

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

**GENERAL AUTHORITY FOR ROADS,
BRIDGES AND LAND TRANSPORT (GARBLT),
MINISTRY OF TRANSPORT,
ARAB REPUBLIC OF EGYPT**

**FEASIBILITY STUDY
ON HIGH PRIORITY
URBAN TOLL EXPRESSWAYS
IN CAIRO**

FINAL REPORT

EXECUTIVE SUMMARY

JANUARY 2009

PREFACE

In response to a request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct the “Feasibility Study on High Priority Urban Toll Expressways in Cairo” and entrusted it to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a Study Team headed by Dr. Hani Abdel-HALIM, who later was replaced by Mr. Masakazu ISHIGURO, of Katahira & Engineers International from August 2007 to September 2008.

The Team held discussions with the officials of the Ministry of Transport represented by GARBLT as well as other officials concerned, and conducted field surveys by assistance of local consultants, data analysis and engineering drawings for the Study routes. Upon returning to Japan, the Team prepared this Final Report to summarize the results of the study.

I hope that this report will contribute to the development in the Arab Republic of Egypt, and to the enhancement of friendly relationship between the two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the Study Team.

January 2009,

Eiji HASHIMOTO,
Vice-President
Japan International Cooperation Agency

Mr. Eiji HASHIMOTO,
Vice President
Japan International Cooperation Agency

January 2009

Dear Sir,

Letter of Transmittal

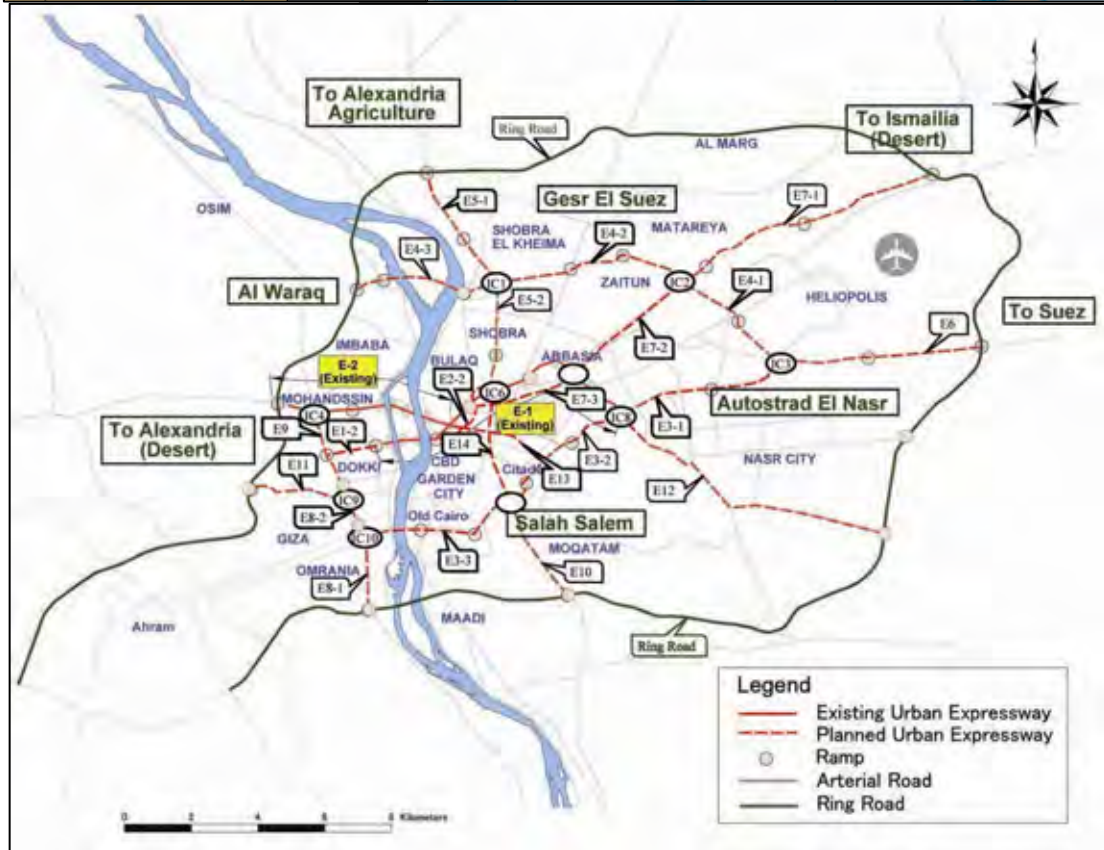
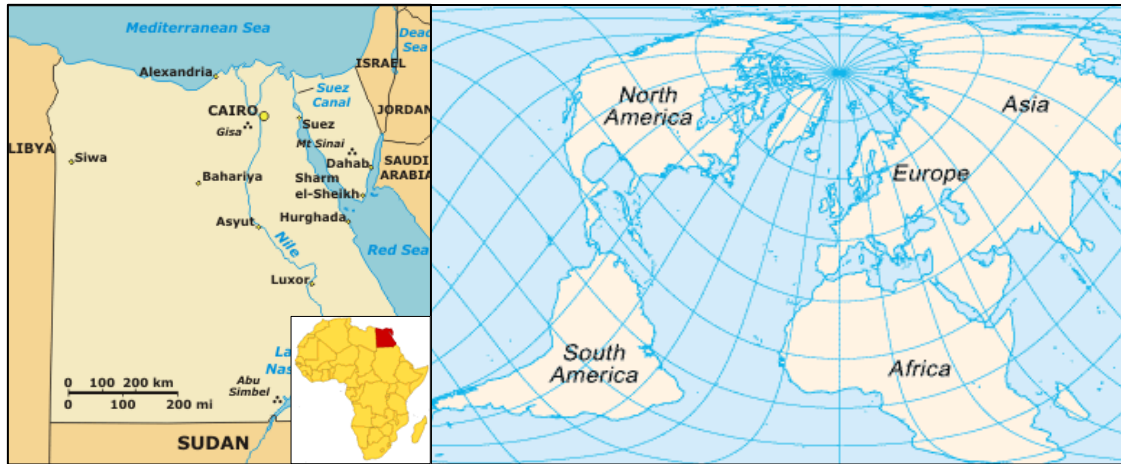
We are pleased to submit herewith the Final Report of the “Feasibility Study on High Priority Urban Toll Expressways in Cairo”. The report compiles the results of the Study and includes the advices and suggestions of the authorities concerned of the Government of Japan and your agency as well as the comments made by the Ministry of Transport and other authorities concerned in the Arab Republic of Egypt.

This report defines the high priority urban toll expressways in Greater Cairo Region, presents the results of traffic forecast and based on traffic analysis, the review and updating of previous PPP Study is offered. The report shows also the results of existing conditions surveys. Alignment/configuration of high priority routes is described. The preliminary geometric and structural design is presented. The toll expressway operation and maintenance systems are illustrated. Expressway legislation, environmental and social impacts are investigated. For economical and financial assessment, construction cost estimation is revealed. Finally, the report presented the project implementation program and the PPP implementation plan.

Wish to take this opportunity to express our sincere gratitude to your agency and the Ministry of Foreign Affairs. We also wish to express our deep gratitude to the Ministry of Transport and especially GARBLT as well as other Governmental Agencies concerned in the Arab Republic of Egypt for the close cooperation and assistance extended to the JICA Study Team during the course of the Study. We hope this report will contribute to the development of the Arab Republic of Egypt.

Very truly yours,

Mr. Masakazu ISHIGURO
Team Leader,
Feasibility Study on High Priority Urban Toll Expressways in Cairo



| Route | Location | Length (Km) | Route | Location | Length (Km) |
|-------|---------------------------------------|-------------|-------|---------------------------------------|-------------|
| E1-1 | 6 th October Elevated Road | 11.0 | E6 | Cairo-Suez Road | 7.5 |
| E1-2 | 6 th October Extension | 4.3 | E7-1 | Gesr El Suez (Ismailia Desert) | 10.5 |
| E1-3 | 6 th October Bypass | 1.6 | E7-2 | El Gheish Street | 5.4 |
| E1-4 | 6 th October Bypass | 1.5 | E7-3 | El Khalefa El Mamon Street | 2.8 |
| E2-1 | 15 th May Elevated Road | 6.4 | E8-1 | Tereat El-Zumur South of King Faisal | 2.9 |
| E2-2 | 15 th May Extension | 1.8 | E8-2 | Tereat El-Zumur North of King Faisal | 1.9 |
| E3-1 | Autostrad El Nasr Street in Nasr City | 6.5 | E9 | Tereat El-Zumur in Bolag el Dakroor | 4.0 |
| E3-2 | Autostrad from Nasr City to Citadel | 5.6 | E10 | Salah Salem from Citadel to Ring Road | 4.0 |
| E3-3 | Salah Salem from Citadel to Giza Sq. | 6.6 | E11 | From Tereat El-Zumur to Ring Road | 4.0 |
| E4-1 | Abu Bakr El-Sedeeg | 4.7 | E12 | El Tiaran Street | 10.8 |
| E4-2 | Ibn El hakam – El Matariyah | 7.1 | E13 | Az Har Tunnel Extension | 5.3 |
| E4-3 | Tereat Ismailia – Al Warraq | 5.2 | E14 | El Qalaa Street | 4.6 |
| E5-1 | Cairo-Alexandria Agriculture Road | 5.3 | | TOTAL | 136.0 |
| E5-2 | Ahmad Helmi Street | 4.7 | | | |

CAIRO URBAN TOLL EXPRESSWAY NETWORK

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Exchange Rate:*LE 1.00 = US\$ 0.1881**LE 1.00 = JPY 19.771**(As of Jun 2008)*

ABSTRACT**Background**

Greater Cairo Region (GCR), is estimated to accommodate 24 million in 2027 which puts growing pressure on all infrastructure systems, including the road network system.

JICA, the official agency responsible for the implementation of the technical cooperation program of the Government of Japan, conducted the “Master Plan of Urban Transport Project in Greater Cairo Region” (CREATS) in which a Master Plan was formulated in 2002, with the target year of 2022.

Under the Master Plan, the construction of the urban toll expressway network with about 78 km in length of new expressways was proposed as one of the priority projects.

The implementation of the proposed urban toll expressway network requires huge financial resources for construction, operation and maintenance.

In this regard, the JICA study on “Public-Private Partnership “PPP” Program for Cairo Urban Toll Expressway Network Development” (hereinafter referred to as “PPP Study”) was started in 2005 and completed in 2006. The PPP Study formulated a financing plan for commercialization and support of PPP system structure with a strategy for introducing Public-Private Partnership (PPP) and applying toll road system on the expressway network. In addition, a new organization, called the Metropolitan Expressway Authority (MEA) was planned to handle all the tasks related to the expressway network.

To promote the construction of the expressway network by the target year of 2022, results of the PPP Study showed the necessity of the immediate constructions of high priority routes that are composed of the extensions of existing elevated Route No.1 and Route No.2 (E1-2 and

E2-2), and the new Route No.3 (E3).

In response to the request of the Government of Egypt, the Government of Japan has decided to conduct this Feasibility Study on High Priority Urban Toll Expressways in Cairo.

Objectives of the Study

The objectives of the Study are:

- To implement Feasibility Study on high priority expressways proposed in the Master Plan of Urban Transport Projects in Greater Cairo Region (hereinafter referred to as “Master Plan”) in November 2002 and Public-Private Partnership (PPP) Program for Cairo Urban Toll Expressway Network Development (hereinafter referred to as “PPP Study”) in May 2006.
- To assist the Ministry of Transport (hereinafter referred to as “MOT”) to strengthen the functions of Metropolitan Expressway Authority (hereinafter referred to as “MEA”).
- To assist MOT and MEA to smoothly introduce toll road system and PPP scheme for the construction of the proposed high priority expressways.

The Study Routes

The Study will cover high priority routes as follows (see the location map):

- E1-2, E2-2 and E3-1: To carry out Feasibility Study
- E1-1 and E2-1: To analyze methods of applying toll and to evaluate the impact of both existing and newly operated sections when extensions and/or new route are opened.
- E3-2 and E3-3: To carry out Pre-Feasibility Study in order to analyze the feasibility of E3 as a whole, as well as the network after implementing and operating E1, E2, and E3.

Scope of the Study

The Study includes the following main Tasks:

- Review of PPP Study and Existing Condition
- Feasibility Study
- Implementation Planning of PPP
- Overall Evaluation and Recommendations

Steering Committee (SC) Meeting

During the duration of the Study four meeting with the SC Members were undertaken as dated hereunder:

- 1st Meeting Sept. 10, 2007
- 2nd Meeting Nov. 27, 2007
- 3rd Meeting Mar. 13, 2008
- 4th Meeting Aug. 26, 2008

Stakeholder Meeting

During the duration of the Study three meetings with the Stakeholders were undertaken as dated hereunder:

- 1st Meeting Mar. 16, 2008
- 2nd Meeting June 23, 2008
- 3rd Meeting Sept. 4, 2008

Three stakeholders meetings during the course of the Study are the minimum requirement for a full EIA.

Counterpart Team Activities

GARBLT assigned to the Study a Counterpart Team composed of nine (9) members having a wide spectrum of expertise. The Team interacting with the Study Team on a daily basis, which instrumental in achieving a promising level of technological transfer believed to have built the capacity of the Counterpart Team members in the areas of the Study. In addition, technical biweekly meetings were held on the progress of the Study in different technical aspects related to the planning and design of the components of expressway sections. Also, a PPP Seminar was conducted and on the job training on using STRAD Program is also done.

High Priority Expressways

This feasibility study deals with high priority

expressways that were concluded in the previous “PPP Study” as follows:

Optimum Network under PPP Study



High Priority Expressway Sections

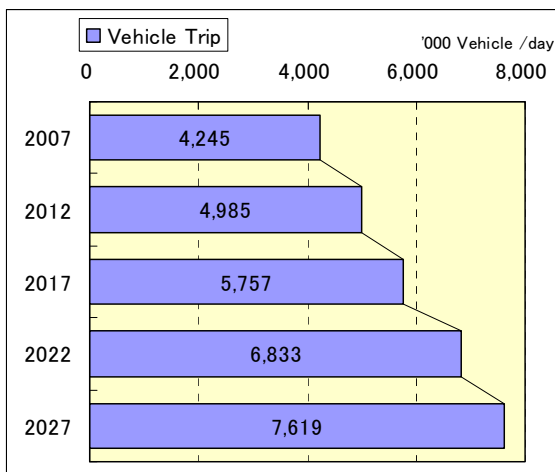
| Section | Location | Length (km) |
|---------|-------------------------------------|-------------|
| E1-2 | 6 th October Extension | 2.1 |
| E2-2 | 15 th May Extension | 1.2 |
| E3-1 | Autostrad El Nasr – Nasr City | 6.8 |
| E3-2 | Autostrad from Nasr City to Citadel | 5.8 |
| E3-3 | Salah Salem from Citadel to Giza | 6.9 |
| Total | | 22.8 |

Traffic Forecast and Analysis

To estimate the future traffic volumes on the planned expressway network, traffic count and affordability-to-pay interview surveys in GCR area are conducted. Traffic count data are used to analyze the present traffic characteristics and to revise present OD tables for vehicle category. Affordability-to-pay interview data are used to decide the parameter of traffic assignment model on the expressways. Then, the forecasted person trips basic of CREATS and SDMP are converted to the Future OD tables for target years of 2012, 2017, 2022 and 2027 of vehicle category.

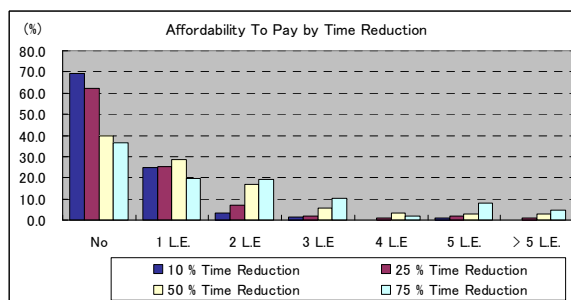
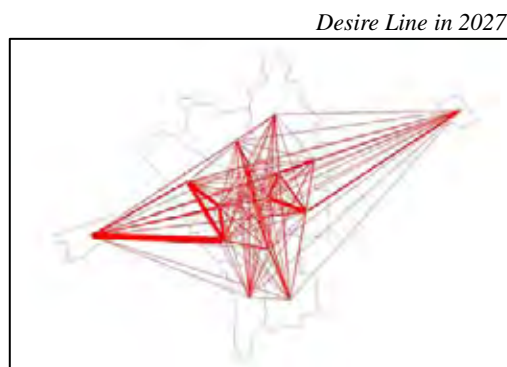
The transport model framework uses a conventional 4 steps approach that basically follows the same model structures as the CREATS and SDMP Models

The estimated numbers of generated vehicle trips are 4.25 million in 2007 and 7.62 million in 2027, with a growth rate of 1.8 times.



Comparing the distribution patterns of vehicle trips estimated for 2007 and 2027, it is seen that the main movement of traffic shifts to east-west direction from the current north-south direction. Giza block grows in a triangle form including 6th of October. The West block also grows by merging the current West block and Qanater and 10th of Ramadan.

The results of the Affordability to Pay Survey show that in the situation of 10% and 25% time reduction by toll expressway, two thirds of driver refused to use toll expressway, but according to increase time reduction, in the case of 50% and 75% time reduction, percentage of the driver who refused to drive on toll expressway, decline to one third. Amounts of affordability to pay in the each case were 1.19 pounds in 10% time reduction, 1.75 pounds in 25%, 2.23 pounds in 50%, and 3.01 pounds in 75%.



Socioeconomic Framework

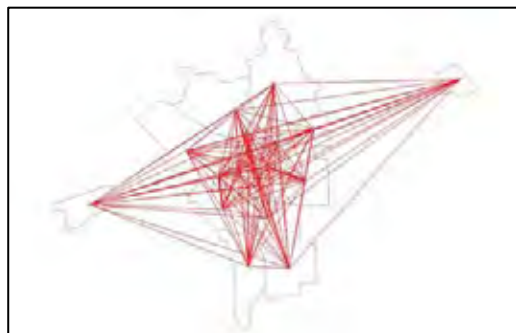
Planning framework for the Study Area was formulated in terms of population, economy, and social development.

Planning Framework until 2027

| | 2007 | 2012 | 2017 | 2027 |
|--------------------|--------|--------|--------|--------|
| Population | 16,464 | 18,411 | 20,369 | 24,192 |
| GRDP Growth Rate | 8 % | 8 % | 7 % | 6 % |
| GRDP Capita (LE) | 10,782 | 14,167 | 17,960 | 27,726 |
| Primary Employed | 266 | 306 | 349 | 427 |
| Secondary Employed | 1,741 | 2,014 | 2,311 | 2,824 |
| Tertiary Employed | 2,467 | 2,876 | 3,323 | 4,126 |
| Total Employed | 4,475 | 5,196 | 5,982 | 7,378 |

(Unit: million)

Desire Line in 2007



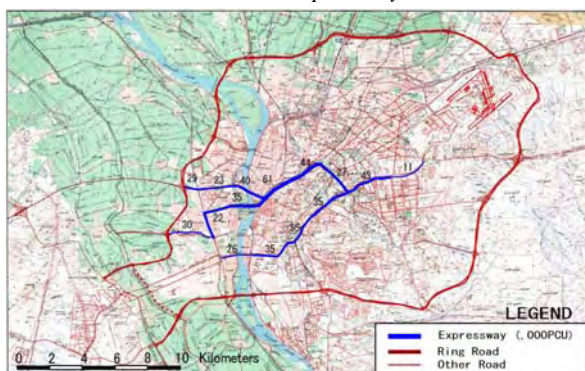
Future Expressway Demand (With Project)

In this Study, the capacity restraint method is applied. Assignment with this method is the most straightforward for use in network models, and the most efficient particularly where the number of zones in the trip matrix is large.

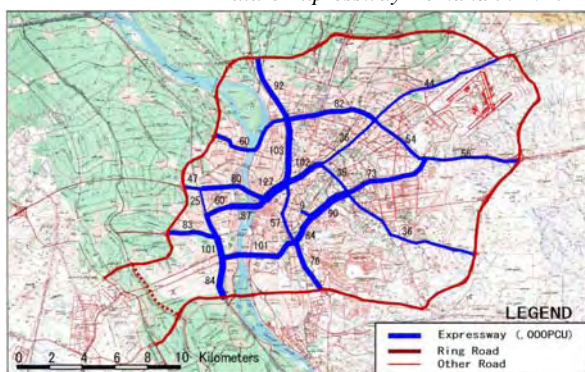
This assignment technique is based on the speed – flow relationship. The traffic simulation software of JICA STRADA is used to estimate traffic volumes.

Traffic assignments are carried out for the future express network based on the CREATS, PPP Study and SDMP Plans. In this “With Project” case, traffic is assigned on both future road network and expressway network together for year 2012 and 2027.

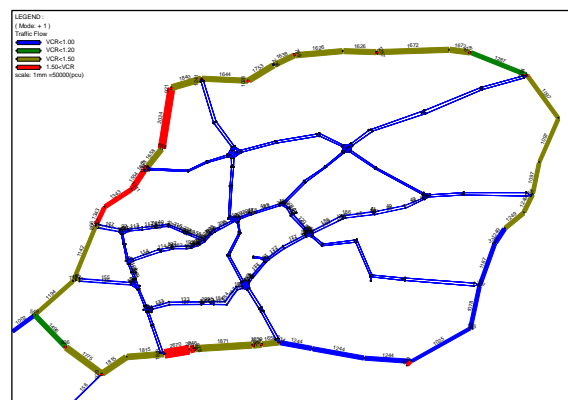
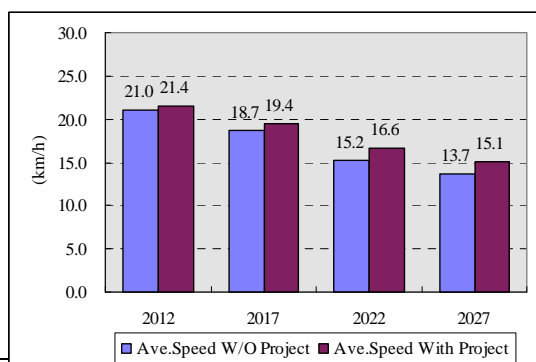
Future Expressway Demand in 2012



Future Expressway Demand in 2027



Average speeds over entire roadnetwork, including the expressways and ordinary streets, of With Project case and Without Project case are not so large. This is because average speed is calculated over entire roadnetwork including congested ordinary street. Traffic condition (VCR) on the expressways are maintained fairly smooth even in year 2027.



Review and Updating of PPP Study

With the target year of 2027; a more comprehensive network is developed with more links as shown in the figures.

PPP 2022 Expressway Network



The newly introduced links that will compose the urban toll expressway network for the year 2027 are as follows:

E7-2: Qubri El-Kobbah Corridor

This link will directly connect Ismailia road with central areas in Cairo.

E10: Cairo South Corridor

This link is getting higher priority than before due to new developments south of Cairo.

E12: New Cairo Corridor

This newly developed section is to directly connect the area proposed for the relocation of governmental ministries and agencies with the

urban expressway network of Cairo. This section has a total length of 22.0 Km.

E13: Extension of Al-Azhar Tunnel (as a long ramp of E3-2)

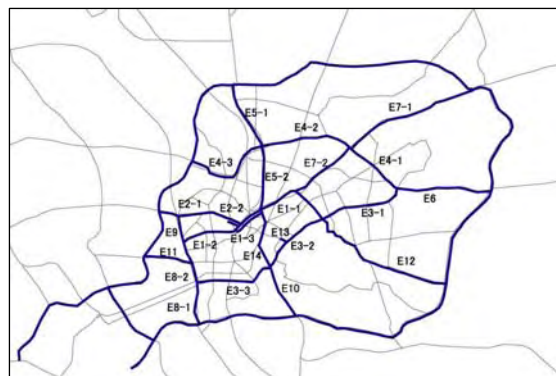
This section is to include Al-Azhar Tunnel in the urban expressway network. Under this plan, it is recommended to extend the tunnel from Salah Salem side till the Autostrade (E3-2) in order to use it as a long ramp for accessibility from the city center to eastern and western areas of Cairo through E3. This tunnel section has a length of 4.0 Km that passes under the cemetery. In future; the tunnel may be extended from the city center side and connected through a viaduct to E2-1 and E2-2 to provide a long corridor from east to west of Cairo. Until 2027, results show no urgent need to carry out this second extension work.

E14: Providing North-South Link in Cairo Side

The planning concept of the urban toll expressway network in CREATS Master Plan (JICA, 2002) is to provide mini-ring roads inside Cairo Ring Road. On the west side of the River Nile, with a narrow urbanized built-up area in Giza Governorate, a north-south link E8 and E9 is provided in the network. Similarly, a new North-South link on the east side of the River Nile was proposed to be included in the network. The most optimum location of this link is found to be the connection between E5-2 and E10.

In addition, to connect E2-2 with E1-1 a new viaduct parallel to 6th of October is required over Ramses Street to allow a connection with E1-1 based on the applied design standard. This viaduct is required on a short section on Ramses Street between the two intersections of 26th of July Street and Orabi Street. In future, it may be necessary to extend it (that is called E1-3) between the River Nile to the East till Ghamra Metro Station to handle heavy traffic from E5, as shown in the figure.

2027 Proposed Expressway Network



E14 link will be constructed in the most congested central areas of Cairo, shield tunnels is the only option. Rough cost estimation was carried out and the cost is estimated to be about LE 5.0 billion.

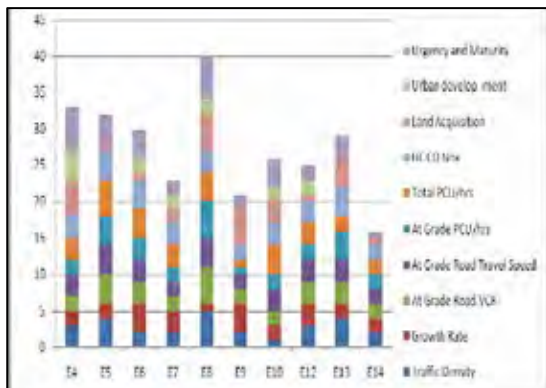
It was necessary to review the prioritization of the different links of the expressway network under the newly introduced conditions taking into consideration the objectives of the urban toll expressway development plan. The future traffic volumes of the new target year of 2027 are applied rather than those of the year 2022 of the PPP Study.

Figure hereafter shows a summary of the analysis results by applying the different prioritization criteria on each individual expressway. With the implementation the whole length of the expressway of E3 and E1-2 till the Zumur Canal and the railway line in Giza, the expressway **E8**, which connects both expressways and provides a link that closes Cairo Ring Road, is getting the highest priority compared with all other routes. Major functions of E8 can be summarized as follows:

- To connect the Study Routes E1 and E3 and with E11 which is under construction.
- To optimize the benefits of implementing E1-2 and E3.
- To provide an Inner Ring Road with E1, E3 and with southern section of Cairo Ring Road as the basic concept of CREATS.
- To provide a missing link closing Cairo Ring Road.

- To provide a North-South link west of the Nile at Giza city.

Prioritization Results



E8 and its Connections to other Expressways



Expressway Tentative Implementation Plan

| Section | Priority | Length (km) | Cost (1000 LE) | Year | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------|------------|-------------|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|---|---|---|---|
| | | | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | | | | | |
| E1-1 | Toll Plaza | 11.0 | 2,074 | | | | | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| E1-2 | FS | 4.3 | 2,648 | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| E2-1 | Toll Plaza | 12.8 | 1,206 | | | | | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| E2-2 | FS | 1.8 | 317 | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| E3-1 | FS | 6.5 | 2,306 | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| E3-2 | Pre FS | 5.6 | 1,529 | | | | ■ | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| E3-3 | Pre FS | 6.6 | 1,853 | | | | ■ | ■ | ■ | | | | | | | | | | | | | | | | | | | |
| E4-1 | 1st | 4.7 | 886 | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| E4-2 | 1st | 7.1 | 1,778 | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| E4-3 | 1st | 5.2 | 980 | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| E5-1 | 2nd | 5.3 | 999 | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| E5-2 | 2nd | 4.7 | 1,177 | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| E6 | 2nd | 7.5 | 1,414 | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| E7-1 | 2nd | 10.5 | 1,979 | | | | | | | | | | | | | | | | | | | | | | | | | |
| E7-2 | 4th | 5.4 | 1,018 | | | | | | | | | | | | | | | | | | | | | | | | | |
| E8-1 | 1st | 2.9 | 726 | | | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | | |
| E8-2 | 1st | 1.9 | 476 | | | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | | |
| E9 | 4th | 4.0 | 754 | | | | | | | | | | | | | | | | | | | | | | | | | |
| E10 | 3ed | 4.0 | 1,001 | | | | | | | | | | | | | | | | | | | | | | | | | |
| E11 | On Ggoing | 4.0 | 1,001 | ■ | ■ | | | | | | | | | | | | | | | | | | | | | | | |
| E12 | 3ed | 10.8 | 2,035 | | | | | | | | | | | | | | | | | | | | | | | | | |
| E13 | 4th | 5.3 | 999 | | | | | | | | | | | | | | | | | | | | | | | | | |
| E14 | 4th | 5.0 | 1,000 | | | | | | | | | | | | | | | | | | | | | | | | | |
| I. C. (Full) | 3ed | 9 | 2,564 | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| I. C. (Half) | 3ed | 9 | 1,442 | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

Revised Implementation Action Plan for HPE

| Major Tasks | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Agency In-Charge |
|---|------|------|------|------|------|------|------------------|
| Cairo PPP Study | ■ | ■ | | | | | JICA ST - ENIT |
| Route Prioritization – HPE | | ■ | | | | | JICA ST - ENIT |
| MEA Secretariat | | ■ | ■ | | | | MOT |
| Feasibility Study on HPE (E1-2/E2-2/E3-1) | | | ■ | ■ | ■ | | JICA ST - GARBLT |
| EIA on HPE | | | | ■ | ■ | | GOPP/MOE |
| MOT Approval | | | | | | | MOT |
| MEA Organization Set-up | | | | ■ | ■ | | MOT |
| MOP / MOF Approval | | | | | ■ | | MOP/MOF |
| Parliament Committee Approval | | | | | ■ | | MOT |
| Cabinet Approval | | | | | ■ | | MOT |
| Consultant Selection | | | | | ■ | | JICA |
| Detailed Design of HPE | | | | | ■ | ■ | ODA/MEA |
| Construction Loan | | | | | | ■ | GARBLT/MEA |
| Tendering | | | | | | ■ | GARBLT/MEA |
| Construction of HPE | | | | | | ■ | GARBLT/MEA/ODA |
| F/S on Next Routes (E3-2/E3-3/E8) | | | | | ■ | ■ | JICA/GARBLT/MEA |

| | |
|---|--|
| <p><i>HPE: High Priority Expressways</i> <i>JICA ST: Study Team</i> <i>D/D: Detailed Design</i> <i>F/S: Feasibility Study</i> <i>EIA: Environmental Impact Study</i> <i>MEA: Metropolitan Expressway Authority</i> <i>CG: Cairo Governorate</i></p> | <p><i>MOT: Ministry of Transport</i> <i>MOP: Ministry of Planning</i> <i>MOF: Ministry of Finance</i> <i>MOE: Ministry of Environment</i> <i>ENIT: Egypt National Institute of Transport</i> <i>GOPP: General Organization for Physical Planning</i> <i>ODA: Official Development Assistance</i></p> |
|---|--|

Survey of Existing Conditions

Data of ordinary at-grade road network is indispensable when an urban expressway network is formulated. Therefore, existing condition survey is implemented. The survey takes into consideration three main existing conditions which are:

- Existing road conditions by undertaken Road Inventory Surveys.
- Existing soil conditions by undertaking Geotechnical Investigations.
- Existing geometric conditions by undertaking Topographical Surveys.

Alignment / Configuration of High Priority Routes

E 1-2

Five (5) alternative routes are investigated and scored. Alt.-4 via Agricultural Museum, al-Sawra

St, Shooting Club, and Gadda (Jeddah) St with double 2-lane shield tunnel (parallel or tandem) and above ENR Track with 2-lane split type viaducts is selected.

E2-2

Four (4) alternative configurations are investigated and scored. As a result, Alternative-3 Eastbound viaduct shall be constructed partially integrated with new westbound viaduct in western half portion, and partially independent from existing westbound viaduct in eastern half portion is recommended.

E 3-1

Three (3) alternative configurations are investigated and scored.

Alt.-1 Viaduct

Alt.-2 Depressed

Alt.-3 At-Grade

As a result, Alternative-2 (Depressed) is selected as most suitable configuration for E3-1.

E 3-2

Three (3) alternative configurations are investigated and scored.

Alt.-1 above Roadway

Alt.-2 above Railway

Alt.-3 between Roadway and Railway

As a result, Alternative-3 (between Roadway and Railway) is selected as most suitable configuration for E3-2.

E3-3

Three (3) alternative configurations are investigated and scored.

As a result, Alternative-3 (Combination) is selected as most suitable configuration for E3-3.

Integration with Future Expressways

Integrations with future expressways (i.e. junctions) are also proposed for reference purpose to not only implementing agencies but also other related public entities as well as stakeholders in order to provide better understandings and advance informations for easy future expansions of the expressways.

Preliminary Geometric Design

The design policy of the expressway components and all supplemental facilities is determined based on AASHTO and consideration of the Egyptian Design Standards. For providing high level of services to road users that meet the newly introduced toll scheme, new standard is formulated in reference to the Japanese Design Standards and experiences for new expressways in Egypt.

Preliminary Structural Design

The preliminary structural design is carried out based on the following basic approach:

- Establish preliminary design policy
- Establish preliminary design criteria
- Make a full appreciation of existing

conditions and constraints

- Establish extent and impact of other existing and proposed works in the vicinity of the structures works in the vicinity of the structure.
- Estimation of engineering characteristics of sub-soils
- Establish operational clearance requirements of existing and proposed traffic lanes
- Establish operational and construction clearance requirements at railway lines
- Determine impact of method of construction
- Establish alternatives and make comparative studies
- Make proper reference to GARBLT counter part team and other concerned bodies

Toll Expressway Operation Systems

The purpose of the traffic management for Cairo Urban Toll Expressways are:

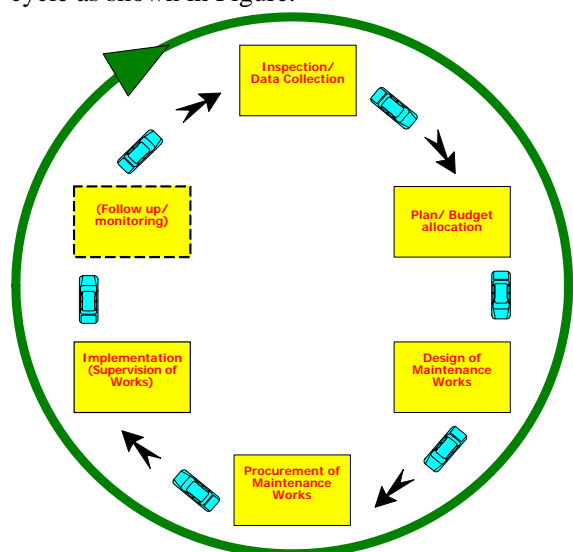
- To prevent unforeseen delay in trip of road users, by presenting necessary information such as occurrence of incidents and by controlling traffic flow.
- To ensure traffic safety by warning to road users and indicating unusual traffic condition
- To maintain suitable traffic volume by suggesting using appropriate route, thus contributing to increase toll revenue.
- To collect and accumulate traffic data automatically to be used to plan traffic management and future expansion of expressway network.
- To rescue and to restore, when accident occurs, rescue work will start cooperating traffic police.

Mini Way



Maintenance Systems

The terminology “maintenance system” usually refers to a series of procedures which form a cycle as shown in Figure.



Usually, road maintenance works are categorized into the following three types.

- (i) Routine maintenance,
- (ii) Periodic maintenance, and
- (iii) Emergency maintenance.

Toll Expressway Legislation

- On PPP structure, the private sector is in charge of design, construction, operation, maintenance, and management of public facilities. The public sector will have agreements with the private sector on service provisions and the private sector will allocate all the risks to consortium members who would best take these risks.
- Main factors for the success of PPP projects with regard to legislative issues can be summarized in three areas: (i) appropriate and effective transfer of businesses from the public sector to the private sector; (ii) effective and efficient selection process of proposals from the private sector; (iii) appropriate risk allocation among the public sector and private participants.

Environmental and Social Consideration

A full EIA was granted by JICA not only for the F/S sections but for the pre-F/S sections as well. Under the Environmental Impact Assessment (EIA), comprehensive measurements on physical environment and social interview surveys were done in areas with possible negative impact by the Project. Next, data were analyzed and prediction techniques were applied on the 2 cases of “With Project” and “Without Project”. The EIA covers the environmental aspects of:

- Air pollution
- Noise and vibration
- Water contamination
- Waste
- Landscape
- Safety and health risk
- Cultural assets
- Distribution of sensitive facilities
- Global warming

Cost Estimation

| | Length (km) | Total Cost (LE '000) | Foreign | Local | Foreign % | Local % |
|--------------------------|-------------|----------------------|--------------|--------------|------------|------------|
| E1-2 | 5.4 | 3,755 | 1,323 | 1,891 | 35% | 50% |
| E2-2 | 1.9 | 468 | 154 | 250 | 33% | 53% |
| E3-1 | 5.7 | 3,276 | 1,066 | 1,753 | 33% | 54% |
| F/S | 13.0 | 7,499 | 2,543 | 3,893 | 34% | 52% |
| E3-2 | 6.9 | 2,332 | 761 | 1,244 | 33% | 53% |
| E3-3 | 5.5 | 2,773 | 1,051 | 1,315 | 38% | 47% |
| Pre-F/S | 12.4 | 5,104 | 1,812 | 2,560 | 35% | 50% |
| F/S & Pre-F/S | 25.4 | 12,603 | 4,354 | 6,453 | 35% | 51% |

Toll Rate Setting

| Section | Light/ Heavy | 2012 | 2017 | 2022 | 2027 | 2028-42 |
|--|--------------|------|------|------|------|---------|
| New Expressways (E1-2, E2-2, E3-1, E3-2, E3-3) | L | 4 | 5 | 6.5 | 8 | 8 |
| | H | 8 | 10 | 13 | 16 | 16 |
| Existing Expressway (E1-1, E2-1, E11) | L | 2 | 2.5 | 3.25 | 4 | 4 |
| | H | 4 | 5 | 6.5 | 8 | 8 |
| Ring Road | L | 2 | 2.5 | 3.25 | 4 | 4 |
| | H | 4 | 5 | 6.5 | 8 | 8 |

Project Implementation Program

| Section | Detail Design | Construction | Year of Operation Start |
|----------------------|---------------|--------------|--------------------------|
| F/S routes | | | |
| E1-2 | 2009 | 2010-2014 | 2014 (middle of year) |
| E2-2 | 2009 | 2010-2012 | 2013 |
| E3-1 | 2009 | 2010-2013 | 2014 |
| F/S & Pre F/S routes | | | |
| E3-2 | 2010 | 2011-2014 | 2014 (middle of year) |
| E3-3 | 2010 | 2011-2015 | 2015 |

Economic and Financial Analysis

Economic Evaluation of Each Route under Scenario 1

| Section | EIRR | NPV (in LE million) |
|----------------------|-------|---------------------|
| F/S Routes | 12.8% | 424 |
| F/S & Pre-F/S Routes | 14.0% | 1,619 |
| E1-2 | 8.5% | -700 |
| E2-2 | 19.5% | 316 |
| E3-1 | 15.1% | 807 |
| E3-2 | 15.1% | 540 |
| E3-3 | 15.9% | 835 |

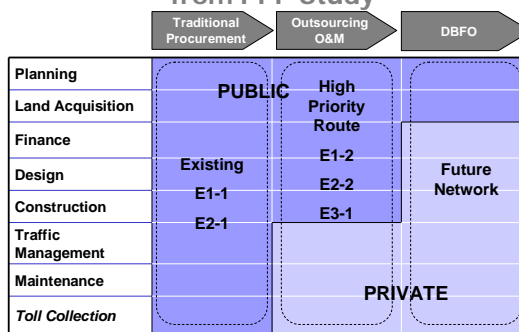
Under Scenario 1, a toll is charged on all expressways and Ring Road.

Financial Evaluation of Each Route

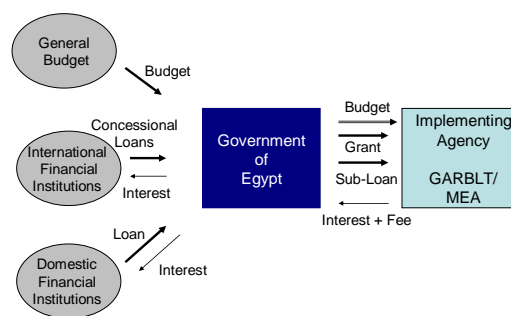
| Section | FIRR | NPV (LE million) |
|----------------------|------|------------------|
| F/S Routes | 4.0% | -3,346 |
| F/S & Pre-F/S Routes | 3.1% | -5,738 |
| E1-2 | 1.0% | -1,976 |
| E2-2 | 8.7% | -105 |
| E3-1 | 5.7% | -1,265 |
| E3-2 | 5.6% | -812 |
| E3-3 | 6.2% | -885 |

PPP Implementation

Comparison of possible PPP options from PPP Study



Funds Flow



Organization of the Study

The Study is undertaken within full cooperation among three main groups which are:

- Steering Committee consists of different concerned Egyptian Authorities
- GARBLT Counterpart Team
- JICA Study Team

The Steering Committee, which is composed of concerned governmental authorities in Greater Cairo, is assembled for the implementation of the Study. The Egyptian side agreed that the Chairman of General Authority for Roads, Bridges and Land Transport (hereinafter will be referred to as GARBLT), will chair the Steering Committee.

| | |
|---------------------------------|---|
| Eng. Tarek El-Attar | Chairman of the Steering Committee Chairman, General Authority of Roads, Bridges and Land Transport (GARBLT), Ministry of Transport |
| General Mohamed Mansour | Director, Central Traffic Directorate, Ministry of Interior |
| Eng. Bahy Yusif Basily | Ministry of Economic Development |
| Dr. Sherif Oteifa | Advisor to the Minister, Ministry of Investment |
| Prof. Dr. Laila Salah Radwan | Ministry of Culture, Professor of Highway Engineering, Cairo University |
| Eng. Ahmed Abou El-Seoud | Head of Central Department for Air Quality and Noise, Ministry of Environment |
| General Eng. Ahmed B. Mahrous | Director, Roads and Transport Directorate, Cairo Governorate |
| Mr. Mousa Mahmoud Hussein | Assistant General Secretary, Giza Governorate |
| Eng. Samy Abozeid | Head, Infrastructure Central Department General Organization of Physical Planning (GOPP), Ministry of Housing |
| Eng. Atta El Sherbiny | Chairman, National Authority for Tunnels (NAT) Ministry of Transport |
| Eng. Hassan Ahmed Selim | Vice Chairman, Transport Planning Authority (TPA), Ministry of Transport |
| Prof. Dr. Abdallah Wahdan | Director, Egypt National Institute Transport (ENIT), Ministry of Transport |
| Eng. Mohamed Gamal Nada | Advisor to the Minister, Head of PPP Unit, Ministry of Transport |
| Prof. Dr. Mohamed R. EL Mitainy | Professor of Highway and Traffic Engineering, Faculty of Engineering, Cairo University |
| Eng. Magdy El-Dahan | Director of Investment Roads Directorate, GARBLT, Ministry of Transport |
| Dr. Hisham Mahmoud Fouad | Technical Advisor to GARBLT Chairman, Committee Secretariat |

The Study is conducted in the manner of joint work of both the Egyptian and Japanese sides. In this context, the Ministry of Transport has allocated the necessary number of counterpart personnel from GARBLT and other related entities, as follows:

| | |
|---------------------------|---|
| Eng. Hosam Badrawy | GARBLT, Ministry of Transport |
| General Salah Abdel Wahab | Central Traffic Directorate, Ministry of Interior |
| Eng. Ahdab Gamal Gaafar | GARBLT, Ministry of Transport |
| Eng. Diaa Eldein Mustafa | GARBLT, Ministry of Transport |
| Eng. Ahmed Shehab | GARBLT, Ministry of Transport |

| | |
|------------------------------|-----------------------------------|
| Eng. Ehab Ismail | GARBLT, Ministry of Transport |
| Dr. Maram Mahmoud Saudi | GARBLT, Ministry of Transport |
| Eng. Mona Samy Khafagi | GARBLT, Ministry of Transport |
| Accountant Mona Abdel-Rahman | GARBLT, Ministry of Transport |
| Prof. Hussam Fahmy | Director, Nile Research Institute |
| Eng. El-Said Metwaly | GARBLT, Ministry of Transport |

The Study is carried out by JICA Study Team which is composed of the following experts:

| | |
|---------------------------|---|
| Dr. Eng. HANI Abdel Halim | Team Leader / Transport Plan, up to September 3rd, 2008 |
| Mr. ISHIGURO Masakazu | Team Leader / Transport Plan, from September 4th, 2008 |
| Mr. ISOMOTO Kenji | Deputy Team Leader / Road Plan |
| Mr. ONO Masazumi | Traffic Survey / Demand Forecast |
| Dr. Eng. Ahmed El-HAKIM | Natural Condition Survey / Operational Coordination |
| Mr. Anthony GOURLEY | Structure Design |
| Mr. MIZUISHI Mitsunori | Road / Facility Design |
| Mr. SHOJI Takeo | Environmental and Social Assessment |
| Dr. Faten A. SAYED | Social Environment |
| Mr. MATSUKAWA Kazufumi | Construction Plan / Cost Estimate |
| Ms. OGAWA Mariko | Economic and Financial Analysis |
| Ms. IKEDA Kaori | Financial Plan |
| Mr. TAKEDA Hiroo | Toll Road Legislation / Organization |
| Mr. FURUSAWA Yasuhisa | PPP Structure / Implementation Plan (1) |
| Mr. Alaa ELSOUENI | PPP Structure / Implementation Plan (2), up to March 31st, 2008 |
| Mrs. Gada EL FEKKI | PPP Structure / Implementation Plan (2), from April 1st, 2008 |
| Mr. SAKURAI Tatsuyuki | Toll Expressway Policy Advisor from April, 2008 |

ABBREVIATIONS**1. Organization Abbreviations**

| | | | |
|--------|--|-------|--|
| AASHTO | : American Association of State Highway and Transportation Officials | GOJ | : Government of Japan |
| CAPMAS | : Central Agency for public Mobilization and Statistics | GOPP | : General Organization for Physical Planning |
| CBE | : Central Bank of Egypt | JBIC | : Japan Bank of International Cooperation |
| CGR | : Cairo Greater Region | JICA | : Japan International Cooperation Agency |
| CMTB | : Cairo Metropolitan Transport Bureau | MEA | : Metropolitan Expressway Authority |
| CPT | : Counterpart Team | MHUUD | : Ministry of Housing, Utilities and Urban Development |
| CTEB | : Cairo Traffic Engineering Bureau | MOC | : Ministry of Cloture |
| EEAA | : Egyptian Environment Affairs Agency | MOD | : Ministry of Defence |
| ENR | : Egyptian National Railways | MOE | : Ministry of Environment |
| EOJ | : Embassy of Japan | MOF | : Ministry of Finance |
| GAFI | : General Authority for Investment and Free Zones | MOI | : Ministry of Interior |
| GARBLT | : General Authority for Roads, Bridges and Land Transport | MOT | : Ministry of Transport |
| GCR | : Greater Cairo Region | NAT | : National Authority for Tunnels |
| GOE | : Government of Egypt | NGO | : Non Governmental Organization |
| | | NUC | : New Urban Community |

2. Technical Abbreviations

| | | | |
|-----------------|--|------|--|
| ADT | : Average Day Traffic | LOS | : Level of Service |
| BH | : Bore Hole | LL | : Liquid Limit |
| BOOT | : Build, Operate, Own and Transfer | NOx | : Nitrogen Oxide |
| BOT | : Build, Operate and Transfer | NPV | : Net Present Value |
| CCTV | : Closed Circuit Television | OBU | : On Board Unit |
| CO | : Carbon Monoxide | OD | : Origin-Destination |
| CO ₂ | : Carbon Dioxide | ODA | : Official Development Assistance |
| CREATS | : Cairo Regional Area Transportation Study | PAP | : Project Affected People |
| D | : Directional Distribution | PCE | : Passenger Car Equivalents |
| DBFO | : Design-Build-Finance-Operate | PCU | : Passenger Car Unit |
| DBO | : Design, Build and Operate | PHF | : Peak Hour Factor |
| DBOT | : Design-Build-Own-Transfer | PHV | : Peak Hour Volume |
| EFC | : Electronic Fee Collection | PL | : Plastic Limit |
| EIA | : Environmental Impact Assessment | PPPs | : Public Private Partnership |
| EIRR | : Economic Internal Rate of Return | RoW | : Right-of-Way |
| FIRR | : Financial Internal Rate of Return | RR | : Ring Road |
| ETC | : Electronic Toll Collection | STEP | : Special Terms for Economic Partnership |
| GC | : Greater Cairo | TIS | : Traffic Information System |
| GDP | : Gross Domestic Products | TOR | : Terms of Reference |
| GPS | : Global Positioning Systems | TP | : Traffic Police |
| HCM | : Highway Capacity Manual | TTC | : Travel Time Cost |
| HPE | : High Priority Expressway | V/C | : Volume Capacity |
| IC | : Interchange | VCR | : Volume Capacity Ratio |
| IEE | : Initial Environmental Examination | veh | : Vehicle |
| ITS | : Intelligent Transportation System | VMS | : Variable Message Signs |
| JCT | : Junction | VOC | : Vehicle Operating Cost |
| JICA STRADA | : System for Traffic Demand Analysis | vpd | : Vehicle per day |
| kph | : Kilometer per hour | WTP | : Willingness-to-Pay |
| LE | : Egyptian Pound | | |

1 INTRODUCTION

Background of the Study

Greater Cairo Region (GCR) recently with 15 million inhabitants and estimated to accommodate 24 million in 2027 which puts growing pressure on all infrastructure systems, including the road network system.

JICA, the official agency responsible for the implementation of the technical cooperation program of the Government of Japan conducted the “Master Plan of Urban Transport Project in Greater Cairo Region” (CREATS) in which a Master Plan was formulated in 2002, with the target year of 2022.

Under the Master Plan, the construction of the urban toll expressway network with about 78 km in length of new expressways was proposed as one of the priority projects.

The implementation of the proposed urban toll expressway network requires huge financial resources for construction, operation and maintenance.

In this regard, the JICA study on “Public-Private Partnership “PPP” Program for Cairo Urban Toll Expressway Network Development” (hereinafter referred to as “PPP Study”) was started in 2005 and completed in 2006. The PPP Study formulated a financing plan for commercialization and support of PPP system structure with a strategy for introducing Public-Private Partnership (PPP) and applying toll road system on the expressway network. In addition, a new organization, called the Metropolitan Expressway Authority (MEA) was planned to handle all the tasks related to the expressway network.

To promote the construction of the expressway network by the target year of 2022, results of the PPP Study showed the necessity of the immediate constructions of high priority routes that are composed of the extensions of existing elevated Route No.1 and Route No.2 (E1-2 and E2-2), and

the new Route No.3 (E3).

In response to the request of the Government of Egypt, the Government of Japan has decided to conduct this Feasibility Study on High Priority Urban Toll Expressways in Cairo.

Objectives of the Study

The objectives of the Study are:

- To implement Feasibility Study on high priority expressways proposed in the “Master Plan” in November 2002 and “PPP Study” in May 2006.
- To assist the Ministry of Transport (MOT) to strengthen the functions of Metropolitan Expressway Authority (MEA).
- To assist MOT and MEA to smoothly introduce toll road system and PPP scheme for the construction of the proposed high priority expressways.

The Study Routes

The Study will cover high priority routes as follows (see the location map):

- E1-2, E2-2 and E3-1: To carry out Feasibility Study
- E1-1 and E2-1: To analyze methods of applying toll and to evaluate the impact of both existing and newly operated sections when extensions and/or new route are opened.
- E3-2 and E3-3: To carry out Pre-Feasibility Study in order to analyze the feasibility of E3 as a whole, as well as the network after implementing and operating E1, E2, and E3.

Scope of the Study

The Study includes the following main Tasks:

- Review of PPP Study and Existing Condition
- Feasibility Study
- Implementation Planning of PPP
- Overall Evaluation and Recommendations

Organization of the Study

The Study is undertaken within full cooperation among three main groups which are:

- Steering Committee consists of different concerned Egyptian Authorities
- GARBLT Counterpart Team
- JICA Study Team

Steering Committee (SC) Meeting

During the duration of the Study four meeting with the SC Members were undertaken as dated hereunder:

- 1st Meeting Sept. 10, 2007
- 2nd Meeting Nov. 27, 2007
- 3rd Meeting Mar. 13, 2008
- 4th Meeting Aug. 26, 2008

During those meeting, the JICA Study Team presented respectively the progress of the Study, highlighted the problems, proposed the solutions and finally obtained the agreement of the SC members about the reasonable measures.

Stakeholder Meeting

During the duration of the Study three meetings with the Stakeholders were undertaken as dated hereunder:

- 1st Meeting Mar. 16, 2008
- 2nd Meeting June 23, 2008
- 3rd Meeting Sept. 4, 2008

Three stakeholders meetings during the course of the Study are the minimum requirement for a full scale EIA. The first meeting has the objective of sharing the initial plan for the project and benefit from the experiences, expertise and knowledge of participating stakeholders. Participants in the first meeting were mainly relevant government officials in addition to some members of civil society and

representatives from private construction companies. The second and third scheduled stakeholders meetings had more balanced list of invitations between government, civil society and private sector.

Counterpart Team Activities

The General Authority of Roads, Bridges and Land Transport (GARBLT) assigned to the Study a Counterpart Team composed of nine (9) members having a wide spectrum of expertise. The Counterpart Team includes representatives from the divisions of: Investment Roads, Roadway Maintenance, Roadway Safety, Project Control and Procurement. Representation of each of these divisions included a senior member for expert advice on the specialty of interest, and a junior member providing a continuous interface with the Study Team.

On the other hand, interacting with the Study Team on a daily basis, which provided the Counterpart Team members with a deep understanding of the Study' methodology, procedures as well as field and office work efforts. This direct interaction was instrumental in achieving a promising level of technological transfer believed to have built the capacity of the Counterpart Team members in the areas of the Study.

In addition, technical biweekly meetings were held on the progress of the Study in different technical aspects related to the planning and design of the components of expressway sections. Also, a PPP Seminar was conducted for the Counterpart Team under a capacity building task and as a technical support for the implementation of PPP. Furthermore, on job training on using JICA STRADA, which is the system for traffic demand analysis, is also done.

For the early implementation of high priority routes, an action plan for different required tasks is developed as presented in Figure.

Under this plan, the detailed design stage is considered for the 2 financing cases of local fund/grant or through ODA loans.

| Major Tasks | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Agency In-Charge |
|-------------------------------|------|------|-------|------|------|------|------------------|
| Cairo PPP Study | █ | █ | | | | | (1), (7) |
| Route Prioritization - HPE | | █ | | | | | (1) |
| MEA Secretariat | | █ | | | | | (3) |
| Feasibility Study on HPE | | █ | █ | | | | (3), (7), (9) |
| EIA on HPE | | █ | █ | | | | (6), (7), (8) |
| MOT Approval | | █ | | | | | (3) |
| MEA Organization Set-up | | █ | | | | | (3) |
| MOP / MOF Approval | | █ | | | | | (4), (5) |
| Parliament Committee Approval | | | █ | | | | (3) |
| Cabinet Approval | | | █ | | | | (3) |
| D/D Loan Preparation | | | | █ | | | (2) |
| D/D Loan Agreement | | | | █ | | | (2) |
| Consultant Selection | | | | █ | | | (2) |
| Detailed Design of HPE | | | Grant | | Loan | | (2), (9) |
| Construction Loan | | | | | █ | | (2) |
| Tendering | | | | | █ | | (2) |
| Construction of HPE | | | | | | █ | (2), (9) |
| F/S on Next Routes | | | | █ | | | (2) |

| | |
|--|---|
| <p>HPE: High Priority Expressways (1) JICA ST: Study Team D/D: Detailed Design F/S: Feasibility Study EIA: Environmental Impact Study (2) MEA: Metropolitan Expressway Authority CG: Cairo Governorate</p> | <p>(3) MOT: Ministry of Transport (4) MOP: Ministry of Planning (5) MOF: Ministry of Finance (6) MOE: Ministry of Environment (7) ENIT: Egypt National Institute of Transport (8) GOPP: General Organization for Physical Planning (9) ODA: Official Development Assistance</p> |
|--|---|

Public Private Partnership (PPP) Strategy

- Setting an appropriate counterpart for PPP in public sector to promote better coordination with private sector

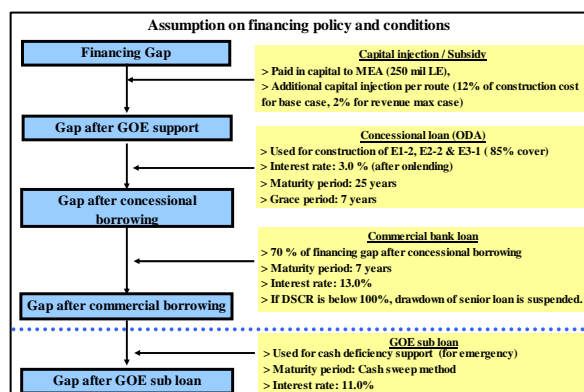
Approach for Private Sector Participation

- Phase I: Establishing implementation framework and building capacity
- Phase II: Promoting PPP
- Phase III: Increasing private participation, such as privatizing MEA

Key Conditions for Private Sector Participation

- A Strong political commitment
- Establishment of an independent and financially sound executing entity for network implementation
- A holistic approach and best utilization of toll revenues from the network for future expansion and upgrading

Financing Plan



3 TRAFFIC FORECAST AND ANALYSIS

Traffic Counting Surveys

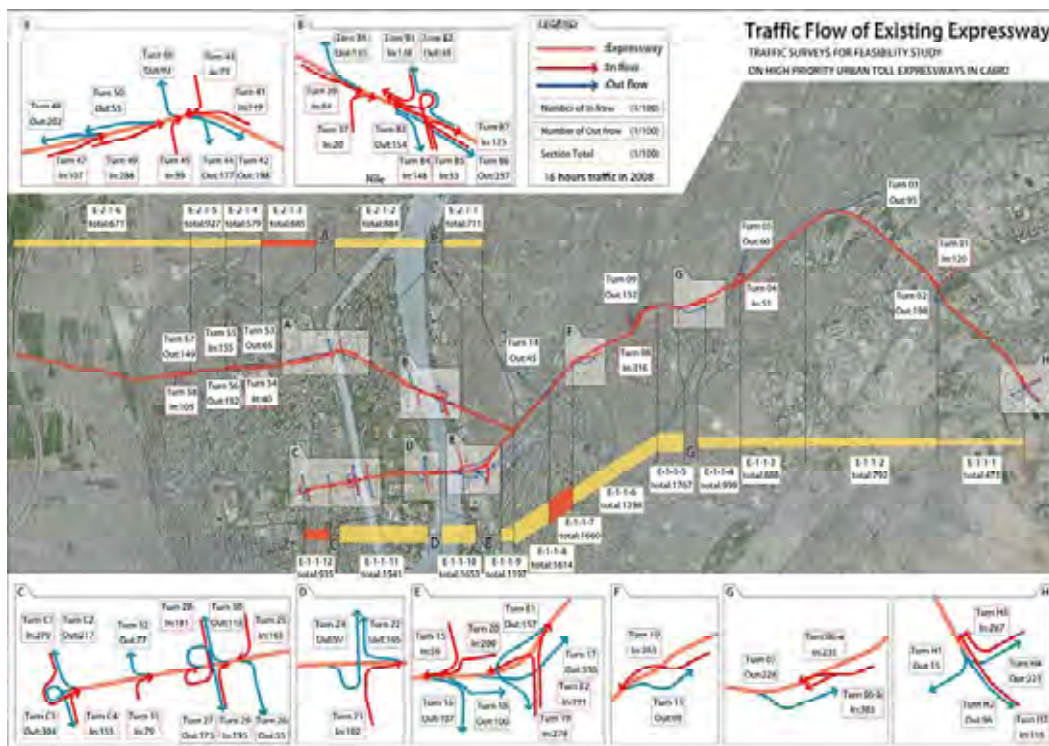
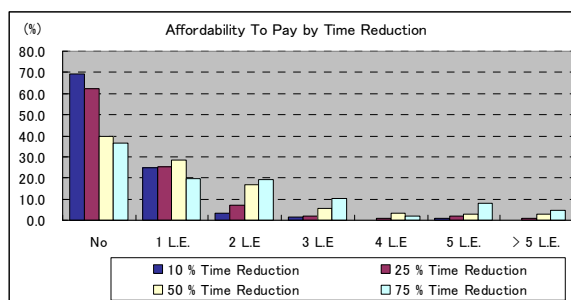
To analysis the existing traffic condition, intersection traffic counting along the proposed alignment of expressway routes at crossings with specified streets, ramp traffic counting on existing expressways are carried out.

- Based on the summary of intersection traffic counting results, unique trend such as increase, decrease or constant between before and after Ramadan, could not be found. The difference total volume in the same location comes from the traffic condition in the survey date, traffic accident, and broken vehicle on the road and so on.
- The overall average expansion factor of 18-hr traffic counts to the entire 24-hr on the expressway is 1.092, i.e., the 24-hour count is 9.2% higher than the 18-hour count. The expressways was found to have a morning peak from 8:00 to 9:00 AM with 6.7 % of daily traffic and evening peak from 17:00 to 18:00 PM with 5.6 % of daily traffic.
- The overall proportions of the different vehicle types on the existing expressways are 77%

passenger cars, 13% taxis, 5% minibuses / shared taxi, 0.8% standard bus, and 3% light trucks and the rest is motorcycle percent. The composition of heavy truck is 0% because it is prohibited to use the existing expressways.

Affordability to Pay

In the situation of 10% and 25% time reduction by toll expressway, two thirds of driver refused to use toll expressway, but according to increase time reduction, in the case of 50% and 75% time reduction, percentage of the driver who refused to drive on toll expressway, decline to one third. Amounts of affordability to pay in the each case were 1.19 pounds in 10% time reduction, 1.75 pounds in 25%, 2.23 pounds in 50%, and 3.01 pounds in 75%.



Socioeconomic Framework

Planning framework for the study area was formulated in terms of population, economy, and social development as mentioned below.

- Total population in the study area will be 24.2 million in 2027 with the incremental population of 8.1 million for the period 2007-2027.
- GRDP will increase with the annual rate of 8% in the period of 2007-2012. Following the proposed growth rate in the Long Term Vision, the high growth rate will remain and slow down to 6% in 2022-2027. This high growth rate will contribute to increase the GRDP per capita with an average growth rate of 5% per year.

Planning Framework until 2027

| | 2007 | 2012 | 2017 | 2027 |
|--------------------|--------|--------|--------|--------|
| Population | 16,464 | 18,411 | 20,369 | 24,192 |
| GRDP Growth Rate | 8 % | 8 % | 7 % | 6 % |
| GRDP Capita (LE) | 10,782 | 14,167 | 17,960 | 27,726 |
| Primary Employed | 266 | 306 | 349 | 427 |
| Secondary Employed | 1,741 | 2,014 | 2,311 | 2,824 |
| Tertiary Employed | 2,467 | 2,876 | 3,323 | 4,126 |
| Total Employed | 4,475 | 5,196 | 5,982 | 7,378 |

(Unit: million)

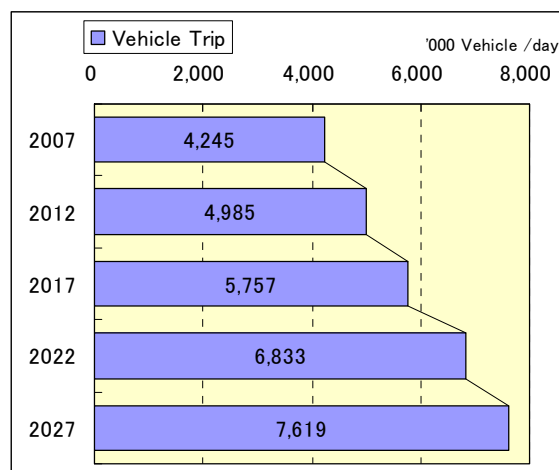
Future Traffic Demand

To estimate the traffic volumes on the planned expressway network, traffic count and affordability-to-pay interview surveys in GCR area are conducted. Traffic count data are used to analyze the present traffic characteristics and to revise present OD tables for vehicle category. Affordability-to-pay interview data are used to decide the parameter of traffic assignment model on the expressways. Then, the forecasted person trips basic of CREATS and SDMP are converted to the Future OD tables for target years 2012, 2017, 2022 and 2027 of vehicle category.

The transport model framework uses a conventional 4 steps approach which has been well-tried and found to be effective in many cities around the world has been adopted. This study

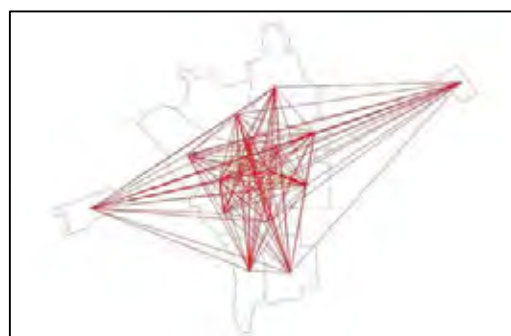
basically follows the same model structures as the CREATS and SDMP Models

Generated numbers of vehicle trips estimated, are 4.245 million in 2007 and 7.619 million in 2027 with 2.5 times growth rate.

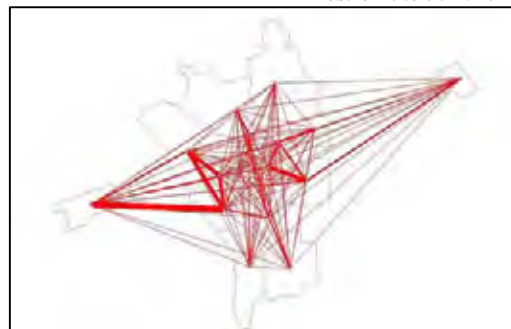


The trip distribution patterns of vehicle trips estimated of 2007 and 2027 are compared. In twenty years from 2007 to 2027 main movement of traffic shifts to west-east direction. Giza block grows to the triangle including 6th of October. The West block also grows by merging the 2007 West block and Qanater and 10th of Ramadan.

Desire Line in 2007



Desire Line in 2027

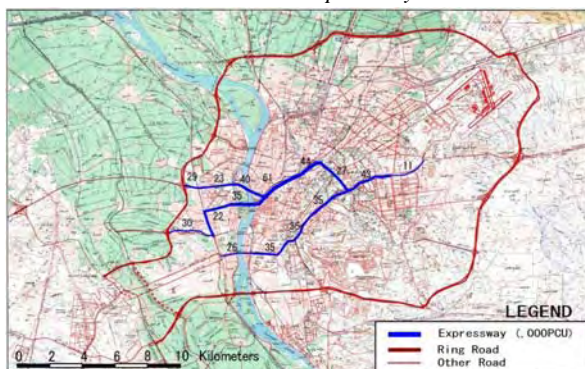


Future Expressway Demand (With Project)

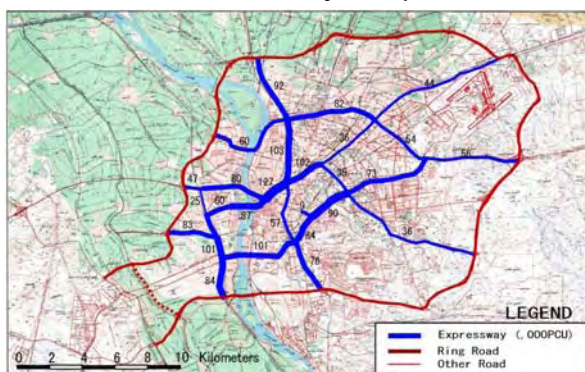
In this study, the capacity restraint method is applied. Assignment with this method is the most straightforward for use in network models, and the most efficient particularly where the number of zones in the trip matrix is large. This assignment technique is based on the speed – flow relationship. The traffic simulation software of JICA STRADA is used to estimate traffic volumes.

Traffic assignments are carried out for the future express network based on the CREATS, PPP study and SDMP Plans. In this “With Project” case, traffic is assigned on both future road network and expressway network together for year 2012 and 2027.

Future Expressway Demand in 2012

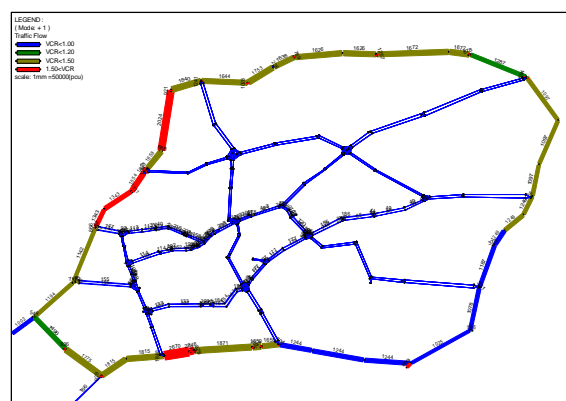
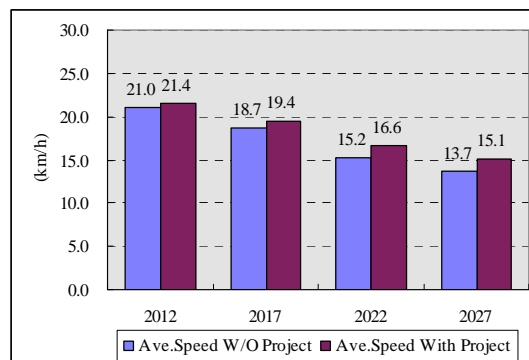


Future Expressway Demand in 2027



Average speeds over entire roadnetwork, including the expressways and ordinary streets, of With Project case and Without Project case are not so large. This is because average speed is calculated over entire roadnetwork including congested ordinary street. Traffic condition (VCR) on the expressways are maintained fairly smooth even in

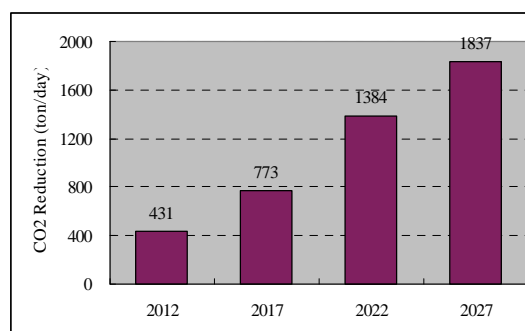
year 2027.



Traffic Efficiency in F/S and Pre-F/S Route

To measuring the impact by implementation of F/S and Pre-F/S routes, the future traffic demand of expressways and at-grade roads in GCR is forecasted. Based on this demand, Traffic performance indicators, such as travel time, vehicle operating cost and air emissions are improved.

Trend of CO2 Reduction by F/S & Pre-F/S Routes



4 REVIEW AND UPDATING OF PPP STUDY

Introduction

The previous PPP Study of “Public-Private Partnership (PPP) Program for Cairo Urban Toll Expressway Network Development, JICA May 2006” is reviewed in regard to the planning aspects of the expressway network. The purpose of this review is to take into consideration new conditions that did not exist during the course of that previous study. Such new conditions include the relocation plans of ministerial buildings outside the central business district to the eastern of Cairo and the early construction of E11 of the expressway network by the Ministry of Housing. In addition, the characteristics and results of the newly developed urban development plan of “The Strategic Urban Development Master Plan Study for Sustainable Development of the Greater Cairo Region in the Arab Republic of Egypt” to be completed under JICA in August 2008, are considered and applied. This urban development plan has the target year of 2027 that is also utilized in this study rather the previous target year of 2022.

Network Component

With the target year of 2027; a more comprehensive network is developed with more links as shown in Figures.

PP 2022 Expressway Network



The newly introduced links that will compose the urban toll expressway network for the year 2027 are as follows:

E7-2: Qubri El-Kobbah Corridor

This link will directly connect Ismailia road with central areas in Cairo.

E10: Cairo South Corridor

This link is getting higher priority than before due to new developments south of Cairo.

E12: New Cairo Corridor

This newly developed section is to directly connect the area proposed for the relocation of governmental ministries and agencies with the urban expressway network of Cairo. This section has a total length of 22.0 Km.

E13: Extension of Al-Azhar Tunnel (as a long ramp of E3-2)

This section is to include Al-Azhar Tunnel in the urban expressway network. under this plan, it is recommended to extend the tunnel from Salah Salem side till the Autostrade (E3-2) in order to use it as a long ramp for accessibility from the city center to eastern and western areas of Cairo through E3. This tunnel section has a length of 4.0 Km that passes under the cemetery. In future; the tunnel may be extended from the city center side and connected through a viaduct to E2-1 and E2-2 to provide a long corridor from east to west of Cairo. Until 2027, results show no urgent need to carry out this second extension work.

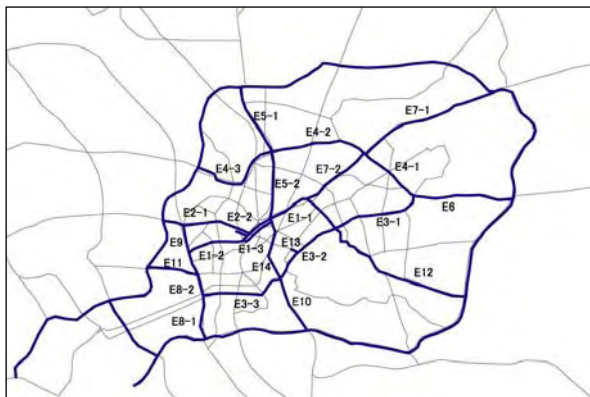
E14: Providing North-South Link in Cairo Side

The planning concept of the urban toll expressway network in CREATS Master Plan (JICA, 2002) is to provide mini-ring roads inside Cairo Ring Road. On the west side of the River Nile, with a narrow urbanized built-up area in Giza Governorate, a north-south link E8 and E9 is provided in the network. Similarly, a new North-South link on the east side of the River Nile was proposed to be included in the network. The most optimum location of this link is found to be the connection between E5-2 and E10.

In addition, to connect E2-2 with E1-1 a new viaduct parallel to 6th of October is required over

Ramses Street to allow a connection with E1-1 based on the applied design standard. This viaduct is required on a short section on Ramses Street between the two intersections of 26th of July Street and Orabi Street. In future, it may be necessary to extend it (that is called E1-3) between the River Nile to the East till Ghamra Metro Station to handle heavy traffic from E5, as shown in Figure.

2027 Proposed Expressway Network



Traffic Volumes

Here the traffic volumes issue is discussed in relation to the required number of lanes on the study routes and the future requirements for bridges crossing the River Nile.

With the year 2027 as a target year, traffic assignment results give 3-lane requirements in each direction for most of the sections of E3 which is under this study. The other 2 sections of E1-2 and E2-2 require only 2 lanes in each direction to accommodate the assigned traffic volumes. The PPP Study proposed only 2 lanes for each direction for the whole network based on the target year 2022. Providing 3 lanes in each direction is expected to increase the construction cost. In addition, there is the political understanding that 3 lanes per direction will be required in later years, even after 2027. The bad experience of future widening after implementing 2 lanes of 6th of October elevated road gives the 3 lane option more practicality.

An analysis is done to investigate the required

number of lanes for bridges over the River Nile in future for both the toll expressways and other ordinary non-toll roads. Results will clarify the impact of transferring the existing E1 (6th of October) and E2 (15th of May) into toll expressways as well as the needs to construct a new bridge for the section E4-3 in future or to use the existing Road El-Farag Bridge. Table presents the summary results of the analysis in which a maximum capacity of 12,000 pcu/day is applied for ordinary lanes and 18,000 pcu for expressway lanes.

At present, there are 70 traffic lanes on the existing bridges over the Nile River including the Greater Cairo Ring Road bridges north and south of Cairo and all bridges in between. In the year 2012, the case of utilizing 8 existing lanes as toll expressway, providing that 2 new lanes can be added to the width of 6th of October Bridge, is compared with the case of keeping existing bridges as non-toll. After the year 2017, assessment is done to explore the necessity of a new bridge on the section E4-3 of the expressway network.

Based on the results in the table, it is clear that applying toll on the inner 4 lanes of the existing 6th of October and 15th of May will improve the total average V/C from 1.332 to 1.238 in the year 2012. In addition, providing a new bridge for the expressway at the section E4-3 is also necessary to keep an average V/C at the level of 1.5, which is considerably high. Without this new bridge the average V/C on all crossings over the Nile will reach 1.665 in 2027. By the year 2017, this new expressway bridge should be constructed.

Assessment of Proposed E14

As this link will be implemented in the most congested central areas of Cairo, implemented as a shield tunnel is the only option. Rough cost estimation was carried out and the cost is estimated to be about LE 5.0 billion.

Traffic Volume over River Nile Bridges

| Year | Type | Lanes | Capacity | Volume | V/C | Remarks |
|------|------------|-------|-----------|-----------|-------|-------------------------------|
| 2007 | Bridges | 70 | 840,000 | 1,123,899 | 1.338 | Existing Bridges including RR |
| 2012 | Bridges | 64 | 768,000 | | | 70-8+2 Lanes |
| | Expressway | 14 | 252,000 | | | E1: 4L / E2:4L / E3:6L |
| | Total (1) | | 1,020,000 | 1,263,045 | 1.238 | |
| | Bridges | 70 | 840,000 | | | Existing |
| | Expressway | 6 | 108,000 | | | E3: 6L / E1 and E2 non-toll |
| | Total (2) | | 948,000 | 1,263,045 | 1.332 | |
| 2017 | Bridges | 64 | 768,000 | | | |
| | Expressway | 14 | 252,000 | | | |
| | Total (1) | | 1,020,000 | 1,431,861 | 1.404 | Without E4-3 |
| | Bridges | 64 | 768,000 | | | |
| | Expressway | 20 | 360,000 | | | |
| | Total (2) | | 1,128,000 | 1,431,861 | 1.269 | With E4-3 |
| | Bridges | 70 | 840,000 | | | Existing |
| | Expressway | 6 | 108,000 | | | |
| | Total (1) | | 948,000 | 1,431,861 | 1.510 | Without E4-3 |
| | Bridges | 70 | 840,000 | | | |
| | Expressway | 12 | 216,000 | | | |
| | Total (2) | | 1,056,000 | 1,431,861 | 1.356 | With E4-3 |
| 2022 | Bridges | 64 | 768,000 | | | |
| | Expressway | 14 | 252,000 | | | |
| | Total (1) | | 1,020,000 | 1,667,020 | 1.634 | Without E4-3 |
| | Bridges | 64 | 768,000 | | | |
| | Expressway | 20 | 360,000 | | | |
| | Total (2) | | 1,128,000 | 1,667,020 | 1.478 | With E4-3 |
| 2027 | Bridges | 64 | 768,000 | | | |
| | Expressway | 14 | 252,000 | | | |
| | Total (1) | | 1,020,000 | 1,698,722 | 1.665 | Without E4-3 |
| | Bridges | 64 | 768,000 | | | |
| | Expressway | 20 | 360,000 | | | |
| | Total (2) | | 1,128,000 | 1,698,722 | 1.506 | With E4-3 |

Due to the assignment results in regard to the traffic characteristics on both the expressway network and at-grade road network in case of with and without E14, a little impact and low revenue are resulted in spite of its high investment.

Route Prioritization

It was necessary to review the prioritization of the

different links of the expressway network under the newly introduced conditions taking into consideration the objectives of the urban toll expressway development plan.

The future traffic volumes of the new target year of 2027 are applied rather than those of the year 2022 of the PPP Study.

Prioritization Criteria

| Criteria | Remarks |
|---|---|
| Magnitude of Traffic Volume (Density) | PCU/km in 2027 |
| Growth Rate of Traffic Volume | AAGR (%) from 2017 to 2027 |
| Volume Capacity Ratio in At-Grade Road | V/C/km, in 2027 |
| Travel Speed in At-Grade Road | km/h / km, in 2027 inside Ring Road |
| PCU*hours in At-Grade Road | PCU*hours / km, in 2027 inside Ring Road |
| PCU*hours in All Road Network | PCU*hours / km, in 2027 inside Ring Road |
| Environmental Aspect | HC, CO and NOx |
| Land Acquisition | Interview to GARBLT |
| Urban development, Urgency and Maturity | Information from and Interview to GARBLT and GOPP |

| Section | Priority | Length (km) | Cost (1000 LE) | Year | | | | | | | | | | | | | | | | | | | |
|--------------|----------|-------------|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | | | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
| E10 | 3ed | 4.0 | 1,001 | | | | | | | | | | | | | | | | | | | | |
| E11 | On Going | 4.0 | 1,001 | | | | | | | | | | | | | | | | | | | | |
| E12 | 3ed | 10.8 | 2,035 | | | | | | | | | | | | | | | | | | | | |
| E13 | 4th | 5.3 | 999 | | | | | | | | | | | | | | | | | | | | |
| E14 | 4th | 5.0 | 1,000 | | | | | | | | | | | | | | | | | | | | |
| I. C. (Full) | 3ed | 9 | 2,564 | | | | | | | | | | | | | | | | | | | | |
| I. C. (Half) | 3ed | 9 | 1,442 | | | | | | | | | | | | | | | | | | | | |

Revised Implementation Action Plan for HPE

| Major Tasks | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Agency In-Charge |
|---|------|------|------|------|------|------|------------------|
| Cairo PPP Study | | | | | | | JICA ST - ENIT |
| Route Prioritization – HPE | | | | | | | JICA ST - ENIT |
| MEA Secretariat | | | | | | | MOT |
| Feasibility Study on HPE (E1-2/E2-2/E3-1) | | | | | | | JICA ST - GARBLT |
| EIA on HPE | | | | | | | GOPP/MOE |
| MOT Approval | | | | | | | MOT |
| MEA Organization Set-up | | | | | | | MOT |
| MOP / MOF Approval | | | | | | | MOP/MOF |
| Parliament Committee Approval | | | | | | | MOT |
| Cabinet Approval | | | | | | | MOT |
| Consultant Selection | | | | | | | JICA |
| Detailed Design of HPE | | | | | | | ODA/MEA |
| Construction Loan | | | | | | | GARBLT/MEA |
| Tendering | | | | | | | GARBLT/MEA |
| Construction of HPE | | | | | | | GARBLT/MEA/ODA |
| F/S on Next Routes (E3-2/E3-3/E8) | | | | | | | JICA/GARBLT/MEA |

| | |
|--|---|
| <p>HPE: High Priority Expressways JICA ST: Study Team D/D: Detailed Design F/S: Feasibility Study EIA: Environmental Impact Study MEA: Metropolitan Expressway Authority CG: Cairo Governorate</p> | <p>MOT: Ministry of Transport MOP: Ministry of Planning MOF: Ministry of Finance MOE: Ministry of Environment ENIT: Egypt National Institute of Transport GOPP: General Organization for Physical Planning ODA: Official Development Assistance</p> |
|--|---|

5 SURVEY OF EXISTING CONDITIONS

Data of ordinary at-grade road network is indispensable when an urban expressway network is formulated. Therefore, existing condition survey is implemented. The survey takes into consideration three main existing conditions which are:

- Existing road conditions by undertaken Road Inventory Surveys.
- Existing soil conditions by undertaking Geotechnical Investigations.
- Existing geometric conditions by undertaking Topographical Surveys.

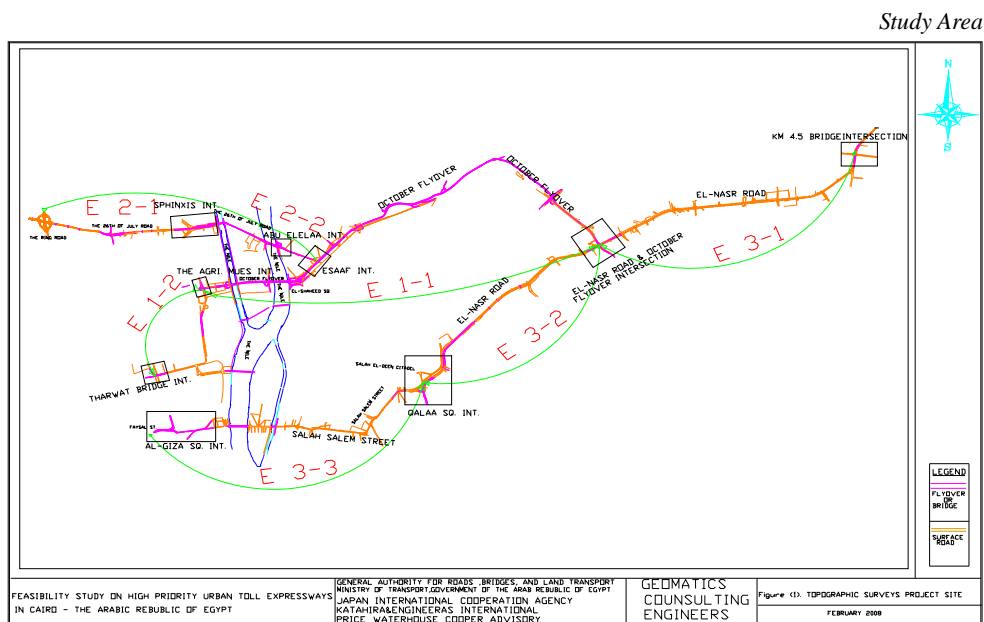
The scope of this Study includes carrying out Feasibility Study for the Expressway Sections E1-2, E2-2 and E3-1 and Pre-Feasibility Study for Sections E1-1, E2-1, E3-2 and E3-3. These sections which belong to Expressways E1 (6th of October), E2 (15th of May) and E3 (Autostrad/Salah Salam) are shown in Figure hereunder.

Road Inventory Survey

The main objective of the road inventory surveys is to prepare and provide technical information needed to perform the required feasibility study for different components of the project.

The following tasks have been performed:

- Data Collection and Assessment:
- Reconnaissance Survey
- Field Works and Preparation of Land Use Maps
- Surveying Field Works and Preparation of Profiles and Cross Sections
- Preparation of the Profiles and Cross Sections
- Field Works and Preparation of the Pavement Assessment Report



The following road inventory surveys information was prepared, both in digital and in hard copy.

- Land Use Plans in scale 1:2,000 (61- Sheets- in A3-size)
- Pavement Assessment Report
- Plan, Profile and Cross-Sections for the following roads:

- Existing E1-1 (from El-Nasr Road Intersection to the Agricultural Museum Intersection)
- Existing E2-1 and E2-2 (from Esaaf Intersection to the Ring Road Intersection)
- E3-1, E3-2 and E3-3 (from Km 4.5 at Cairo-Suez Road (Flyover Intersection) to Giza Square Intersection)

- Plans and Profiles for the Ground levels along the routes of the following roads:
 - Existing E1-1 and E1-2 (from El-Nasr Road Intersection to Tharwat Bridge Intersection), and
 - Existing E2-1 and E2-2 (from Esaaf Intersection to Sphinx Intersection)

The data collected through the road inventory survey have been consisted for check-ups of at-grade street cross-sections produced from satellite imagery, road facilities and structures, pavement conditions, elevations, etc., and outputs include:

- The Profile and Cross Sections of Road E3-1.
- The Profile and Cross Sections of Road E3-2.
- The Profile and Cross Sections of Road E3-3
- The Amended Profile for Road E3-3.
- The Profile and Cross Sections of Road E1-1
- The Profile and Cross Sections of Roads E2-1 and E2-2.
- Ground-Surface Profile for E1-1 and E1-2.
- Ground-Surface Profile for E2-1 and E2-2.
- The Pavement Assessment Survey Report for Roads (E1-1, E1-2, E2-1, E2-2, E3-1, E3-2 and E3-3).
- The Land-Use Plans along the Roads (E1-1, E1-2, E2-1, E2-2, E3-1, E3-2 and E3-3), (61-Plans).

In case of residential areas, the number of building floors are surveyed and shown in drawings since such data will be required during the social environmental assessment of the project. The existing facilities and utilities are also surveyed and assigned on plans. The data about the existing facilities and utilities will be required in case of needs for utility relocation.

Topographical Survey

The topographical survey is undertaken to update the 1/5,000 topographical maps using 2006 satellite images to produce updated topographical plans in 1/2,000 scale.

The main objective of the topographic surveying is

to prepare and provide topographic information needed to perform Roads Inventory Surveys and to conduct the required feasibility study for different components of the Study.

The Study covered high priority expressway routes shown in Figure 5-1.

The following tasks have been performed:

- Data Collection and Assessment
- Reconnaissance Survey
- Updating Available Topographic Maps
- Surveying for Layout Mapping
- Methodology of Topographic and Land Surveying
- Preparation of the Topographic Plans

The following topographic surveying information was prepared:

- The Updated 1:2,000 scale topographic plans for the routes corridors (61- Sheets).
- Topographic plans (layout) with scale of 1:1,000 for 9- Intersections which are:
 - Esaaf Intersection
 - Abu Elelaa Intersection
 - Sphinxix Intersection
 - Tharwat Bridge Intersection
 - The Agricultural Museum ntersection
 - Giza Square Intersection
 - Salah El-Deen Citadel Intersection
 - Km (4.5) Bridge Intersection, and
 - El-Nasr Road and October Flyover Intersection

Geotechnical Investigations

The geotechnical investigation implemented at 16 locations along the three expressways under this FS and Pre FS Study.

The investigations to be carried include:

- Boring Survey about 20 m depth
- Standard Penetration Tests with rate one sample every 2 m

- Laboratory and Physical Tests

The details of the investigations and outputs are presented in Table hereunder.

Description of Soil Investigations

| Type | | Contents | | Outputs |
|-----------------------|---------------|---|----------------------|--|
| Boring Survey | | - Section E1-2 | - 20m x 3 locations | - Key Map for Drilling Points - Soil Boring |
| | | - Section E2-2 | - 20m x 3 locations | |
| | | - Section E3-1 | - 20m x 10 locations | |
| | | - 5m after confirming bearing layer (N-value is 30 or more) - Boring Depth: 20m in average - Other sections beside the above, existing data shall be utilized for determination of the conditions | | |
| Std. Penetration Test | | - 1 sample/2m x 20m x 16 locations = 160 samples | | - Summary Sheet for Laboratory Test, and Individual Data Sheets of Physical Test Results |
| Laboratory Test | Physical Test | - Unit Volume Weight, Specific Gravity, Liquid Limit, Plastic Limit, Grading Distribution, and Moisture Content Tests | | |

- Expressway Section E1-3
Three field borings are undertaken within the land adjacent to Al Nasr Road under the authority of Al Azhar University and GARBLT. Two locations are located inside the boundary of Al-Azhr University (BH2 and BH3) and one location is located within the boundary of GARBLT (BH1). Additional four boring data are collected by the Local Consultant from previous projects.

Based on the obtained data and the carried out boring investigation, the longitudinal section for Soil Profile along each section are produced. The contents of the Geotechnical Report for each expressway included the Following:

- Expressway Section E1-2
This section is located within the boundaries of the Agricultural Museum, Shooting Club, Gadah Street and Sudan Street.

Five borehole logs could be obtained, three along Sudan Street and the other two boreholes are one at the site of shooting Club, denoted and the other at Mohandisin Area.

- Expressway Section E2-2
At the busy site of this section official permission to carry out the soil boring can not be obtained under the scope of FS Study. The Local Egyptian Consultant can collect previous eight (8) undertaken borehole-log. Five (5) of the obtained borehole logs are located along 26th of July Street. The other three (3) boreholes are located along Galaa Street.

- Introduction
- General Description and testing program
 - Objective of Investigation
 - Scope of field Exploration Program
 - Standard Penetration Test Procedure
- Laboratory Testing Program
 - Grain Size Analysis
 - Atterberg Limits (LL and PL)
 - Free Swell Test
- Subsurface Soil Condition
 - General soil description
 - Ground Water
- Soil Profile
- Closure
- Appendices

6 ALIGNMENT / CONFIGURATION OF HIGH PRIORITY ROUTES

E1-2

As shown in the table and figures hereinafter, following 5 alternative routes are investigated and scored.

As a result, Alternative-4 (via al-Sawra St) is selected as most suitable alignment for E1-2, although its cost will be most expensive.

Alt.-1 via al-Duqqi St and ‘Abd al-Salam ‘Arif St with single 4-lane viaduct

Alt.-2 via Umm Kalsum (al-Gabalaya) St, al-Tahrir St and al-Sudan St with single 4-lane viaduct

Alt.-3 via long-span bridge or submerged tunnel to cross River Nile then pass through al-Tahrir St, al-Giza St, and ‘Abd al-Salam ‘Arif St with single 4 or 6-lane viaduct

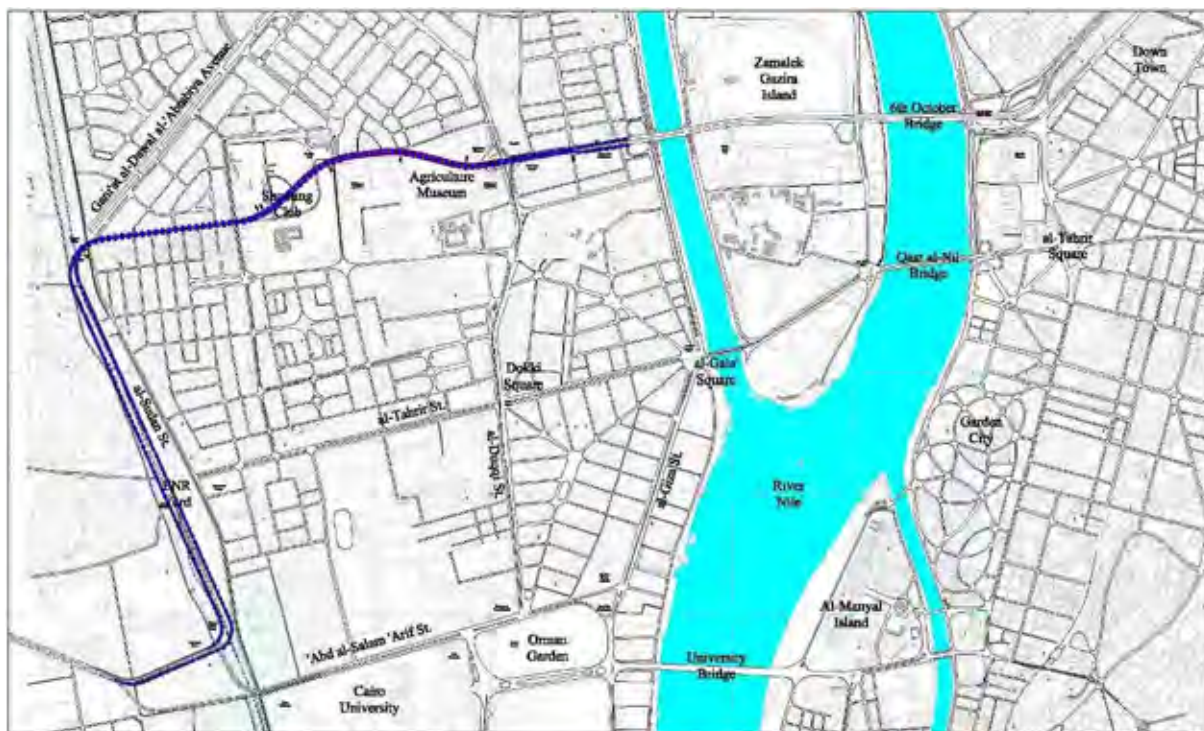
Alt.-4 via Agricultural Museum, al-Sawra St, Shooting Club, and Gadda (Jeddah) St with double 2-lane shield tunnel (parallel or tandem) and above ENR Track with 2-lane split type viaducts

Alt.-5 via al-Batal Ahmad ‘Abd al-‘Aziz St, Gazirit al’ Arab Circle, and Gam’at al-Dawal al-‘Arabiya Avenue with single 4 or 6-lane viaduct

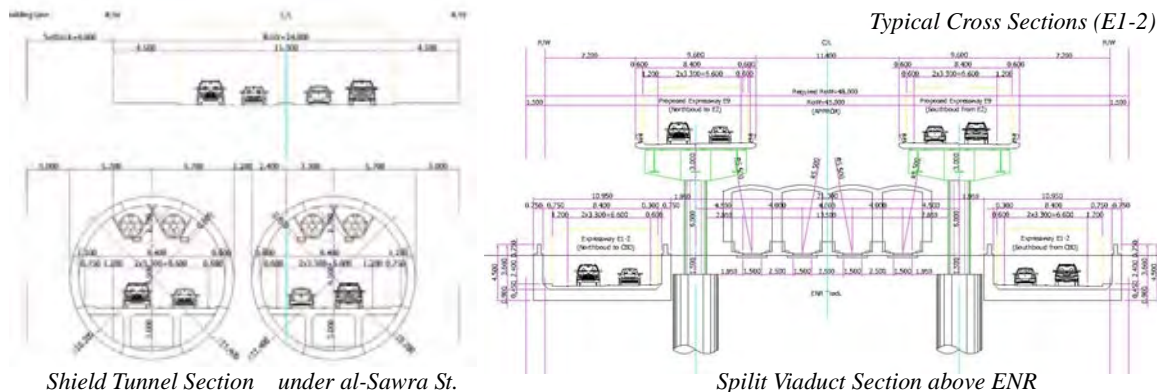
Scoring Summary (E1-2)

| Alternatives | Alternative-1 (via al-Duqqi St.) | | Alternative-2 (via al-Tahrir St.) | | Alternative-3 (via al-Giza St.) | | Alternative-4 (via al-Sawra St.) | | Alternative-5 (via al-Arabiya St.) | |
|---|--|----|---|----|---|----|---|----|---|----|
| Length (km) | Relatively Short (4.4) | 4 | Relatively Long (6.1) | 2 | Intermediate (5.1) | 3 | Relatively Short (4.5) | 4 | Intermediate (5.3) | 3 |
| Configuration | Viaduct (Parallel-4) | 3 | Viaduct (Parallel-4) | 3 | Viaduct & Long Span Bridge or Submerged Tunnel (Parallel-4or-6) | 2 | Tunnel & Viaduct (Parallel-4) | 1 | Viaduct (Parallel-4) | 3 |
| Geometric (m) [Radius and Number of Curves] *Ramp | R120 x 2 (2) R360 x 1 (5) R300 x 1 (5) R600 x 1 (5) | 4 | R240 x 1 (3) R150/180 x 1 (3) *R90 x 1 (3) | 3 | R360 x 2 (5) R180 x 1 (3) R120 x 1 (2) | 4 | R360 x 4 (5) R120/150 x 1 (2) *R90 x 1 (3) | 4 | R90 x 2 (1) R240 x 3 (3) R270 x 1 (4) R360 x 1 (5) *R90 x 1 (3) | 3 |
| Land Acquisitions (ha) | Secondary School or Ministry of Agriculture | 1 | Railway Police Office | 4 | Mosque beside Giza Police HQ | 3 | Railway Police Office | 4 | Agriculture Museum, Railway Police Office | 1 |
| Community Ac- cessibility | Partially Limited | 3 | Partially Limited | 3 | Partially Limited | 3 | Non Limited | 5 | Partially Limited | 3 |
| Traffic Diversion | al-Duqqi | 1 | al-Tahrir | 3 | al-Giza | 3 | Al-Masthaf al-Zira’i | 3 | Al-Batal Ah- mad Al-Alamiya | 1 |
| Public Utilities | Large | 1 | Large | 1 | Large | 1 | Small | 5 | Large | 1 |
| Landscape | Oman Garden | 1 | Nile River (Channel) | 3 | Nile River (Main) Opera House | 3 | Agriculture Museum Shooting Club | 5 | Agriculture Museum | 3 |
| Environmental Impact | Cairo University | 2 | Gazira Sports Club | 3 | Cairo University | 2 | Al-Sawra Square | 3 | Mohandiseen | 2 |
| Other Infrastructures | Dokki Flyover (585m) | 3 | Metro No.2 ENR | 1 | Metro No.2 | 3 | Metro No.2 & 3 Extension, ENR, Irrigation Canal | 2 | Metro No.2 & 3 Extension, ENR, Irriga- tion Canal | 2 |
| Overall Score | | 22 | | 26 | | 27 | | 36 | | 22 |

Alignment Layout Plan (E1-2)



Typical Cross Sections (E1-2)



E2-2

As shown in the table and figures indicated hereinafter, following 4 alternative configurations are investigated and scored
As a result, Alternative-3 (combination) is recommended.

Alt.-1 Eastbound viaduct shall be constructed independently above existing westbound structures without touching existing structures

Alt.-2 Eastbound viaduct shall be constructed integrated with new westbound viaduct by removing existing westbound structures first.

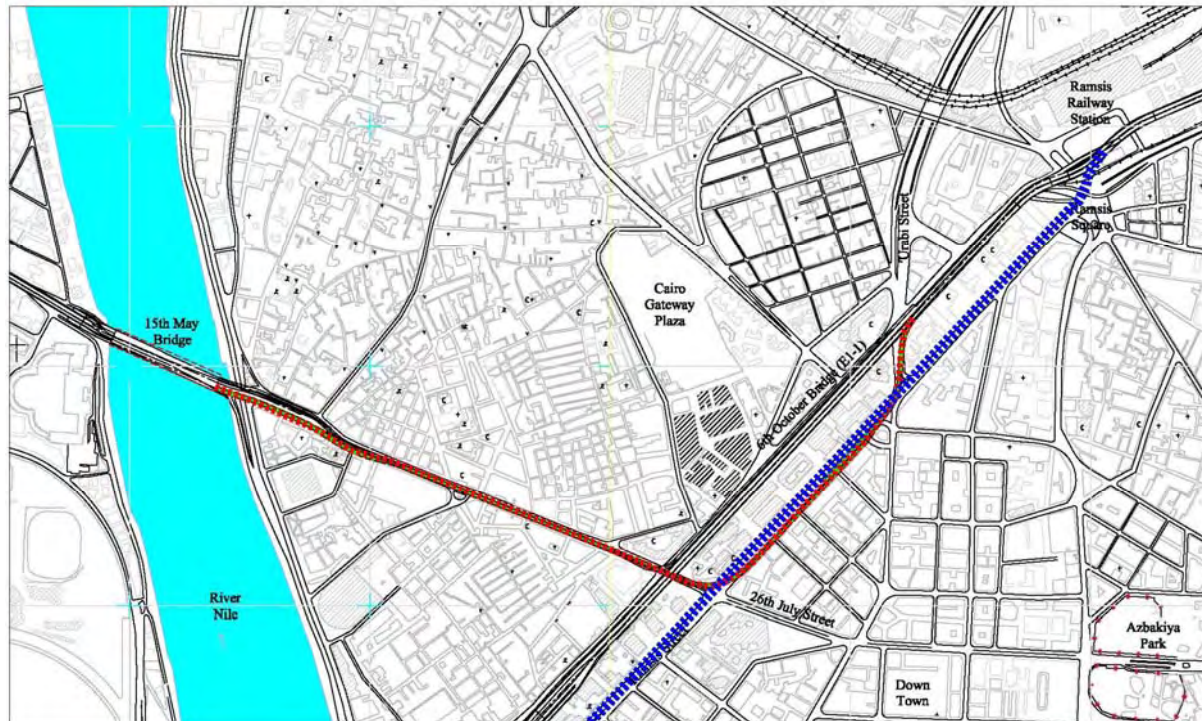
Alt.-3 Eastbound viaduct shall be constructed partially integrated with new westbound viaduct in western half portion, and partially independent from existing westbound viaduct in eastern half portion

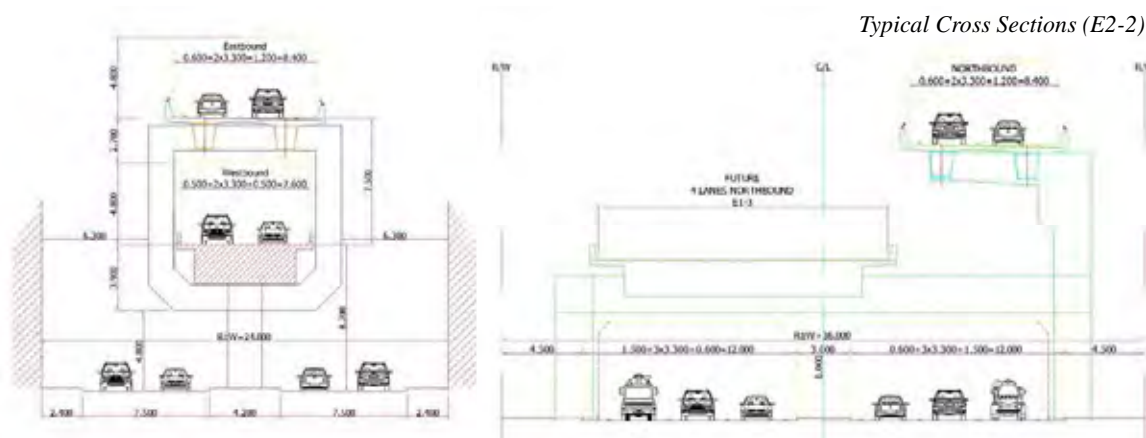
Alt.-4 Eastbound viaduct shall be constructed beside existing westbound viaduct by acquiring lands along 26 July St between Corniche al-Nil St and al-Gala St.

Scoring Summary (E2-2)

| Alternatives | Alternative-1 (Additional) | | Alternative-2 (Replacement) | | Alternative-3 (Combination) | | Alternative-4 (Parallel Deck) | |
|---|--|----|--|----|--|----|--|----|
| | | | | | | | | |
| Length (km) | 1.8 (1.0 / 26 July St. and 0.8 / Ramsis St.) | 4 | 1.8 (1.0 / 26 July St. and 0.8 / Ramsis St.) | 4 | 1.8 (1.0 / 26 July St. and 0.8 / Ramsis St.) | 4 | 1.8 (1.0 / 26 July St. and 0.8 / Ramsis St.) | 4 |
| Configuration | Viaduct (Double-4) | 3 | Viaduct (Double-4) | 1 | Viaduct (Double-4) | 2 | Viaduct (Parallel-4) | 4 |
| Geometric (m) [Radius and Number of Curves] | R120 x 1 | 2 | R120 x 1 | 2 | R120 x 1 | 2 | R120 x 1 | 2 |
| Land Acquisitions | (Museum) | 3 | Nil | 5 | Nil | 5 | Very Large Scale | 1 |
| Community Accessibility | Partially Limited | 3 | Partially Limited | 3 | Partially Limited | 3 | Partially Limited | 3 |
| Traffic Diversion | 26 th July St. (eastbound) | 3 | 26 th July St. (both) | 1 | 26 th July St. (both) | 2 | 26 th July St. (Westbound) | 3 |
| Public Utilities | Intermediate | 3 | Intermediate | 3 | Intermediate | 3 | Relatively Less | 4 |
| Landscape | Ramsis St. | 3 | Ramsis St. | 3 | Ramsis St. | 3 | Ramsis St. | 3 |
| Environmental Impact | Relatively Large | 2 | Relatively Large | 2 | Relatively Large | 2 | Large | 1 |
| Other Infrastructures | Metro No.1 & No.3 | 1 | Metro No.1 & No.3 | 3 | Metro No.1 & No.3 | 3 | Metro No.1 & No.3 | 3 |
| Overall Score | | 27 | | 27 | | 29 | | 28 |

Alignment Layout Plan (E2-2)





Double Deck along 26 July St.

Single Deck along Ramsis St.

E3-1

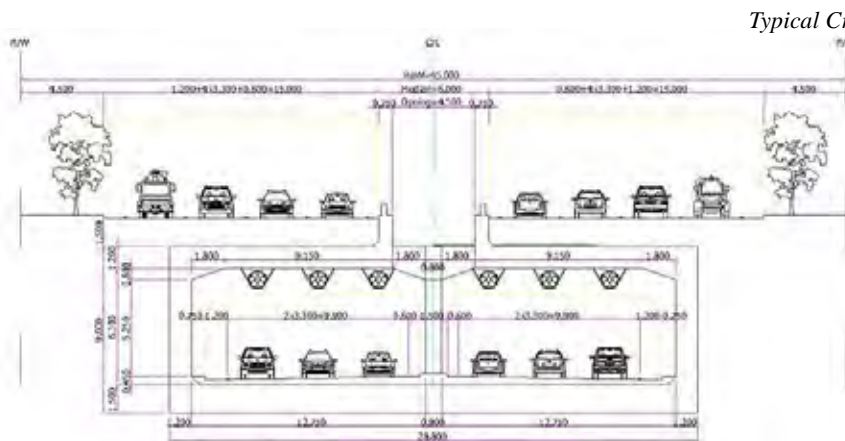
As shown in the table and figures indicated hereinafter, following 3 alternative configurations are investigated and scored.

- Alt.-1 Viaduct
- Alt.-2 Depressed
- Alt.-3 At-Grade

As a result, Alternative-2 (Depressed) is selected as most suitable configuration for E3-1.

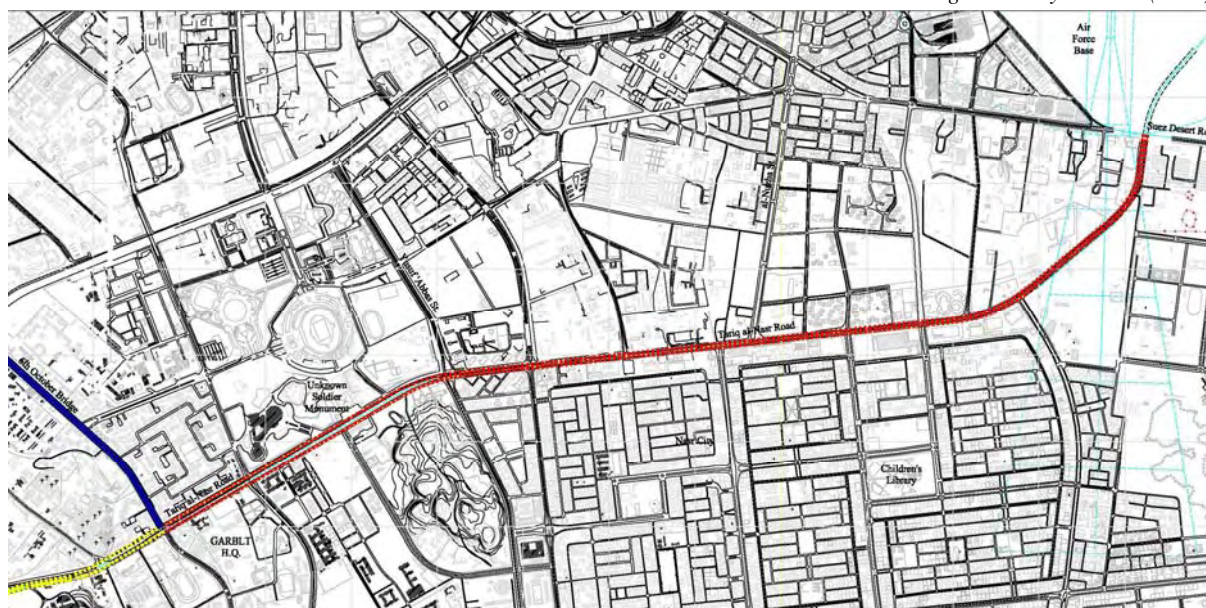
Scoring Summary (E3-1)

| Alternatives | Alternative-1 (Viaduct) | | Alternative-2 (Depressed) | | Alternative-3 (At-Grade) | |
|---|----------------------------|----|------------------------------|----|-----------------------------|----|
| | | | | | | |
| Length (km) | Intermediate (6.5) | 2 | Intermediate (6.5) | 2 | Intermediate (6.5) | 2 |
| Configuration | Viaduct (Parallel-6) | 3 | Depressed (Parallel-6) | 3 | At-Grade (Parallel-6) | 5 |
| Geometric (m) [Radius and Number of Curves] | R450 x 1 R900 x 2 | 5 | R450 x 1 R900 x 2 | 5 | R450 x 1 R900 x 2 | 5 |
| Land Acquisitions | Nil | 5 | Nil | 5 | 7.5m x 2 x where RoW=45m | 1 |
| Community Accessibility | Partially Limited | 3 | Non Limited | 5 | Full Limited | 1 |
| Traffic Diversion | Autostrade | 3 | Autostrade | 2 | Autostrade | 1 |
| Public Utilities | Intermediate | 3 | Relatively Large | 2 | Relatively Small | 4 |
| Landscape | Very Affected | 1 | Not Affected | 5 | Affected | 3 |
| Environmental Impact | Intermediate | 3 | Small | 5 | Large | 1 |
| Other Infrastructures | Tram | 3 | Tram | 3 | Tram | 3 |
| Overall Score | | 32 | | 38 | | 27 |



Depressed Section (Parallel-6) along al-Nasr Road

Alignment Layout Plan (E3-1)



E3-2

As shown in the table and figures indicated hereinafter, following 3 alternative configurations are investigated and scored.

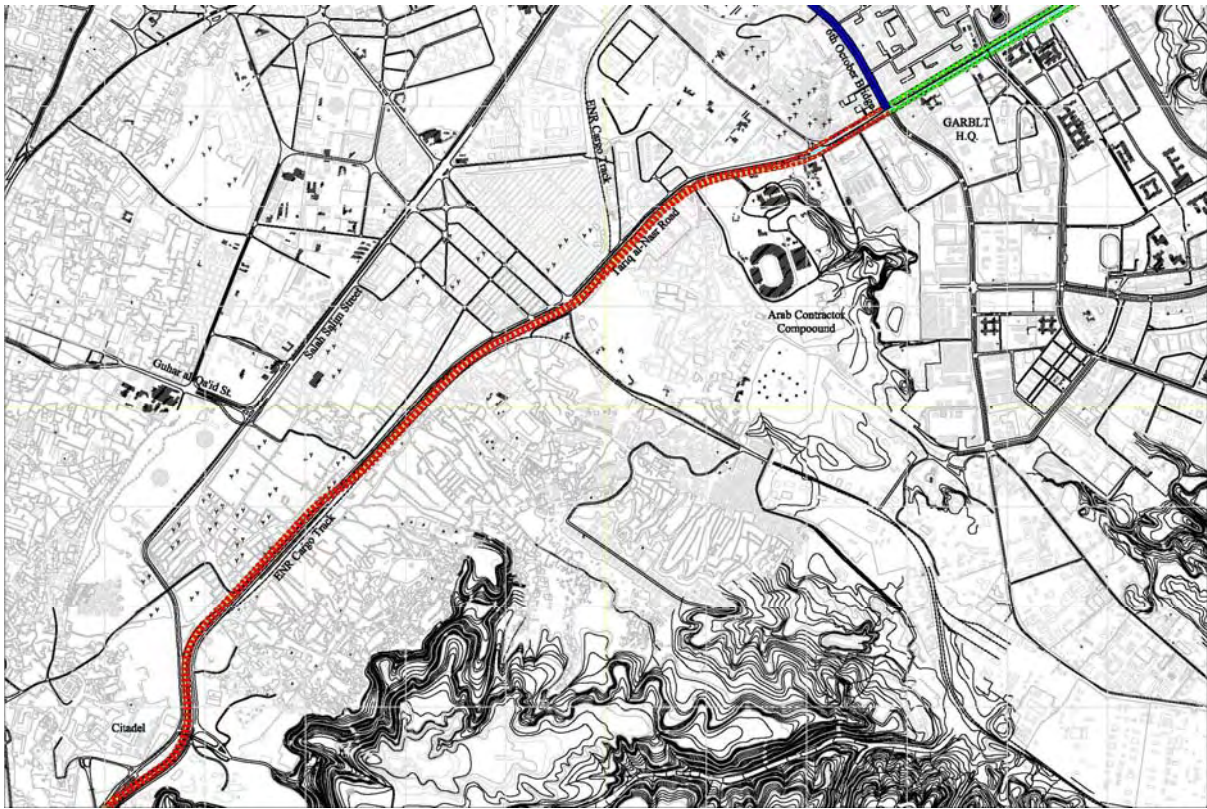
- Alt.-1 above Roadway
- Alt.-2 above Railway
- Alt.-3 between Roadway and Railway

As a result, Alternative-3 (between Roadway and Railway) is selected as most suitable configuration for E3-2.

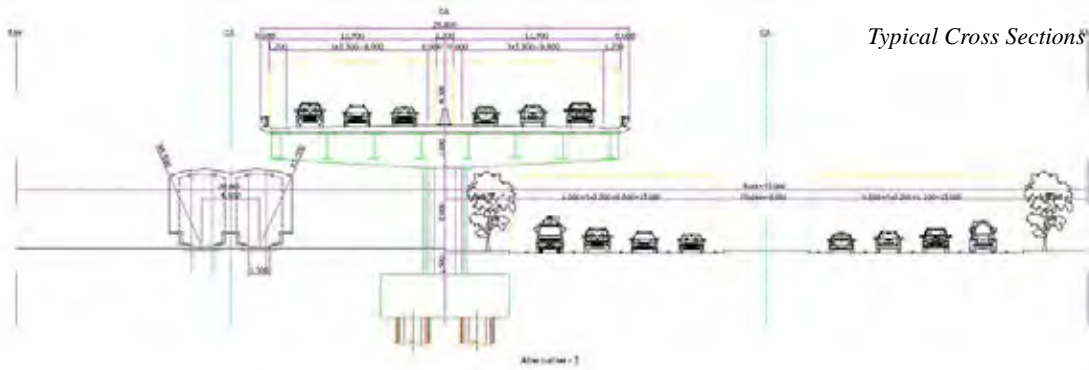
Scoring Summary (E3-2)

| Alternatives | Alternative-1 (above Roadway) | | Alternative-2 (above Railway) | | Alternative-3 (between Roadway and Railway) | |
|---|--|----|---|----|--|----|
| | | | | | | |
| Length (km) | Intermediate (5.6) | 2 | Intermediate (5.6) | 2 | Intermediate (5.6) | 2 |
| Configuration | Single Pier Viaduct (Parallel-6) | 3 | Double Pier Viaduct (Parallel-6) | 2 | Single Pier Viaduct (Parallel-6) | 3 |
| Geometric (m) [Radius and Number of Curves] | R600 x 3, R900 x 1, R1050 x 2, R300 x1, and R330 x 1 | 5 | R600 x 3, R900 x 1, R750 x 2, R300 x1, and R330 x 1 | 3 | R600 x 3, R900 x 3, R300 x1, and R330 x 1 | 4 |
| Land Acquisitions | Arab Contractor | 3 | Arab Contractor | 3 | Arab Contractor | 3 |
| Community Accessibility | Partially Limited | 3 | Partially Limited | 3 | Partially Limited | 3 |
| Traffic Diversion | Autostrade | 1 | Cargo Train | 3 | Autostrade Cargo Train | 2 |
| Public Utilities | Large | 1 | Small | 5 | Intermediate | 3 |
| Landscape | Slightly Affected | 3 | Slightly Affected | 3 | Slightly Affected | 3 |
| Environmental Impact | Intermediate | 3 | Intermediate | 3 | Small | 5 |
| Other Infrastructures | n/a | 5 | ENR | 3 | ENR | 4 |
| Overall Score | | 29 | | 30 | | 32 |

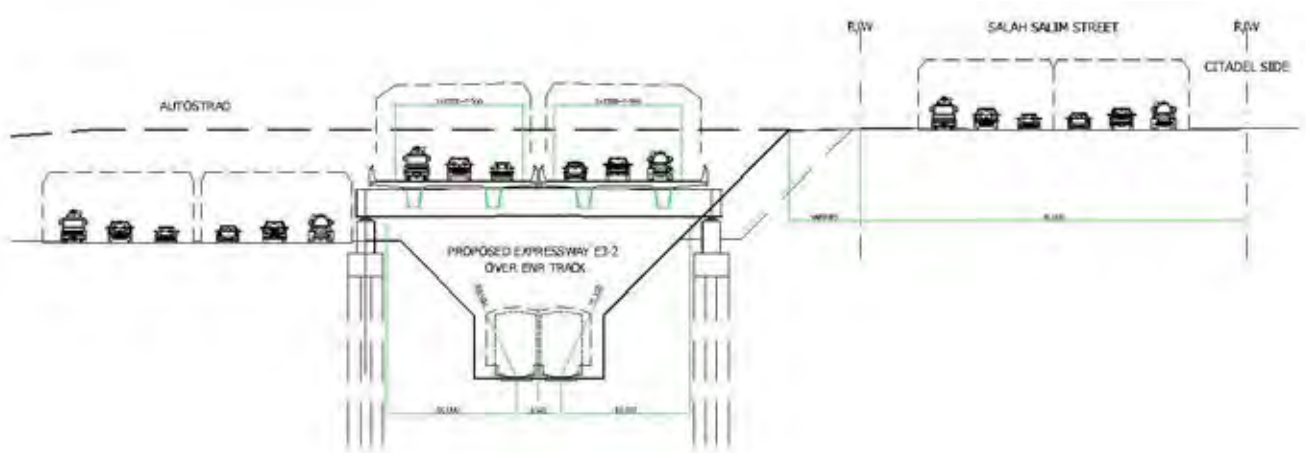
Alignment Layout Plan (E3-2)



Typical Cross Sections (E3-2)



Single Deck (Parallel-6) Section along al-Nasr Road



Single Deck (Parallel-6) Section in front of Citadel

E3-3

As shown in the table and figures indicated hereinafter, following 3 alternative configurations are investigated and scored.

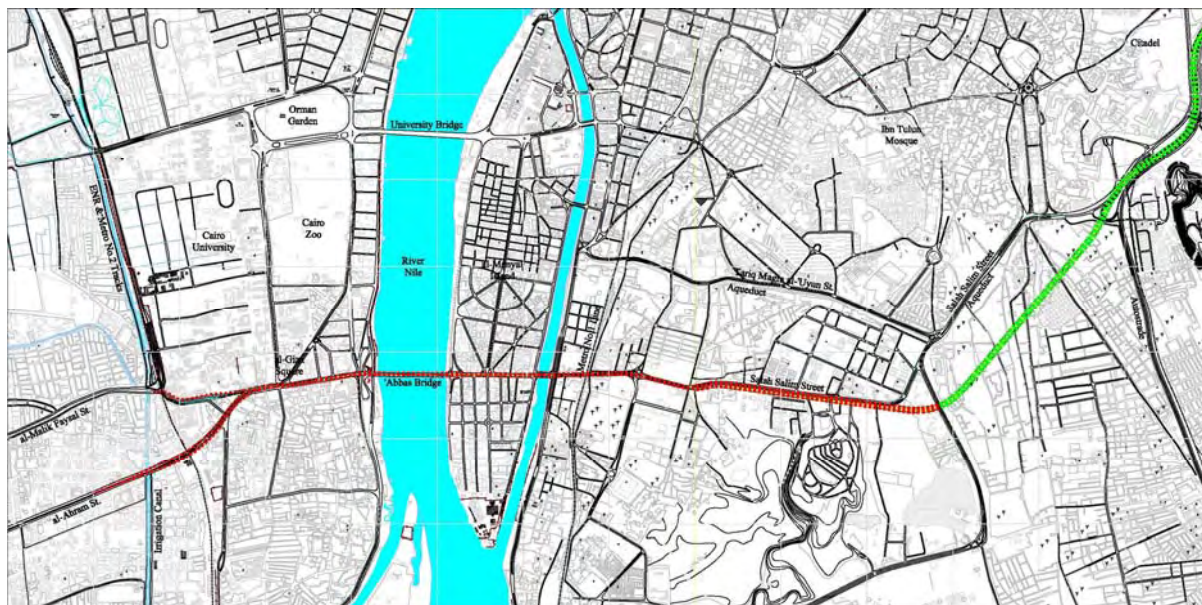
- Alt.-1 Single Deck
- Alt.-2 Double Deck
- Alt.-3 Combination of Above Two Type

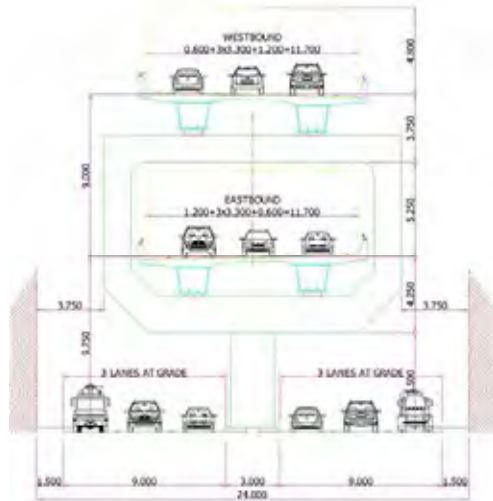
As a result, Alternative-3 (Combination) is selected as most suitable configuration for E3-3.

Scoring Summary (E3-3)

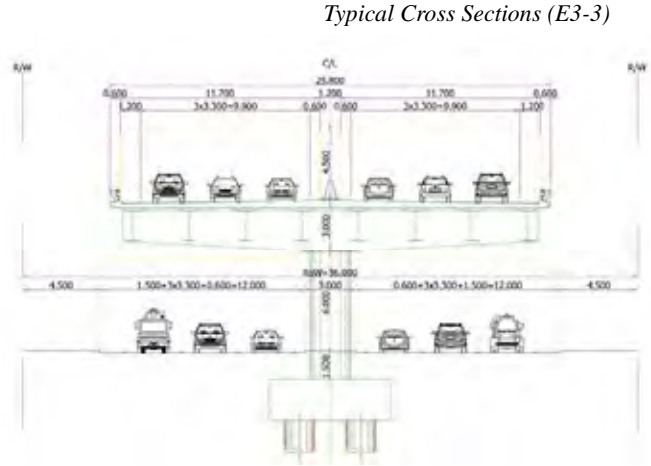
| Alternatives | Alternative-1 (Single Deck) | | Alternative-2 (Double Deck) | | Alternative-3 (Combination) | |
|--|--|----|--|----|--|----|
| | | | | | | |
| Length (km) | Intermediate (6.6) | 3 | Intermediate (6.6) | 3 | Intermediate (6.6) | 3 |
| Configuration | Viaduct (Parallel-6) w/ Cable Stayed Bridge | 4 | Viaduct (Double-6) w/ Cable Stayed Bridge | 2 | Viaduct (Parallel-6 & Double-6) w/ Cable Stayed Bridge | 3 |
| Geometric (m) [Radius and Number of Curves] | R480 x 2, R360 x 5, R240 x 1, R600 x 1 | 4 | R360 x 8, R180 x 1, R120 x 1, R240 x 1, R600 x 1 | 3 | R480 x 2, R360 x 5, R240 x 1, R600 x 1 | 4 |
| Land Acquisitions | Large | 1 | Small | 5 | Intermediate | 3 |
| Community Accessibility | Partially Limited | 3 | Partially Limited | 3 | Partially Limited | 3 |
| Traffic Diversion | Salah Salim St. | 3 | Salah Salim St. | 3 | Salah Salim St. | 4 |
| Public Utilities | Relatively Large | 2 | Large | 1 | Intermediate | 3 |
| Landscape | Affected | 2 | Very Affected | 1 | Partially Affected | 3 |
| Environmental Impact | Intermediate | 3 | Very Large | 1 | Relatively Large | 2 |
| Other Infrastructures | Metro No.1 & No.4 | 3 | Metro No.1 & No.4 | 3 | Metro No.1 & No.4 | 3 |
| Overall Score | | 28 | | 25 | | 31 |

Alignment Layout Plan (E3-3)





Single Deck along Salah Salim St.



Double Deck along Salah Salim St.

Integration with Future Expressways

Integrations with future expressways (i.e. junctions) are also proposed for reference purpose to not only implementing agencies but also other related public entities as well as stakeholders in

order to provide better understandings and advance informations for easy future expansions of the expressways as shown in the figures indicated below:

Layout Plan of E1-1 Bypass Extension w/ E5 Jct.-1



Layout Plan of E3-1 w/ E4 & E6 Jct.



Layout Plan of E1-1 Bypass Extension w/ E5 Jct.-2



Layout Plan of E3-3 w/E8 Jct.

