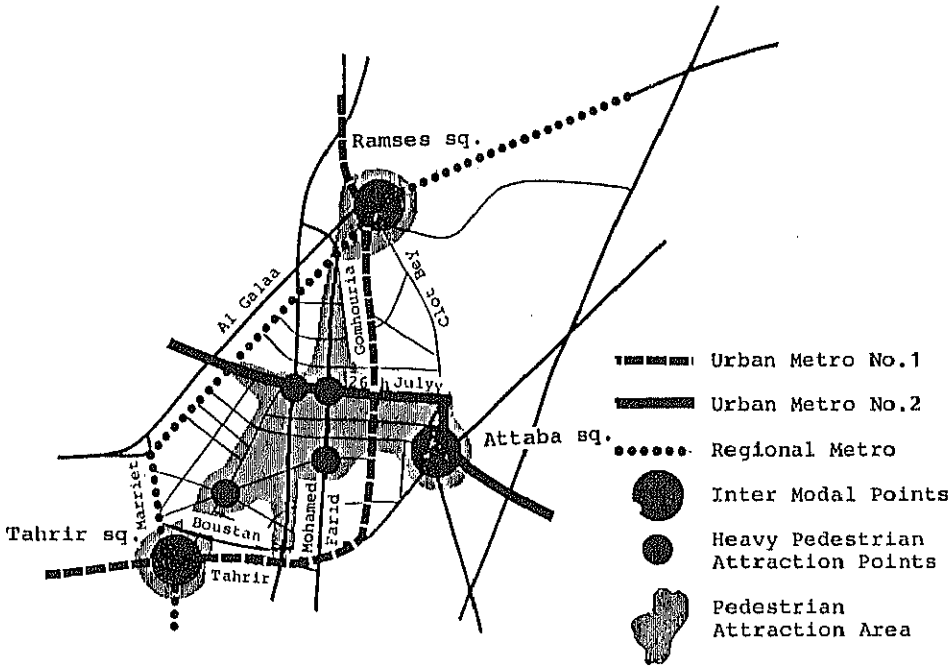


Fig. 11.4.8 Subway Network in CBD

(2) Route and Station Location

The starting point is at Al Darassah, at the location of the Heliopolis Metro line Al Darassah sta. The ending point is Embaba ENR station. The route is along Moski st. Azbakiah park, 26th July st. and near Ahmed Orabi st. Seven intermediate stations are planned; four at Azhar, Attaba (Azbakiah, connection with Urban Metro line No. 1), intersection of 26th July st. and Mohamed Farid st. (centroid of CBD), Nasser Regional Metro sta. (connection with Regional Metro line), and three stations along 26th July st. Total route length is 7.8 km as shown in Fig. 11.4.9.

Fig. 11.4.9 Route Location of Urban Metro No. 2 Line

(3) Operation Plan

Urban Metro line No. 2 is not considered as a fundamental transport measure in this Masterplan. If constructed, however, it should be operated as a trunk line. At present a 6-car train formation with 10 minutes headway operation is planned. At a pitch of 10 minutes, the time it would take to travel the 7.8 km route length is 10 minutes. Four trains, each consisting of 6 cars are required, with a total of 30 cars, including one reserve train.

Configuration of Urban Metro No. 2 line is considered the same as that of Urban Metro No. 1 line.

(4) Construction Works

a. Engineering Works

The entire route length is 7.8 km. The shield driving method is adopted to the section crossing Nile river. from Sphinx sq. in Giza to Boulaq along the existing 26th July br. with a length of 2.1 km and to the section from Attaba sq. to Salah Salem st. along Azhar br. for a length of 2.0 km.

The cut and cover method is adopted for the remaining 3.6 km section.

b. Electrical Works

The same specifications as those adopted for Urban Metro No. 1 line, shall be applied to Urban Metro No. 2 line.

c. Car Depot

The car depot shall be prepared to accommodate 30 additional cars in the Embaba side.

4) Regional Metro Giza Branch Line (R004)

(1) Concept

While transport demand between Giza and CBD is high, transport service is hindered by the Nile river. A branch line will be added to the Regional Metro line in order to ease congestion over the Nile river and to make effective use of the existing transport capacity of the Regional Metro.

a. Route Location

The starting point will be Mary Gergis sta. where there are a few existing structures which are considered as obstacles against construction. The station will be used as a junction station.

The ending point will be at the planned intercity bus terminal near the Giza Pyramids. This together with another junction station with ENR line will allow the line to serve tourists and long-distance travelers as well as commuters.

Part of the route will run parallel to the Ring Road. The total length of the line will be 11.7 km as shown in Fig. 11.4.10.

The maximum planned transport capacity is 343 thousand trips/day or 62 thousand trips/hour without consideration of the capacity limit of the main line.

b. Station Location and Track Layout Plan

The Mary Gergis station will serve as the junction. Connection in the direction of Mubarak sta. (Ramses sq.) and sidings to give access to the existing train depot will be provided.

Major Stations:

(a) A station near the crossing with the ENR Aswan line will allow passengers to transfer to the Aswan line when a new station is established at this location for the Aswan line.
(b) A station near the crossing with Ahram st. will provide convenient service for tourists.

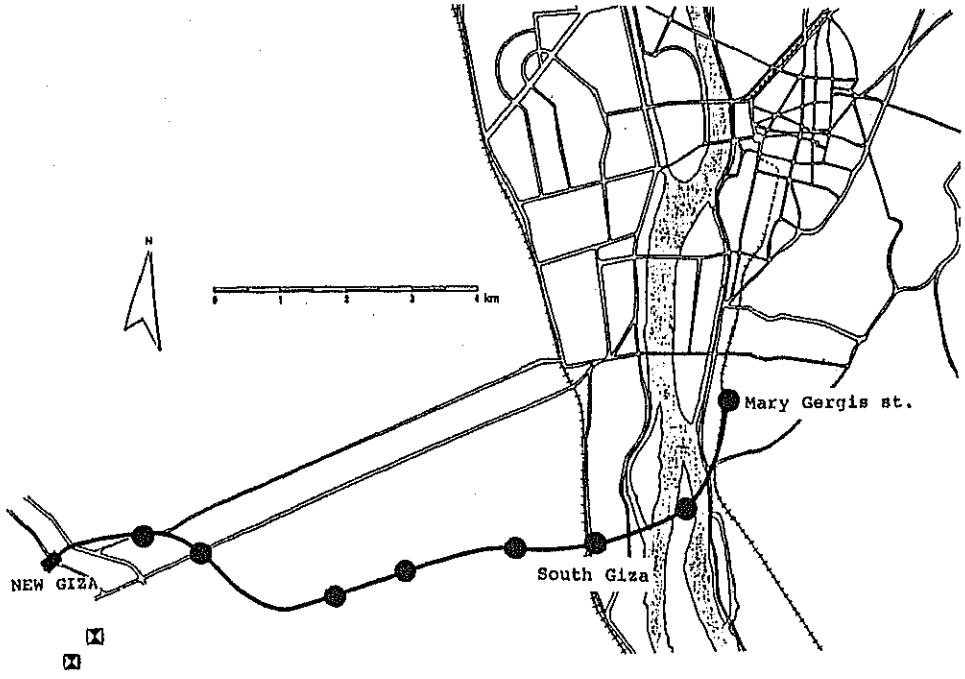


Fig. 11.4.10 Route Location of Regional Metro Giza Branch

Other stations will be established every 1 - 2 km along the entire route length of 11.8 km (Fig. 11.4.11) in anticipation of the future urbanization of the area.

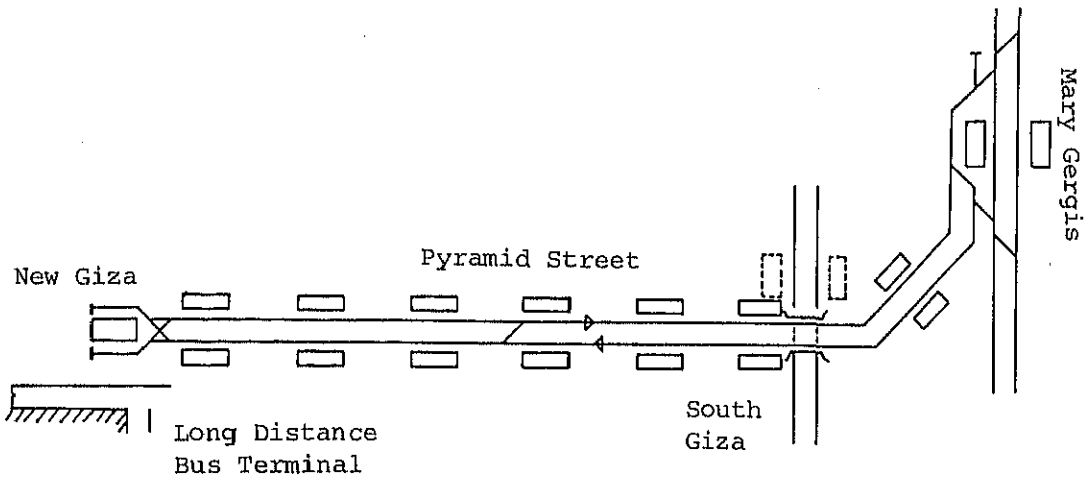
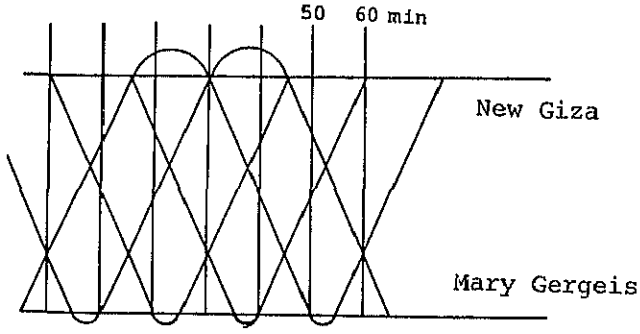


Fig. 11.4.11 Track Layout of Regional Metro Giza Branch

(2) Operation Plan

In spite of the large planned transport capacity, at present no large demand is expected because of the route location which is at some distance from densely populated areas. Therefore, and due to space shortage at Mary Gergis sta. in the first stage the branch line will not enter the main line. Because of single

platform limitation, initially the trains will use one transferring platform only, and be operated at 15 minute intervals. Fig. 11.4.12 illustrates the train operation system for the Giza line. The travel time from one end to the other is expected to be around 20 minutes.



Note: Turn back time at Mary Gergeis Sta. will be 5 minutes

Fig. 11.4.12 Train Diagram of Giza Branch

(3) Construction Works

a. Land

The section located about 6 km west of the Nile river will be built in conjunction with the Ring Road, and the land for this purpose will be acquired together with the acquisition of the Ring Road land. A public square will be provided in front of each station.

b. Engineering Work and Station Construction

Basic facilities will have the same specifications as those existing for the main line. Elevated section length shall be 300 meters adjacent to the bridge crossing the Nile river (530 meters).

c. Tracks

Ballast tracks with 50 kg rails will be used. Track connections will be provided for maintenance and emergencies.

d. Electrical Equipment

Basic facilities will be the same as those existing for the main line.

e. Train Depot

The existing depot of the main line will be used.

11.5 Street Car Plan (CTA Tram and Heliopolis Metro Lines)

1) Planning Policy

(1) General

Fig. 11.5.1 shows the present operating speeds of tram lines by sections surveyed in July 1988. Some tram lines can not maintain the operating speed of 10 km/h; most of these tram lines are in the CBD, where the tracks are not segregated. In future, the operating speed of these tram lines will be reduced further because of heavier traffic congestion is anticipated. This would result in fewer passengers.

On the other hand, some tram lines can maintain speeds of 10-20 km/h, reaching more than 20 km/h for some sections of Heliopolis Metro lines. These lines have segregated tracks and will be able to maintain present speeds against more congested road traffic condition in the future. Buses however, will lose speed due to the anticipated increase in road congestion. From these facts the importance to upgrade running condition of the tram lines becomes evident.

Therefore, the Study purpose is to determine which sections of the lines should be upgraded, and which should be removed.

(2) Heliopolis Metro

Heliopolis, Nozha, Nasr City and their outskirts including the new settlements show a remarkable population increase, which in turn produces a large traffic demand to CBD. In the year 2000, public transport demand from Heliopolis and Nozha is estimated at 220 thousand trips per day, and 80 thousand trips from Nasr City and its outskirts.

The traffic demand from Heliopolis and Nozha to CBD will concentrate on the Koliet Al Tarbia section of the Heliopolis Metro. Therefore, the main issue for the Heliopolis Metro network is to upgrade the main line of Ramses sq. - Roxi sq. to an urban railway line with higher speed and less headway to increase the rail capacity. The demand from Nasr City and its outskirts will be handled by connecting Heliopolis Metro with Urban Metro No. 2 at Darassah in the future.

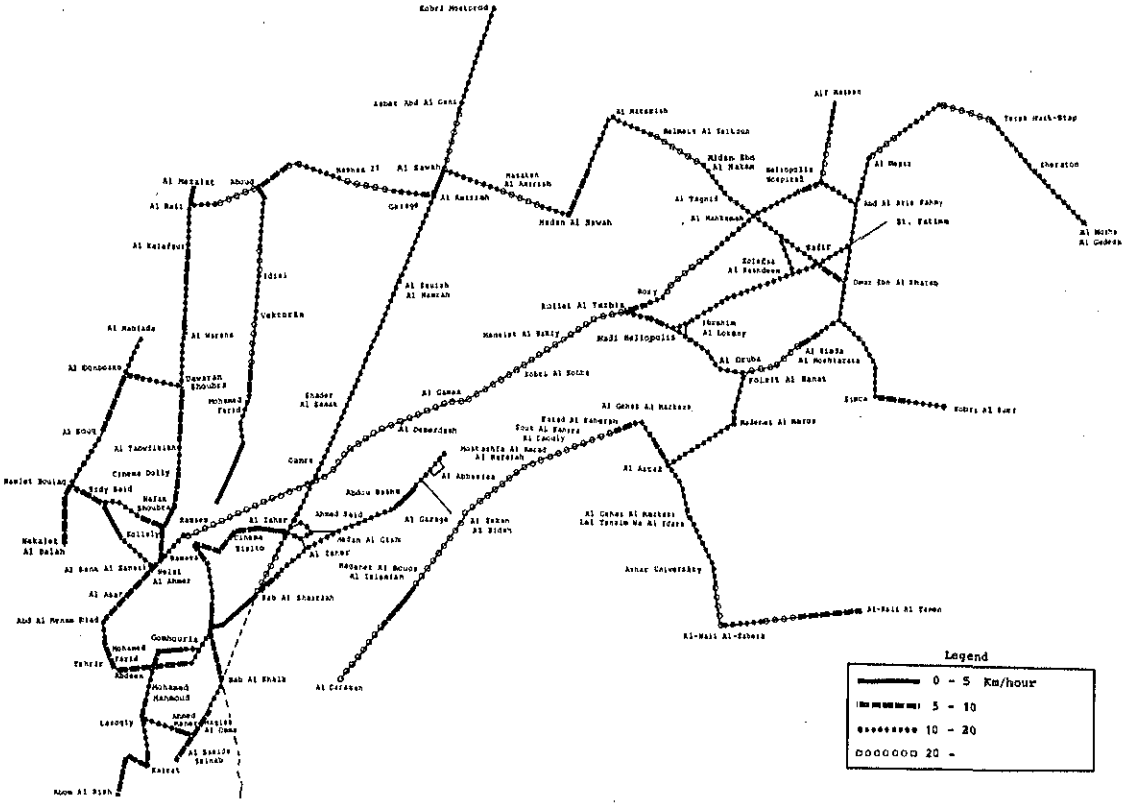
An effort should be made to segregate the existing tram lines from vehicle traffic in order to maintain the present operation speed.

(3) CTA Tram lines

According to the present operating speed and the expected population growth in the future, the most important CTA Tram lines are:

a. Mazzalat - Ramses sta. on Shubra st.

(1) 8:00 - 11:00 AM



(2) 2:00 - 5:00 PM

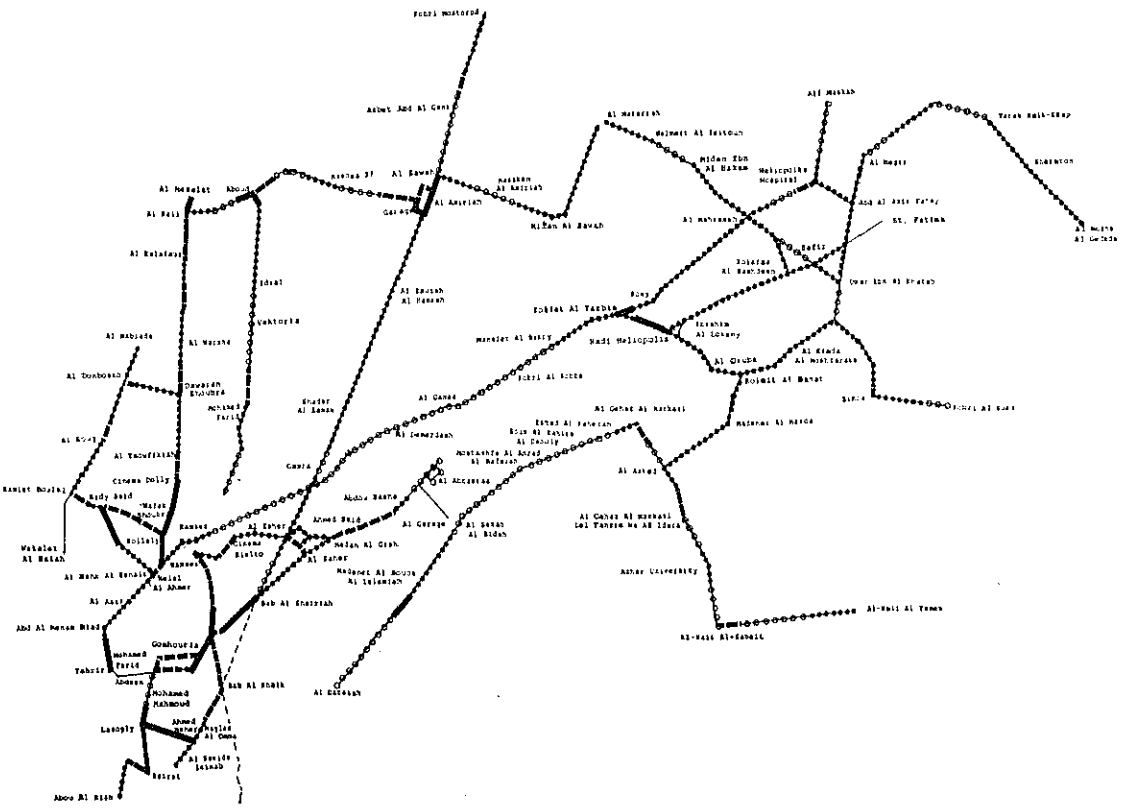


Fig. 11.5.1 Travel Speed of CTA Tram and HCHD Metro, 1987

b. Kobri Mostorod - Bab Al Shaaria on Port Said st.
c. Aboud - Ahmed Badawi on Ahmed Helmi st.

Two-thirds of the first line is segregated; however the last one-third of the line from Dawaran Shubra to Ramses sta. is non-segregated. Therefore, the improvement of this section is essential.

The total length of the 2nd line is segregated. An extension of the Port Said line up to the newly opened Sayedah Zeinab sta. of the Regional Metro is recommended for the convenience of railway passenger transfers.

The 3rd line stops before the culvert where Ahmed Helmi st. crosses Ahmed Badawi st. Since the culvert is not strong enough to allow the tram line to pass over it, it is therefore recommended that the culvert be strengthened so that the tram line can extend to the northern entrance of the Cairo Central sta.

The north loop line which connects these three lines from Al Raii on Shubra st., via Aboud on Ahmed Helmi st., to Amyriah on Port Said st. up to Mataria sq. will have a more important role in the future. It is therefore recommended that the Heliopolis Metro should connect with the loop at Mataria sq.

The lines listed below will have lower operating speeds and consequently less demand is anticipated. It is, therefore, proposed to remove these tracks gradually in a well planned manner (Fig. 11.5.2).

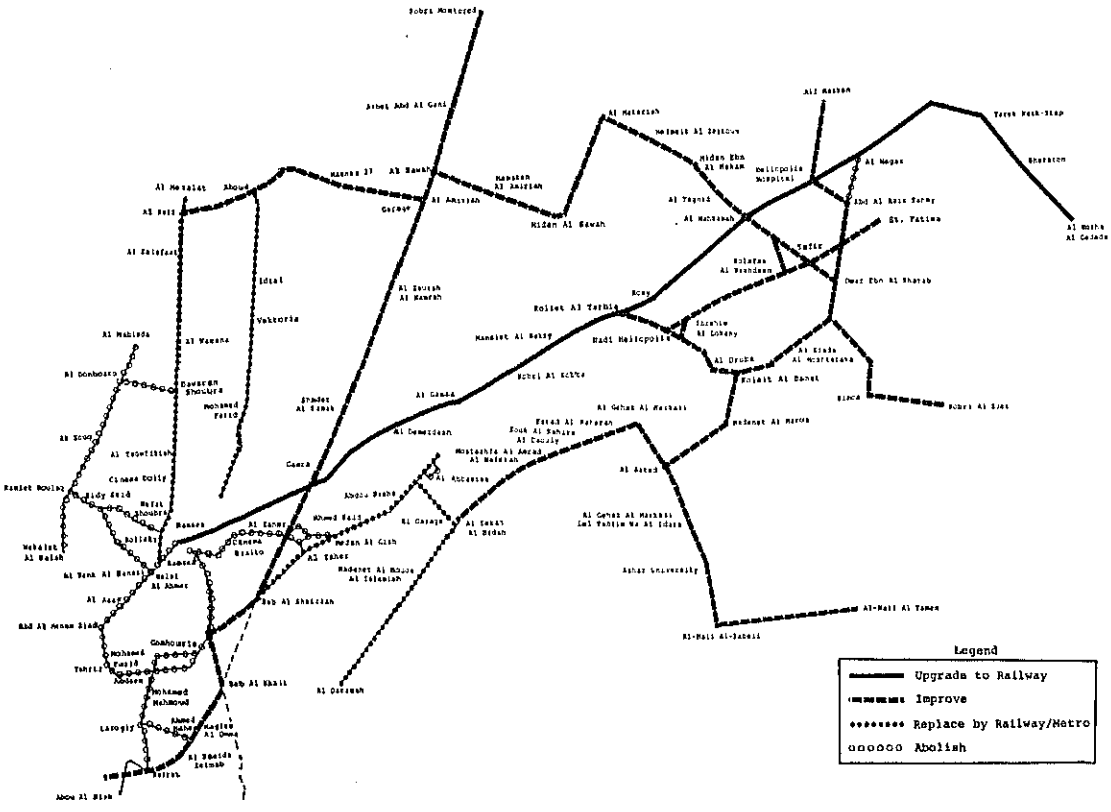


Fig. 11.5.2 Proposals to CTA and HCHD Metro

a. Khairat - Gomhouria
b. Magles Al Shaab - Lazoghli
c. Attaba sq. - Ramses sq.
d. Ramses sq. - Gueish sq.
e. Al Bank Al Senaai - Souq Al Aser
f. Al Koulali - Ramlet Boulaq
g. Wekalet Al Balah - Al Mabiada
h. Don Bosco - Dawaran Shubra

2) Upgrading and Extension of Heliopolis Metro Main Line (R101)

(1) Outline of the Plan

The Ramses sq. - Roxi sq. - Nozha section of the Heliopolis Metro network will be upgraded to an urban train line by raising its transport capacity, increasing its operation speed and providing regular service. The route to be upgraded is shown in Fig. 11.5.3. Hereafter this route is referred to as the main

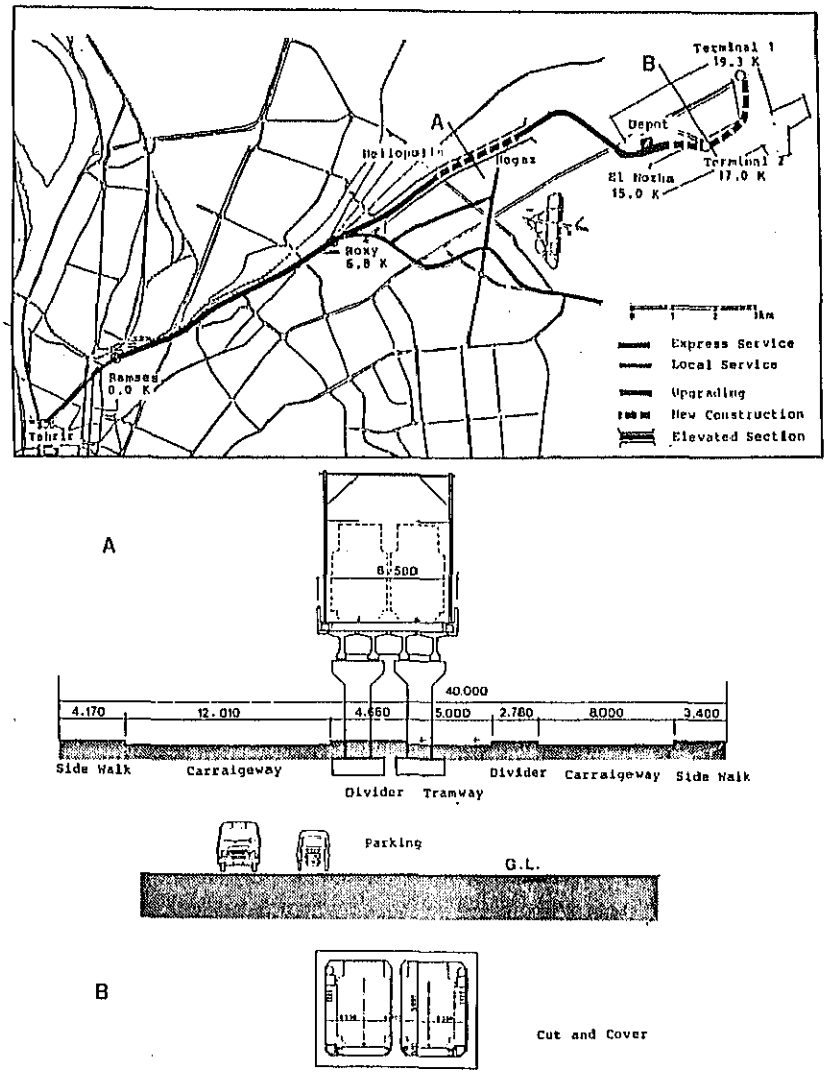


Fig. 11.5.3 HCHD Main Line Upgrading/Extension

line, and other Metro lines are referred to as branch lines. This route was selected from the view points of:

a. to provide straight lines of tracks, and
b. to avoid major shopping streets so as not to disturb the atmosphere by the frequent trains, and avoid the sense of oppression caused by the elevated railway.

The future concept for the main line includes its extension from Nozha to Terminal 1 of the airport via Terminal 2 in order to provide service for airport users and employees.

The total extension of the main line, from Ramses sq. to Terminal 1, will be 19.8 km, of which the section from Heliopolis sq. to Hegaz (4.5 km) and the section from Nozha to Terminal 1 (4.4 km) will be newly constructed. The remainder will consist of upgrading of the existing line.

There are two alternatives to improve the very congested conditions in Roxi sq.:

a. The Ramses sq. - Roxi sq. section will share tracks with the existing branch line which enters the main line at Roxi sq. and terminates at Tahrir sq.
b. The main line and the branch lines will be separated at Roxi sq. The branch lines will terminate their operation at Roxi sq. and the passengers to CBD shall transfer to the main line.

For the time being, the Study adopts the first alternative to avoid drastic change in the operation system. However, the second alternative shall be adopted when the service on the branch lines becomes too heavy to be merged in the main line. Roxi station will then become a new terminal serving Heliopolis area, Nasr city and their outskirts.

The maximum planned transport capacity of the main line, as listed in Table 11.2.1, is 180 thousand passengers/day or 32 thousand passengers/peak hour.

(2) Operation Plan

The operation plan outlined in Table 11.5.1 is established on the basis of the peak-hour demand. The layout of the tracks based on this operation plan is shown in Fig. 11.5.4. The main line will terminate at Nozha until the year 2000, after which the line will be extended to Airport Terminal 1. Express service to the airport will commence at the same time.

(3) Upgrading to Train Line (R101)

The tram line will be upgraded to a train line by implementing the following measures:

Table 11.5.1 Operation Plan for HCHD Main Line

Item	Unit	After Improvement	After Extension
1 Max. Speed	km/h	60	70
2 Scheduled Speed	km/h	30	30
3 Min. Headway			
Ramses - Roxi	min.	4.0	2.0
Roxi - Nozha	min.	6.0	4.0
Nozha - Airport	min.		4.0
4 Train Formation	cars	6	6
5 Max. Passengers	pax/car	180	180
	pax/train	1,080	1,080
6 Service		Local	Local Express
7 Travel Time	min.	33 (Ramses-Nozha)	30 (Ramses-Airport)

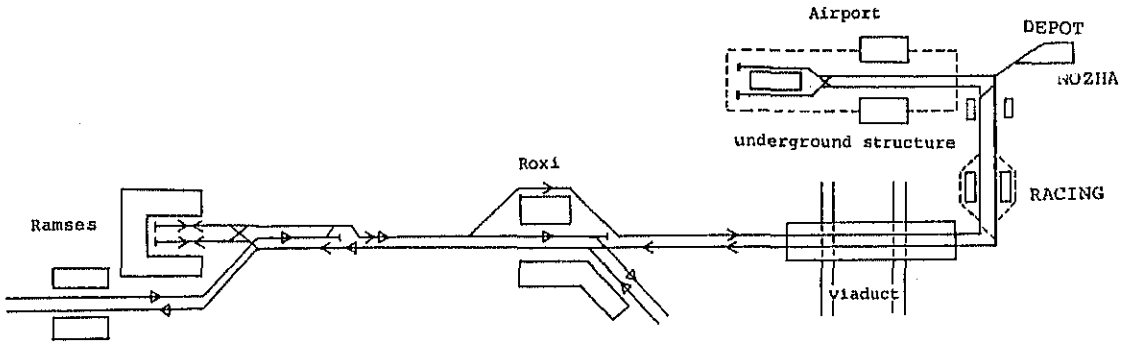


Fig. 11.5.4 Track Layout of HCHD Metro Mainline

a. Provision of exclusive tracks, with right-of-way at all crossings. This entails:

   (a) Installation of crossing alarms and, at appropriate points, crossing barriers
   (b) Construction of flyovers at existing grade crossings with other lines
   (c) Resumption of way-side signals

b. Improvement of track conditions
c. Establishment of a minimum 500 m distance between stations

The following construction work will be implemented under the condition that the construction specifications will allow existing tram cars to be used.

a. The entire section between Roxi sq. and Hegaz st. (4.5 km) will be elevated to allow the main line to fly over major crossings in the section, as well as the Mataria and Alf Maskan lines of the Heliopolis Metro.

b. The Ramses terminal will be reorganized.
c. An operations center equipped with Centralized Traffic Controller (CTC) system will be established, together with the necessary communication network.

(4) Extension of the Main Line (R102)

The transport demand to the Cairo International Airport includes air line passengers, welcomers and well wishers, and airport employees. According to the traffic counting survey conducted in Aug. 1988 and an air transport statistics, trip number generated/attracted from the airport is approx. 62 thousand trips for one direction. Figures 11.5.5 through 11.5.7 show the hourly fluctuation, composition of trip purpose and trip modes.

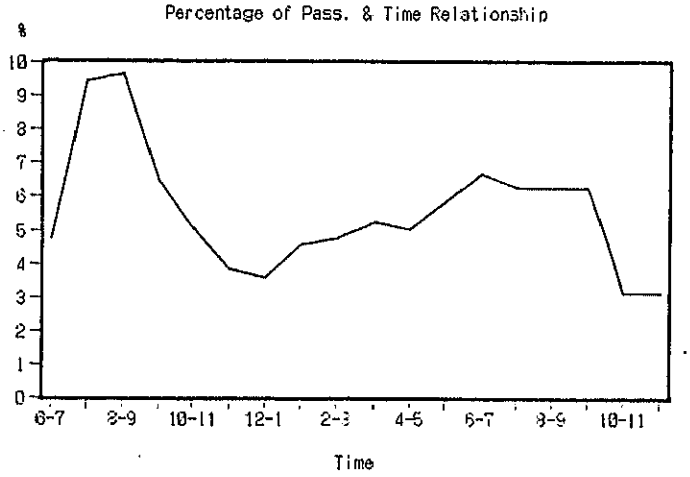


Fig. 11.5.5 Fluctuation of Airport Passengers

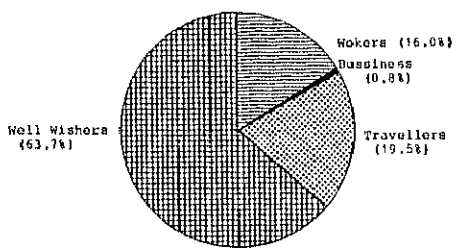


Fig. 11.5.6 Airport Passenger Trips by Purposes

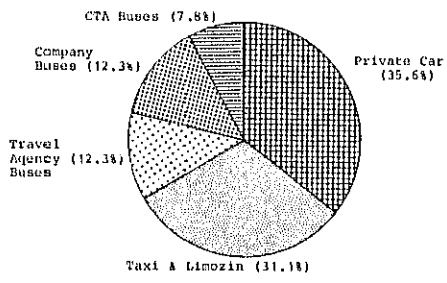


Fig. 11.5.7 Airport Passenger Trips by Modes

The international air passenger traffic is forecast to increase up to 2 million or 4 times the present traffic of 0.5 million passenger in the year 2000, according to the 1987 estimation of the Airport Information Center. Approx. 10 thousand employees including three thousand Cairo Airport Authority (CAA) staff are working in the airport at present. The center also

estimates a 5% increase in the 1987 employee number to cope with air transport demand in the year 2000.

The future airport-related trips in the year 2000 can be estimated at 148 thousand trips/day taking the above factors into consideration.

A new line, when it becomes necessary, including a 1.2 km underground section, will be constructed between Nozha and Terminal 1 during the second stage of the Heliopolis Metro improvement. At this stage, it will become necessary to install through tracks at several stations for express trains. The stations at the airport will be constructed under the airport parking.

3) Grade Separation at Al Gehaz Al Markazi (R103)

The Heliopolis Metro line along Salah Salem - Orouba streets, which forms one of the main arterials to connect Giza and Heliopolis and had a traffic volume of approx. 150 thousand veh/day in 1987, crosses four other arterials at the intersections of Al Gehaz Al Markazi, Koliet Al Banat, Al Kiada Al Mostaraka and Nozha, the last three of which are already grade separated.

According to the present operating speed survey, speed of more than 20 km/h is maintained in the 6.2 km section from Darassah to Al Gehaz Al Markazi; however, the speed is reduced at

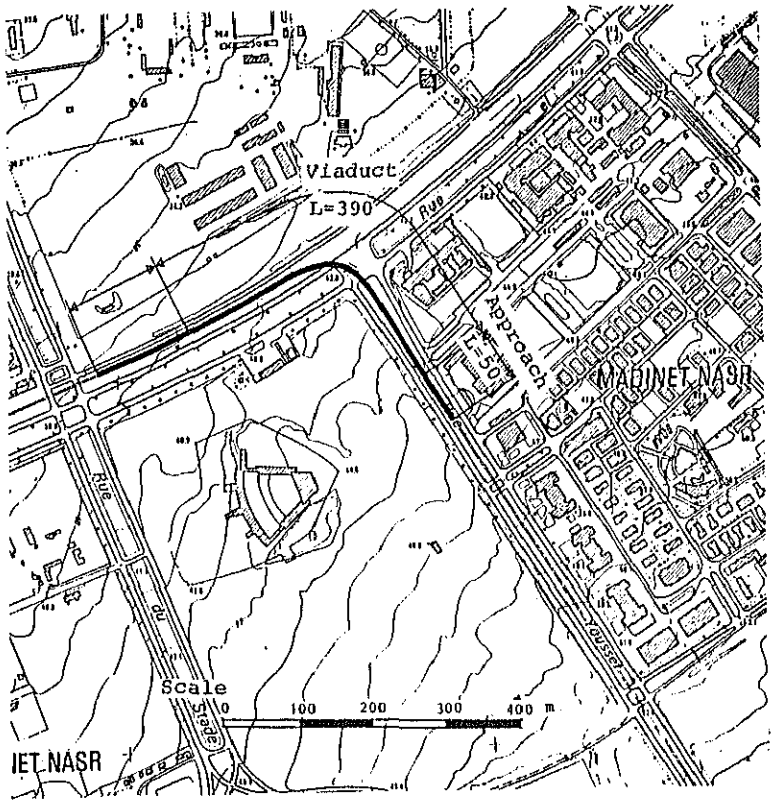


Fig. 11.5.8 Al Gehaz Al Markazi Grade Separation Plan

the Al Gehaz Al Markazi intersection to less than 5 km/h because the railway crosses the main arterial at grade. Therefore, the grade separation of Heliopolis Metro at this intersection is recommended from the view points of railway operation and vehicle traffic flow as well.

Fig. 11.5.8 shows the section to be grade separated. The viaduct length is 390 m and the station at present located along the viaduct section at Orouba st. shall be elevated.

4) Connection of CTA Tram and Heliopolis Metro (R104)

The CTA Tram Mataria line ends just before Mataria sq. while the Heliopolis Metro terminates on the other side of the square, with some 300 m between the two. The plan calls for the connection of these two lines (Fig. 11.5.9) to form the North Loop Line from Al Raii, on Shubra st. to Heliopolis main line by a streetcar network.

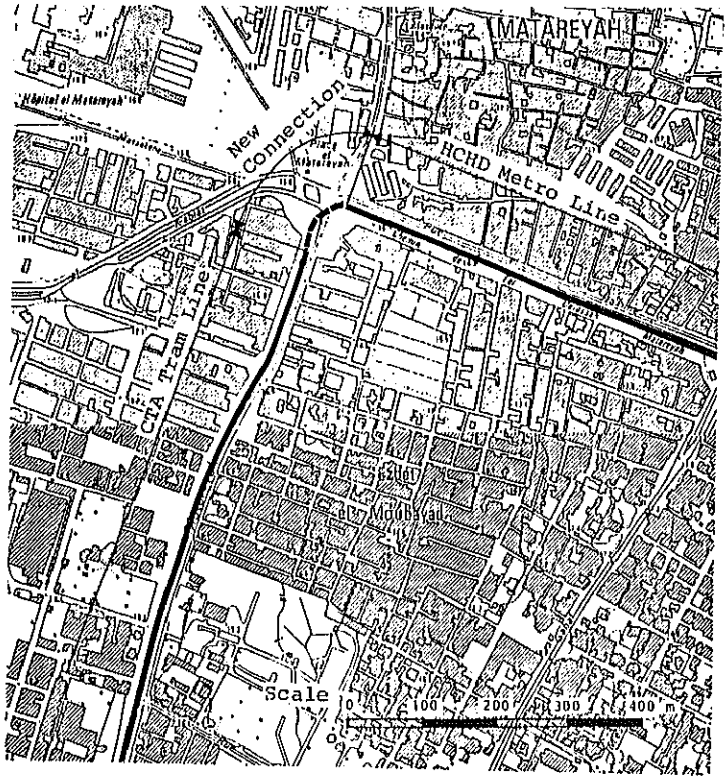


Fig. 11.5.9 Connection at CTA Tram and HCHD Metro

5) Extension of CTA Tram Port Said Line (R105)

At present the CTA tram Port Said line returns at Sayedah Zeinab Sq. located at the end of Port Said st., while the Khairat st. line turns a sharp bend at the corner of Khairat st. and Port Said st. and returns at Abou Al Rish at the end of Khalig Al Masri st.

The plan calls for the connection of the Port Said line with Khairat st. line and the extension of operation up to the newly constructed Sayedah Zeinab sta. of the Regional Metro, for the following purposes:

a. This would be for the convenience of transfer passengers from the Regional Metro to the tram, thus making the railway network more effective.
b. Avoidance of the blockage of vehicle traffic caused when the tram turns at the sharp bend.

Two alternatives for the extension routes are shown, routes A and B in Fig. 11.5.10. The advantage and disadvantage of the routes are:

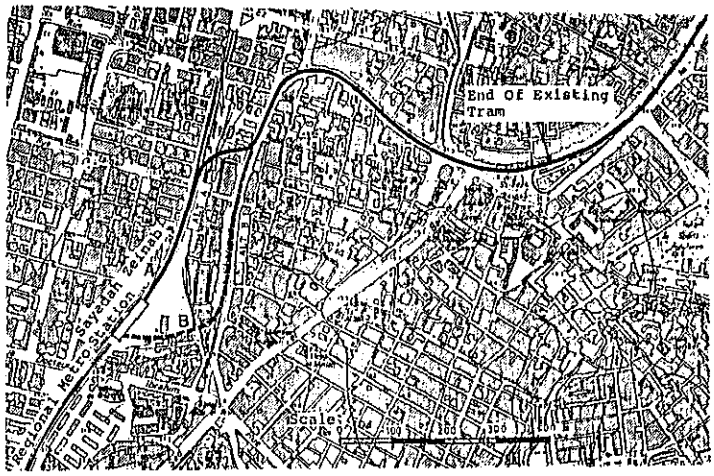


Fig. 11.5.10 Extension of CTA Tram Port Said Line

a. Route A is planned along the Regional Metro Helwan line. The completely segregated section is longer than route B, however existing buildings between Khalig st. and the Helwan line would be affected (Total length: 1.1 km).

b. Route B, which is an alternative to Route A when the latter cannot be realized because of the said existing buildings, passes through the existing narrow Khalig st. and would disturb vehicle traffic. In addition the route requires the removal of a collapsing building at the entrance to Sayedah Zeinab sta. (Total length: 1.2 km).

6) Small Scale Improvement (R107 and R108)

In the section where good operating speed of the trams was observed, the following small scale improvements are planned to improve the level of segregation of tracks in order to maintain or improve the present operating speed in the future:

(1) Installation of a fence between carriageway and tram track
(2) Installation of the following equipment at major intersec-

tions (Fig. 11.5.11) to secure the non-stop operation of trams:

a. Automatic alarm signal system
b. Cross bar barrier
c. Track cable and detector

(3) Installation of the following equipment at minor intersections to give priority to trams:

a. Automatic alarm signal system
b. Track cable and detector

The numbers of main and minor intersections needing equipment installation are 62 and 112 respectively. The total fence length is estimated at 121.8 km.

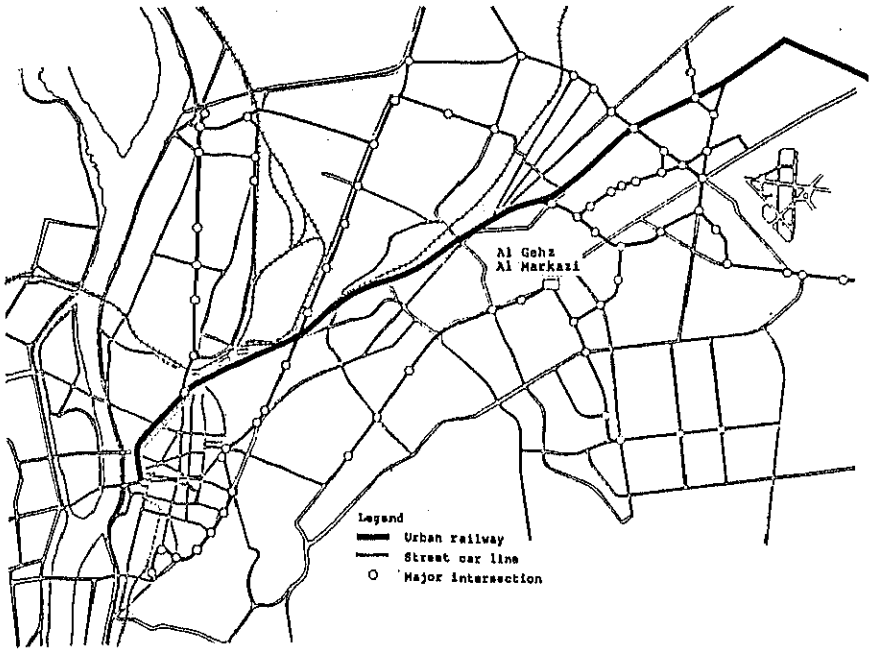


Fig. 11.5.11 Location of Major Intersections for Small Scale Improvement

7) CTA Tram Extension in Helwan (R106)

(1) Improvement Concept

The center of Helwan district fans out from the public square in front of the Regional Metro's Helwan sta., and factories and residences are scattered in the surrounding areas. As shown in Fig. 11.5.12 the tram network in the city has three operating routes. In addition, the construction of an extension from Al Ezzab to 15th May new town is now nearing completion. This extension will provide the inhabitants of 15th May, forecast to be roughly 100 thousand in the year 2000, access to the city center and to various locales in the direction of Cairo, as well as to surrounding factories.

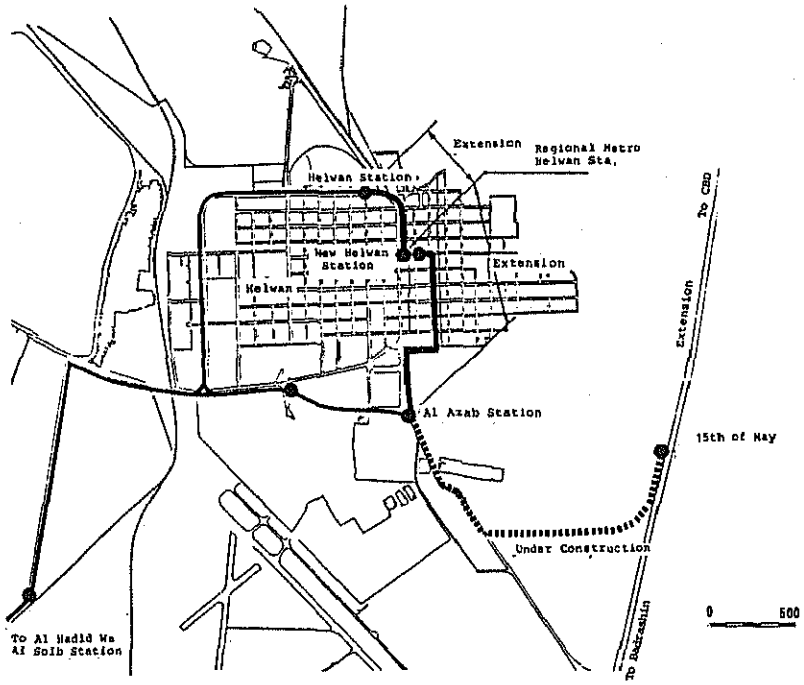


Fig. 11.5.12 Route of CTA Tram Helwan Line Improvement

However, the existing Helwan terminal of the CTA Tramway is located at some distance (500 m) from the Helwan terminal of the Regional Metro, which is a trunk line that links Helwan to CBD. On the other hand, the competing bus line has a terminal directly on the public square and thus has the advantage of providing access transport.

For a traveler on the 15th May line to use the Regional Metro, he would either have to make a detour on the tramway to Helwan sta. and walk a further 500 m, or walk about 1.2 km from Al Ezzab sta.

In order to solve these problems, it is necessary to extend the tram tracks as shown in Fig. 11.5.13.

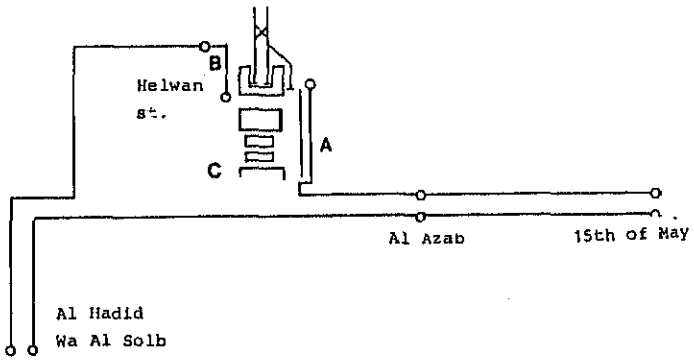


Fig. 11.5.13 Proposed Operation of CTA Tram Helwan Line

(2) Construction Works

The extension length is given in Table 11.5.2.

Table 11.5.2 Extension works for CTA Tram Helwan Line

	A	B
Track	1500m	550m
Trolley	1500m	550m
Terminal Facility	1 place	1 place
Earthwork	100m	

8) Further Consideration on Heliopolis Metro Mataria Line Extension to New Settlements

The present Mataria line runs from Kobri Al Suez to Mataria. New settlements to the east of the Ring Road are forecast to have a population of 700 thousand in the year 2000. To provide transportation service for the inhabitants of the new settlements, the Heliopolis Mataria line will be extended (Fig. 11.5.14) 17.5 km to link up with three of the settlements (planned population, 450 thousand in 2000 and 750 thousand when fully completed).

In addition to the existing Mataria route, if a branch route is established between Omar Ibn Al Khattab and Roxi sq., it would be possible to provide service in the direction of Ramses sq. and Tahrir sq.

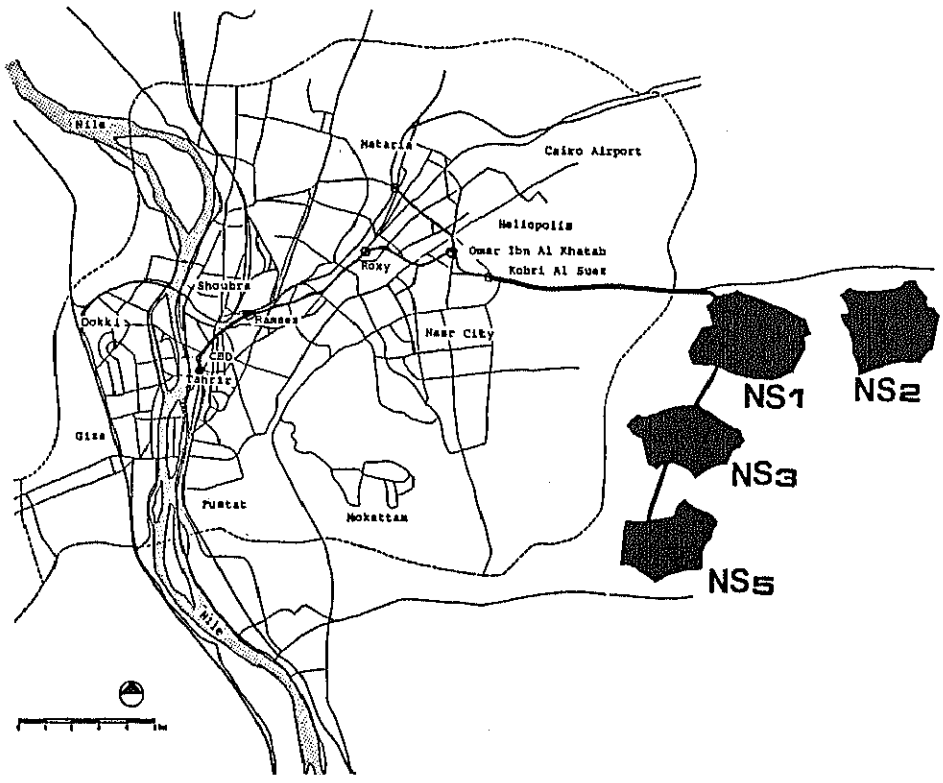


Fig. 11.5.14 Future Extension of HCHD Metro Suez Line

11.6 ENR Plan

1) Planning Policy

The rail transport service shall continue to be unsatisfactory in the Embaba and Dokki areas unless the planned Urban Metro No. 2 is constructed. Therefore the introduction of commuter service on the existing ENR line is planned. Commuter service shall be introduced in the section from Giza sta. in the south to Shubra sta. in the north.

2) ENR Commuter Train Service (R005 and R006)

(1) Outline of Commuter Service

Commuter service will be initiated by introducing through operation on the Aswan and Minouf lines (Figures 11.6.1 and 11.6.2). The starting point for commuter service is a new station to be constructed south of the existing Giza sta., in the vicinity of the Regional Metro Giza branch line flyover. The ending point will be Shubra Al Kheima sta., where various transportation systems converge.

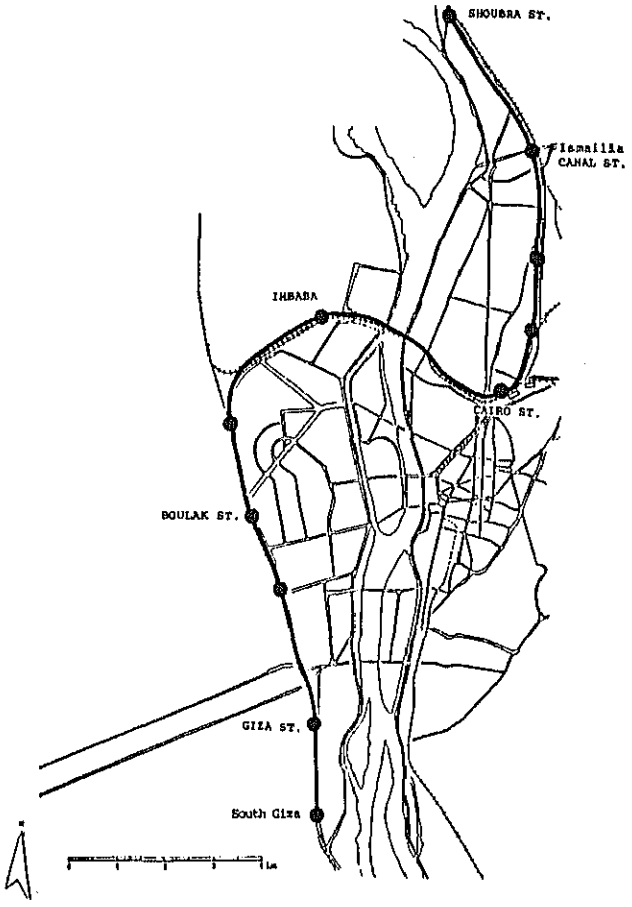


Fig. 11.6.1 Outline of ENR Commuter Service

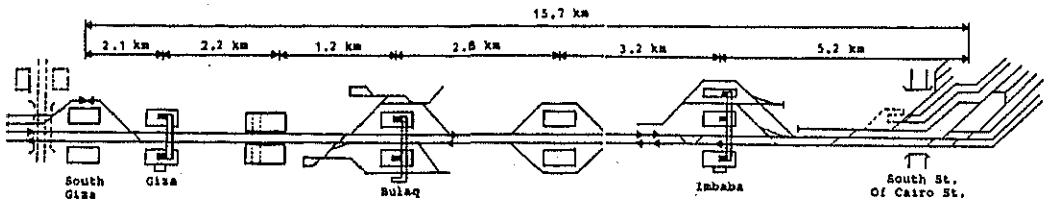


Fig. 11.6.2 Track Layout Plan for ENR Commuter Service

The entire line will consist of double tracks, with the exception of the section inside Cairo Central sta. premises and the Ismailia Canal - Shubra section.

(2) Operation Plan

After the improvement of Cairo Central sta. is completed, intercity train service will be increased. This means that commuter and other local lines will have to be scheduled to fit within the increased flow of overall rail traffic.

In general, as long as there are shunting facilities, a section which deals with a variety of trains can manage 120 trains per day, one way. Moreover, ENR data also indicate a one-way track capacity of 140 trains.

Two train types could be operated on the commuter line:

a. Push-pull type composed of passenger cars (PC) and diesel locomotives (DL)
b. Self-drive diesel car (DC) type

It is assumed that the push-pull type trains used on the Al Marg line will be diverted to the commuter line, keeping the same passenger capacity and train formation. The present number of trains operated along the section between Cairo sta. and Shubra Al Kheima sta. is 143 trains (both directions), and the number is 112 trains (both directions) at the section between Cairo sta. and Giza sta. Assuming that all lines operate the same number of trains as at present, 48 trains by each direction can operate in a day. Again assuming 16 hours operation (6:00 AM - 10:00 PM) 3 trains can be operated every hour in accordance with all other lines operation. Considering the increase in inter city train services mentioned in the first paragraph of this section, and deviation of arrival and departure times of long distance trains, it is safer to assume an operation of only 2 trains every hour.

(3) Commuter Train Facilities Plan

Since the freight line shares tracks with the passenger lines between Ismailia Canal and Shubra Al Kheima, the commuter line shall use a single track in this section. Assuming 4 minutes as the time required to travel this section, the track capacity is calculated at 216 trains which can be managed without any problem on a single track.

a. New Stations

New stations will be constructed at intervals of 1 - 2 km for commuter service. On the Aswan line, new stations will be established between all existing stations. A new terminal station south of the Giza sta. shall be constructed. A new station with shunting facilities to allow trains with higher priority to bypass slower trains, will be built on the Aswan line.

As discussed above, the number of stations to be constructed is shown in Table 11.6.1. The effective length of the platforms will be 160 m. The new stations can all be built on land currently owned by the railway.

Table 11.6.1 New Stations for ENR Commuter Service

Line	Station Type	Qty	Remarks
Aswan Line	With Through Track	1	New
	Without Through Track	1	New
	Terminal	1	New
Minouf Line	With Through Track	3	New
	Without Through Track	1	Improvement

b. Signals and Interlocking Devices

In conjunction with the alteration of the track layout, signal facilities and interlocking devices will be improved.

In order to reduce the minimum headway in the section on the Aswan line from 7 min. to 4 min., the block system will be introduced. CTC devices will be improved.

3) Cairo Central Station Improvement

As a precondition to providing commuter train service between South Giza sta. and Shubra Al Kheima sta., some improvements in Cairo Central sta. are necessary.

4) Partial Opening of Commuter Service

If the improvement of the Cairo Central sta. is delayed, it is possible to provide commuter service between Cairo Central sta. and Shubra Al Kheima sta. on the Minouf line by using a single track and installing bypass facilities on the line. This alternative may also be necessary within the process of shifting to double-track operation (Fig. 11.6.3).

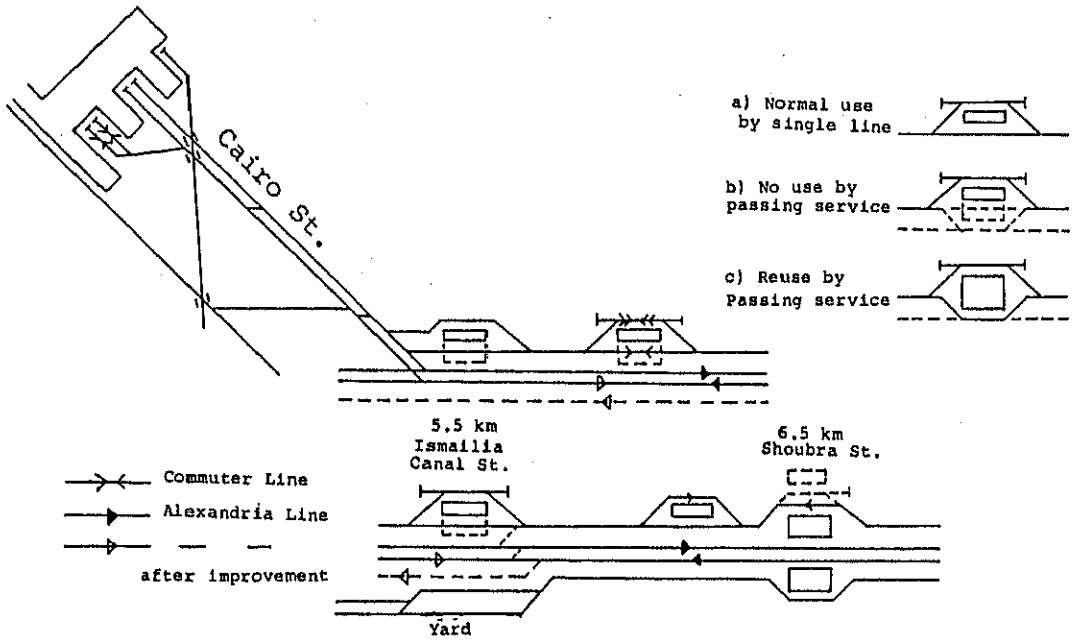


Fig. 11.6.3 Track Layout Plan for Single Track Operation

11.7 Bus Plan

1) Regular Size Bus

(1) Policy and Future Demand

Under the conditions of the Masterplan network and the policy of discouraging private car use, daily bus passengers will increase in number from 4.0 million in the year 1987 to 6.5 million in the year 2000. Fig. 11.7.1 shows the result of traffic assignment of this demand to the Masterplan network without consideration of road capacity constraint. Total bus transport will increase by 1.64 times from 27.2 million passenger.km to 44.5 million. This fact indicates that in the future bus transport will be the fundamental public transport measure in the absence of introduction of significant new transport projects. The actual CTA bus traffic pattern in November 1987 is shown in Fig. 5.3.7 in Chapter 5. This pattern also continues without significant change up to the year 2000 (Fig. 11.7.1). Major roads for bus transport are:

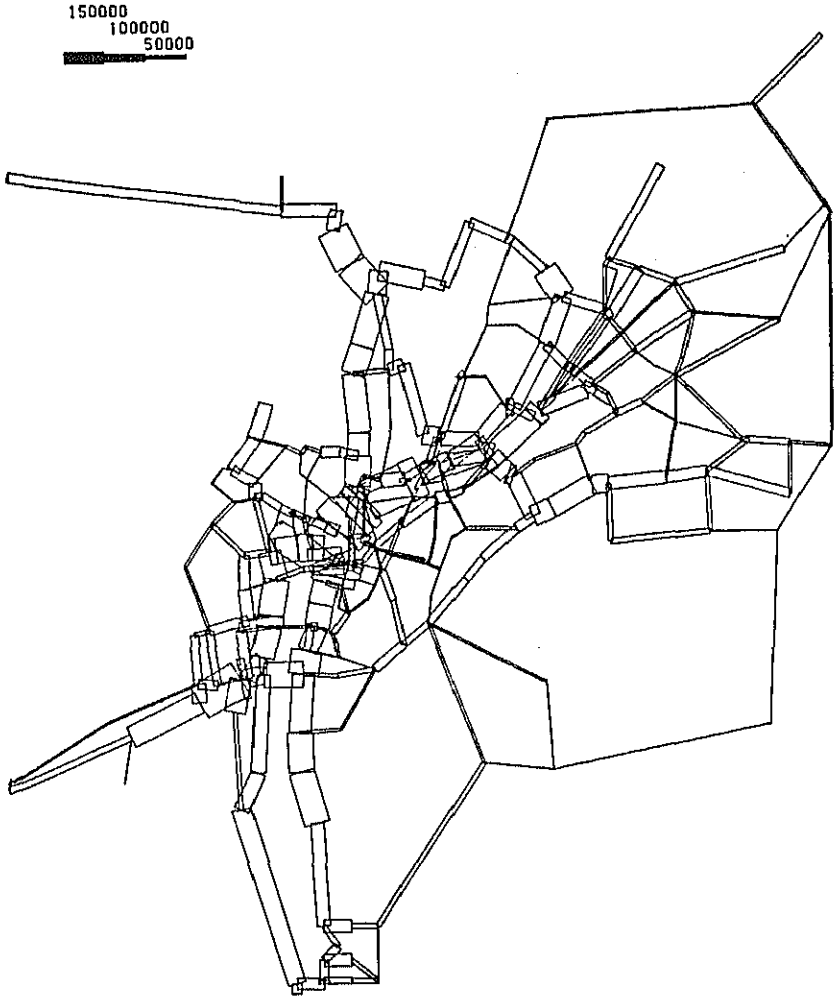


Fig. 11.7.1 Bus Use Trip Demand in 2000

a. Ramses st.
b. Shubra st.
c. Cairo and Giza Corniche streets from south
d. Ahram and King Faisal streets
e. Mataria st.
f. Khalifah Al Mamoun st.

Assigned bus trips to these trunk roads in the year 2000 are:

a.	Ramses st.	671 thousand trips/day
b.	Shubra st.	319 thousand trips/day
c.	Corniche st.	377 thousand trips/day
d.	Nile st. (Dokki area)	337 thousand trips/day
e.	Ahram st.	419 thousand trips/day
f.	King Faisal st.	129 thousand trips/day
g.	Mataria st.	231 thousand trips/day
h.	Khalifah Al Mamoun st.	285 thousand trips/day

The ceiling figure for the max. trips is considered to be 160 thousand trips/day assuming 80 passengers/bus, 180 buses/peak hour and 0.18 peak hour rate. When that ceiling figure is compared with the demand assignments in the year 2000, it is clear that demand exceeds capacity in all of the trunk roads, except for King Faisal st.

In light of the demand exceeding capacity, the role of bus transport must be considered in combined operation with rail systems.

Even in combined operation, however, bus transport will be the major transport measure up to year 2000. At the same time, feeder services to the rail systems will become more important. It is a fact that at present about 25% only of total public transport demand is transported by the rail systems. In order to increase this figure, some policies shall be discussed.

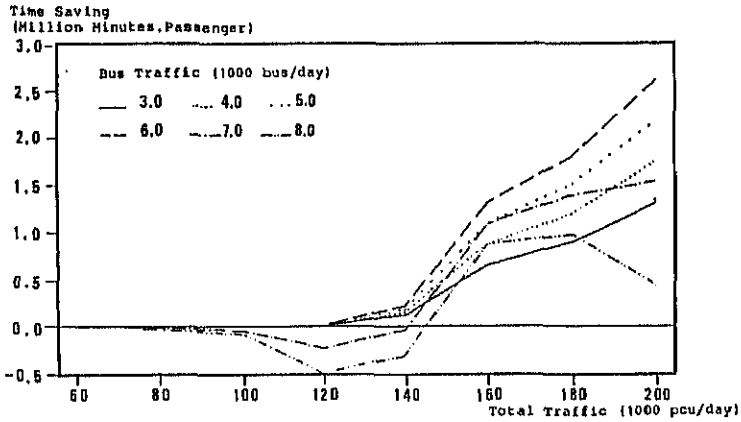
(2) Bus Trunk Roads and Exclusive Bus Lanes

Fig. 11.7.1 shows that several bus trunk roads exist. In order to attain reasonable speed and punctuality for bus operation on those roads, introduction of exclusive bus lanes shall be considered.

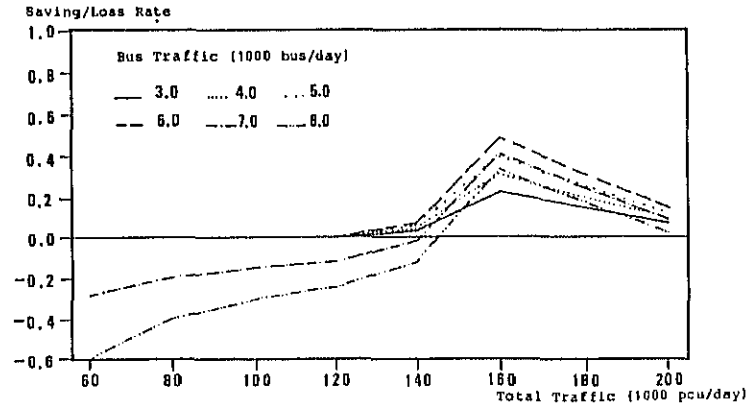
An analysis was made to determine under what conditions an exclusive bus lane would function advantageously, taking a six lane road as the standard. Designating the outside lane (curb lane) in each direction as the exclusive bus lane, 5,000 pcu (about 3,000 buses including minibuses and microbuses) would be the maximum daily capacity in order to keep an average speed of over 15 km/hr. Assuming the capacity of each inside lane to be 17,000 pcu/day/lane and the free running speed at 55 km/hr, the effects of the exclusive bus lane are examined by calculating the total travel time in terms of passenger.hour for each one kilo-

meter. The results are shown in Fig. 11.7.2, in which the following is observed:

a. When the total traffic volume is in the range of 100,000 to 140,000 pcu/day (1.0 - 1.4 times the road capacity, without the exclusive bus lanes), there is no merit for bus lanes. Under such conditions, if the percentage of buses increases, buses then crowd the bus lanes, and instead of being given priority, bus passengers' total travel time would become longer (Fig. 11.7.2 -(1)).



(1) Travel Time Saving of Bus Passengers



(2) Saving/loss Rate by Traffic Volume

Fig. 11.7.2 Effects of Exclusive Bus Lane

b. In general, the bus lanes give advantage to buses when the total traffic volume exceeds 1.5 times the road capacity. However, this advantage would be lost if the bus traffic increases beyond the bus lane capacity (Fig. 11.7.2 -(1)).

c. Bus lanes will give privilege to bus traffic on one hand and disadvantages to other traffic on the other hand. Fig. 11.7.2 - (2) shows the ratios of saved time by bus passengers to lost time by other vehicle passengers; thereby

revealing that the total saving can never offset total loss. This ratio takes the maximum value when total traffic volume reaches 160,000 to 170,000 pcu/day, that is 1.5 times the road capacity.

In summary, exclusive bus lanes can be recommended only under the following conditions:

a. The road is wide enough with more than six lanes.
b. Total traffic exceeds the road capacity.
c. Bus traffic volume does not much exceed bus lane capacity.

Based on the information above, it is worth studying the introduction of bus lanes along the following roads for the year 2000 road network (Fig. 11.7.3).

a. Roxi - (Ramses st.) - Ramses sq.
b. Ramses sq. - (Galaa st.) - (6th Oct. br.) - (Giza Corniche) - Giza sq. - (Ahram st.) - Manssoureya Canal
c. 6th Oct. br. - Tahrir sq. - (Qasr Al Aini st./ Corniche) - Maadi
d. Abbasseya sq. - (Gueish st.) - Attaba sq.
e. Ismailia Canal - (Ahmed Helmi st.) - Cairo Central sta.

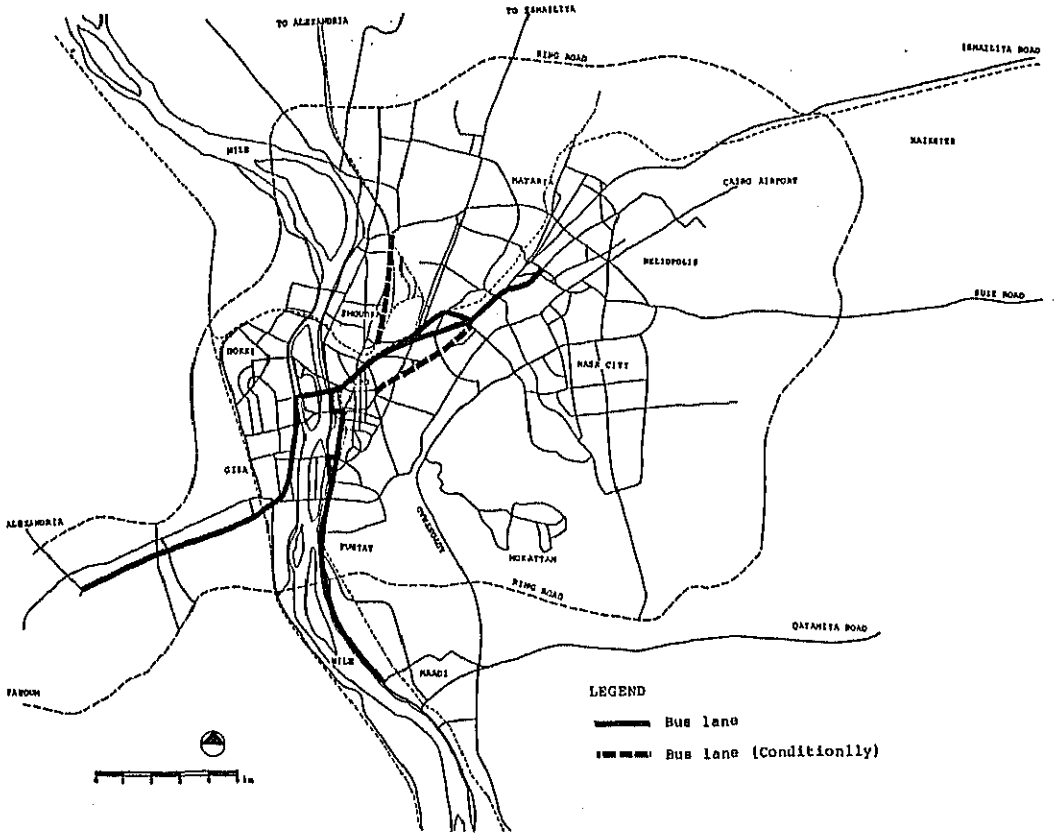


Fig. 11.7.3 Proposed Route of Exclusive Bus Lane

Of the roads listed above, route (d) will require the construction of Metropolitan Expressway No. 3 as a precondition, and route (e) depends on the operation of ENR's urban railway service and the abolition of CTA tram line. Introducing bus lanes in route (c) is also difficult without the construction of Metropolitan Expressway No. 2 and rerouting of the present bus network.

(3) Bus Fleet (B001)

Operation indicators of bus, minibus and microbus (1987) are shown in Table 11.7.1. Average age of bus in operation is not clear. Only average age of bus registration is available, which is currently 5.6 years. An exact figure for the average life of buses is also not available, but it can be empirically assumed to be 8 years. About 12.5% of the whole fleet must be replaced every year.

Table 11.7.1 Operation Indicators of Bus, Minibus and Microbus (1987)

	Bus	Minibus	Microbus
1 Passengers (1000 pax)	2,651	107	1,270
2 Av. No. of Passengers per bus	47.90	14.60	8.40
3 Av. Trip Length (km)	7.42	7.35	5.33
4 Av. Daily Operating Distance (km)	244	105	194
5 Passengers km (1000)	19,670	786	6,769
6 Vehicle.km (1000)	411	54	806
7 Share of pax.km (%)	72.20	2.90	24.90
8 Share of Vehicle.km (%)	32.30	4.30	63.40

Source: PT Survey

Masterplan case simulation indicates the figure of 44,477 thousand passenger.km as total transported by bus. In the simulation case, bus represents the total fleet of regular size bus, minibus and microbus. Assuming operation indicators at present do not change in the future, the bus fleet in the year 2000 may be composed of 2,748 units.

In 1987, 1,900 regular buses were being operated by CTA and GCBC. In order to operate and maintain in operable condition 2,748 units in the year 2000, it is necessary to introduce 330 new bus units annually which will cost about 37.8 million LE during the coming decade up to the year 2000.

If it is possible to assume an average bus life of 10 years, the number of new buses to be introduced per year can be reduced to 275 units which will reduce the said cost to about 31.3 million LE. Such saving in cost shows the importance of qualified maintenance capability.

Breakdown of those figures are:

a. In the case of 8 years; 1,018 bus units to be increased, 2,280 to be replaced.

b. In the case of 10 years; 848 bus units to be increased, 1,900 to be replaced.

(4) Bus Terminal

Urban bus terminals should be located, in principle, at main transferring points and intermodal points. Large terminals are located at Ramses, Tahrir, Attaba, Abbasseya and Giza squares; the Ramses and Tahrir terminals were re-developed according to new plans after the completion of the Regional Metro line construction.

Attaba terminal should be developed based on the long-term masterplan for the Attaba/Azbakiah transportation complex (the guideline is shown in Chapter 12). As for Abbasseya terminal, such basic facilities as a waiting room and toilet facilities for passengers should be installed. Giza terminal is too small even for the present demand. As the number of bus passengers increases significantly in the CBD-Giza-Ahram corridor, the capacity of Giza terminal must be expanded.

With the future development of the railway network in GCMR, construction of station terminals will become important in order to link bus service with railway service. Terminals linking urban bus service with intercity bus service should also be developed in a systematic way. In 1986, a comprehensive study was made; "The Intercity and Urban Transport Inter-changes Study in Greater Cairo" which identified 8 proposed sites as inter-urban bus terminals (Fig. 11.7.4). At each terminal, space for urban buses should be planned together with a bus rerouting plan.

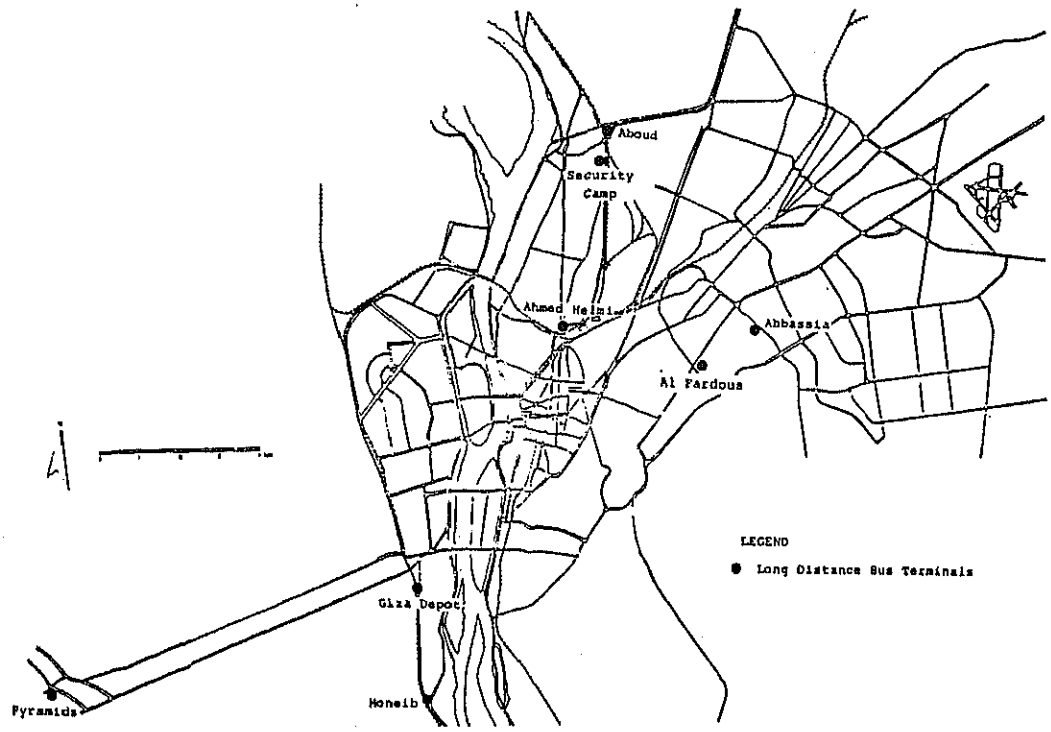


Fig. 11.7.4 Location of Inter Urban Bus Terminals

(5) Other Services

a. Introduction of Deluxe Bus (B002)

All types of efforts must be made to attract passenger car users to bus transport. For this purpose, bus service must be improved not only in quantity but also in quality.

Comfort is one of the important factors to make bus service more attractive. Comfort may be characterized by three elements; a) seat is available, b) air conditioning, and c) the bus is neat and clean. The success of the CTA minibus service is one evidence that people are willing to pay even five times the regular bus fare to have better service.

Transport costs of such deluxe buses are estimated as shown in Table 11.7.2.

Table 11.7.2 Transport Costs of Deluxe Bus

(A)	Estimate Pre-conditions	
	Price of bus	280,000 LE/unit
	Capacity	40 seats
	Operating distance	300 km/day
		10,000 km/year
(B)	Cost per passenger	
	50% seat occupancy	53 pt/ride
	60% seat occupancy	44 pt/ride
	70% seat occupancy	38 pt/ride
	80% seat occupancy	33 pt/ride

Adding an appropriate margin of profit to the above, 1 LE is regarded reasonable for the deluxe bus fare, considering the current fares of the minibus and the regular bus.

It is recommended that the feasibility of introducing the deluxe bus project in GCMR should be studied. As a first step, the operation of an experimental deluxe bus service (200 units) should be started between CBD and comparatively high income areas such as Heliopolis, Nasr City, Maadi and Dokki.

b. Introduction of CBD Bus

At present there is no bus service inside CBD except along 26th July st. It is recommended that a CBD circulating bus service be introduced together with pedestrian streets, in order to discourage passenger car use and provide better public transport service in the CBD.

The CBD bus should provide such a service that short-distance passengers would readily use without hesitation. For this reason the service must have the following characteristics;

(a) Frequent service
(b) Easy riding (low floor type bus)
(c) Cheap fare

It is suggested that the CBD bus service be introduced step by step with careful monitoring, instead of the complete introduction of the service at once.

2) Minibus, Microbus and Taxi

Minibus, microbus and taxi are categorized as well qualified public transportation modes. Of the three modes, taxi is the most demand responsive, while the first two modes provide easy access to the public.

These modes are small size mass transit modes. Therefore it is reasonable to consider that they must be operated for short distance transport. In line with the policy to reinforce rail transit modes, these small size but demand responsive mass transit modes are very suitable to be operated as a feeder service to a rail transit station.

It is a generally supported policy to stimulate change of private car use to public transport mode. However, this policy can not be achieved in one stride. The first step might be to transfer short-distance trips by private car to taxi, and long-distance trips by private car to taxi-train-taxi trips (ex. Helwan to CBD). Improvement of taxi pool in front of stations and development of taxi stops along streets which provide easy access to taxi use are recommended in order to encourage such mode transfer.

Microbus and taxi are operated by private entities. Such entities are generally more efficient than public entities, however being profit-oriented, they tend to service only high demand areas. Some guide line to control their behavior is necessary.

From the commencement of minibus operation, microbus and minibus were destined to compete against each other. At present this problem is not manifest due to the overwhelming majority in number of microbuses. In order to avoid falling into a state of less productive competition in the future, some guidance policy to separate roles of microbus and minibus will be required.

11.8 Estimation of Cost of Public Transportation Projects

1) Estimation Method

Estimation method is the same as that described in Chapter 10 for the road construction cost.

2) Result of Cost Estimate

Result is summarized in Table 11.8.1.

Table 11.8.1 Summary of Public Transport Project Costs

Project No.	Length (km)	Max. No. of Passengers at Section (yr 2000) (1000)	Financial Cost			Economic Cost
			Foreign 1000 US$	Local 1000 LE	Total 1000 LE	Total 1000 LE
R001	10.2	217	267,814	271,534	887,505	955,591
R002	7.5	90	162,781	162,903	537,300	576,217
R003	7.7	140	271,591	273,021	897,681	964,291
R004	11.7	175	84,411	167,790	361,935	371,925
R005	7.0	54	2,688	7,766	13,949	13,632
R006	13.5	15	2,792	7,241	13,661	13,497
R101	15.0	157	40,761	69,493	163,242	170,452
R102	4.3	-	83,502	92,091	284,147	302,383
R103	0.5	41	2,234	2,566	7,705	8,486
R104	0.3	92	134	234	541	563
R105	0.9	7	401	703	1,624	1,689
R106	1.7	17	757	1,327	3,067	3,190
R107	-	-	6,066	7,289	21,239	21,935
R108	-	-	8,293	9,886	28,960	29,729
B001	1018 (unit)			115,840	115,840	84,799
B002	200 (unit)		24,348	-	56,000	67,200