CHAPTER 7 TRAIN OPERATION PLAN

7.1 PASSENGER TRANSPORT

7.1.1 Passenger Train in Future by cases

(1) Possibility of ENR for coming new age

Rail transport has a characteristic of linear transport "from station to station". Road transport has the characteristic of area transit and direct access from door to door. Railway must compensate for its handicap of transport from station to station with much better speed than road transportation.

Tariff and speed are two key factors impacting passenger share of each transport mode. The elasticity of tariffs are limited by modal share or public opinion, as shown in the results of the questionnaire survey. Shorter travel time can be achieved by sincere efforts of transportation enterprises.

In Egypt, automobiles on main roads parallel to rail lines run at 90 - 100 km/h between cities and 50 - 60 km/h inside cities. The average speed of cars are 80 - 85 km/h. Almost all trains on trunk lines are running at 60 - 80 km/h, except turbo train running at 90 - 100 km/h on Cairo - Alexandria line. The average speed of all express trains should be raised to compete with the road transport.

The railway track figure of ENR is suitable for higher speed operation. ENR has the potential to run its trains at world class speeds on current lines at relatively low cost. Current technology permits higher speed without large investments.

The technical level and experience of ENR employees can improve the railway to compete with highway transport and operate a profitable service by utilizing its railway tracks which have good alignment of curves and gradients.

When train service, average speed, comfort, etc., is superior to road transport, the tariff rate of ENR can be accordingly increased.

(2) The transportation capacity

The demand forecast group estimated the cross-sectional passenger volume for each main line. From these results, we can estimate future traffic flow patterns. The following table shows the estimated cross-sectional passenger volume and train km.

1995 train km is estimated from the data in the Train Time Table of ENR for 1995/1994.

The passenger-km of the three cases ("Without Case", "Case 1-1/2", "Case 2-1/2") show that the passenger volume of "Without Case" and "Case 2-1/2" are similar.

This is because changing travel time has a small effect on passenger demand, according to analysis of the demand forecast group. This means that efforts to decrease travel time contributes only to lower costs by increasing efficiency of rolling stock and personnel.

Table 7.1. 1 Data for Passenger volume and Train km in Future

Section	Share	94/95 base	2002	2007	2012
Cairo - Alexandria		19,085	23,666	26,911	31,109
Passenger numbers Index (94/95 = 100)		100	124	141	163
Cairo-Benha-Zagazig-Ismailia-Port Said		7,497	9,371	11,245	12,744
Passenger numbers Index (94/95 = 100)		100	125	150	170
Cairo-Tanta-Mansura-Sherbin-Damietta		5,168	6,357	7,236	8,269
Passenger numbers Index (94/95 = 100)		100	123	140	160
Cairo - Asyut - Aswan - El Sad El Ali		46,818	57,587	65,546	74,910
Passenger numbers Index (94/95 = 100)		100	123	140	160
Subtotal of main line	64 %	78,569	96,981	110,937	127,033
Train km Index (94/95 = 100)		100	123	141	162
Other lines Train km/day	36 %	43,287	52,902	59,661	67,937
Train km Index (94/95 = 100)		100	122	138	157
TOTAL Train km/day	100 %	121,856	149,883	170,598	194,970
Train km Index (94/95 = 100)		100	123	140	160

Note: Total train km are assumed to increased at the same rate as passenger volume.

Results of calculations for the major lines and 3 cases are outlined below.

1) "Without Case"

No speed-up, 5% ENR tariff increase, 5% bus tariff increase, is defined as the "Without Case".

Table 7.1. 2 The passenger numbers and coach km in "Without Case"

Study Team estimation				
Article	**1995**	**2002**	**2007**	**2012**
Passenger-km / day (1000)	145,224	182,986	213,242	245,377
Passenger-km / day (growth)		3.36 %	3.11 %	1.41 %
Coach km per day (index starting 1995)	100	126	147	169

2) Case 1-1/2

10% speed-up, 7% ENR tariff increase, 5% bus tariff increase, is defined as "Case 1".
The different tariff increase has a large impact on passenger numbers.

Table 7.1. 3 Passenger-km and coach km "Case 1-1/2"

Study Team estimation				
Article	**1995**	**2002**	**2007**	**2012**
Passenger-km / day (1000)	145,224	164,335	192,313	221,651
Passenger-km / day		1.8 %	3.2 %	2.9 %
Coach km / day (index starting 1995)	100	113	132	153

3) Case 2-1/2

10% speed-up, 7% ENR tariff increase, 7% bus tariff increase, is defined as "Case 2".
Case 2 is different from the "Without Case" in that speed-up is 10% (not 0%), and ENR and bus tariffs increase 7% (not 5%). The main competitor to ENR is road transport, and when tariffs are increased the same percentage, there is very little impact of increased train speed, according to the estimation model of the Study Team. As the result, the traffic volumes of

Case 2 and the "Without Case" are very similar. So the necessary number of cars for passenger transport are also very similar.

Table 7.1. 4 Passenger-km and coach km in "Case 2-1/2"

Study Team estimation				
Article	1995	2002	2007	2012
Passenger-km/day (1000)	145,224	182,789	213,048	245,141
Passenger-km/day (growth)		3.3 %	3.1 %	2.8 %
Coach km/day (index starting 1995)	100	126	147	169

(3) Alexandria - Abu Quir Line

The number of cars necessary for this line are calculated from the Passenger km of ENR, and from the population increase in Alexandria. The number of locomotives and coaches, calculated in the following table, is already included in the figures of each case shown above.

Table 7.1. 5 Necessary number of Locomotives and coaches on Alexandria - Abu Quir Line

Population (1000)

Article		1995	1998	2002	2007	2012
- Population in Alexandria - Growth		3,431	3,743 2.94 %	4,057 2.03 %	4,822 3.52 %	5,156 1.35 %
Locomotives (1650 HP)	In operation	14	15	16	19	21
	In reserve	3	3	4	4	5
	Total	17	18	20	23	26
Coaches	In operation	84	90	96	114	126
	For reserve	21	22	24	28	31
	Total	105	112	120	142	157
	Total current	175				

Note: Approximately 20 % of total rolling stock in reserve.

7.1.2 Train Operation Forecast

The train operation pattern can be checked by the traffic demand forecast on major sections of each line. The following shows the growth of passenger volume which was used for the base case for calculating required train capacity.
From the analysis of future traffic patterns, the train operation pattern will remain approximately the same on each line.

(1) Cairo - Alexandria Line

Passenger traffic between Cairo and Alexandria might be separated into 5 sections :

Cairo - Qalyub
Qalyub - Benha
Benha - Tanta
Tanta - Damanhur
Damanhur - Alexandria

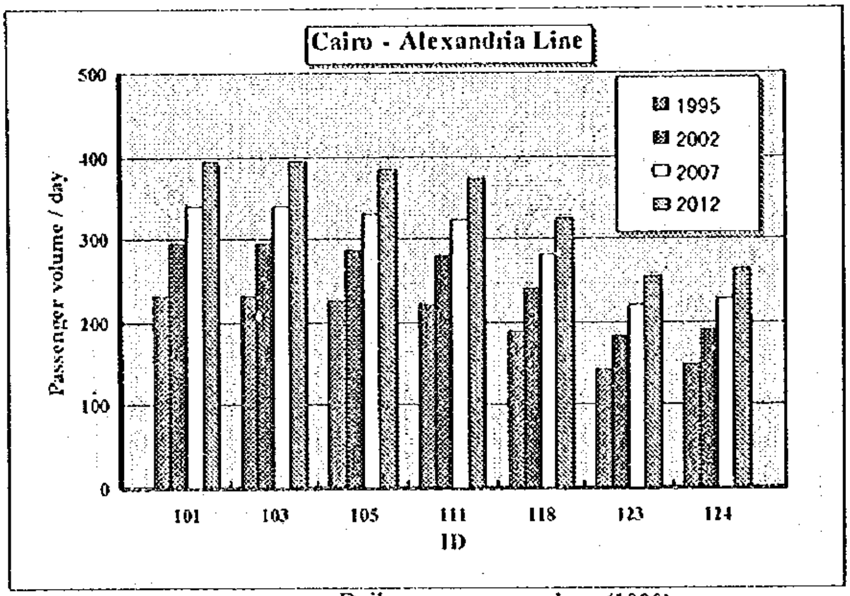
Although part of the passenger volume splits at Benha station towards Zagazig, the passenger volume between Benha and Tanta maintains a similar level because of dense passenger traffic between Benha and Tanta. Until Tanta, traffic from Greater Cairo is a large part of total traffic. From Damanhur to Alexandria, fewer passengers are to/from Cairo, and more to/from Alexandria. The railway line between Cairo and Alexandria is the most important section for the commercial transport of ENR.

The future diagram pattern for 2002, 2007 and 2012 may be similar to the current train diagram, according to the traffic flow forecast by the questionnaire survey, and by the calculation of traffic demand of passengers as shown in the following figures. But we should note that on the Damanhur and Alexandria section is increasing its role in transportation yearly compared to passenger flows among Cairo, Benha and Tanta.

Table 7.1. 6 Passenger Train Capacity growth between Alexandria and Cairo in the Base Case

Section			Base Case			
From	To	ID	1995	2002	2007	2012
Cairo	Shubra Rail (Br.)	101	100	126	146	169
Shubra El Kheima	Qalyub	103	100	126	146	169
Toukh	Benha	105	100	127	147	170
Berket El Sabai	Tanta	111	100	127	147	170
Etai El Barud	Damanhur	118	100	127	149	172
Bohairet El Hagar	Sidi Gaber	123	100	128	154	179
Sidi Gaber	Alexandria	124	100	128	154	179

Fig. 7.1.1 Passenger Train Capacity required between Alexandria and Cairo in the Base Case



Daily passenger numbers (1000)

The vertical axis shows the passenger volume which will determine the transport capacity of trains, and the horizontal axis is for the coded sections. The codes are shown in the above table. The increase of Alexandria is a little greater than other areas, but the train diagram will keep the same formation, because the number of trains near Alexandria is relatively more densely diagrammed than other sections.

(2) Cairo - Benha - Zagazig - Ismailia - Port Said Line

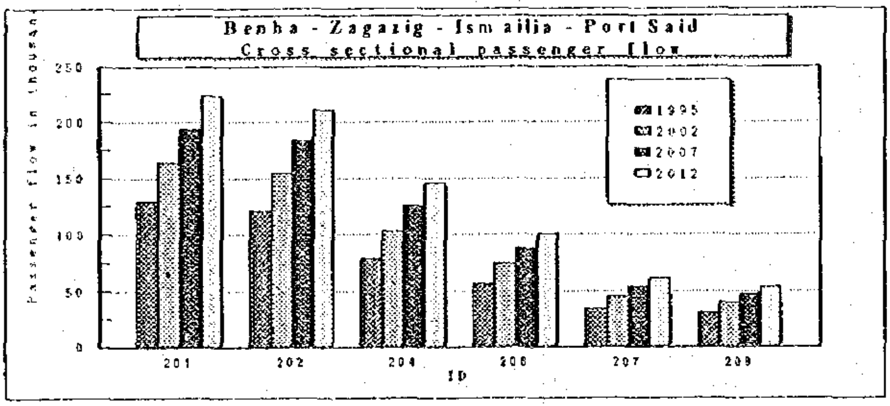
The trunk line between Cairo, Benha, Zagazig, Ismailia and Port Said is essentially different from the other two trunk lines along the Nile. This line faces severe competition from road transport because of the relatively slow speed of trains, since completion of the highway network which connects directly to Greater Cairo.

By 120 km/h operation, travel between Cairo and Zagazig can be reduced to 1 hour, and travel between Cairo and Ismailia will become 2 hours. Zagazig will have good connections to Greater Cairo by this project, which is not so difficult. Whereas road traffic between Ismailia and Cairo runs in 2 hours by desert road, railway traffic will be arranged to target regional traffic among cities between Benha and Ismailia, by utilizing its double track line.

Table 7.1.7 Passenger Train Capacity required between Benha, Zagazig, Ismailia, and Port Said in the Base Case

Section			Base Case			
From	To	ID	1995	2002	2007	2012
Benha	Minya El Qamh	201	100	127	151	174
Minya El Qamh	Zagazig	202	100	128	151	174
Abu El Hammad	Tall El Kebeer	204	100	131	160	184
Nefesha Faez S.	Ismailia	206	100	132	154	178
Ismailia	Qantara Gharb	207	100	133	156	179
Qantara Gharb	Port Said	208	100	134	156	180

Fig. 7.1.2 Passenger Train Capacity required between Benha, Zagazig, Ismailia and Port Said in the Base Case



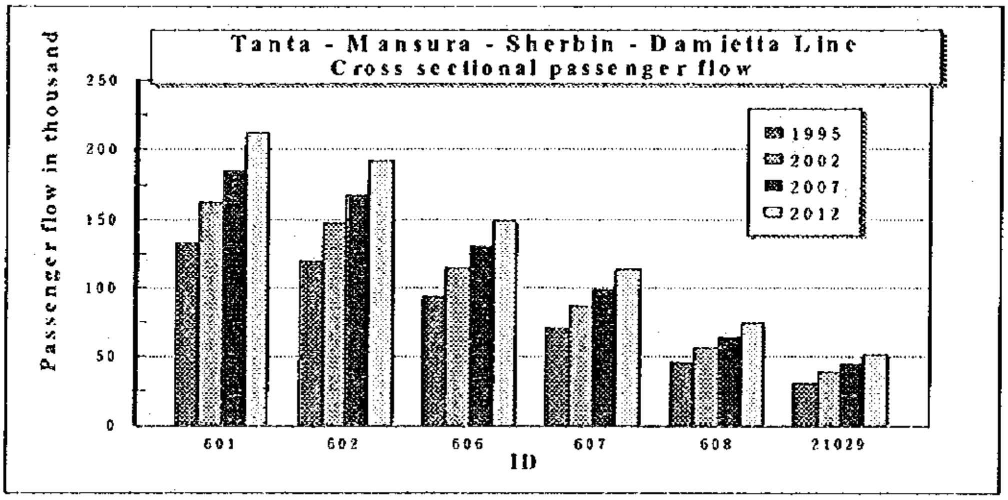
Daily passenger flow (1000)

(3) Cairo - Tanta - Mansura - Sherbin - Damietta Line

Table 7.1.8 Passenger Train Capacity required between Tanta, Mansura and Damietta in the Base Case

Section			Base Case			
From	To	ID	1995	2002	2007	2012
Tanta	Mahalet Roh	601	100	126	144	167
Mahalet Roh	Mahalla El Kob	602	100	126	144	167
Talkha	Mansura	606	100	125	143	166
Mansura	Sherbin	607	100	125	144	167
Sherbin	Kafr Sad	608	100	126	145	169
Kafr El Battekh	Damietta	21029	100	126	146	170

Fig. 7.1.3 Passenger Train Capacity required between Tanta, Mansura and Damietta in the Base Case



Daily passenger flow in thousand

(4) Cairo - Asyut - Luxor - Aswan - El Sad El Ali Line

Cairo - Asyut - Aswan - El Sad El Ali line might be separated into following 7 sections.

Cairo - Giza
Giza - El Wasta
El Wasta - Beni Suef - El Minya
El Minya - Asyut - Sohag
Sohag - Qena - Luxor
Luxor - Aswan
Aswan - El Sad El Ali

Cairo - Giza section is used for the commuter traffic of Greater Cairo and for the terminal section of Express trains in Upper Egypt. The role of commuter traffic of this section is increasing, and this section will become a bottleneck for ENR train operations until the opening of Metro No. 2 line to Giza station.

Giza - El Wasta section is used for relatively short distance inter-city transport, with good connections to Greater Cairo.

El Wasta - Beni Suef - El Minya section is used for middle distance inter-city express trains to Cairo and for business use. This section faces fierce competition from road transport using the parallel highway road along the Nile.

The El Minya - Sohag section is for relatively long distance inter-city transport to Greater Cairo for business and for connections to mid-sized cities. Until Sohag, railway trains are very competitive with road transport, and passenger volume is relatively high.

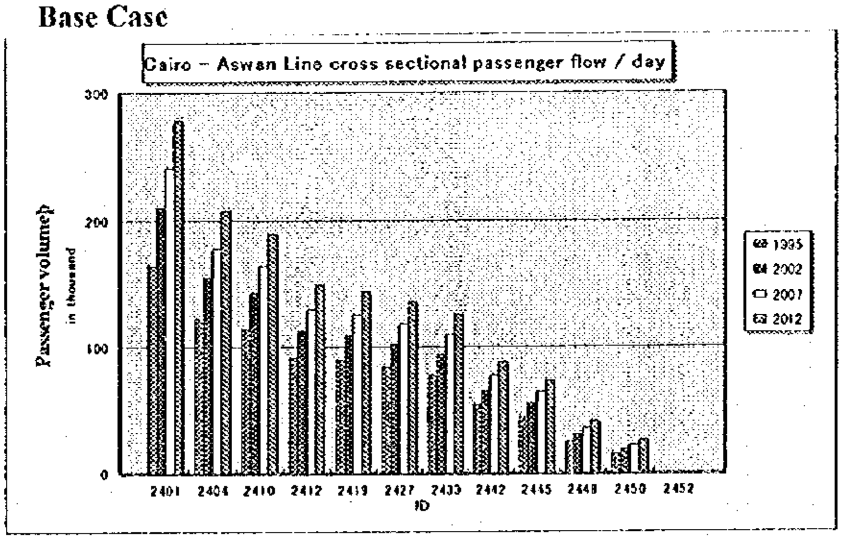
Sohag - Luxor section is for inter-city traffic for business, school and tourist use. This section has two purposes: a transport line alongside major cities, and transport for long distance tourists.

The section between Luxor and Aswan is rich for the many world famous historical monuments. Many tourists will use deluxe and rapid trains by day when proper service is available.

Table 7.1.9 Transition of Passenger Train Capacity required between Cairo, Asyut and Aswan in the Base Case

Section			Base Case			
From	To	ID	1995	2002	2007	2012
Cairo	Imbaba Br.	2401	100	128	147	171
Bouluq El Dakro	Giza	2404	100	127	146	169
Aiyat	El Wasta	2410	100	125	144	166
Bushu	Beni Suef	2412	100	124	142	164
Samalout	El Minya	2419	100	122	140	160
Manfalut	Asyut	2427	100	122	141	161
Maragha	Sohag	2433	100	122	142	163
Desna	Qena	2442	100	122	144	165
Qous	Luxor	2445	100	122	144	166
Idfu	Kom Ombo	2448	100	123	145	166
Abu El Rishu Qeb	Aswan	2450	100	123	145	167
Sadqa	El Sad El Ali	2452				

Fig. 7.1.4 Passenger Train Capacity required between Cairo, Asyut and Aswan in the Base Case



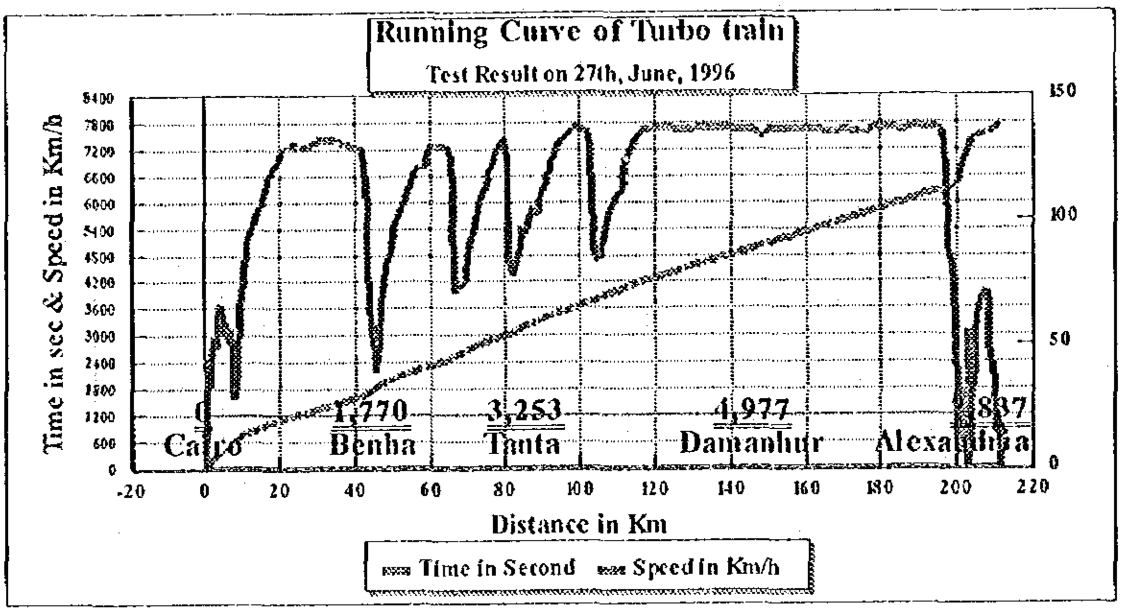
Daily passenger flow (1000)

7.1.3 Possible Train Speed in Future

(1) Test results of train running performance

1) Turbo Train

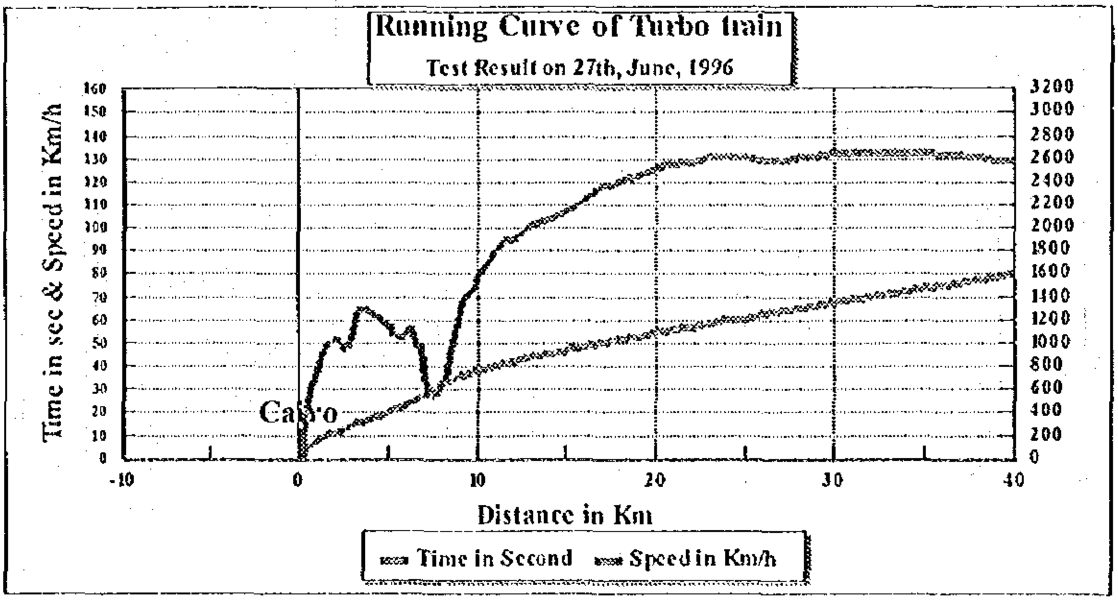
Fig. 7.1.5 Test results of running performance of Turbo Train



This running test was held between Cairo and Alexandria by the 905 Turbine Train on 27th, June, 1996.

The turbine train runs at 140 km/h in most places, but the acceleration is relatively slow in low and in middle speed zones, and the speed restrictions near big stations dramatically reduce average running speed. This train requires 20 km to increase speed from 0 to 140 km/h, so it requires approximately 20 km on the section between Cairo and Tanta. The Turbo train cannot maintain its maximum speed for long distances.

Fig. 7.1.6 Turbo train running performance near Cairo

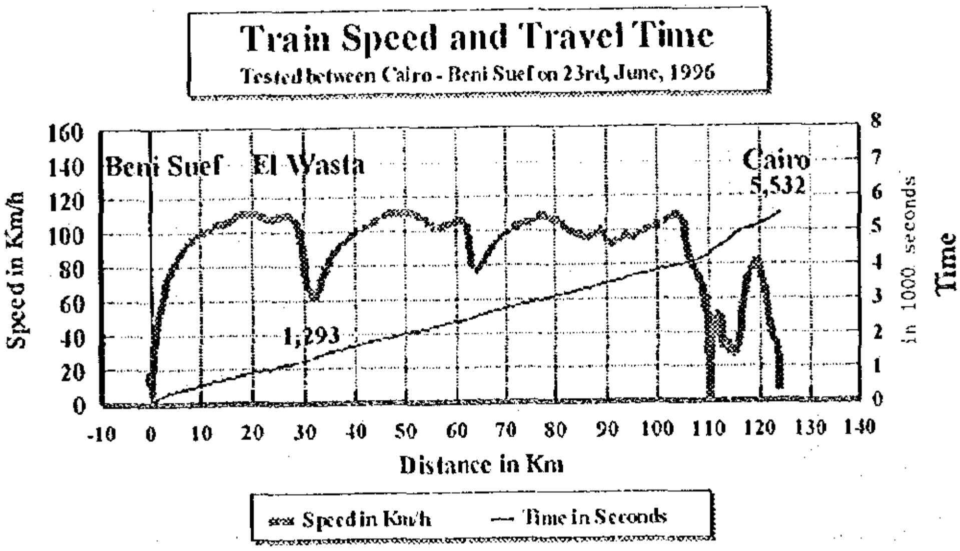


Slow train speed near Cairo and Alexandria significantly reduces travel time between Cairo and Alexandria.

2) Ordinary express trains

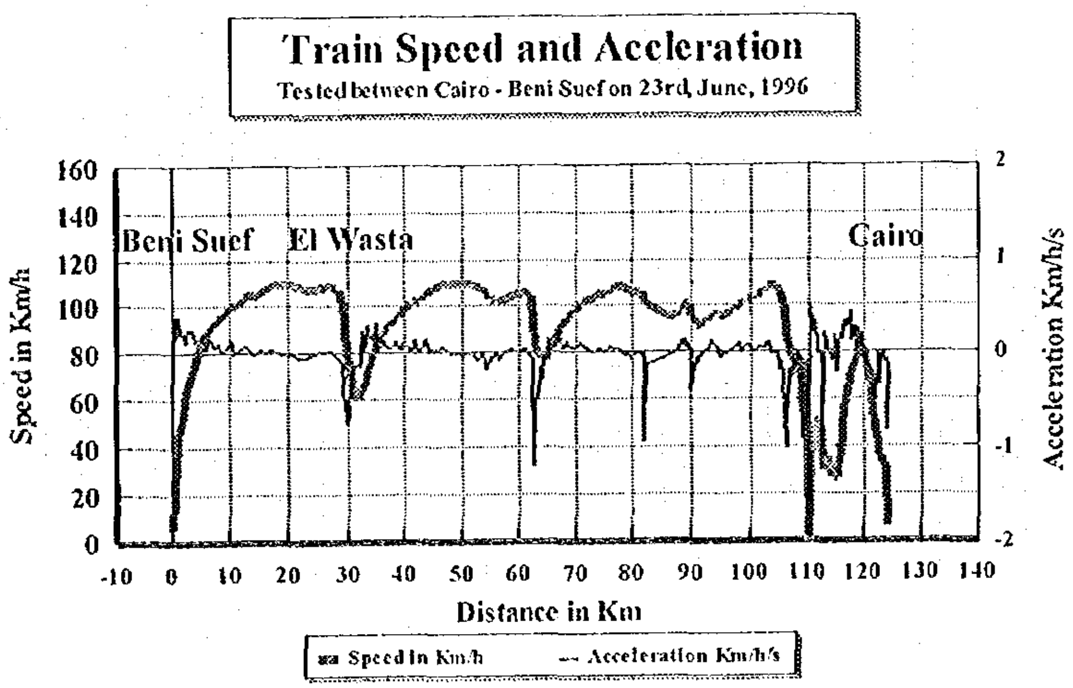
This running test was held between Beni Suef and Cairo by the No. 163 passenger train, hauled by a 2475 HP locomotive on 23rd, June, 1996. The formation of train set was 1 locomotive and 13 coaches (1 Brake Van, 4 AC coaches, and 8 ordinary cars).

Fig. 7.1. 7 Ordinary Express Train



Current train speed is 110 km/h maximum, but the travel time between Beni Suef and Cairo equaled the scheduled time. If the maximum speed and acceleration is improved, travel time may be shortened significantly.

Fig. 7.1.8 Speed and Acceleration force of express train



Acceleration is 0.45 km/h/sec in low speed areas, with maximum speed of about 110 km/hr in high speed areas. Normal braking performance is -1.5 km/h/sec in most cases. More acceleration can be expected in lower speed areas without friction force problems between rail and wheel. From the test results, engine output efficiency might be considered as 85. Through many running tests, we have the impression that almost all locomotives used for Express trains are maintained in good condition and the skill of drivers are good enough for future improvement of train speed.

(2) Results of simulation

1) Cairo - Alexandria Line

(a) Track figure for train operation

As shown in the following figures, the track configuration of Cairo - Alexandria line is suitable for 160 km/h operation and the section between 112 km and 200 km might be able to handle 200 km/h operation in the future. By introducing new rolling stock and ATC safety devices, etc., 200 km/h operation can be achieved by reducing speed at Qalyub, Benha, Birket El Sab, Tanta, near Kafr El Zayat and Sidi Gaber - Alexandria sections. The potential of Egypt's track alignment is a valuable asset of ENR and of Egypt. Introducing pendulum type rolling stock will not have a big impact on the Cairo - Alexandria line, because locations with maximum speeds of 200 km/h or 160 km/h are restricted to very few sections near Cairo, Benha, the Sidi Gaber - Alexandria section, etc.

Fig. 7.1.9 Limiting speed of Curves for ordinary type trains on Cairo - Alexandria line

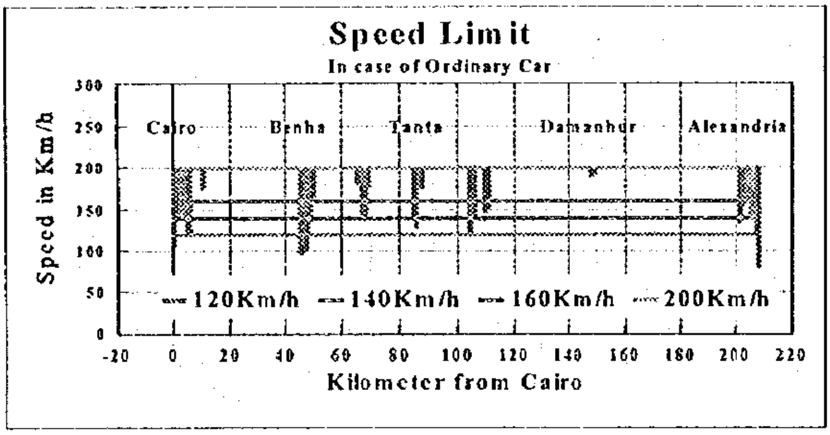
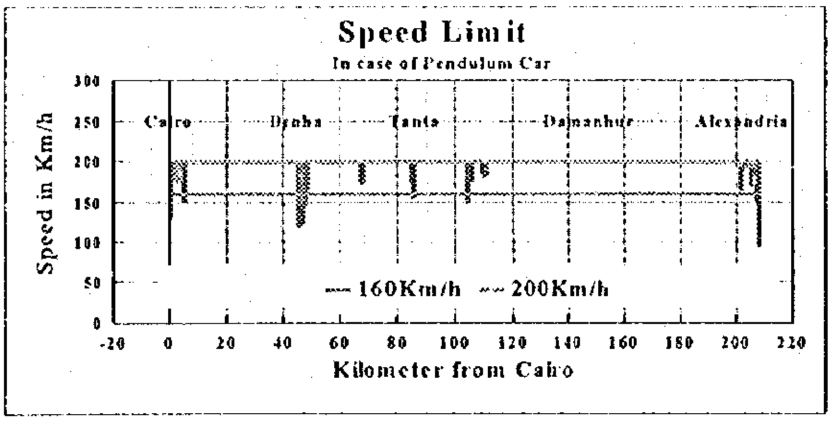


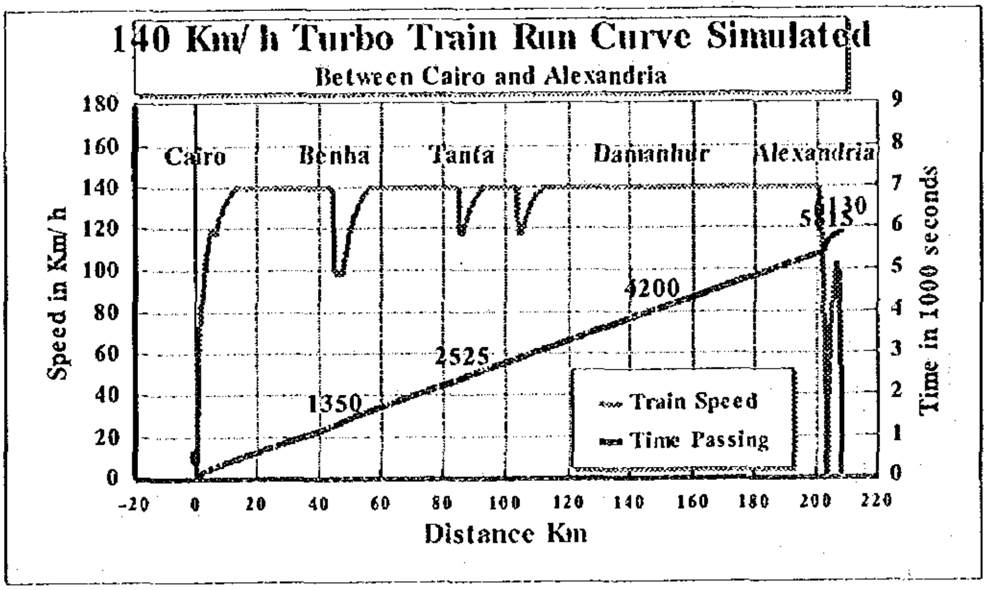
Fig. 7.1. 10 Limiting speed by Curves for Pendulum Type trains on Cairo - Alexandria line



Track running speed capability is enough to cut travel time to 1 hour 50 minutes between Cairo and Sidi Gaber. A convenient uniform diagram has business use inter-city trains between Cairo and Alexandria run between Cairo and Sidi Gaber, and long distance trains which run to Luxor or Aswan may depart from Alexandria. Travel time within 2 hours can be achieved by this efficient equal departure time train diagram, by high efficiency rotation of train formations by equipping service facilities at both terminal stations.

(b) Train running curve

Fig. 7.1.11 Figure of running performance of 140 km/h Turbo Train simulated in ideal conditions



(c) Travel time

Table 7.1.10 Assumed Travel Time of Turbine Train

Assumed Travel Time of 140 km/h Turbo Train

Item	Cairo - Sidi Gaber	Cairo - Alexandria
	Minutes	Minutes
Current Travel time	115	130
Calculated Travel time	101.8	109.3
	102	110
Improvement	-11	-15
	1 Hr 42 minutes	1 Hr 50 minutes

Calculated travel time = Simulated time + 5 + 2 minutes stop time at Sidi Gaber

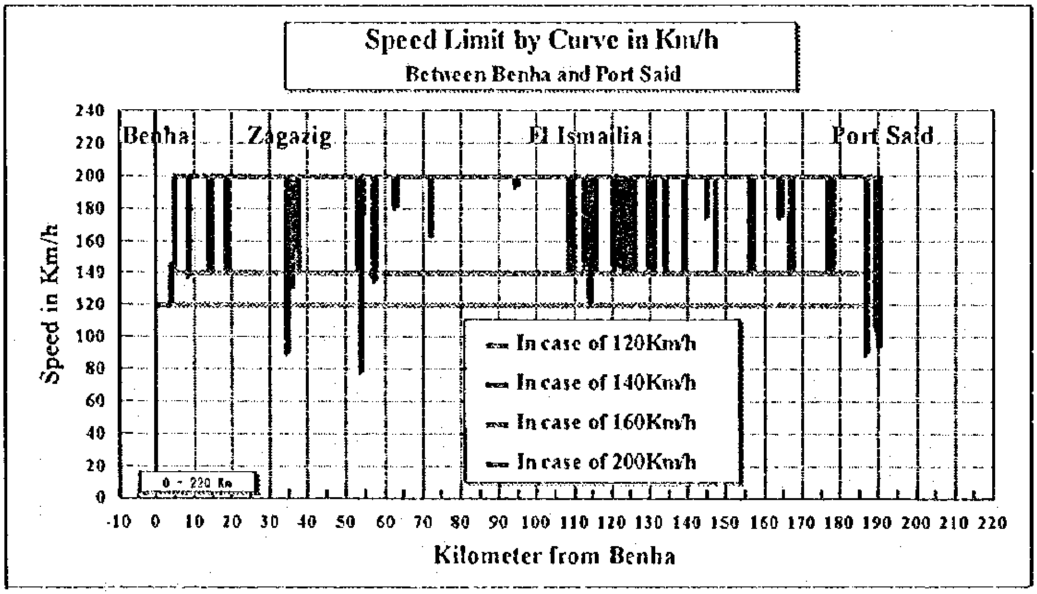
At first, travel time might be shortened 10 minutes, because improvement of train speed should be gradually increased inside Cairo and Alexandria. Problems with track facilities, especially track simplification and safety device improvement inside Cairo station and between Sidi Gaber - Alexandria should be resolved when the reduction of travel time is recognized as important for competition with road transport.

2) Benha - Zagazig - Ismailia - Port Said Line

(a) Track figure for train operation

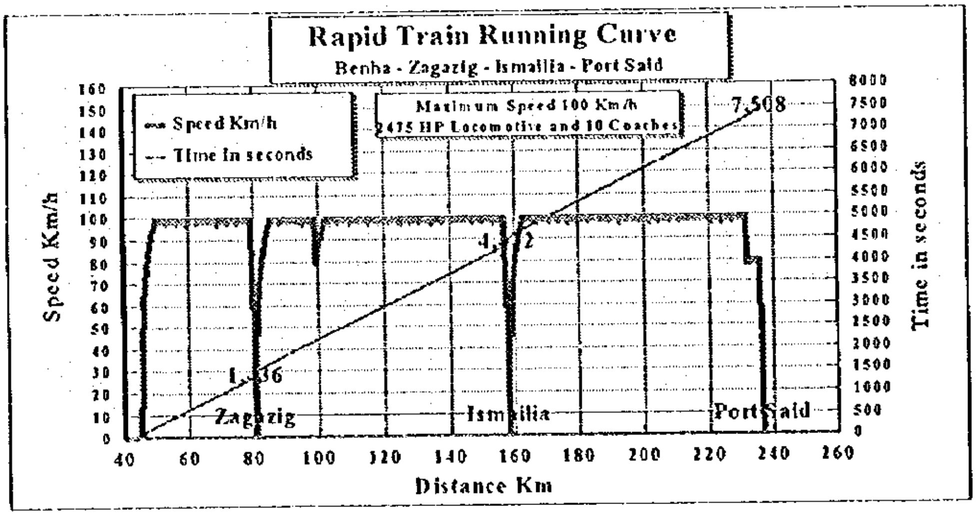
The double track lines between Benha - Zagazig and between Zagazig - Ismailia can handle 140 km/h by improved train sets. By 120 km/h operation with current train sets, the travel time between Cairo and Zagazig can be reduced to 1 hour, and the travel time between Cairo and Ismailia will become 2 hours. Zagazig will have good connections to Greater Cairo with these measures, which are not very difficult. Road transport between Ismailia and Cairo takes 2 hours by desert road. Railway traffic can be arranged to handle regional traffic among cities between Benha and Ismailia, and for inter-city service between Cairo and Zagazig, by utilizing the advantages of the double track.

Fig. 7.1.12 Curves and maximum speed of Benha - Zagazig - Ismailia - Port Side section



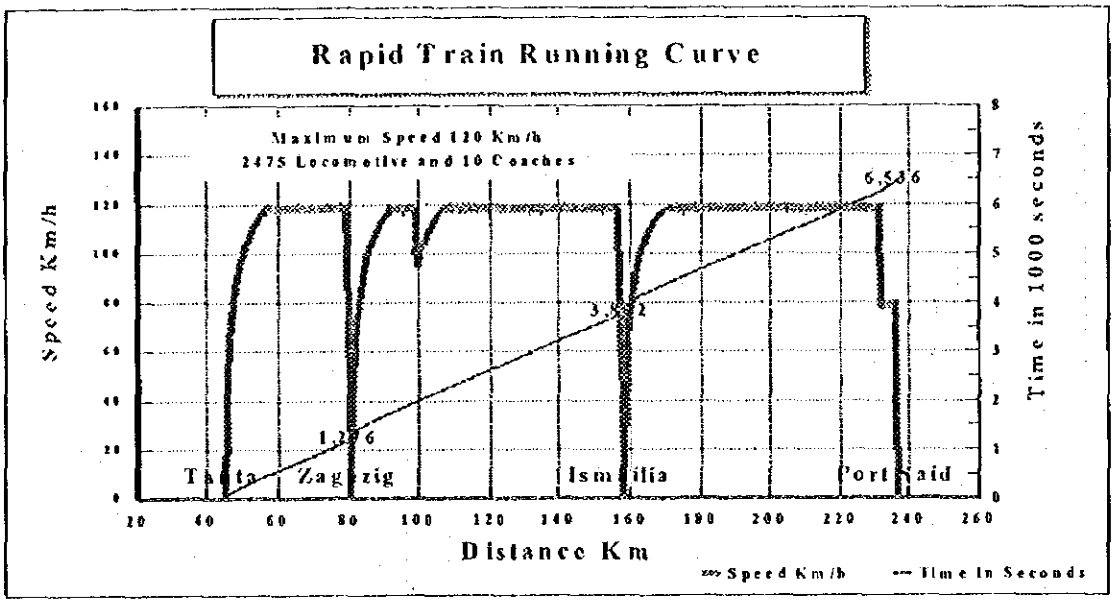
(b) Train running curve

Fig. 7.1.13 Simulated Running Curve of 100 km/h Express Train hauled by 2475 HP locomotives



This is a simulation for the case of Running Curves of 100 km/h Express Train, hauled by 2475 HP locomotives (assumed 10 coaches).

Fig. 7.1.14 Simulated Running Curve of 120 km/h Express Train hauled by 2475 HP locomotives



This simulation is for the case of Running Curves of 120 km/h Express Train, hauled by 2475 HP locomotives (Assumed 10 Coaches).

(c) Travel time

Current maximum speed on this section is 90 km/h. We have calculated in case of 100 km/h and 120 km/h. The results of the simulation are shown in the following table.

Table 7.1.11 Travel Time assumed for 100 and 120 km/h Express Trains

Category	Benha - Zagazig	Benha - Ismailia	Benha - Port Said
	Minutes	Minutes	Minutes
Current Travel time	35	105	185
Calculated Travel time 100 km/h train	28.63	84.74	153.89
Rate of decrease	-18.2	-19.3	-16.8
Calculated Travel time 120 km/h train	25.83	76.76	142.43
Rate of decrease	-26.2	-26.9	-23.0

Calculated travel time = Simulated time + 5 + 1 minute stop time at each station
Lost time of 1 stop by 100 km/h train is calculated at 3 min. 30 second.
Loss time of 1 stop by 120 km/h train is calculated at 4 min. 30 second.
(1 minute stop case)
Current maximum speed of Express Train on this section is 90 km/h.
Decreasing speed from 100 km/h to 30 km/h is calculated to take 90 seconds on Ismailia - Port Said line.
Decreasing speed from 120 km/h to 30 km/h is calculated to take 150 seconds on Ismailia - Port Said line.
Non stop train passes 8 stations on Ismailia - Port Said section.

(d) Lost time by lowering speed at passing station

On the section of tablet system, trains are operated by decreasing speed at passing stations. Currently trains are operated at maximum speed of 90 and 75 km/h sectional wise on Ismailia - Port Said line, by decreasing speed for passing 8 stations. Two typical cases are shown for indicating the reason of time lost at one passing station by decreasing speed. This time loss model can be applied to other sections approximately.

Fig. 7.1.15 Lost time (In case of maximum speed 100 km/h)

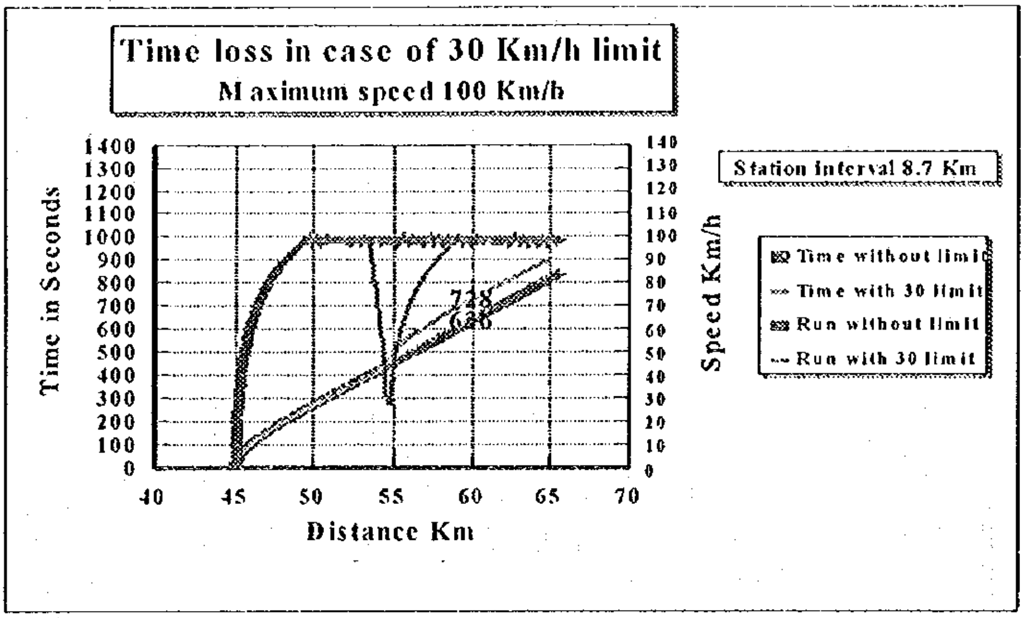
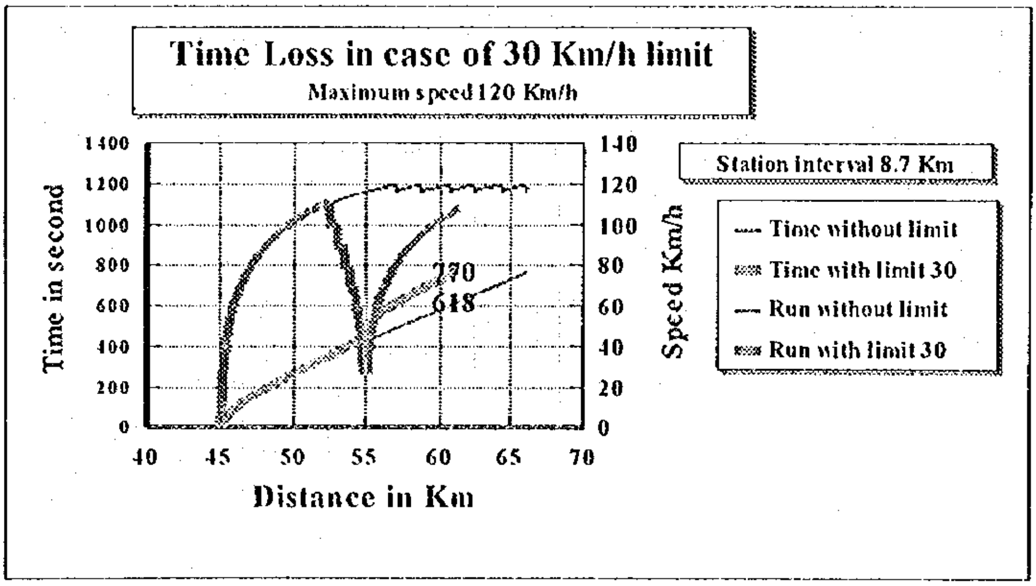


Fig. 7.1.16 Lost time (In case of maximum speed 120 km/h)

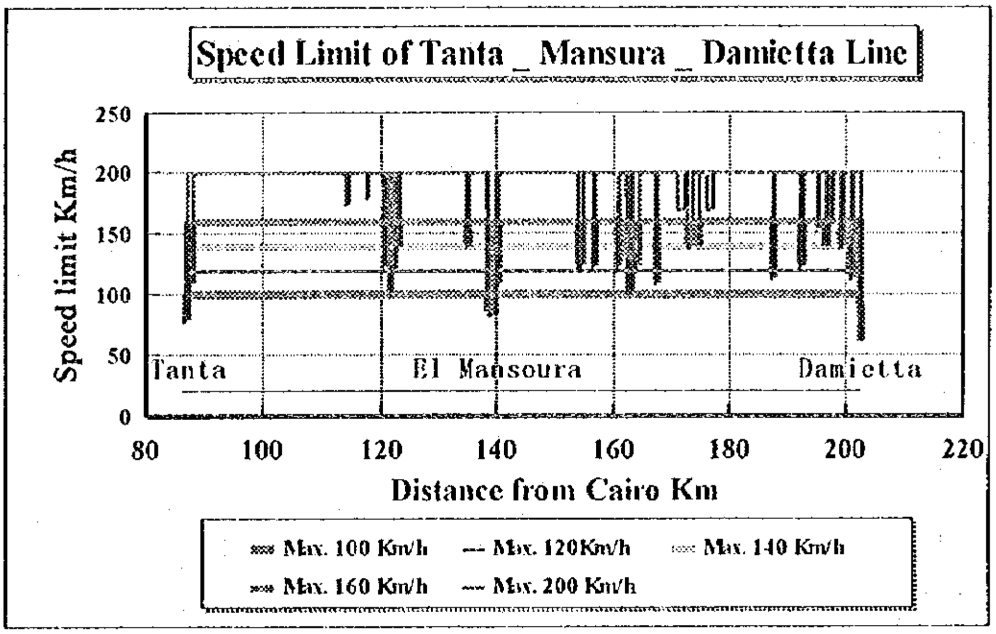


The time lost by decreasing train speed from 100 km/h to 30 km/h is approximately 90 seconds. The time lost by decreasing train speed from 120 km/h to 30 km/h is approximately 150 seconds.

3) Tanta - Mansura - Damietta Line

(a) Track figure for train operation

Fig. 7.1.17 Curves and maximum speed

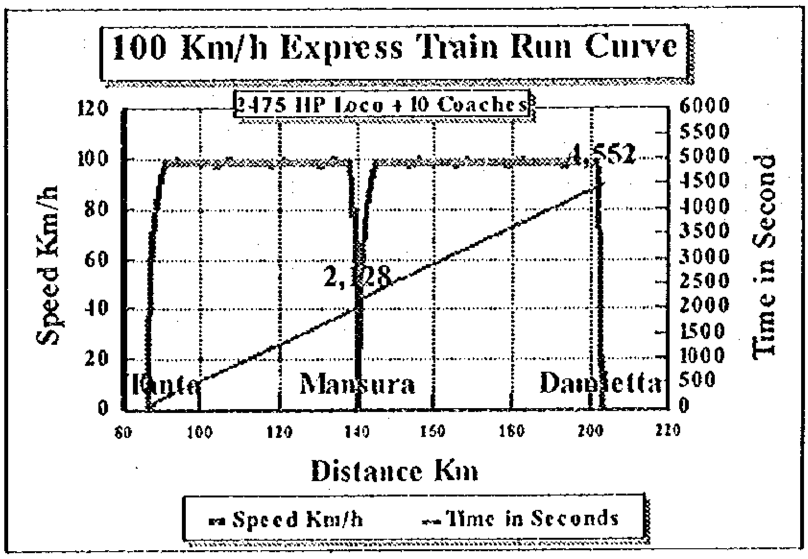


For 120 km/h operation, there exist few speed restrictions on the Tanta - Mansura - Damietta line. Current express trains run at a maximum speed of 90 km/h. Other passenger trains run at 70 km/h. Much shorter travel time between Cairo and Mansura can be achieved by increasing speed, and by reducing the stopping time at Tanta station, etc. 140 km/h operation can be achieved by utilizing a safety system between Tanta and Mansura section. Trains to Zagazig or Mansura decrease their average speed to 45 - 60 km/h by stopping a long time at Benha or Tanta.

There are few sections on the Tanta, Mansura and Damietta line which cannot handle 120 km/h.

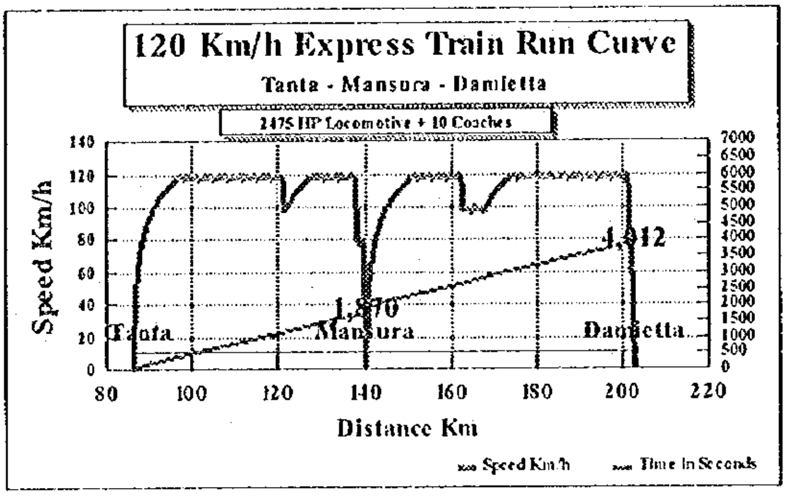
(b) Train running curve

Fig. 7.1.18 100 km/h Express Train running curve



This run curve is simulated for the case of Running Curves of 100 km/h Express Train, hauled by 2475 HP locomotives (Assumed 10 Coaches.).

Fig. 7.1.19 120 km/h Express Train running curve



This run curve is simulated for the case of Running Curves of 120 km/h Express Train, hauled by 2475 HP locomotives (Assumed as 10 Coaches).

The average speed between Tanta and Mansura was 65 - 78 km/h, and current train sets can achieve 120 km/h operation, although current maximum speed of rapid trains is 90 km/h. Trains between Cairo and Mansura can run at an average 90 km/h, like the train between Cairo and Alexandria, if maximum speed is increased to 120 km/h.

(c) Travel time

The analysis of the travel time should be done on two sections of Tanta - Mansura and Mansura -Damietta separately, because of the different operating systems. The travel time is calculated by adding 5% to the simulated run time, for maintenance of track, for operation of train driver, and for formation of Train Diagram. The travel time between Tanta and Mansura will be 35 minutes in case of 120 km/h operation, and 37 minutes 30 seconds in case of 100 km/h operation. If this section adopts the method of operation without lowering speed at passing stations, the travel time between Mansura and Damietta will be 36 minutes in case of 120 km/h operation and 43 minutes 30 seconds in case of 100 km/h operation.

Table 7.1.12 Travel Time

Travel Time of 120 km/h and 100 km/h

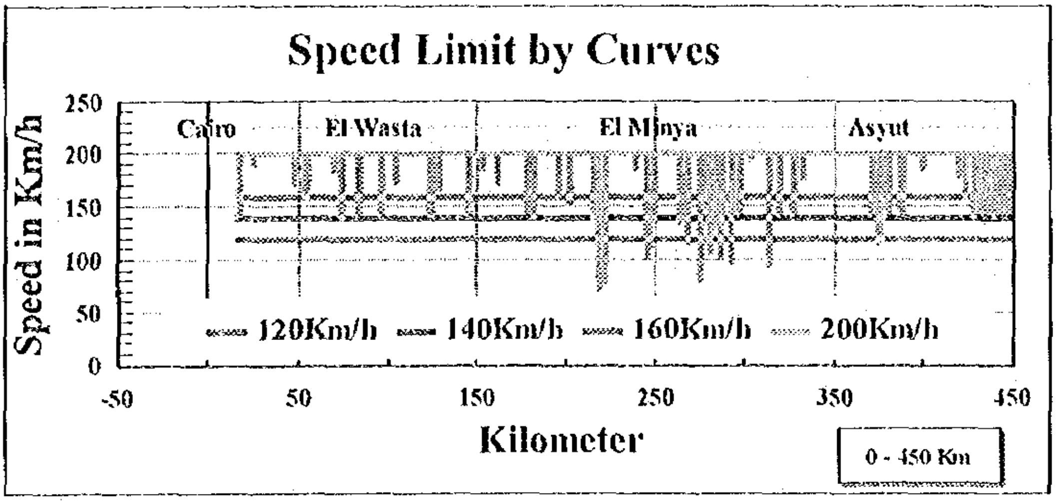
	Maximum Speed	Signal System	Case	Tanta - Mansura (seconds)	Mansura -Damietta (seconds)
Calculation	120	Automatic Signal	Case 1	1,970	2,042
Calculation	120	Tablet Block	Case 2		4442
Calculation	100	Automatic Signal	Case 3	2,128	2,424
Calculation	100	Tablet Block	Case 4		4,824
For Diagram	120	Automatic Signal	Case 1	2,069	2,144
For Diagram	120	Tablet Block	Case 2		4,664
For Diagram	100	Automatic Signal	Case 3	2,234	2,545
For Diagram	100	Tablet Block	Case 4		5,065

Note: There are 16 stations between Mansura and Damietta.

4) Cairo - Asyut - Luxor - Aswan Line

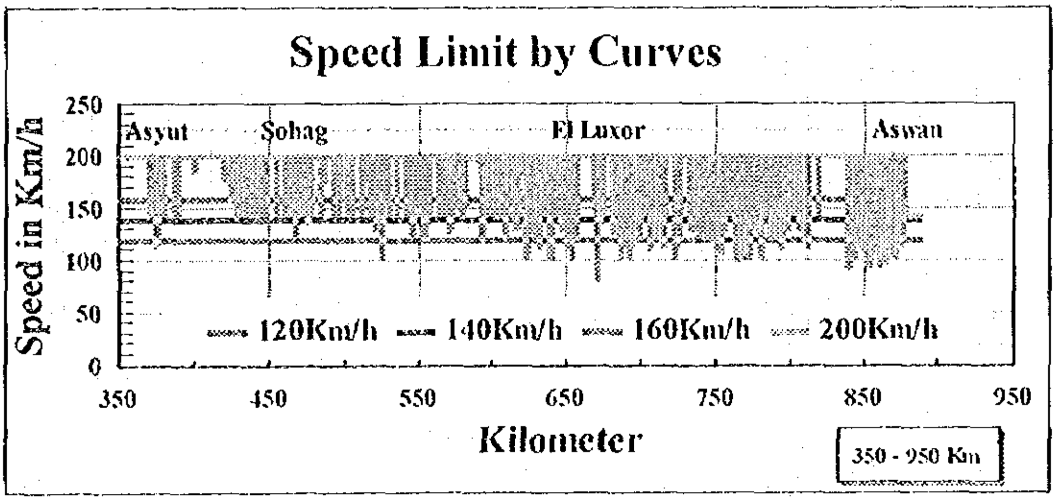
(a) Track figure for train operation

Fig. 7.1.20 Curves and maximum speed From Cairo to Asyut



Between 15 km (near Giza station) to 670 km (near Luxor station), 140 km/h operation can be easily achieved by running at 100 km/h nearby major stations of Kafr Amar, El Rapa, near El Wasta, Beni Suef, Biba, Mahagha, near Samalut (only 75 km/h), El Minya, El Mahras, Al Rupa, Deirut, Asyut etc.

Fig. 7.1.21 Curves and maximum speed from Asyut to Aswan

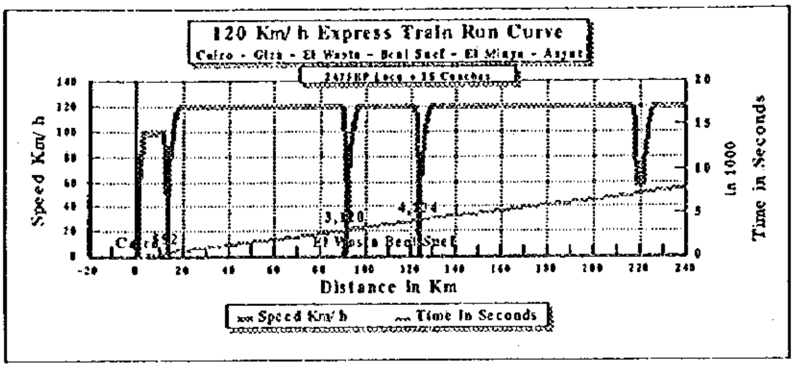


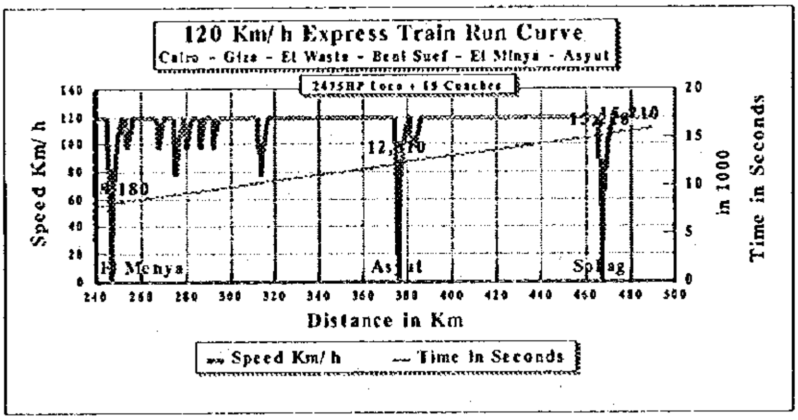
From Luxor to Deraw, 120 km/h operation is suitable by restricting speed at major stations, which can be seen in the following figure. Sections between 765 km and 813 km, and between 838 km and Aswan (880 km) might be restricted to 100 km/h operation for better control by driver.

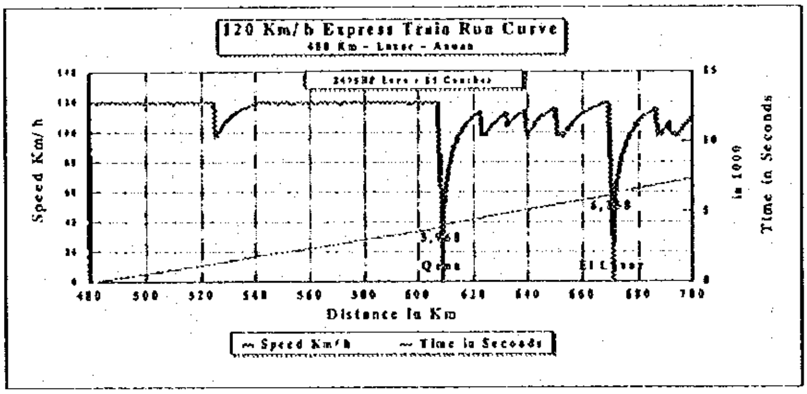
(b) Train running curve

There is too much train running simulation data to process at one time. To process, the data is separated into two sections: 0 - 480 km, and 480 - 880 km. The following shows the simulation results of perfect operation, and after considering control by the driver :

Fig. 7.1.22 Train running curve in case of 120 km/h max. speed - by perfect simulated operation (no allowance for driver control)







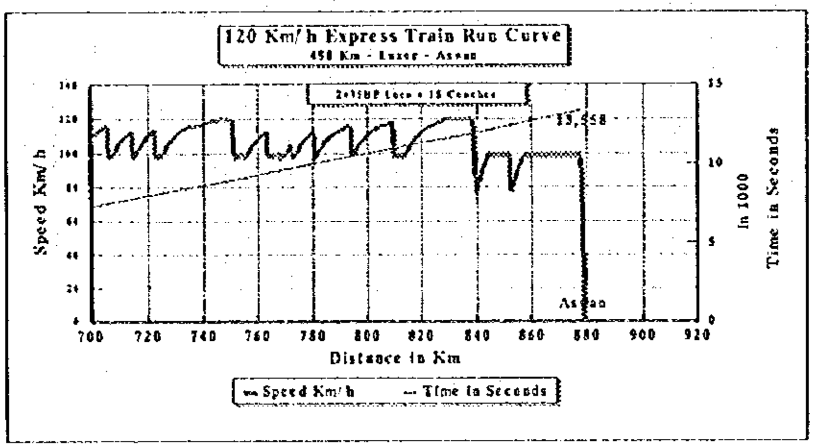
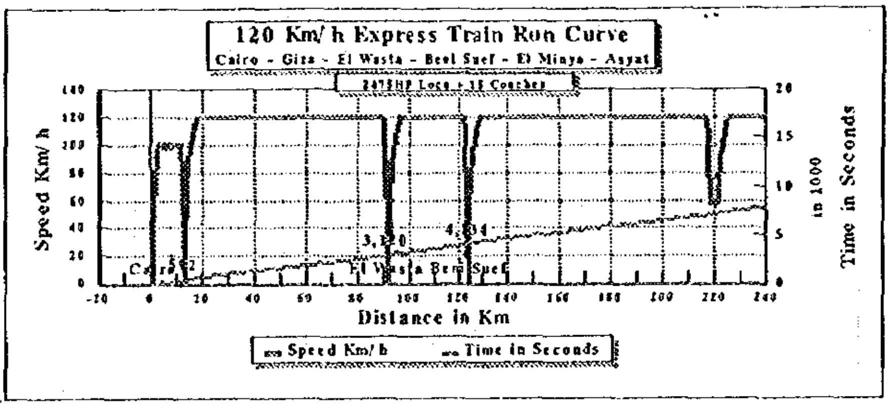
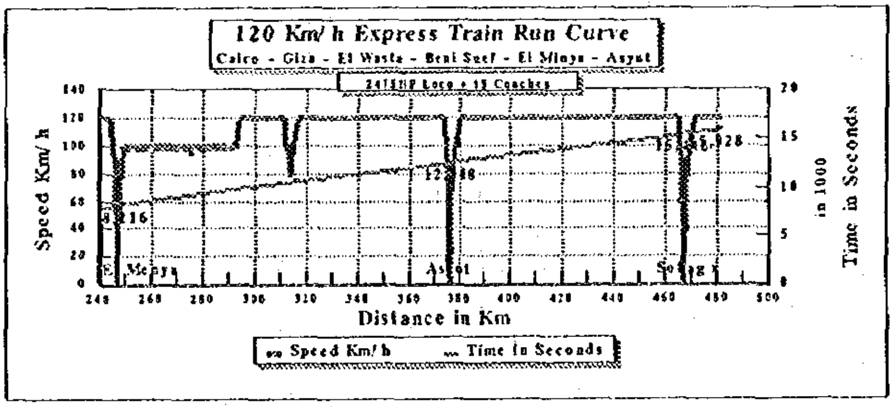
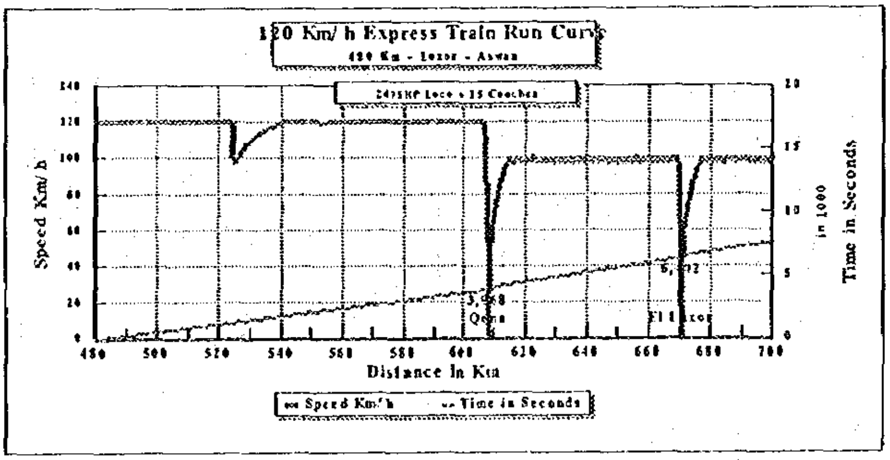
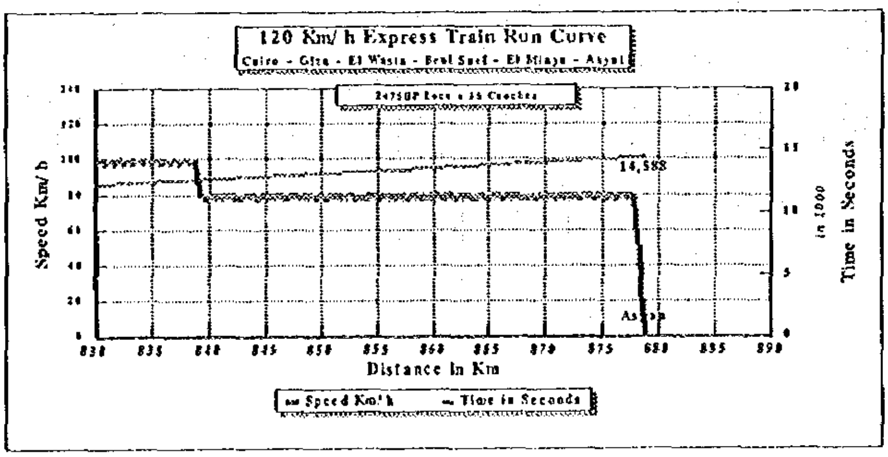


Fig. 7.1.23 Train running curve in case of 120 km/h maximum speed - by recommendable operation (allowance for driver control)









(c) Travel time

Table 7.1. 13 Travel time

Running Time and Travel Time (Second)

Article	Speed	Cairo - Giza	Cairo - Wasta	Cairo - Beni Suef	Cairo - Minya	Cairo - Asyut	Cairo - Sohag	Cairo - 480 km
Simulation	120	592	3,180	4,354	8,360	12,550	15,528	16,070
Diagram	120	622	3,339	4,572	8,778	13,178	16,304	16,874
Simulation	100 - 120	592	3,180	4,354	8,396	12,558	15,746	16,288
Diagram	100 - 120	622	3,339	4,572	8,816	13,217	16,533	17,102

Article	Speed	480 km - Qena	480 km - Luxor	480 km - Aswan	Cairo - Qena	Cairo - Luxor	Cairo - Aswan
Simulation	120	592	3,180	4,354	16,662	19,250	20,424
Diagram	120	622	3,339	4,572	17,526	20,379	21,674
Simulation	100 - 120	3,968	6,502	14,708	20,256	22,790	30,996
Diagram	100 - 120	4,166	6,827	15,443	21,269	23,930	32,546

Note: 100 - 120 means the different speed limit from Qena to Aswan. Additional stopping time at station is 60 seconds.

The average running speed between Cairo and Aswan may be increased to 80 - 85 km/h from the current 58- 62 km/h.

(d) New service

Deluxe trains, which earn important revenues for ENR, can run in less than 11 hours, after completion of the double tracking project between Idfu and Aswan.

The train sets of night sleeper luxury cars can be utilized near the destination for daytime medium distance transport between Aswan and Luxor, or between Cairo and El Minya. The passengers who use the night trains can enjoy a full day at their destination, because the trains which depart at 19:00 - 21:00 in the evening will arrive at 6:00 - 8:00 in the morning.

By utilizing the locomotives in daytime, train service can be improved between Aswan and Luxor, between Cairo and El Minya, etc., providing additional service for tourists. There are now very few services on this very important single line section in Upper Egypt.

Rapid trains would run at 140 km/h between Cairo and Asyut or Luxor. That speed is not very difficult to achieve by more powerful locomotives in the future. Travel between Cairo and Aswan within 10 hours might become possible then. Trains would start after peak hour in the evening, and arrive at the destination before morning rush hour. Efficient rotation of train sets will require appropriate facilities for passenger service and for operational preparation work at both terminal stations.

7.1.4 Number of Rolling Stock

(1) Necessary number of locomotives for passenger service

We estimated the necessary number of rolling stock. The estimation work was done by using the current number of rolling stock, operation conditions, operation results, traffic volume estimation data, improvement of train operation, etc. The results are as follows.

1) Without Case

As mentioned before, the "Without Case" is defined as : No speed-up, and 5% tariff increase of ENR and bus.

Table 7.1.14 Required future number of Locomotives ("Without Case")

Condition: No speed-up, 5% tariff raise for ENR and bus
Passenger Train Locomotives

Locomotive	1994/95	2001/02	2007	2012
Passenger Locomotive: 2,475 HP	142	179	209	240
Passenger Locomotive: 1,650 HP	256	323	376	433
Subtotal passenger locomotives	398	501	584	672
Shunting locomotives	80	80	80	80
In place of Turbo Train 1650 HP		6	6	6
Total necessary passenger locomotives	478	587	670	758

2) Case 1

Table 7.1.15 Required future number of locomotives ("Case 1-1/2")

Condition: 10% speed-up on main lines, 7% ENR tariff increase, 5% bus tariff increase
Passenger Train Locomotives

Locomotive	1994/95	2001/02	2007	2012
Passenger Locomotive: 2,475 HP	121	123	144	166
Passenger Locomotive: 1,650 HP	232	263	307	354
Subtotal passenger locomotives		6	6	6
Shunting locomotives	353	392	457	526
In place of Turbo Train 1650 HP	80	80	80	80
Total necessary passenger locomotives	433	478	543	612

"Case 1" is defined as 10% speed-up on main lines, 7% ENR tariff increase, 5% bus tariff increase

3) Case 2

Table 7.1.16 Required future number of Locomotives ("Case 2-1/2")

Condition: 10% speed-up on main lines, 7% tariff raise for ENR and bus

Passenger Train use Locomotives

Locomotive	1994/95	2001/02	2007	2012
Passenger Locomotive: 2,475 HP	121	137	160	184
Passenger Locomotive: 1,650 HP	232	292	340	392
Subtotal passenger locomotives		6	6	6
Shunting locomotives	353	435	506	581
In place of Turbo Train 1650 HP	80	80	80	80
Total necessary passenger locomotives	433	515	586	661

10% speedup, 7% ENR tariff increase, 7% bus tariff increase, is defined as "Case 2".

(2) Necessary number of coaches

1) Without Case

Table 7.1.17 Necessary number of Passenger Coaches in "Without Case"

Condition: No Speed up, 5% tariff increase for ENR and bus

Without Improvement of AC

Coaches		1994/95 on book	94/95 base in use	2001/02	2007	2012
Air condition Express (long distance) Main line		786	710	895	1,043	1,200
In place of Turbo train				30	30	30
Power Car	Main lines	113	113	142	166	191
2nd class	Other lines	835	820	1,033	1,204	1,386
3rd class	Other lines	1,148	1,127	1,420	1,655	1,904
Luggage		211	209	263	307	353
Other car Total		2,551	2,513	3,166	3,690	4,246
GRAND TOTAL		3,337	3,223	4,091	4,763	5,476

With Improvement of AC	On book	94/95 base	2001/02	2007	2012
Air condition necessary	786	710	966	1,101	1,267
Other cars necessary	2,551	2,513	3,125	3,661	4,209
Grand Total	3,337	3,223	4,091	4,763	5,476

No speedup, 5% ENR tariff increase, 5% bus tariff increase, is defined as the "Without Case".

2) Case 1

Table 7.1.18 Necessary number of Passenger Coaches in "Case 1-1/2"

Condition: 10% speed up on main lines, 7% ENR tariff raise, 5% bus tariff increase
Without Improvement of AC

Coaches	1994/95 On book	94/95 base in use	2001/02	2007	2012
Air condition Express (long distance) Main line	786	710	723	846	975
In place of Turbo train			30	30	30
Other car, Power Car, Main line	113	113	115	135	155
2nd class Other line	835	835	945	1,106	1,274
3rd class Other line	1,148	1,148	1,299	1,520	1,752
1st class Suburban	244	244	276	323	372
Luggage Average	211	209	237	277	319
Other car Total	2,551	2,549	2,872	3,361	3,873
GRAND TOTAL	3,337	3,259	3,625	4,237	4,879

With Improvement of AC	On book	94/95 base	2001/02	2007	2012
Air condition necessary	786	710	781	894	1,030
Other car necessary	2,551	2,549	2,844	3,343	3,848
Grand Total	3,337	3,259	3,625	4,237	4,879

10 % speedup, 7% ENR tariff increase, 5% bus tariff increase, is defined as "Case 1".

3) Case 2

Table 7.1.19 Necessary number of Passenger Coaches in "Case 2-1/2"
Condition: 10% speed-up on main lines, 7% ENR tariff increase, 7% bus tariff increase
Without Improvement of AC

Coaches	1994/95 On book	94/95 base in use	2001/02	2007	2012
Air condition Express (long distance) Main line	786	710	804	937	1,079
In place of Turbo train			30	30	30
Other car, Power Car, Main line	113	113	128	149	172
2nd class Other line	835	820	1,032	1,203	1,384
3rd class Other line	1,148	1,127	1,419	1,653	1,902
1st class Suburban	244	244	307	358	412
Luggage Average	211	209	263	307	353
Other car Total	2,551	2,513	3,149	3,670	4,223
GRAND TOTAL	3,337	3,223	3,983	4,638	5,332

With Improvement of AC	On book	94/95 base	2001/02	2007	2012
Air condition necessary	786	710	868	990	1,139
Other car necessary	2,551	2,513	3,115	3,647	4,192
Grand Total	3,337	3,223	3,983	4,638	5,332

Speedup 10%, ENR tariff increase 7%, bus tariff increase 7%, is defined as "Case 2".

7.2 FREIGHT TRANSPORT

7.2.1 Freight Flow Pattern

As shown in the Chapter of demand forecast, the estimated freight volume after 2002 shows remarkable growth, reflecting the desire of ENR to improve its financial condition by increasing freight transport.

Because the forecast of freight traffic is done by regional traffic flow, some adjustments were made to the original forecast data, showing the train-km on each line by using actual data in January 1995 and July 1994, with cooperation of freight transport experts of ENR.

The result of the freight traffic volume in 1000 Ton-km is shown in the following figure.

The base data, adopted for assumption, shows the exact contracted freight transport, indicating the type of goods, Ton-km, origin station, destination station, distance, and revenue. In necessary cases, classification by zones can be divided into more detailed sections.

Fig. 7.2.1 Freight Ton Km Transported Between Regions

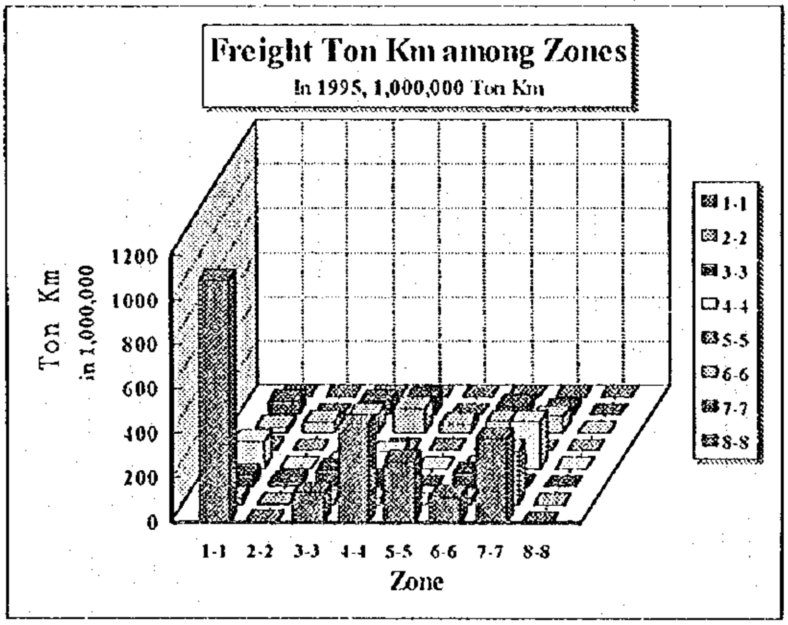


Table 7.2. 1 Freight Ton-km Transported Between Regions

(Ton-km O-D between zones) in 1994/95

Zone Name	O-D	1-1	2-2	3-3	4-4	5-5	6-6	7-7	8-8	Total
Central R	1-1	1,086,168	3,664	128,807	436,827	271,222	120,739	377,318	0	2,424,744
Middle D. R	2-2	28,750	2,956	19,280	26,588	0	26,654	239,529	0	343,757
East D. R	3-3	51,073	21,042	71,541	28,917	0	58,207	1,341	0	232,121
West D. R	4-4	123,181	687	27,048	72,409	0	5,185	211,840	0	440,351
North D. R	5-5	11,025	40	0	2,342	1,682	3,544	0	0	18,633
Intermediate R	6-6	22,430	46,341	81,271	105,176	39,775	49,918	71,387	0	416,299
South Region	7-7	59,555	194	58,661	76,526	0	40,102	18,599	0	253,637
Metro Cairo R.	8-8	0	0	0	0	0	0	0	0	0
	Total	1,382,182	74,924	386,608	748,784	312,678	304,349	920,015	0	4,129,541

The base O/D train numbers are adjusted to the total number of yearly freight trains of 1995/1994, for projecting the traffic pattern in January and February to the whole year.

Fig. 7.2. 2 Loaded Freight Train Numbers Between Regions

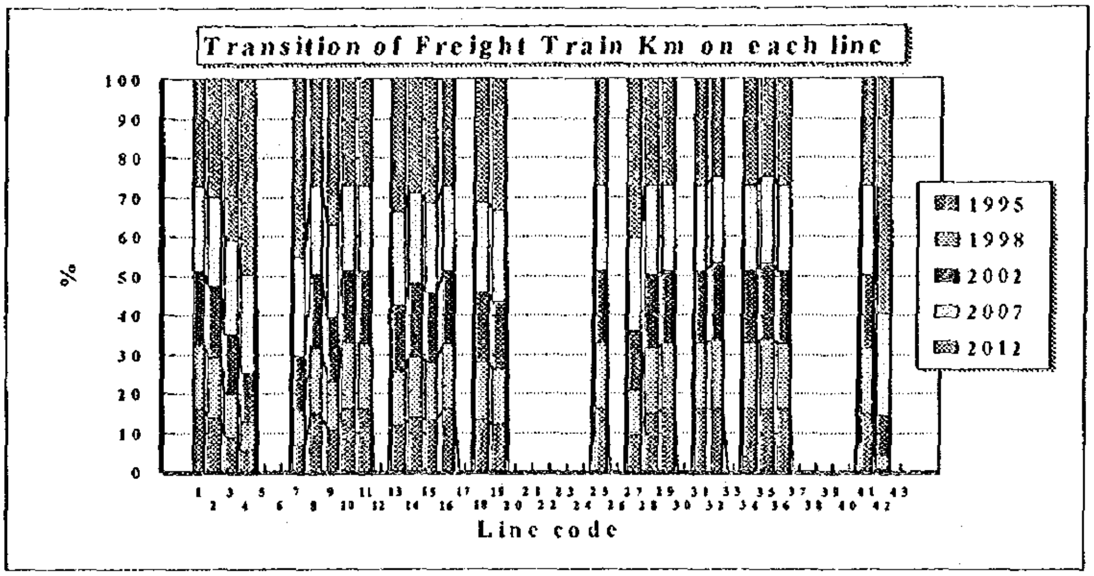
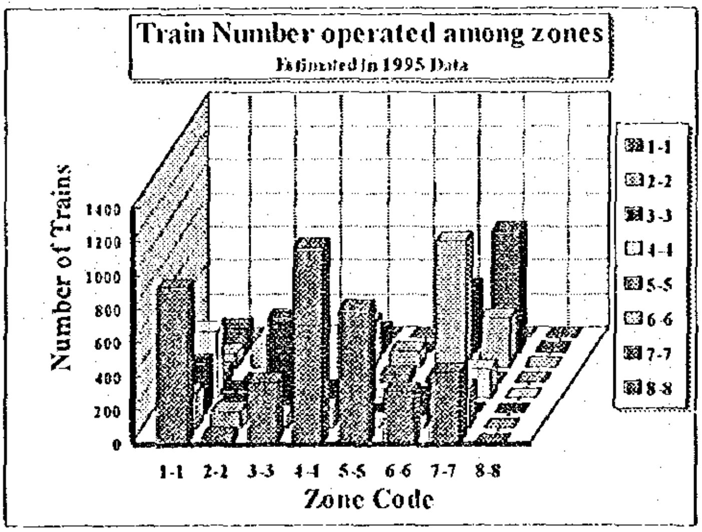


Table 7.2. 2 Loaded Freight Train Numbers Between Regions (1994/95)

Zone Name	Zone	1-1	2-2	3-3	4-4	5-5	6-6	7-7	8-8	Total
Central R.	1-1	924	42	366	1,158	792	306	420	0	4,008
Middle D. R.	2-2	216	102	78	120	0	24	234	0	774
East D. R.	3-3	294	138	564	144	0	96	0	0	1,236
West D. R.	4-4	396	6	90	426	0	12	168	0	1,098
North D. R.	5-5	66	6	0	12	42	12	0	0	138
Intermediate R.	6-6	84	132	174	264	96	750	294	0	1,794
South Region	7-7	144	0	78	120	0	378	714	0	1,434
Metro Cairo R.	8-8	0	0	0	0	0	0	0	0	0
	Total	2,124	426	1,350	2,244	930	1,578	1,830	0	10,482

Fig. 7.2.3 Train Number Operated between Regions



The above figures show that many trains are operated in few freight regions. This means that there are few profitable zones for ENR. Freight transport strategy should concentrate on profitable lines. ENR should consider the financial cost of freight operations in each zone.
Train-km forecast necessary on each line to carry the estimated freight is approximately calculated by considering current average tonnage, and by the current freight train operation route on each line.
The cited data for analysis are acquired from Jan. 1995 and July 1994. As samples, they are used to analyze the demand forecast data for 1995, 2002, 2007, and 2012.

Table 7. 2.3 Freight Train-km forecast on Each Line

Line Code	Loaded Train km	Empty Train km	Total Train km	Total Train km	Total Train km	Total Train km	Total Train km
	1995	1995	1995	1998	2002	2007	2012
1	226,694	172,031	398,725	420,755	460,841	539,233	675,079
2	1,798,399	1,364,754	3,163,152	3,516,637	4,119,864	5,199,272	6,902,556
3	138,888	105,398	244,286	301,631	415,490	659,706	1,115,080
4	111,470	84,591	196,061	284,257	477,635	939,576	1,886,699
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	160,564	121,847	282,411	381,021	585,667	1,043,879	1,925,258
8	75,395	57,215	132,609	146,424	167,688	199,921	241,311
9	4,458	3,383	7,841	9,319	12,094	17,690	27,578
10	47,864	36,323	84,187	88,838	97,302	113,853	142,536
11	80	61	141	148	163	190	238
12	0	0	0	0	0	0	0
13	5,734	4,351	10,085	11,743	14,649	20,037	28,823
14	709	538	1,247	1,414	1,677	2,090	2,638
15	4,495	3,411	7,906	8,889	10,589	13,726	18,957
16	332	252	584	616	675	790	989
17	0	0	0	0	0	0	0
18	24,437	18,545	42,982	48,326	57,569	74,620	103,058
19	7,323	5,557	12,880	14,713	17,985	24,279	35,182
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
25	333	253	586	618	677	792	992
26	0	0	0	0	0	0	0
27	117,635	89,270	206,905	249,851	335,752	542,176	887,462
28	1,356	1,029	2,385	2,634	3,016	3,596	4,340
29	174	132	306	323	354	414	518
30	0	0	0	0	0	0	0
31	174	132	306	323	354	414	518
32	10,695	8,116	18,811	20,278	22,404	25,395	28,781
33	0	0	0	0	0	0	0
34	19,142	14,526	33,668	35,529	38,913	45,533	57,004
35	217,722	165,223	382,946	412,815	456,088	516,977	585,907
36	264,192	200,488	464,679	490,354	537,070	628,430	786,746
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	13,389	10,161	23,550	26,003	29,779	35,503	42,853
42 }	24,237	18,393	42,630	178,670	497,083	1,293,676	2,961,402
43 }	0	0	0	0	0	0	0
Total	3,275,890	2,485,979	5,761,869	6,652,131	8,361,377	11,923,768	18,462,503

7. 2. 2 Freight Car Run Km by Commodity and by Car Type

The future freight traffic demand by commodity is estimated by the Study Team's demand forecast group. The calculation of future necessary number of freight cars by type is executed by the adequate type of cars for each freight commodity and by the capacities of currently owned cars. The number of necessary cars which are calculated from the most suitable freight wagons for transported goods are described in the Chapter on rolling stock. Consideration was made for the fact that several types of freight cars are suitable for each type of freight.

The calculated necessary number of freight cars by type are shown below.

(1) Open type cars

Open type cars are running relatively well and freight demand in future is relatively high. Sometimes open type freight cars and open type Hopper cars are used for similar commodities, although big customers prefer Hopper type cars over open type cars. The demand for each and both car types is shown below.

Table 7.2.4 The run performance of Open type cars and Open type Hopper Cars

Open Type Car

Category	1995	1998	2002	2007	2012
Ton - km	954,510	1,371,418	2,271,880	4,376,543	8,586,239
Car Number	3,359	3,359	3,359	3,359	3,359
Capacity ton/car	50	50	50	50	50
Ton-km/day/car	779	1,119	1,853	3,570	7,003
Run-km/car/day	15.6	22.4	37.1	71.4	140.1

Range of Freight km: 200 - 255 - 265 - 300 - 350 - 500 - 745

Hopper Open

Category	1995	1998	2002	2007	2012
Ton - km	1,718,496	1,852,538	2,046,730	2,319,968	2,629,298
Car Number	1,039	1,039	1,039	1,039	1,039
Capacity ton/car	40	40	40	40	40
Ton-km/day/car	4,531	4,885	5,397	6,117	6,933
Run-km/car/day	113.3	122.1	134.9	152.9	173.3

Range of Freight km: 250 - 265

Open Car + Hopper Open Car

Category	1995	1998	2002	2007	2012
Ton - km	2,673,006	3,223,956	4,318,610	6,696,511	11,215,537
Car Number	4,398	4,398	4,398	4,398	4,398
Capacity ton/car	45	45	45	45	45
Ton-km/day/car	1,665	2,008	2,690	4,172	6,987
Run-km/car/day	37.0	44.6	59.8	92.7	155.3

Range of Freight km Open Car: 200 - 255 - 265 - 300 - 350 - 745
Hopper Open Car: 250 - 265

Table 7.2.5 Ideal number of Open type cars and Open type Hopper Cars

Category	1995	1998	2002	2007	2012
Ton - km	2,673,006	3,223,956	4,318,610	6,696,511	11,215,537
Car Number	4,398	4,398	4,398	6,000	9,000
Capacity (tons/car)	45	45	45	45	45
Ton-km/day/car	1,665	2,008	2,690	3,058	3,414
Run-km/car/day	37.0	44.6	59.8	68.0	75.9

Range of Freight km: Open Car 200 - 255 - 265 - 300 - 350 - 500 - 745
Hopper Open Car 250 - 265

Open type car operations will cover their costs in 2007 or 2012 if their transport volume is increased to meet expanded demand without increasing the number of cars, by increasing operating efficiency.

If open cars are operating at full capacity, some investment in new open cars might become reasonable to purchase some open type freight cars after 2002.

(2) Covered type cars

Table 7.2.6 The performance of Covered cars and Covered Hopper cars

Covered Cars

Category	1995	1998	2002	2007	2012
Ton - km	656,578	667,535	684,036	708,433	738,202
Car Number	3,609	3,609	3,609	3,609	3,609
Capacity (tons/car)	50	50	50	50	50
Ton-km/day/car	498	507	519	538	560
Run-km/car/day	10.0	10.1	10.4	10.8	11.2

Range of Freight km: 50 - 220 - 250 - 615 - 815 - 1090

Hopper Covered

Category	1995	1998	2002	2007	2012
Ton - km	712,277	819,943	1,007,087	1,356,420	1,941,973
Car Number	133	133	133	133	133
Capacity (tons/car)	65	65	65	65	65
Ton-km/day/car	14,683	16,890	20,745	27,941	40,004
Run-km/car/day	225.9	259.9	319.2	429.9	615.4

Range of Freight km: 200 - 675

Covered Car and Hopper Car Covered

Category	1995	1998	2002	2007	2012
Ton - km	1,369,355	1,487,478	1,691,123	2,064,853	2,680,175
Car Number	3,742	3,742	3,742	3,742	3,742
Capacity ton/car	60	60	60	60	60
Ton-km/day/car	1,003	1,089	1,238	1,512	1,962
Run-km/car/day	16.7	18.2	20.6	25.2	32.7

Range of Freight km: Covered Car : 50 -220 - 250 - 625 - 815 - 1090
Hopper Car Covered : 200 - 675

Table 7.2.7 Ideal number of Covered cars and Covered Hopper cars

Category	1995	1998	2002	2007	2012
Ton - km	1,369,354	1,487,478	1,691,123	2,064,853	2,680,175
Car Number	3,742	3,742	3,200	2,700	2,200
Capacity (tons/car)	60	60	60	60	60
Ton-km/day/car	1,003	1,089	1,448	2,095	3,338
Run-km/car/day	16.7	18.2	24.1	34.9	55.6

Range of Freight km: Ordinary Covered Car : 50 - 220 - 250 - 615 - 815 - 1090 km
Hopper Car Covered : 200 - 675

The traffic demand for Covered Hopper Cars is so large that the substituting ordinary covered cars should be expanded by increasing the merits of ordinary covered cars for customers, by reducing the cost of loading and unloading, and of water proof clean service, etc. The demand for Covered Hopper Cars is mainly from big customers of grain and wheat, etc. Ordinary Covered Cars which mainly provided this service in the past, are significantly inferior to the performance of Covered Hopper Cars.

Thus Ordinary Covered Cars should be decreased to 2000 cars from the current 3600 cars, by increasing their efficiency until 2012.
The combined utilization of the both types of covered cars will be increased by concentrating freight handling stations and by equipping loading and unloading facilities for decreasing the transfer cost of customers.

Half of the ordinary covered cars should be eliminated by increasing their utilization rates, by equipping brakes on all cars used, etc. If half of improved covered cars can supply twice the transport demand, freight transport costs will be covered, and new investment for further traffic expansion after 2012 will become possible.

(3) Tank cars

Table 7.2.8 The performance of Tank Cars

Category	1995	1998	2002	2007	2012
Ton - km	398,700	453,722	538,644	667,423	827,306
Car Number	2,002	2,002	2,002	2,002	2,002
Capacity ton/car	40	40	40	40	40
Ton-km/day/car	546	621	737	913	1,132
Run-km/car/day	13.6	15.5	18.4	22.8	28.3

Range of Freight km: 25 - 295 - 435 - 710 - 800 - 1125 - 1130

Table 7.2.9 Ideal Number of Tank Cars

Category	1995	1998	2002	2007	2012
Ton - km	398,700	453,722	538,644	667,423	827,306
Car Number	2,002	1,800	1,500	1,250	1,000
Capacity ton/car	40	40	40	40	40
Ton-km/day/car	546	691	984	1,463	2,267
Run-km/car/day	13.6	17.3	24.6	36.6	56.7

Range of Freight km: 25 - 295 - 435 - 710 - 800 - 1125 - 1130

There are too many Tank Cars, even for estimated traffic in 2012. 1,000 Tank Cars should be enough for future demand, by increasing running speed and shortening loading and unloading time at terminal stations.

(4) Flat cars

The traffic demand for Flat Cars may be limited to container transport, special military use, etc. The 1924 flat type cars might be altered to handle container transport in the future.

(5) Brake vans

The number of Brake Vans is approximately enough for 7 days rotation. Efforts of ENR staff can increase the rotation efficiency by increasing the train running speed and shortening the stopping time at terminal stations. After 2007, Brake Van rotation should be decreased to 2 or 3 days. At that time, all freight cars which are still in use might be equipped with air brakes. New technology of freight trains can eliminate coupling the brake van itself, because disconnection of the freight cars from the freight train on route will be detected by automatic emergency brakes.

Table 7.2.10 Necessary number of Brake Vans

Category	1995	1998	2002	2007	2012
Freight Ton Km	3,899,249	4,556,326	5,842,446	8,586,250	13,725,808
Car Number	435	435	435	435	435
No. of Train /year	20,057	23,437	30,052	44,166	70,603
No. of Train /day	55	64	82	121	193
Day / one rotation	6.7	5.8	4.5	3.1	1.9

7.3 TRACK CAPACITY AND IMPROVEMENT MEASURES FOR FUTURE TRAIN OPERATION

7.3.1 Definition of Track Capacity

Track capacity is defined in the following two ways :

- **The limit of train numbers able to operate in both directions in one day.**
- **The limit of train numbers able to operate in both directions in peak hours.**

Nowadays, the latter definition is being adopted for clear understanding the capacity of train operations on track, because the capacity of terminal stations in peak hours actually decides the capacity of train operation for urban commuter traffic trains and the intercity trains at the same time.

Track capacity depends on the following various factors, so its is not very simple to calculate exactly :

- **Track facilities of major stations,**
- **Distance between stopping stations,**
- **Travel time between stations,**
- **Signal facilities,**
- **Technical backup safety system for train operation,**
- **Accelerating and decelerating characteristics of train sets,**
- **Stopping times at stations,**
- **Operation system, etc.**

We have defined the standard track capacity according to the track situation (double or single), and the operation system. On each track line, there exist various factors which decrease the track capacity, such as mutual crossings on intermediate way, technical train operation supporting system, etc. Such factors are clarified on each line as far as possible by general rules with experience through daily train operation on various lines.

Table 7.3.1 Standard of Train Operation Capacity for one direction in Peak Hour

Operation system	Double track line	Single track line
Unified metro line (9-10 car formation emu train)	24 trains / hour 2.5 minute intervals	4 - 5 trains / hour
Urban line by emu (10 - 15 car formation train)	20 trains / hour 3 minute intervals	3 - 4 trains / hour
Push pull train by locomotives (10 - 12 car formation train)	12 trains / hour 5 minute intervals	3 - 4 trains / hour
Locomotive hauled train (12 - 15 car train)	10 trains / hour 6 minute intervals	3 trains / hour

The current number of trains is based on the train time table published by ENR. Future numbers of trains are estimated from the forecast of traffic demand by the Study Team. The following track capacity is calculated for one direction. In case of both directions, the number of trains will be multiplied by 2. When significant factors to decrease capacity exist, real capacity is expressed and the ideal number of trains is described in ( ) in the next figures.

In the following, the possibility and capacities of train operation on each trunk line are explained. The current number of trains and the future number of trains are explained by the data in one peak hour.

7. 3. 2 Track Capacity of Main Line

(1) Cairo - Alexandria Line

The track can handle speeds high enough to cut the travel time to 1 hour 50 minutes in the future between Cairo and Alexandria. A convenient uniform diagram would have business use intercity trains between Cairo and Alexandria run between Cairo and Sidi Gaber, and long distance trains which will run to Luxor or Aswan may depart from Alexandria station. By equipping service facilities at both terminal stations, this equal departure train diagram can achieve very efficient train formations, and travel time of less than 2 hours.
Tariffs can be raised if passenger service is improved: speed, frequency, comfort, safety, etc..

Table 7.3.2 Track Capacity of Cairo - Alexandria line and its Future capability of Train Operation

From	To	Track capacity train number /hour	Current number of regular trains	Future number of trains in 2012
Cairo	Qalyub (main double line*)	10 trains per one hour	6 trains per one hour	10 trains per one hour
Qalyun	Benha **	8.5 (10)	6	10
Benha	Tanta ***	9.0 (10)	5	8
Tanta	Damanhur	9.0 (10)	4	7
Damanhur	Sidi Gaber	9.0 (10)	4	7
Sidi Gaber	Alexandria (main double line ****)	9.0 (10)	4	7

Note: *
This section is a quadrupled line. On both side of Cairo - Alexandria trunk line runs two single track lines from Minuf and Zagazig, which flow in at Qalyub station to Cairo.
Note: **
At Benha station to the Tanta side, blocked time of approximately 6 minutes in one peak hour comes from mutual interference of two lines of Cairo - Alexandria trunk line and Benha - Minuf line. On Minuf - Benha line, 1 train / hour runs. To Benha - Zagazig line, 1 train runs per hour to block the trunk line. This through operation will use approximately 3 minutes interference by one train because of safety interlocking. The 1.5 train capacity of the trunk line might be decreased by 9 minutes mutual interference. It means that the unnecessary mutual interference by Minuf - Benha line should be solved, by separating the two lines in the near future.
Note: ***
At Tanta station, 1 train is operating through to Mansura in peak hour. This interference causes approximately 3 minutes influence for train operation capacity. Whereas the influence at Benha station remains partially to Benha - Tanta section, the track capacity of this section will be reduced to 9 trains per hour.
Note: ****
At Sidi Gaber station, suburban trains of Abu Qir - Alexandria line flow into the two double track section. The capacity above mentioned is for the double tracked Cairo - Alexandria trunk line.

(2) Benha - Zagazig - Ismailia - Port Said Line

Table 7.3.3 Track Capacity Of Benha - Zagazig - Ismailia - Port Said Line and its Future Capability Of Peak Hour Train Operation

From	To	Track capacity train number per hour	Current number of regular trains	Number of trains in 2012
Benha	Zagazig	10 trains per one hour	2.5 trains per one hour	3.5 trains per one hour
Zagazig	Ismailia	10	2	3
Ismailia	Port Said	3	1	1.5

Note: * At Benha station, crossing of main line is necessary for through train operation to Zagazig line. To decreasing the effect of interference, it's necessary to construct a flyover.

Improvement of the single track section between Ismailia and Port Said might become important to carry container freight to Cairo. The train speed on the single track section is relatively high, because of a special train diagram to avoid the chance of train crossings, and waiting in intermediate stations. This method will become difficult when the number of trains is increased. For expanded operations, a partial double tracking project might be discussed in the future for freight transport, not passenger transport. This single track section is very important for freight transport, especially international container transport, and for the economic and political activities of Egyptian society to connect the important ports with Greater Cairo.

(3) Tanta - Mansura - Damietta Line

Table 7.3.4 Track Capacity Of Tanta - Mansura- Damietta Line and its Future Capability Of Peak Hour Train Operation

From	To	Track capacity train number per hour	Current number of regular trains	Number of trains in 2012
Tanta	Mahalla El Kobra (Double)	10 trains per one hour	3 trains per one hour	4.5 trains per one hour
Mahalla El Kobra	Mansura (Double)	10	3	4.5
Mansura	Sherbin (Single)	3	1.5	2.5
Sherbin	Damietta (Single)	3	1.5	2.5

The track capacity between Sherbin and Damietta is sufficient, but the freight transport from Damietta port and the train diagram formation with Sherbin - Qallin line will need partial double tracking between Mansura and Sherbin in the future.

(4) Cairo - Aswan - El Sad El Ali Line

On this line, many seasonal trains are running, but in general, seasonal trains will be operated by avoiding peak hour. We estimated the track capacity by regular trains described in the official time table.

Table 7.3.5 Track Capacity of Cairo - Aswan -El Sad El Ali Line and its Future Capability of Peak Hour Train Operation

From	To	Track capacity train number per hour	Current number of regular trains	Future number of trains in 2012
Cairo	Giza	10 trains per one hour	6 trains per one hour	10 trains per one hour
Giza	El Wasta	10	4	7
El Wasta	El Minya	10	3	5
El Minya	Asyut	10	3	5
Asyut	Sohag	10	3	5
Sohag	Luxor	10	2	3.5
Luxor	Idfu	10	1.5	3
Idfu	Aswan *	10	1.5	3
Aswan	El Sad El Ali (Double track **)	8	0.5	1

Note: * A double tracking project commenced in October 1996.
Note: ** This section is constructed as a double track line. The gradient on this section is very steep, *requiring a supplementary locomotive in several situations (i.e. long distance trains).*

(5) Cairo Station

Track Alignment inside Cairo station is too complicated. Although the double slip switch is convenient for movement of trains or locomotives inside the terminal station, the dense traffic of trains necessitates strict safety precautions, so the train speed inside the station is too low, because any rolling stock can enter the train operation route. Very slow train speed inside Cairo station fundamentally limits train operation capacity on Alexandria - Cairo line, and on Cairo - Asyut - Aswan line. The track alignment of Cairo Central Station should be simplified for higher movement of trains, for increased track capacity, and for the higher train safety.

(6) Cairo - Imbaba section

In the future, the south and west areas of Greater Cairo will be developed, and the urban trains will be operated more as time passes. Port Said and Damietta Port will be supported by container trains passing this section. To decrease the number of trains, urban transport trains will be stopped at Giza Station after completion of Metro No. 2 line, to conserve track capacity of this section. The demand for connecting directly to Cairo Central Station for long distance trains and for the enlarging the Metro area will require the improvement of this bottleneck section by a four-tracking project in the future.

(7) Cairo Metro No.1 Line (Helwan - El Marg)

Table 7.3.6 Track Capacity of Helwan - El Marg Line and its Future Capability of Peak Hour Train Operation

From	To	Track capacity train number per hour	Current number of regular trains	Future number of trains in 2012
El Marg	Helwan (main double line *)	24 trains per one hour	10 trains per one hour	24 trains per one hour

The traffic increase on this line is very rapid, and in 2012 the track capacity will reach its limit, with 3 unit trains (9 cars) operation. No. 2 line will be completed before that time, so then the fundamental behavior of passenger traffic flow can be evaluated for resolving the issues on this Metro line.

(8) Alexandria - Abu Quir Line

Table 7.3.7 Track Capacity of Alexandria - Abu Quir Line and its Future Capability of Peak Hour Train Operation

From	To	Track capacity train number per hour	Current number of regular trains	Number of trains in 2012
Alexandria	Sidi Gaber (main double line)	12 trains per one hour	6 trains per one hour	10 trains per one hour
Sidi Gaber	Abu Quir	12	6	10

(9) Direct connection of freight line for Suez area

The Suez Port area is not suitable for railway freight transport, after Metro No. 1 construction cut Ein Shams - Suez line from the Main line which connected to the center of Cairo, and to Upper Egypt. A connection line to Tura - Tebbin section is necessary for short-cutting the railway freight operation route. The railway traffic volume from Suez area is remarkably low compared to other Ports, especially considering the importance to Egypt of Suez Port trade to the Far East.

7.4 ALTERNATIVE OF UPGRADING OF TRAIN OPERATION

7.4.1 Passenger Train Operation

Further effort should be concentrated on the improvement of Railway Passenger Transport on main lines and in Cairo and Alexandria.

(1) Trunk line between Cairo and Alexandria

As shown in the track figure, the line facilities of Cairo - Alexandria is suitable for 160 Km/h and higher speed operation, and the section between 112 Km and 200 Km might be able to handle 200 km/h operation in the future. By introducing ATC safety devices, 200 Km/h operation can be achieved, by reducing speed at Qalyub, Benha, Birket El Sab, Tanta, near Kafr El Zayat, and Sidi Gaber - Alexandria Section. ENR's excellent track alignment is a very valuable asset for Egypt.

The current traction force of locomotives is not enough to take advantage of ENR's excellent track facilities.

The effect of introducing pendulum type rolling stock will not be very large, although such rolling stock would reduce the number of sections which cannot handle 200 Km/h or 160 Km/h near Cairo, Benha, in Sidi Gaber - Alexandria, etc.

(2) Trunk line between Cairo, Benha, Zagazig, Ismailia and Port Said

The trunk line between Cairo, Benha, Zagazig, Ismailia and Port Said is essentially different from the other two trunk lines along the Nile. This line faces severe competition with road transport, because of the relatively low speed of train operation, and because the highway network connecting Ismailia and Port Said directly to Greater Cairo is completed.

Although the trains arrive at Benha station approximately achieving an average speed 75 Km/h from Cairo station, the average speed then falls to 50 - 60 Km/h, because of the low speed in Benha - Zagazig - Ismailia line, although the section has a good double track. The double track lines between Benha - Zagazig and between Zagazig - Ismailia can handle 140 km/h, if there are improved train sets. With 120 km/h operation, the travel time between Cairo and Zagazig can be reduced by 1 hour, and the travel time between Cairo and Ismailia will become 2 hours. Zagazig will have strong connections to Greater Cairo by this project, which is not very difficult. Road traffic between Ismailia and Cairo runs in 2 hours by desert road. Railway traffic can be arranged to target regional traffic among cities between Benha and Ismailia, and for inter-city trains between Cairo and Zagazig, by utilizing the double track line.

The improvement of the single track section between Ismailia and Port Said will become important for carrying container freight to Cairo. The train speed on the single track section is relatively high, using a special train diagram to avoid the chance of train crossings, and waiting in intermediate stations. This method will become difficult when number of trains increases. For expanded operation, a partial double tracking project might be discussed in the future, to expand both passenger and freight transport. This single track section is very important for freight transport, especially international container transport, and for the economical and political activities of Egyptian society to connect important ports with Greater Cairo and the rest of Egypt.

(3) Trunk line between Cairo, Tanta, Mansura and Damietta

The train average speed between Tanta and Mansura is 65 - 78 km/h, and can achieve 140 - 160 km/h operation with new more powerful locomotives, although the current maximum speed of rapid trains is 90 km/h. The train between Cairo and Mansura can run at an average speed of 90 km/h, like the train between Cairo and Alexandria. This means the travel time between Cairo and Mansura can be decreased to 1 hour 42 minutes, from the current 2 hours 25 minutes, by introducing the operation method of passing Tanta station, using the current train sets. This shows that the trains between Cairo and Mansura stations can compete with road transport sufficiently.

Shorter travel time between Cairo and Mansura can be achieved by elevating speed and by short-cutting the stopping time at Tanta station, etc. 140 km/h operation can be realized by strengthening the power of locomotives and the safety system between Tanta and Mansura.

(4) Trunk line between Cairo and Aswan

The average running speed between Cairo and Aswan in the near future could be 80 - 85 km/h. These trains which earn very important revenues for ENR can run in less than 11 hours, after completion of the double tracking project between Idfu and Aswan. The train sets of night sleeper luxury cars can be utilized at their destination for daytime medium distance transport between Aswan and Luxor, or between Cairo and El Minya. Passengers who use the night trains can enjoy a full day in their destination, because the trains depart at 19:00 - 21:00 and will arrive at 6:00 - 8:00 in the morning. The rapid train can run at 140 km/h between Cairo and Asyut or Luxor, by introducing more powerful locomotives. That speed is not so difficult to achieve. Travel time within 10 hours might become possible then, and trains will start after peak hour in the evening and arrive before morning rush hour. Efficient rotation of train sets will require some appropriate facilities for passenger service and for operational preparation work at both terminal stations.

Between 15 km (near Giza station) to 670 km (near Luxor station), 140 km/h operation can be achieved easily by raising the speed restriction to 100 km/h at major stations of Kafr Amar, El Rapa, near El Wasta, Beni Suef, Biba, Mahagha, near Samalut (only 75 km/h here), El Minya, El Mahras, Al Rupa, Deirut, Asyut etc.

From Luxor to Deraw, 120 km/h operation is possible by restricting speed at major stations, which can be seen in the track and maximum speed figures. The sections between 765 km and 813 km, and between 838 km and Aswan (880 km) might be restricted to 100 km/h operation, for easy maintenance work of track and rolling stock.

(5) Urban transport in Alexandria area

Residential and commercial areas are densely spread along to the coastline, and the road traffic is reaching the limit of congestion inside Alexandria. The city environment is very favorable for railway mass transport. The residential area is still expanding to the Abu Qir terminal area, and the role of the Alexandria - Abu Qir line is increasing. Dense operation of push-pull type trains is effective for utilizing valuable rolling stock, with high efficiency of rotation. For example, the necessary number of train formations for operation of 10 minutes interval is 12 sets, with 2 sets in reservation and 3 sets for maintenance. Thus very dense operation of 10 minute intervals can be realized by 17 sets of train formations. For urban lines, there is lost time at both terminal stations, but the efficiency of operation can overcome the problem of this lost time at both terminal stations.

Road congestion can be reduced and the road capacity be increased by railway mass transportation. Almost all big cities are eager to construct subways or urban lines, to contribute to the overall economy of big cities, not to build a financially self-supporting railway business.

(6) Urban lines in Greater Cairo

Urban transport by a high speed railway network is increasingly required, especially in northern and north west suburban areas of Greater Cairo City. This is an important residential and social area. The construction plan of Metro No. 1, No. 2. and No. 3 lines is very important for the solution of urban transport of Cairo. Further effort should be paid to the utilization of current urban lines of ENR. The railway network was formed many years ago, and its functions are not well suited to current demands, with a very concentrated population in city centers. The first efforts should be concentrated in Cairo, but in the future, urban rail transport should be emphasized in Alexandria where the populated area is spread along the coastline, because this geography is very favorable for urban transport and intercity railway transportation.

(7) Local branch lines

On local lines, the service level is inferior to road transport, in terms of speed, frequency, and tariff. Many local branch lines are facing severe competition from taxis and microbuses. The tariffs of competitors are set below the ENR 3rd Class passenger tariff. The frequency and speed of competitors are better than those of ENR, even considering the ENR advantage of transfer to main line trains. The time has already arrived for ENR to convert many local branch lines to road transport, finding a smooth method to make this conversion, considering the utilization of valuable rolling stock and cutting operation costs. The local residents know that the existence of ENR keeps road transport tariffs low, by providing a competing service. So if ENR provides road transport, then this will help eliminate the fear of lack of service and competition after ENR closes its railway service.

7.4.2 Freight Train Operation

Concentrated effort should be expended on freight transport. ENR needs both systematic software improvements and hardware reconstruction to meet the severe competition with road transport. ENR's current situation is inadequate to meet customer requirements.

The survey of customers of freight transport show that demand for railway transport exists, and rail transport service is needed in various fields.

The following actions will be profitable for railway freight transport :

(1) Various improvement measures

Speed-up of freight trains is necessary for their operation in daytime dense traffic of high speed passenger trains. Speed-up of freight trains can be achieved by equipping them with air brakes to block train wagons, which will require investment.

(2) Freight train operation planning on trunk lines

Shorter cycle time of block trains will increase the number of freight trains, without requiring procuring more wagons and locomotives. The cycle time of freight wagons is amazingly long in ENR. Decrease of each train's operation cost can be achieved by increasing the train operation efficiency directly.

(3) Freight car improvement

Equipping brakes on all freight cars should be done, considering the necessity of increasing the running km of each freight wagon and the demands of users. Speed-up of freight trains can be achieved by equipping them with air brakes to block train wagons, which will require investment.

(4) Improvement of freight handling facilities in terminal freight yard

To save time at freight stations, some loading and unloading devices should be equipped on the terminal siding lines, to reduce the long cycle time of freight wagon use.

(5) Improvement of freight line for Suez area

The Suez Port area is not suitable for railway freight transport, since Metro No. 1 construction cut the Ein Shams - Suez line from the Main line which connected to the center of Cairo and to Upper Egypt. A connection line to Tura - Tebbin section is necessary for short-cutting the railway freight operation route. The railway traffic volume from Suez area is remarkably low, compared to other ports, especially considering the importance of Suez Port for Egypt's commerce with the Far East.

7.4.3 Way of Improvement of Train Operation

(1) Increase train capacity

Most trains are hauled by Diesel Electric Locomotives. Egypt is progressing very rapidly in improving its infrastructure, represented by the aggressive construction work of Metro lines in Cairo, and by its highway construction. Forecasts shows demand increase for railways reflecting the progress of Egypt, so utilization of current track facilities should be improved as much as possible for the welfare of the nation. Urban and intermediate distance trains will run on some lines two times or more in the near future. For that purpose, except for long distance trains between Cairo and Aswan, the trains might be converted, as far as possible, into Push-Pull type trains, like the Turbo train on Alexandria - Cairo line, and suburban trains on Alexandria - Abu Qir line.

Road transportation is suffering from serious congestion in big cities along the Nile, which reduces road transport capacity, and increases the social cost of transportation.

The attractive measures of railway, above mentioned, also contribute to road capacity. The utilization of railway capacity should be promoted for the healthy development of society, by improving railway transport service, but should not be enforced by regulation and law.

(2) Increase of train speed

Lighter weight rolling stock is being produced by materials and by technological developments each year. New running gear of rolling stock decreases the lateral forces and the impact on the rail. The transition curve regulation in years past, leaves some allowance for speed-up using new type cars. Precise measurement of the running performance of rolling stock on transition curves, and other technologies of railways, open the possibility of low cost speed-up on curved sections.

(3) Increase of hauling capacity of locomotives

Current trains cannot fully take advantage of the track facilities of ENR, because of their low acceleration force. The trains require 10 km to reach 120 km/h, and 20 km to reach 140 km/h. Automobiles reach maximum speed after 30 or 40 seconds by running only 1 km. For almost all Express Trains the interval of stations is 35 to 50 km. The running distance at maximum speed should be enlarged as far as possible, and the acceleration should be increased, to increase the average speed of trains.

(4) The maximum speed

The *maximum speed of trains, in cases of maintenance or construction work,* is too low. Commercial activities and maximum speed should be balanced. The lost time from too low speeds can have a fatal impact on cost and competition with road transport. The running curves of ENR, and simulations of train running curves show that raising the maximum speed on intermediate way and inside big terminal stations should be considered.

7.4.4 Backup System for Train Operation

Modernization is proceeding on trunk lines and on some sections :

- CTC;
- Electric block and electric signal;
- Computerized information system;
- Automatic train operation recording system;
- *Data processing in operation department*
- Ticket reservation system at some important stations, etc.

These projects should be accelerated for raising the efficiency of ENR train operations.

(1) Train block system

Site surveys show the current control system and its problems are being improved gradually. Color light signal and CTC system is being introduced on some sections. But almost all local lines are operated by mechanical control and tablet block system, which makes improvement of speed difficult, and that reduces ability to compete with road transport. Furthermore, the communication system for train operation is old and lacking.

(2) Modernized train operation planning system

Changes in work are very slow, because of defects of communication and the old and deteriorating telecommunication system. Improvement of the communication system should be accelerated.

Modernization of the operation planning and daily train operation control system is very important for the following reasons. The demand for improving service quality is increasing due to competition among transport modes. Simulation work for train running performance, now proceeding, is necessary to analyze the effects of improvement measures of train operation service.

(3) Train dispatching system

The train dispatching system in regions is being improved but insufficient, although the train control system is gradually being modernized by introducing CTC system, color light signal, and automatic block system partially on major lines, but almost all local lines still have an old system, and face a severe situation, due to the clear advantage of faster automobile speed.

(4) Information system for train operation

Demand for freight and passenger trains should be supported by a quick response information system, because competition among different transport modes is increasing, and the utilization of valuable rolling stock is very important for decreasing the operation cost of each train.

(5) Marketing information system

The data gathering from working sites including customers and its planning work using a computer data processing system combined with a good communication system is necessary for constructing a quick response system and for aggressive marketing activity.

(6) Statistic control system

The statistic data are gathered by stations, regions and head office. But the form of gathered data is inadequate for understanding the working efficiency of each region. For analysis of ENR operations on each line, the current system of data gathering is not effective.

7.4.5 Glimpse on Train Operation System

① Simulation of train running curve is important for understanding the operation efficiency and for competitiveness with road transport. ENR operation department is striving to adopt a computerized calculation system, which should be accelerated.

② Stopping times at major stations should be decreased as much as possible because of the big reduction of competitiveness with road transport.

③ By computerized diagram, reformation of train diagrams is speedily worked out, and the effect of various improvement plans can be measured correctly. The traditional train diagram method is now changing in ENR. This modernization should be accelerated, because the progress of computers and communication systems has been very rapid, and computer systems are now very practical for complicated data processing such as formation of train diagrams.

④ Train arriving and departure times should be broken down to every 15 seconds. A one minute system is insufficient nowadays for analysis and for internal train operations.

Analysis by computer of train running performance is being introduced in the operations department of ENR. After introduced, the evaluation and programming method may be revolutionized to high speed processing and much higher precision in the near future.

⑤ Improvement of train operations on trunk lines should be achieved as soon as possible, and the effect of improvement projects should be expressed on train time tables after a sufficient seasoning period.

⑥ Increasing train operation capacity is possible on each ENR line, by some improvements which are relatively easy to implement.

⑦ Further efforts should be concentrated on the improvement of railway passenger transport on main line intercity and urban areas in Cairo and Alexandria.

CHAPTER 8 INVESTMENT PLAN

8.1 CONCEPT OF RAILWAY INVESTMENT

As mentioned in the Chapter 4, Basic Improvement Proposal, investments are required to maintain a railway system, to expand capacity for future demand and to improve the quality of the railway transport. However, too much investment beyond the cash flow may cause the long term debt to increase and eventually worsen the financial status. Therefore, a railway investment plan must be efficient and effective. In view of the strong government desire for a financially self-supporting railway, the Study Team considered the following issues when making its investment plan.:

a. Amount of investments until 2001/02. During this period, ENR needs to restructure, and should avoid accumulating too much debt.
b. Investment amounts through 2001/02 which would encourage profitability of ENR.
c. Investments are mostly limited to business improvement items, maintenance, and expansion to meet increased demand of daily operations.
d. Investments for national policy goals, such as Sinai new Railway line, should be completely borne by the government.

According to these concepts, improvements which require a huge amount of investments, such as electrification between Cairo and Alexandria, cannot be adopted. The investment proposals in this report are in accordance with the business management alternatives proposed to improve the ENR finances.

The investment plan is divided into 2 stages, one until 2002 (short term), and other one from 2003 to 2012 (middle and long term). The short term plan (until 2002) is forecast in detail, but the plan until 2012 is described only in general, with strategies necessary to make ENR play an important role in the transport system with sound operation and finances.

8.2 INVESTMENT PLAN UNTIL 2002

The investment plan until 2002 is made for the "Without Case" and "With Case" as follows.

8.2.1 Investment Plan of "Without Case"

The investment plan of Without Case is made assuming ENR maintains existing investment patterns.

The total amount of investment cost of Without Case during 1995/96 to 2001/2002 is LE 4,525 million, which consists of following items.

(1) Rolling stock

The plan forecast the number of rolling stock required to handle increased passenger volume. This plan also forecasts necessary replacements of rolling stock.

The cost of rolling stock from 1995/96 to 2001/02 is forecast at LE 1,711 million. Detailed cost estimation of rolling stock is as follows.

1) Number of Rolling Stock and costs

Type of rolling stock		Quantity	Unit Price (1000 LE)	Total (1000 LE)
Locomotive	DEL 2475	31	11,350	351,850
	DEL 1650	42	7,610	319,620
Passenger Coach	AC Cars	215	2,710	582,650
	Normal	653	700	457,100
Total				1,711,220

Notes: Unit price includes inflation from 1995/96 to 2001/02.
DEL : Diesel Electric Locomotive

2) Additional number of Freight wagons

Even with increases in the utilization of freight wagons, additions are not necessary until 2002 by the way of increase of availability of freight wagons.

3) Improvement of freight wagons : installing brakes

Not considered

4) Improvement of depots

Not considered

(2) Permanent way

At present, ENR has been rapidly rehabilitating track (more than 200 km per year). When the current effort at track rehabilitation covers most of the lines, rehabilitation work volume will decrease. The investment forecast for track rehabilitation considers this situation. Also, procurement of additional Multiple Tie Tamper (MTT) is included in the plan, taking into account future modernization of track maintenance.

The investment cost for permanent way from 1995/96 to 2001/02 is LE 1,131 million (details as follows).

a. Track rehabilitation costs are estimated based on the plan of Permanent Way Department.

Item	1995/96	1996/97	1997/98	1998/99	99/2000	2000/01	2001/02	Total
Planned km	315.2	315	300	300	240	50	50	1,570
Unit price/km	508,100	540,600	573,000	607,400	643,900	682,500	720,000	
Cost (LE mil.)	160.2	170.3	171.9	182.2	154.5	34.1	36.0	5,909.2

Note: Unit price of each year includes inflation, based on 510,000 LE as 1995/96 price.
Unit cost in1995/96 is actual price.

b. Additional MTTs are estimated by Team considering the expansion of mechanical maintenance work.

Additional MTT : 15 units
Replacements : 7 units

	1996/97	1997/98	1998/99	99/2000	2000/01	2001/02	Total
Add. M.T.T	4	4	4	4	4	4	24
Unit price (1000 LE)	8,000	8,400	8,900	9,500	10,000	10,600	
Costs (LE mil.)	31.8	33.7	35.7	37.9	40.1	42.4	221.6

Note: Unit price of each year is including inflation based on LE 7,500,000 as 1995/96 price.

(3) New Lines

Recently, development of the Sinai Peninsula is emphasized as part of national policy. In accordance with this policy, the railway line between Ismailia and Rafah (border of Palestine) is to be constructed. This new line is now in the design and tendering stage. The investment for the new line, being estimated at LE 950 million including a Suez Canal swing bridge, is included in "Without Case".

Also, there are investments of signaling systems for Baharia Line and Abu Tartour Line. Costs are LE 72 million for Baharia Line, and LE 106 million for Abu Tartour Line. These estimates do not include costs incurred by organizations other than ENR.

(4) Bridge and building

The cost for replacement or improvement of bridges and railway buildings are applied from the ENR improvement plan. The cost for the bridges and buildings from 1995/96 to 2001/02 is LE 438 million.

(5) Signaling

The CTC signaling system and improvement of signaling systems on substantial lines which are now underway, are also counted. Also, installation of an ATC system on main lines is considered. The cost for signaling is LE 141 million and details are as follows.

a. Installing ATC system: 3 years from 1996 to 1998, total 18.9 million LE.
(6.3 million LE per year)
b. Installing CTC between Cairo and Giza during 2 years, 1995 and 1996, 35.2 million LE.
c. Improvement of signaling system on substantial lines: every year, 2 million LE.

(million LE)

Item	1995/96	1996/97	1997/98	1998/99	99/2000	2000/01	2001/02	Total
Install ATC	-	6.3	6.3	6.3	-	-	-	18.9
Install CTC	-	17.6	17.6	-	-	-	-	35.2
Improve Signal	75.0	2.0	2.0	2.0	2.0	2.0	2.0	87.0
Total	75.0	25.9	25.9	8.3	2.0	2.0	2.0	141.1

Note: Investment cost of 1995/96 is according to the budget.

8.2.2 Investment Plan of "With Case"

There are 4 cases for "With Case": Case 1-1; 1-2; 2-1; and 2-2. These 4 cases assume different amounts of fare increases, which impact passenger volume and eventually scale of investment. Total investment costs until year 2002 are LE 3,210 million for Case 1-1 & 1-2, and LE 4,021 million for Case 2-1 & 2-2.

(1) Rolling stock

The investment plan for rolling stock in the "With Case" includes the following items.
Improvements of rolling stock availability are forecast, assuming higher efficiency of rolling stock maintenance-work. The current low availability of locomotives (74 %) is forecast to be improved to 85 %.
The plan assumes higher utilization of rolling-stock due to a 10 % speed increase on main lines.
"With Case" also assumes ENR installs brake systems on all freight wagons now without brakes, and improvement of rolling stock maintenance depots.
The total investment for rolling stock from 1995/96 to 2001/02 is LE 730 million for Case 1-1 & 1-2, and LE 1,542 million for Case 2-1 & 2-2. Different passenger demand forecasts create different forecasts of rolling stock needed.

1) Number of Rolling Stock and costs

With Case 1-1 & Case 1-2

Type of rolling stock		Quantity	Unit Price (1000 LE)	Total (1000 LE)
Locomotive	DEL 2475	3	11,350	34,050
	DEL 1650	13	7,610	98,930
Passenger	AC Cars	108	2,710	292,680
	Normal	313	700	219,100
Total				644,760

DEL : Diesel Electric Locomotive

With Case 2-1 & Case 2-2

Type of rolling stock		Quantity	Unit Price (1000 LE)	Total (1000 LE)
Locomotive	DEL 2475	17	11,350	192,950
	DEL 1650	42	7,610	319,620
Passenger	AC Cars	197	2,710	533,870
	Normal	585	700	409,500
Total				1,455,940

2) Additional freight wagons
By increasing wagon availability, more freight wagons are not needed until 2002, same as in the "Without Case".

3) Improvement of freight wagons : installing brakes
Until 2002, all useful wagons without brakes have brakes installed.
Total number of wagons without brakes : 3,280, cost per wagon : 41,000 LE
Total cost : LE 134.5 million

All With Case (million LE)

Item	1995/96	1996/97	1997/98	1998/99	99/2000	2000/01	2001/02	Total
Install Brakes	-	19.3	20.4	21.7	23.0	24.3	25.8	134.5

4) Improvement of depot

Hadra and Zagazig maintenance depot are planned to be improved by installing an Overhead Crane and Wheel Lathe as follows.

All With Case (million LE)

Item	1995/96	1996/97	1997/98	1998/99	99/2000	2000/01	2001/02	Total
Overhead Crane	-	-	4.2	4.2	4.4	4.7	-	17.5
Wheel Lathe	-	7.5	-	-	-	-	10.0	17.5
Total	-	7.5	4.2	4.2	4.4	4.7	10.0	35.0

(2) Permanent way

Investment costs for permanent way in the 4 "With Cases" are the same as "Without Case".

(3) Bridge and building

Investment costs for bridges and buildings in the 4 "With Cases" are the same as "Without Case".

(4) Station improvement and others for speed-up

In the 4 "With Cases", 10 % train speed increase is planned for the main lines. To cope with this measure, some up-grading of tracks and stations should be carried out. Necessary measures will be replacement of aged or poor turnouts, additional tamping work, and supplemental ballast on main lines. The estimation of this cost is LE 89 million from 1995/96 to 2002/03.

440 turnouts are assumed replaced on main lines of Benha - Ismailia and Tanta - Mansoura.

Tamping work is assumed on 1,970 track km on main lines.

	1995/96	1996/97	1997/98	1998/99	99/2000	2000/01	2001/02	Total
No. of turnouts	-	74	74	74	74	74	70	440
Cost (mil. LE)	-	8.2	8.7	9.3	9.8	10.4	10.4	56.8
Tamping (km)	-	330	330	330	330	330	320	1970
Cost (mil. LE)	-	4.6	4.9	5.2	5.5	5.8	6.0	32.0
Total (mil. LE)	-	12.8	13.6	14.5	15.3	16.2	16.4	88.8

Note: Costs include inflation

(5) Signaling

In addition to costs in "Without Case", "With Case" introduces an automatic signaling system for the main line.

(million LE)

Item	1995/96	1996/97	1997/98	1998/99	99/2000	2000/01	2001/02	Total
Install ATC	-	6.3	6.3	6.3	-	-	-	18.9
Install CTC	-	17.6	17.6	-	-	-	-	35.2
Improve Signal	75.0	2.0	2.0	2.0	2.0	2.0	2.0	87.0
Automatic Signaling System	-	87.9	87.9	87.9	87.9	87.9	87.9	527.4
Total	75.0	113.8	113.8	96.2	89.9	89.9	89.9	668.5

Notes:
Investment cost of 1995/96 is by the budget.
The automatic signaling system on the Beni Suef - El Minya line costs 5 million LE/km, 123 km, for a total 615 million LE. The project will require 7 years (1996/97 - 2002/03), but this table only includes investments until 2001/02.

(6) Management system

In order to improve the ENR management system, especially data information, computerization should be adopted for office management, which is described in Chapter 4.2.12. For this purpose, the installation costs for this system are forecast at LE 15 million.

(7) New line project

Cost of the new line between Ismailia and Rafah is not included in the 4 "With Cases". This investment cost should be fully covered by the government.

Investment costs for all cases are shown in Tables 8.2.1 to 8.2.3. Comparison of "Without Case" and the "With Cases" are shown in Table 8. 2. 4.

8.2.3 Analysis and Examination of Investment Plan

If ENR aims to be a financially independent operation, it cannot continue its current level of investment, and must keep its annual investments within cash flow as far as possible. The investment plan of "With Case" has been projected in accordance with this principle. Investments are divided into the following 4 investment goals :

a. Replacement and rehabilitation necessary to maintain system.
b. Upgrading of safety devices.
c. Raising operational and financial efficiency and rationalization.
d. Increasing transport capacity to cope with the demands and improving the quality of transport to compete with other modes.

Some projects are invested in to achieve 2 or more of the above goals.
It is especially difficult to quantitatively analyze projects invested in to meet goals a.(maintenance) and b.(safety). These investments are for safety of human lives and commodities, and maintaining safety is the most fundamental and essential mission of the railway business. Although it is not totally impossible to quantify the value of the safety and to financially analyze such investment, it usually does not worth its efforts.
Therefore, investment projects related to goals c.(efficiency) and d.(improvement) are analyzed below.

1) Rolling stock

Rolling stock investments are made for procurement of new rolling stock, installing brakes, and improvement of depots. Procurement are made both to replace old rolling stock, and to expand transport capacity coping with the increase of demand. The necessary number of locomotives to be procured has been calculated taking the rise of availability into consideration. Actions to increase the availability of locomotive are described in Chapter 4.2.8; most of these actions require little investment. These investments are not of a nature to be made based on financial evaluation.

Installation of brakes for wagons greatly improves the speed limit of the freight train and thus increase the transport capacity of the track and improve the train operation efficiency. Taking the relatively small amount of investment into consideration, the proposal is clearly required. Improving depot is in response to its present poor status; this is similar to rehabilitation in nature, which is not appropriate for quantitative analysis.

2) Permanent way

Investments on permanent way are primarily for track rehabilitation and increasing MTTs. Rehabilitation of tracks in poor condition is a sort of continually required project. Therefore, quantitative analysis of permanent way rehabilitation is not very appropriate.

3) Bridges and buildings

Bridge investments are to replace old bridges. Building investments are for stations, factories, etc., and to improve customer service. Therefore, quantitative analysis of these improvements is not very appropriate.

4) Station and other improvements for increasing speed

These investments are for improving transport, and can be quantitatively evaluated, in addition to the benefits for passenger service.

Investment :	88.8 million LE		
Demand increase :	2001/02	588,000 km/day	
	2006/07	689,000 km/day	
	2011/12	781,000 km/day	
			% of funds invested
Revenue increase :	2001/02	2,360,000 LE	2.65%
	2006/07	3,490,000 LE	3.93%
	2011/12	5,070,000 LE	5.71%

These financial returns are small, and will not even pay for the interest payments for such investments. This is because the Study Team's passenger survey has shown that reduced travel time has limited impact on passenger volume at present. However, the Study Team's analysis is based on the model built according to current passenger attitudes, and also the line on which speed-up is proposed are lines with strong competition from road transport. Therefore, as the transportation environment changes in near future, the railway will have to increase its speed up cope with the situation.

Moreover, higher speed not only increases demand and eventually revenues, but also significantly decreases cost by raising productivity of rolling stock, drivers, and conductors. However, quantitative analysis of these factors requires drawing up a sequential schedule of the rolling stock and crews on the examined line/segments before and after speed-up. The team does not have enough time to perform this analysis, to its regret.
Therefore, regardless of its poor returns calculated above, this investment is worth to be executed.

5) Signaling

Similar to the investments for increasing speed, installation of the automatic signaling system requires large investments, and has small impacts on revenues. But the passenger survey showed that passengers consider 'safety' as the very dominant reason why they choose the rail over other modes of transport. Moreover, signaling improvements are considered important for smooth operations as the numbers of trains increase, and for safety as train frequency increases.

6) Management system

Office automation system improvements proposed by this study are to provide accurate data to management. This is a basic necessity for sound management, so this project is not appropriate for quantitative measurement of its impact.

Table 8.2.1 Investment Plan - Without Case

(Million LE)

Item	Total 96-2002	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	Remarks
Rolling Stock	1,711.3	203.9	216.1	229.1	242.8	257.4	272.8	289.2	
Permanent way	1,130.8	160.2	202.1	205.6	217.9	192.4	74.2	78.4	
Bridge Replacement	235.1	-	33.7	35.8	37.9	40.2	42.6	44.9	
Bridge Construction (Suez)	350.0	-	100.0	150.0	100.0				
New Line (Ismailis - Rafah)	600.0	-	100.0	200.0	200.0	100.0			
Building improvement	203.2	-	29.2	30.9	32.8	34.7	36.8	38.8	
Station improve. & others for speed-up	-	-	-	-	-	-	-	-	
Signalling & Tele-communication system	141.1	75.0	25.9	25.9	8.3	2.0	2.0	2.0	ATC
Improvement of OA system	-		-	-	-	-	-		
Improvement of Car maintenance depot	-		-	-	-	-	-	-	
Freight wagon Improvemenmt	-	-	-	-	-	-	-	-	
Others	138.0	65.0	10.0	11.0	12.0	13.0	13.0	14.0	
Grand Total	4,509.5	504.1	717.0	888.3	851.7	639.7	441.4	467.3	

Excluding Metro

Table 8.2.2 Investment Plan - With Case 1-1, 1-2

(Million LE)

Item	Total 96-2002	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	Remarks
Rolling Stock	644.8	76.8	81.4	86.3	91.5	97.0	102.8	109.0	
Permanent way	1,130.8	160.2	202.1	205.6	217.9	192.4	74.2	78.4	
Bridge Replacement	235.1	-	33.7	35.8	37.9	40.2	42.6	44.9	
Bridge Construction (Suez)	(350)		(100)	(150)	(100)				Governmental Subsidy
New Line (Ismailis - Rafah)	(600)	-	(100)	(200)	(200)	(100)			Governmental Subsidy
Building improvement	203.2	-	29.2	30.9	32.8	34.7	36.8	38.8	
Station improve. & others for speed-up	88.8	-	12.8	13.6	14.5	15.3	16.2	16.4	
Signalling & Tele-communication system	668.5	75.0	113.8	113.8	96.2	89.9	89.9	89.9	ATC Aout. Signal
Improvement of OA system	15.0		3.0	3.0	3.0	3.0	3.0		
Improvement of Car maintenance depot	35.0	-	7.5	4.2	4.2	4.4	4.7	10.0	
Freight wagon Improvemenmt	134.5	-	19.3	20.4	21.7	23.0	24.3	25.8	
Others	138.0	65.0	10.0	11.0	12.0	13.0	13.0	14.0	
Grand Total	3,293.7	377.0	512.8	524.6	531.7	512.9	407.5	427.2	

Excluding Metro

Table 8.2.3 Investment Plan - With Case 2-1, 2-2 (Million LE)

Item	Total 96-2002	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	Remarks
Rolling Stock	1,456.0	173.5	183.9	194.9	206.6	219.0	232.1	246.0	
Permanent way	1,130.8	160.2	202.1	205.6	217.9	192.4	74.2	78.4	
Bridge Replacement	235.1	-	33.7	35.8	37.9	40.2	42.6	44.9	
Bridge Construction (Suez)	(350)		(100)	(150)	(100)				Governmental Subsidy
New Line (Ismailis - Rafah)	(600)	-	(100)	(200)	(200)	(100)			Governmental Subsidy
Building improvement	203.2	-	29.2	30.9	32.8	34.7	36.8	38.8	
Station improve. & others for speed-up	88.8	-	12.8	13.6	14.5	15.3	16.2	16.4	
Signalling & Tele-communication system	668.5	75.0	113.8	113.8	96.2	89.9	89.9	89.9	ATC Aout. Signal
Improvement of OA system	15.0		3.0	3.0	3.0	3.0	3.0		
Improvement of Car maintenance depot	35.0	-	7.5	4.2	4.2	4.4	4.7	10.0	
Freight wagon Improvemenmt	134.5	-	19.3	20.4	21.7	23.0	24.3	25.8	
Others	138.0	65.0	10.0	11.0	12.0	13.0	13.0	14.0	
Grand Total	4,104.9	473.7	615.3	633.2	646.8	634.9	536.8	564.2	

Excluding Metro

Table 8.2.4 Comparison of Investment Plan for each Case

Investmrnt Items	Without Case			With Case 1-1 & 1-2			With Case 2-1 & 2-2		
1. Rolling stock									
- Replace & addition of rolling stock			Cost (mil. LE)			Cost (mil. LE)			Cost (mil. LE)
DEL 2475	No. of Loco.	31	351.9	No. of Loco.	3	34.1	No. of Loco.	17	193.0
DEL 1650	No. of Loco.	42	319.6	No. of Loco.	13	98.9	No. of Loco.	42	319.6
AC cars	No. of car	215	582.7	No. of car	108	292.7	No. of car	197	533.9
Psg. cars	No. of car	653	457.1	No. of car	313	219.1	No. of car	585	409.5
Freigt cars	No. of car	-	-	No. of car	-	-	No. of car	-	-
			1,711.3			644.8			1,456.0
- Install brakes	Not considered			No. of Wagons	3,280	134.5	No. of Wagons	3,280	134.5
- Depot improvement									
Install Overhead crane & Wheel Lathe	Not considered			Hadra and Zagazig depot		35.0	Hadra and Zagazig depot		35.0
			1,711.3			814.3			1,625.5
2. Parmanent Way									
- Track rehabilitaion		1570 km	909.2		1570 km	909.2		1570 km	909.2
- Addition & replacement M.T. T		24 units	221.6		24 units	221.6		24 units	221.6
			1,130.8			1,130.8			1,130.8
3. Bridge replacenment	Planned by ENR		235.1	Planned by ENR		235.1	Planned by ENR		235.1
4. New Line construction Sinai: Ismailia - Rafah	Planned by ENR		950.0	Supported by the government, so it does not include.			Supported by the government, so it does not include.		
5. Building improvement	Planned by ENR		203.2	Planned by ENR		203.2	Planned by ENR		203.2
6. Station & other improvement for speed-up	Not considered								
- Replacement of turnouts on main lines				440 units on main lines		56.8	440 units on main lines		56.8
- Additional Tamping works				1,970 km on main lines		32.0	1,970 km on main lines		32.0
						88.8			88.8
7. Signalling System									
- Install ATC system	ENR Plan		18.9	ENR Plan		18.9	ENR Plan		18.9
- Install CTC system (Cairo - Giza)	ENR Plan		35.2	ENR Plan		35.2	ENR Plan		35.2
- Improve signaling system	ENR Plan		87.0	ENR Plan		87.0	ENR Plan		87.0
- Install automatic signal	Not considered			Beni Suef - El Minya 123 k (1996/97 - 2002/03)		527.4	Beni Suef - El Minya 123 k (1996/97 - 2002/03)		527.4
			141.1			668.5			668.5
8. Improve OA System	Not considered					15.0			15.0
9. Others			138.0			138.0			138.0
Total (million LE)			4,509.5			3,293.7			4,104.9

8.3 INVESTMENT PLAN FROM 2002/3 - 2011/12

For the investment plan from 2002/03 to 2011/12, the basic principles are mostly same as for the plan until 2001/02. Furthermore, ENR will be forced to be more financially self supporting. Capital for railway investments will have to be raised by the railway itself. Therefore, the scale of investments should be limited within the level of cash flow. Costs of the 2 items below should be borne by the government.

a. Construction of new lines required by government policy
b. Large improvements for commuters in urban and suburban areas, if demanded by either the central or the local government.

As for item b., the construction of new lines in large cities should capture the external benefit, such as the raise of the value of the real estate in the vicinity of stations due to the development of various activities, caused by the installation of the mass rapid transit system.

In any case, ENR's financial condition after 2002/03 has many uncertain factors. This is especially true because there were many assumptions for the forecast until 2001/02. Therefore, the investment plan after 2002/03 does not give numerical forecasts. The plan from 2002/03 to 2011/12 only describes the strategy ENR must follow, and annual investment items ENR must make to meet this strategy.

8.3.1 Continuing Investments

In order to maintain the railway system in good condition, investment for the following items must be continued.

(1) Rolling stock

ENR must replace rolling stock which is worn out, and purchase additional rolling stock, to transport increasing numbers of passengers and freight. For reference, the necessary number of rolling stock after 2002/03 is shown in Appendix 3.11.17.

(2) Permanent way

Even though track rehabilitation work will be mostly complete by 2001/02, track work will still be necessary, especially on the main lines. Replacements of MTT machines should be carried out.

(3) Improvement of bridges and buildings

This is primarily for replacement and maintenance, so quantitative analysis is not meaningful.

(4) Installation of automatic signaling system

After 2003, installation of the automatic signaling system must be continued for main lines.

(5) Modernization of business management system

Computerization for data collection, information, seat reservation system, etc. should be continued after 2003.

8.3.2 Railway Strategic Items

The Study Team selected the following items as future improvements at ENR. However, separate feasibility studies should be carried out for each of these items.

(1) Up-grading of railway transport for Abu Quir Line

The Abu Quir Line plays an important role in commuter transport in Alexandria's urban and suburban areas. On this line there are many road crossings, even though about 200 trains operate every day. The study for the improvement of this line has been already carried out by an Italian consultant, and it is being reviewed by a local consultant. Upgrade of this line should be carried out. There are several of improvements : improvement and increase of number of trains (push-pull system); elevated track; electrification; underground construction, etc. However, investments for these improvements should be paid for by the government at least partly, because they will be made for the society and economy of urban Alexandria.

(2) Up-grading of El Marg - Shebeen Kanater Line

Along the this line, many new housing estates are actively developing since the inauguration of Metro Line. The Metro reduced access time from/to the center of Cairo to only 40 minutes. Housing development on this line will continue. Railway transport for this area is still poor, even though there have been improvement such as track rehabilitation and installation of crossing tracks in the stations. To increase number of rail commuters, ENR needs to further improve this line.

This line should be improved with double track, installation of an automatic signaling system, more and better rolling stock, etc. To carry out this improvement, its investment also be born by the government at least partly or the capture of the external benefits should be taken into consideration.

(3) Modernization of freight transport

To make freight transport successful in the future, ENR should emphasize following:

a. Large volume in fixed sizes transport
b. Abolition of shunting work as much as possible
c. Scheduling of departures and arrivals
d. Containerization for high price commodities
e. Speedup of freight trains
f. Establishment of information system

For these items, there are many ideas described in Chapter 4.2.4. First, many small freight stations should be closed. The remaining freight stations should be improved with adequate facilities. Meanwhile, a computer information system for freight transport should be installed to maintain accurate scheduled arrivals and departures, and to rationalize freight transport.

Container transport is important for successful freight transport business, especially marine container transport. However, containerization requires huge investments, such as containers, container depots, loading/unloading equipment, etc. Therefore, after an elaborate feasibility study is carried out, this measure should be adopted.

A marine container study was carried out by Transmark in 1987, but it is already 9 years old. During this time, the economic conditions for containerization have been significantly changed. A review of this study should be carried out. A summary of Transmark's study is in Appendix 4.2.4.

(4) New line for new town

To develop Greater Cairo, especially development of new housing estates, the railway transport system should be strengthened. For this purpose, Metro No.1 line has been built, and No.2 line was recently opened on October 1996. No.3 line is still in the planning stage. A big city like Cairo requires commuter railway transport.

One railway project has been suggested by the Ministry of New Urban Communities. The 1st stage is a new line between 10th of Ramadan City and El Marg Metro Line. The 2nd stage is a line along the Outer Ring Road. The final stage is an extension of the 2nd stage line to 6th of October City, which is approximately 90 km in total.

Among these lines, the 1st stage line from 10th of Ramadan to El Marg should be examined in relation with utilization of the existing Railway line of Suez.

This project should have a feasibility study which covers the issue of securing project funds. If this project is not funded by government, it should be done with a BOT system or by related real estate developments.

(5) Increase line capacity

The demand forecast and train operation plan after 2002/03 shows the number of trains will exceed track capacity on some sections. To meet increased demand, the following actions should be taken:

a. Improvement at Benha station to the side facing Tanta : Menuf - Benha line and Benha - Zefta line should be separated from Cairo - Alex. line.
b. Additional track for some sections between Ismailia and Port Side for smooth train operation.
c. Additional track for some sections between Mansoura and Domietta for the smooth train operation
d. Improvement of the section between Cairo and Imbaba: additional track.
e. Modification of track layout in Cairo station: To speed up trains at Cairo station yard, its complicated track layout should be simplified.

CHAPTER 9 EVALUATION OF THE ALTERNATIVES

9.1 FINANCIAL EVALUATION

9.1.1 Forecast of Income Statement

The purpose of the income statement forecast is to evaluate optimal alternative proposals discussed in chapter 5 from a financial point of view.
Based on each alternative proposal shown in table 5.1.1, a financial forecast will be conducted over the period 1995/96 - 2001/2002. A financial forecast will be carried out for ENR excluding Metro, and for Metro separately based on the assumptions as follows:

<u>Assumptions</u>

(1) Passenger km
Passenger km is based on the demand forecast shown in Chapter 6.

Passenger km (compound annual growth rate)

Cases	1994/95 - 1997/98	1997/98 - 2001/02
Without	3.498 %	3.332%
With Case 1-1	1.638 %	1.890 %
With Case 1-2	1.638 %	1.890 %
With Case 2-1	3.498 %	3.350 %
With Case 2-2	3.498 %	3.350 %
Metro (With & Without)	8.847 %	1.798 %

(2) Ton km
Ton km forecasts are based on the demand forecast shown in chapter 6.

Ton km (compound annual growth rate)

	1994/95 - 1997/98	1997/98 - 2001/02
(With & Without)	5.819 %	7.023 %

(3) Tariff
The rate of increase of ENR tariff is based on two cases which contain 5% increase rate and 7% increase rate together with 5% and 7% increase rate of other mode such as taxi, bus and truck for the period 95/96 through 2001/2002. However tariff raise is set up at 10% in January 1997, 1998. Because there were no tariff raise in January 1996.

(4) Material input prices
The rate of increase of material input prices are 1% below the growth rate of the wholesale price index. Wholesale price inflation is 6% for the period 1995/96 through 2000/01, and 5.5% in 2001/2002.

(5) Service input
The rate of increase of service inputs prices is 1% below the growth rate of the wholesale price

index described above.

(6) Investment
Investments are based on chapter 8. In "With Case", after 1998/99, investments which will be conducted solely the government's policy, such as the new line (Ismailia-Rafah) construction in Sinai, are to be financed by the government.

(7) Depreciation
Depreciation is calculated based on fixed assets, capital expenditure, and depreciation rate. Each fixed asset has different useful life. One of main fixed assets, locomotives, have a 25 years useful life. Straight line depreciation is used. The current average depreciation rate (calculated as depreciation divided by fixed assets) was 4.5% in 94/95. Depreciation rates are assumed to be 4.5% in ENR (excluding Metro) and 3.5% in Metro.

(8) Interest rate
The average annual interest rate applied to the debt after 1998/99 is assumed to be 10%.

(9) Debt
Repayment of debt is assumed to have a 3 year grace period for principal, and be repaid over 10 years.

(10) Transfer of Metro assets
Metro line 2 is operated from October, 1996. The assets of Metro line 2 are assumed to be steadily transferred to ENR from the National Authority for Tunnels over 5 years beginning in 1996/97.

(11) Number of employee and rate of wage rise
In the 4 "with Cases", the number of employees are assumed to be reduced by severely curbing (at 1% of the total employee each year, for Case 1-2 and Case 2-2) or totally stopping (for Case 1-1 and Case 2-1) new recruitment up until Jan. 2002 to raise the labor productivity to an optimal level from the international point of view. The optimal number of employees is deduced by using a regression model as explained in 4.2.7. From Jan. 2003 the new recruitment is to be resumed in the manner to raise the labor productivity to the point that it will reach almost close to that of the developed countries in 1990s.
In the "Without-Case", ENR is assumed to recruit new employees at the current pace.

The annual growth rate of wages per employee is assumed to be 1% above the growth of the consumer price index. In other words, real wages for employees will grow at an annual rate of 1%.

(12) Closure of unprofitable lines
In the 4 "With Cases" the following lines are assumed to be closed in 1998/99.

Line #22	Faqus to El Semaina
Line #30	El Fayum to Sinnuris
Line #37	Beni Suef to Gaweish to El Lahum
Line #38	Gaweish to Menshat Abu El Sammad
Line #40	Kafr Saad to Kafr Silman

(13) Strengthen ticket inspection
15% to 25% of total passengers are seemed to be passengers who illegally don't pay for tickets. The collection of ticket revenue from non-paying passengers is assumed to improve 5% in 97/98, and 15% in 2001/2002 from the current level, by strengthening ticket inspection. These 5% and 15% improvements are multiplied by the sum of 2^{nd} and 3^{rd} class passenger revenues.

(14) Compensation for loss from excessively discounted tickets
ENR season ticket discounts for government employees and students is very high compared with other railways. If these heavy discounts are necessary from the political reasons, losses from excessive discounts should be compensated by the government. This compensation is assumed to be given to ENR after 1998/99. More than 50% discount is considered an excessive discount rate. The government is assumed to compensate the portion of discount over 50%.

(15) Revenue from diversified business
1% of the sum of passenger and freight revenue are assumed to be revenue from diversified business after 98/99.

(16) Government support concerning finance of investments after 1998/99.
In the "Without Case", government support for finance of investment is assumed to be terminated after 1998/99. The 4 "With Cases" were analyzed both assuming government supportis extended until 2001/02 and terminated in 1998/99.

9.1.2 Forecast of income statement of ENR (excluding Metro)

(1) Result of "Without Case"
(Table 9.1.1, 9.1.8, 9.1.15, 9.1.20)

If ENR doesn't take any of the actions proposed, its deficit will worsen each year and grow to LE 660 million in 2001/2002, from LE 196 million in 94/95. The cost recovery ratio will fall from 76% in 94/95 to 63% in 2001/2002.

1) Revenue
Revenue will increase 8.7% per year for the period 94/95 through 2001/2002. Passenger km will rise at an annual rate of 3.4%. Ton km will increase 6.5% annually. Price (defined as revenue/pass-km) for passenger will increase 5.6% annually. Price (revenue/ton-km) for freight will rise at an annual rate of 6.0%.

2) Expense
Total expenses will increase at an annual rate of 11.7% for the period 94/95 through 2001/2002. Higher growth rate of expenses are mainly caused by interest costs. As explained in 3.8, ENR is scheduled to resume interest payments from 1998/99. Interest payments will amount to LE 286 million in 2002/2002. Total expenses excluding interest cost will increase 9% annually. Wage costs will increase much more than other costs except interest cost. This is because the number of employees are estimated to expand from 72,184 in 95/96 to 86,476 in 2001/2002.

3) Deficit
ENR's deficit is estimated to expand to LE 660 million in 2001/2002 from LE 196 million in

94/95, because expenses will rise much higher revenue. The cost recovery ratio, excluding and including depreciation, will worsen from 107% and 76% in 94/95, to 79% and 63% in 2001/2002, respectively.

(2) Result of the 4 With Cases

(Tables 9.1.2, 9.1.3, 9.1.4, 9.1.5, 9.1.9, 9.1.10, 9.1.11, 9.1.12, 9.1.16, 9.1.17, 9.1.18, 9.1.19, 9.1.21, 9.1.22, 9.1.23, 9.1.24)

If ENR takes the actions proposed, its financial situation will improve. However, ENR won't be able to earn profits without government support, even in 2001/2002. From 94/95 to 2001/02, its deficit will improve from LE 196 million, to LE 12 million in "With Case 1-1", and to LE 91 million in "With Case 2-2". If government support will be continued, ENR can earn a profit in 2001/02. The differences between "With Case 1-1 & 1-2", and "With Case 2-1 & 2-2, are fare raises of other modes, and ENR staff recruitment. Differences in fare raises of other modes affect railway traffic demand, and ENR investment. According to the demand forecast, a relative fare raise has a big impact on demand. The growth rate of traffic units in "With Case 2-1 & 2-2" is much higher than in "With Case 1-1 & 1-2". As a result, the investment amount in "With Case 2-1 & 2-2" is much larger than in "With Case 1-1 & 1-2". This means that "With Case 2-1 & 2-2" have a much larger capital cost burden than "With Case 1-1 & 1-2".

1) Revenue

Revenue will increase at an annual rate of 9.5% and 10.5% in "With Case 1-1 & 1-2" and "With Case 2-1 & 2-2" respectively over the period 94/95- 2001/2002. Passenger-km will rise 1.78% in "With Case 1-1 & 1-2", and 3.41% in "With Case 2-1 & 2-2" annually. Ton-km will increase 6.5% per year. Price (revenue/pass-km) for passengers will increase at an annual rate of 6.55%. Price (revenue/ton- km) for freight will rise 6.93% annually.

2) Expense

"With Case 1-1" and "Case 2-2" are mentioned from among 4 "With Cases". Total expenses will increase at annual rates of 6.2% and 8.1% in "With Case 1-1 " and "With Case 2-2", during the years 94/95 - 2001/2002. Expenses except interest cost will increase 5.15% in "With Case 1-1" and 6.47% in "With Case 2-2" for the same period. Wage costs will increase 4.43% in "With Case 1-1" and 5.5% in "With Case 2-2" annually until 2001/2002. The number of employees fall from 72,184 to 54,613 in "With Case 1-1", and fall to 58,500 in "With Case 2-2" in 2001/2002 by curbing new recruitment. Depreciation costs will rise 3.5% in "With Case 1-1" and 5% in "With Case 2-2" annually.

3) Deficit

"With Case 1-1" and "Case 2-2" are mentioned from among 4 "With Cases". ENR's deficit will fall from LE 195.9 million to LE 12 million in "With Case 1-1", and fall to LE 91 million in "With Case 2-2" in 2001/02. Cost recovery ratios including depreciation will improve from 75.94% to 99.03% in "With Case 1-1" and from 75.94% to 93.55% in "With Case 2-2" respectively. Although ENR will pay interest cost after 98/99, growth rates of major costs such as wages and depreciation are below the revenue growth rate. Also, several proposals including strengthening ticket inspection, diversified business, and compensation for discounted tickets will start to contribute to increased revenue from 98/99. Compensation is the largest contributor to financial improvement.

9.1.3 Forecast of Income Statement of Metro
(Table 9.1.6, 9.1.7, 9.1.13, 9.1.14, 9.1.25, 9.1.26)

There are 2 cases for Metro. In "With Case", ticket prices rise 7% per year. In "Without Case", tickets rise 5% per year. The forecast of passenger-km is based on chapter 6.
Line 2 is under construction. As explained in 3.8, Line 1A bagan operation in October, 1996. Line 1B will begin in October, 1997. Line 2A will begin the end of 1999. Construction costs for 1A and 1B are about LE 4800 million, which have been already contracted. Construction cost for 2A is LE 1750 million, which has been already contracted, too. Now the committee which consists of ENR, NAT are discussing the method to transfer the assets of line 2. As for line 1, transfer of assets has been carried out over several years. In line 2, the same multi-year transfer method will be used. If all assets related to line 2 are owned by ENR, depreciation cost would be huge compared with revenue. Depreciation rates are assumed to be 3.5%. Under this assumption, depreciation cost will increase at an annual average rate of 9.9%.
If ENR bears this huge capital cost , it will be very difficult for ENR to earn profits in spite of its high transport density.

(1) The result of Without Case
The deficit will worsen to LE 311 million in 2001/2002, from LE 133 million in 94/95. The cost recovery ratio will fall slightly from 35.7% in 94/95 to 31% in 2001/2002.

1) Revenue
Revenue will increase 9.6% annually for the period 94/95 through 2001/2002. Passenger-km will rise 3.5% annually for the same period. Line 2 will contribute to increased passenger volume.

2) Expense
Expenses will increase 11.8% annually for the period 94/95 through 2001/2002. Expenses other than interest costs will rise 10% annually. Depreciation cost which is the biggest cost item will increase 10% annually. Depreciation cost will be 1.99 times larger than revenue in 2001/2002.

3) Deficit
The deficit will worsen from LE 133 million in 94/95, to LE 311 million in 2001/2002. The main cause of the deficit will be the huge depreciation cost. In particular, construction costs for line 2 are very large as mentioned above. As a result, depreciation costs will rise steadily.

(2) Result of With Case
The deficit will worsen from LE 133 million in 94/95, to LE 295 million in 2001/2002. The cost recovery ratio will improve from 35.7% in 94/95 to 33.6% in 2001/2002.

1) Revenue
Revenue will increase 10.5% annually for the period 94/95 through 2001/2002. Passenger-km will rise 3.5% annually for the same period. Line 2 will contribute to increase passenger volume.

2) Expense
Expenses will increase 11.5% annually for the period 94/95 through 2001/2002. Expense other than interest cost will rise 9.8% annually. Depreciation cost which is the biggest cost