7 PRELIMINARY GEOMETRIC DESIGN

Design Standards

Geometric design standards for expressway segments and standard cross-sections are summerized in table and figures, redicated hereinafter.

Design Speed

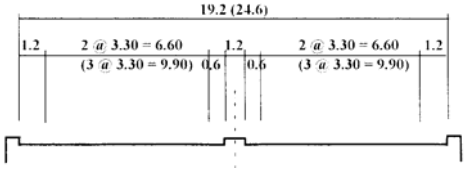
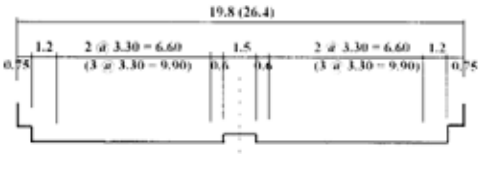
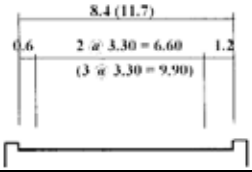
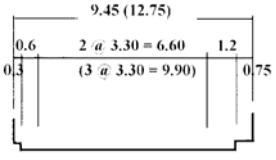
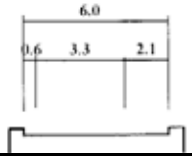
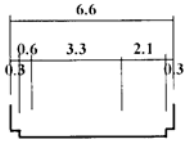
Expressway Route E3-1, E3-2 and E3-3 are classified as the Class-A (design speed:60kph) and Route E1-2 and E2-2 are classified as the Class-B (design speed:50kph).

Geometric Design Standards for an Expressway

Description	Unit	E3-1/2/3	E1-2&E2-2
Design Speed	kph	60	50
Lane Width	m	3.3	3.3
Shoulder Width (outer)	m	1.2	1.2
Shoulder Width (inner)	m	0.6	0.6
Median Width	m	1.2/1.5*	1.2/1.5*
Minimum Stopping Sight Distance	m	75	55
Minimum Radius	m	120	70
Minimum Curve Length	m	100	80
Minimum Spiral Curve	m	70	50
Minimum Spiral Curve Length	m	50	40
Minimum Radius for without Spiral Curve	m	600	400
Minimum Radius for Normal Cross Slope	m	1500	1000
Maximum Grade	%	5	6
Minimum Length of Vertical Curve	m	50	40
Minimum "K" for Crest		11	8
Minimum "K" for Sag		18	7
Maximum Superelevation	%	8	8
Normal Cross Slope	%	1.5	1.5
Maximum Superelevation Transition	m/m	1/125	1/115
Composite Gradient	%	10.5	11.5
Vertical Clearance	m	5.5 (4.5)	5.5(4.5)

Note : The figure in ( ) shows absolute minimum/maximum value to be used only when the condition necessitate.
* Tunnel Section

Standard Cross Section

Structure Type	Elevated	Depressed/Tunnel
Two Way : 4-Lane (6-Lane) Expressway		
One Way : 2-Lane (3-Lane) Expressway/ Interchange Ramp		
One Way : 1-Lane On/Off Ramp		

Lane Width

Lane width 3.30 meter is adapted for highly urbanized areas, taking into consideration:

- Present vehicle users driving manners and
- Construction cost.

Outer Shoulder Width

Outer shoulder width of 1.2 meter throughout an expressway was recommended due to the following reasons:

- Traffic demand for expressway in Greater Cairo is high, thus all traffic lanes will be in use for the most of the time of a day.
- Where shoulder width is not sufficient, a stopped vehicle will disrupt traffic not only on the occupied lane but on all lanes in that direction.
- There are many obsolete vehicles which are still in use in Greater Cairo.
- It is expected that a rate of vehicle breakdown on an expressway is high, wider outer shoulder width is desired to be provided throughout an expressway.

Types of Interchanges

Factors to be considered in selecting the most appropriate types of interchanges include:

- Design speed of expressway
- Functionality according to traffic volume and highway capacity
- Construction cost
- Difficulty in R.O.W. acquisition
- Topographical feature
- Environmental/aesthetic consideration

Location of On/Off Ramps

Therer is always demand to provide many access ramps to expressway. While this meets the desires to local traffic in general, it carries many incidental dangers, such as ramps closely spaced which create congested weaving areas and interference. Adequate space between on/off ramps shall be provided as specified. Ramps may closely intervene streets, unless the ramps are carefully placed.

The selected locations of On and Off ramps are shown in table here under.

List of On and Off Ramps

Route	Station	Provided Ramp	No. of Lanes	No. of Booths	Connecting Road	Remarks	Drawing No.
E1-2	3+400	ON	1	2	Sudan St.	In Bound	E1-2/A-01
	3+600	OFF	1	-	Canal St.	Out Bound	E1-2/A-01
E3-1	0+950	OFF	1	-	Autostrad	East Bound	E3-1/A-01
	1+520	ON	1	2	Autostrad	West Bound	E3-1/A-01
	2+620	OFF	1	-	Autostrad	West Bound	E3-1/A-01
	3+100	ON	1	2	Autostrad	West Bound	E3-1/A-01
	4+600	ON	1	2	Autostrad	East Bound	E3-1/A-01
	5+010	OFF	1	-	Autostrad	East Bound	E3-1/A-01
E3-2	8+500	OFF	1	-	Autostrad	Ease Bound	E3-2/A-01
	9+500	ON	1	2	Autostrad	East Bound	E3-2/A-01
	13+400	OFF	1	-	Autostrad	West Bound	E3-2/A-01
	13+400	ON	1	2	Autostrad	West Bound	E3-2/A-01
E3-3	14+000	ON	1	2	Autostrad	East Bound	E3-3/A-01
	14+000	OFF	1	-	Autostrad	East Bound	E3-3/A-01

Design Policy

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.

At Grade Streets

With an introduction of an expressway over an at-grade street, necessary improvement must be simultaneously implemented. At-grade street design was so undertaken that existing number of lanes and sidewalk width be maintained as much as possible, even though lane width is sacrificed

8 PRELIMINARY STRUCTURAL DESIGN

Introduction

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.
- Determination 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

Preliminary Design Policy

The policy adopted for the preliminary structural design is as follows:

- Rapid Bridge Construction Techniques
- Cost Competitive Construction
- Minimal Maintenance Obligations in the Future
- Pre-cast or prefabricated construction over railway lines
- Foundation Types selected to Minimize Disruption During Construction
- No Detrimental Effect on Existing Structures
- Minimize Expansion Joint and Bridge Bearing Locations
- Clean Structure Lines where possible to Enhance Visual Impact

Preliminary Design Criteria

The preliminary design in the Study is undertaken based on Egyptian standards. Egyptian standards are supplemented where necessary by AASHTO and Japan Road Association (JRA) standards.

Rapid Bridge Construction

The benefits of accelerated bridge construction in a confined urban environment, with a focus on prefabrication of structural elements, are well known. They include minimized traffic disruption and congestion, improved work zone safety, and minimized environmental impact. Additionally, prefabrication can improve constructability, increase quality, and lower life-cycle costs. Rapid bridge construction is prevalent in urban areas of Europe and Japan.

The Study has therefore made use of suitable forms of construction in conceiving preliminary bridge designs at locations where rapid bridge construction is identified as a high priority.

Superstructure and Substructure Types: E1-2

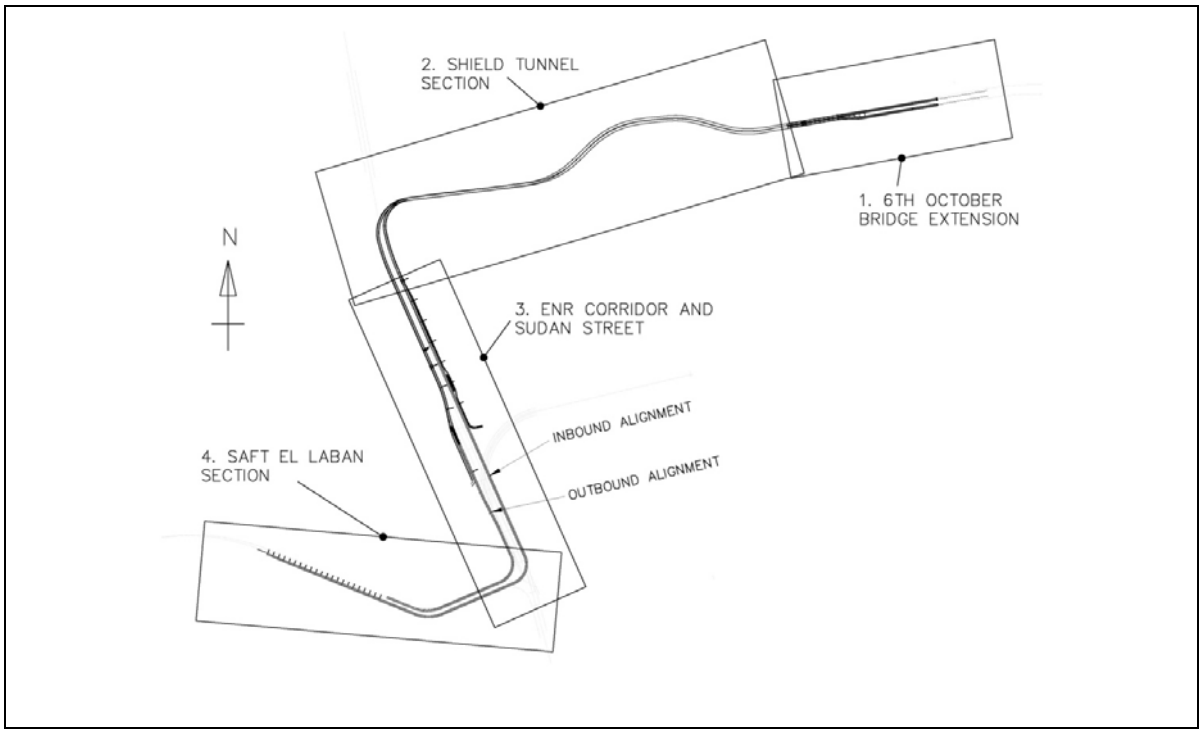
Expressway section E1-2 will be an extension of Expressway E1-1 (6^{TH} October Bridge) commencing from a location before the Agricultural Museum in Giza and terminating at Saft El-Laban, also in Giza. The overall length of the expressway is 5.5km with approximately 3km of that length in tunnel.

The expressway comprises structural components for the following sections:

- 6^{TH}October Bridge Extension
- Shield Tunnel Section (including a short stretch of Endless Self Advancing (ESA) box tunnel)
- ENR Corridor and Sudan Street Section
- Saft El Laban Section

The existing 6th October Bridge will require widening, demolition and reconstruction works in order to accommodate the new expressway structure.

The proposed new expressway structure and the ramps for local traffic to access the remaining 6th October Bridge shall be in the form of reinforced concrete cellular decks in order to remain sympathetic with the existing structure.



Overall Layout of Section E1-2

The section along ENR Corridor and Sudan Street is identified as a high priority for rapid construction. The advantages provided by structural steel twin tub girder decks combined with precast concrete deck slabs in constructing the expressway viaducts along the ENR corridor were key in selecting this form of construction to illustrate the preliminary design. The simplified steel tub design can also be very effectively integrated with composite columns.

The section at Saft El Laban is identified as a candidate for rapid construction with regard to constructability issues. Given that the Saft El-Laban viaduct currently under construction features post-tensioned precast beam and slab decks, the same form of construction was adopted in the preliminary design in order to achieve compatibility in form and to promote constructability.

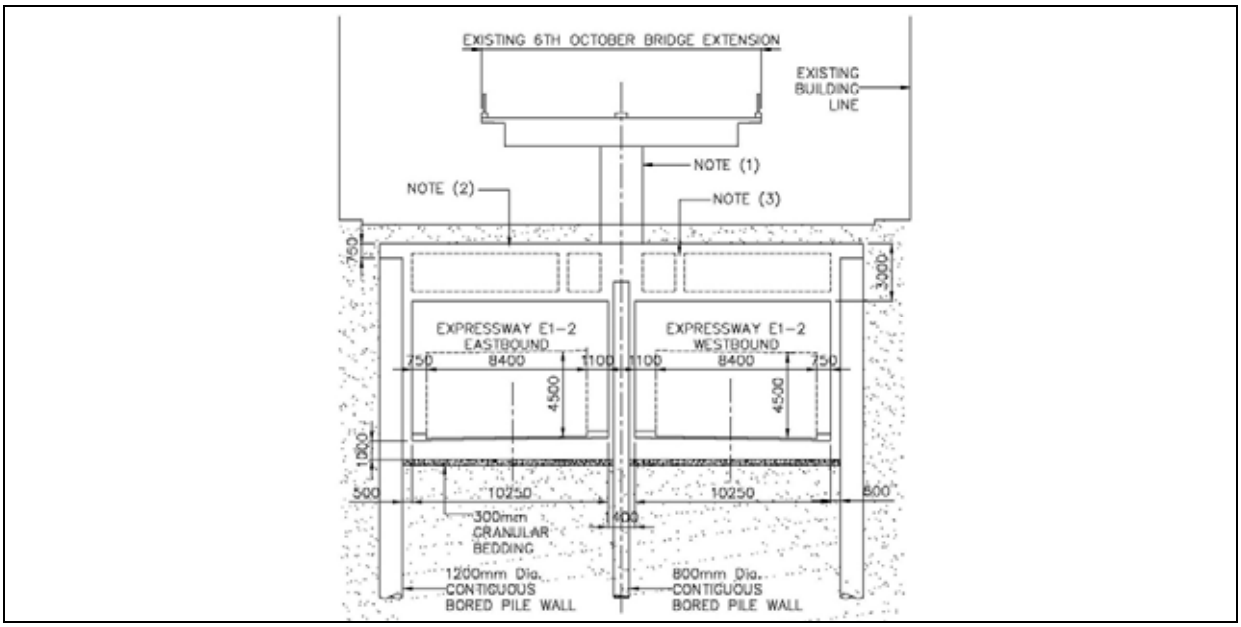
The substructure for the new expressway and the new ramps off the 6TH October Bridge shall be in the form of single column reinforced concrete piers monolithic with the deck to remain sympathetic with the existing structure. For structures along ENR Corridor and Sudan Street, single composite pier columns are proposed.

Bored pile foundations have been selected as the foundation type to be applied to the preliminary design. For the purposes of establishing quantities for the cost estimate in this Study, both 800mm diameter bored piles and single large diameter bored pile foundations have been selected.

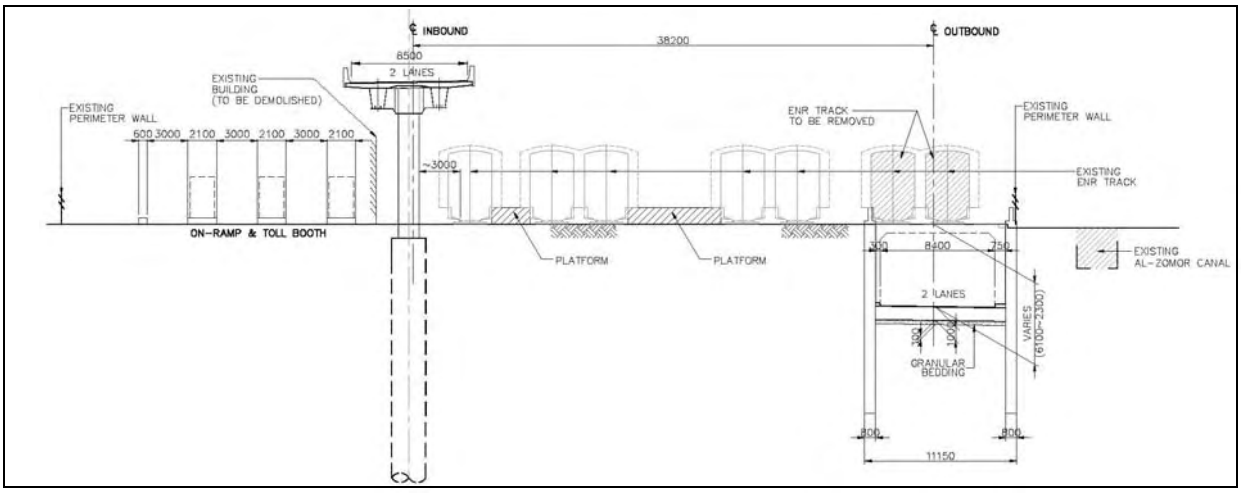
For structures at Saft El Laban, conventional reinforced concrete columns with conventional bored pile foundations typically are selected to illustrate the preliminary design in this section. This substructure form matches with the ongoing Saft El Laban construction.

Along El-Mat haf az-Zira'i Street, cut and cover construction is adopted for the tunnel structure. Bored pile curtain walls have been selected for the preliminary design.

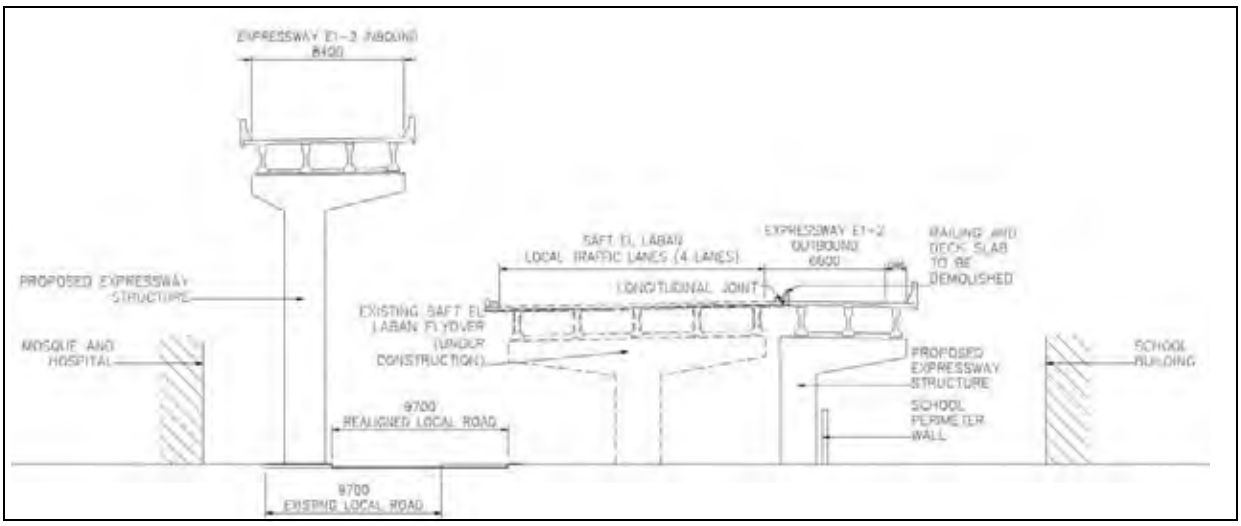
The deck of the existing 6TH October Bridge above the cut-and-cover tunnel section of the expressway will rest on temporary supports during construction. This will allow the existing bridge piers and foundations to be demolished to enable the cut-and-cover tunnel to be constructed. Pier supports will then be reconstructed monolithic with the tunnel structure.



Sta. 0+600 El-Mat haf az-Zira'i Street : E1-2



Sta. 3+500 ENR Corridor : E1-2



Sta. 4+418 Saft El Laban : E1-2

Along Sudan Street rapid methods of construction have been selected to illustrate the preliminary design. Diaphragm walls combined with precast pre-stressed planks for the cover slab are proposed.

Superstructure and Substructure Types: E2-2

Expressway section E2-2 will provide the "missing link" for Eastbound traffic in the network, connecting E2 with E1. The proposed missing link will provide two lanes, passing directly above the Westbound traffic along 26TH July Street.

The expressway section will be elevated for a total length of 1.8km; including a 1.0km double deck section along 26TH July Street. No on ramp/off ramp facilities are proposed in this relatively short section.

The National Authority for Tunnels (NAT) are currently undertaking the construction of Metro Line 3. Phase 3 of Metro Line 3 will pass beneath the E2-2 expressway on 26TH July Street. At this location the Maspero underground station is proposed to be constructed.

The strategy for construction of the elevated expressway along 26TH July Street will have an influence on the type of superstructure selected. There are several alternative strategies for the construction along 26TH July Street including the following:

1. Retain the existing 15TH May Bridge and construct a single new deck above it on separate independent foundations.
2. Demolish the existing 15TH May Bridge and construct new double-deck structure on new foundations along 26TH July Street
3. Partially demolish the existing bridge at the location of the proposed Maspero MRT underground station.

Strategy 3 has been selected given that it combines the advantages of the other two strategies including the option of completely demolishing the section of existing bridge at the proposed site of Maspero Station.

Given the advantages brought with the use of steel closed box tub girders combined with pre-cast deck slab, this form of deck construction has been selected to illustrate the preliminary design, rather than a multiple steel I-girder deck.

The study on foundations basically can be divided into two main sections, (1) 26TH July Street section in the vicinity of the existing 15TH May Bridge and (2) Ramsis Street section. The proposed foundation and pier types are as follows:

- (1) 26TH July Street 800mm Dia: Bored Piles and Pile Caps supporting Single Column Piers
- (2) Ramsis Street : 2.5m Single Bored Piles supporting Single Column Piers

The study on pier column type has been driven primarily by considerations of rapid bridge construction. Primarily single column piers featuring structural steel and composite columns have been adopted in the preliminary design.

Twin column pier portals are necessary both where the alignment transitions from 26TH July Street to Ramsis Street and in the vicinity of Orabi Station on Metro Line 1.

There are several scenarios to consider for the Integration with Proposed Metro Line 3 Maspero Underground Station:

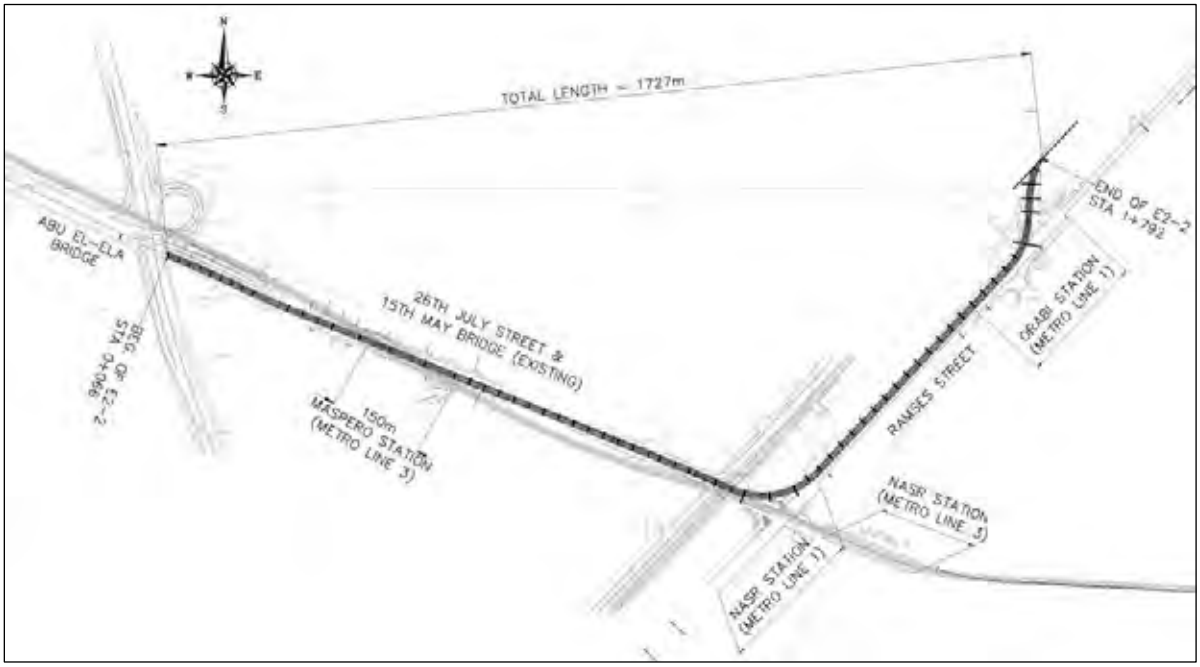
Scenario 1. E2-2 is constructed in advance of Metro Line 3 Phase 3 with:

a. EITHER conventional bridge foundations (piles and pile caps), OR
b. Maspero Station included wholly are partly in the E2-2 contract so that the structures can be fully integrated

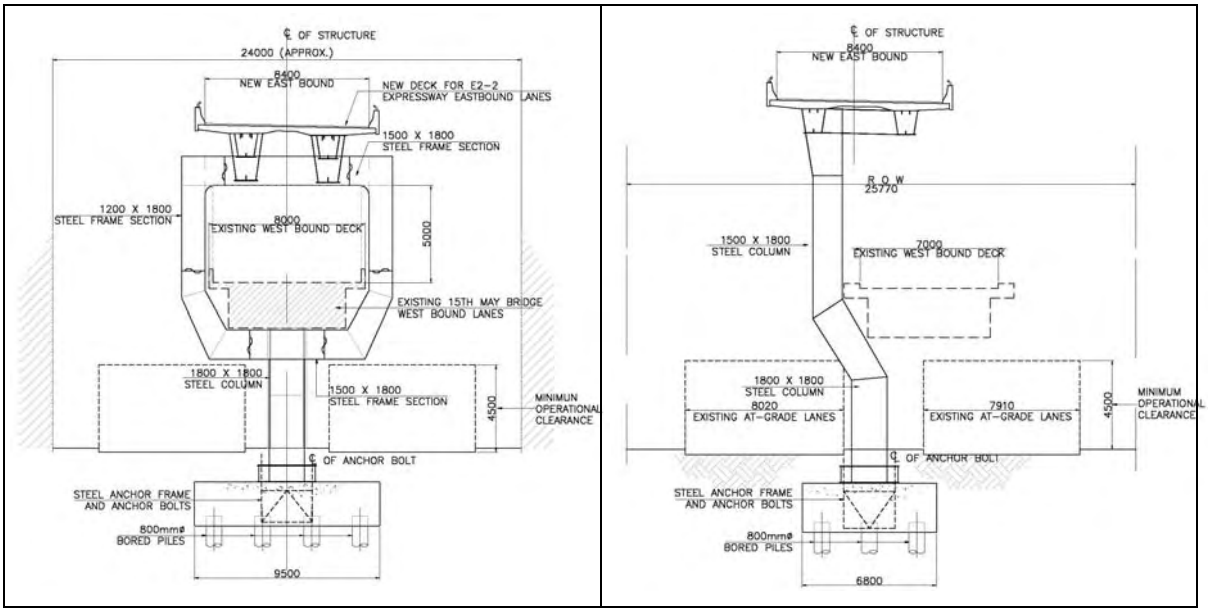
Scenario 2. Metro Line 3 Phase 3 is constructed in advance of E2-2 with provision made in the Maspero station design to support the future bridge piers of E2-2

Scenario 3. Both constructions occur more or less concurrently with provision made in the Maspero station design to support the E2-2 bridge piers

Most of the above scenarios involve a non-conventional foundation for the E2-2 structure, with the pier column integrated into the station roof. This arrangement has therefore been incorporated into the preliminary design.



Layout of Expressway Section E2-2



Sta. 0+270 : 26th July Street: E2-2 *Sta. 0+910 : 26th July Street: E2-2*

An alternative to the double deck configuration proposed for the preliminary design is an option that involves the demolition of buildings along 26TH July Street. This will create space on the north side of 26TH July Street to allow the construction of an additional deck adjacent to the existing structure, thereby avoiding the need to construct a double deck bridge.

The demolition concept requires westbound traffic, currently using the existing 15TH May Bridge, to be transferred onto the new adjacent structure, so that Eastbound traffic can then be carried on structure using the space currently occupied by the existing bridge.

Superstructure and Substructure Types: E3-1

Expressway section E3-1 on El-Nasr Road will be constructed in two stages in order to connect with the proposed E4/E6 components of the expressway system on the Suez Desert Road. The first (initial)

stage will commence on El-Nasr Road 700m from the intersection of E3-1 (El-Nasr Road) with E4/E6. The second (ultimate) stage will complete the connection once the E4 /E6 sections of the expressway are constructed. The overall length of E3-1 is 6.5km with 5.8km constructed in the initial stage.

The initial stage of the expressway comprises the following structural components:

- Westbound Mainline (to 6th October Bridge and E3-2) – primarily depressed
- Westbound Onramp and Off ramp facilities
- Eastbound Mainline (to Suez Desert Road) - depressed
- Eastbound Onramp and Off ramp facilities

The Eastbound and Westbound depressed structures are separated in order to pass each side of the existing centrally located ramps of the 6th October bridge at the junction of El-Nasr Road with Ramsis Extension. At this location a connection is provided between E3-1 and 6TH October Bridge (E1) in the form of a 4-lane centrally located ramp to the depressed expressway. The main expressway structures carry 3-lanes in each direction. The on and off ramps provide single lane access/egress.

The expressway is proposed to be constructed in two stages, (1) the initial stage and (2) the ultimate stage.

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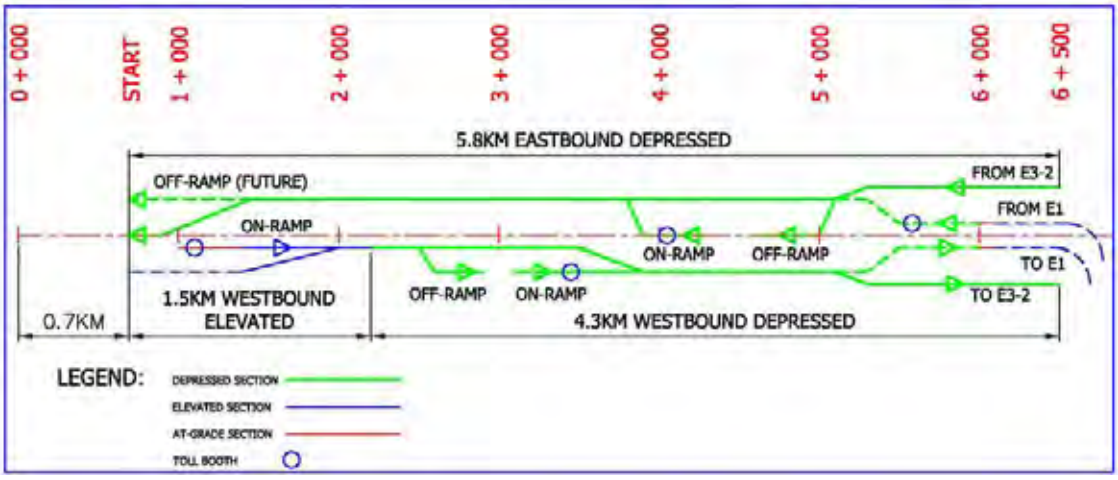
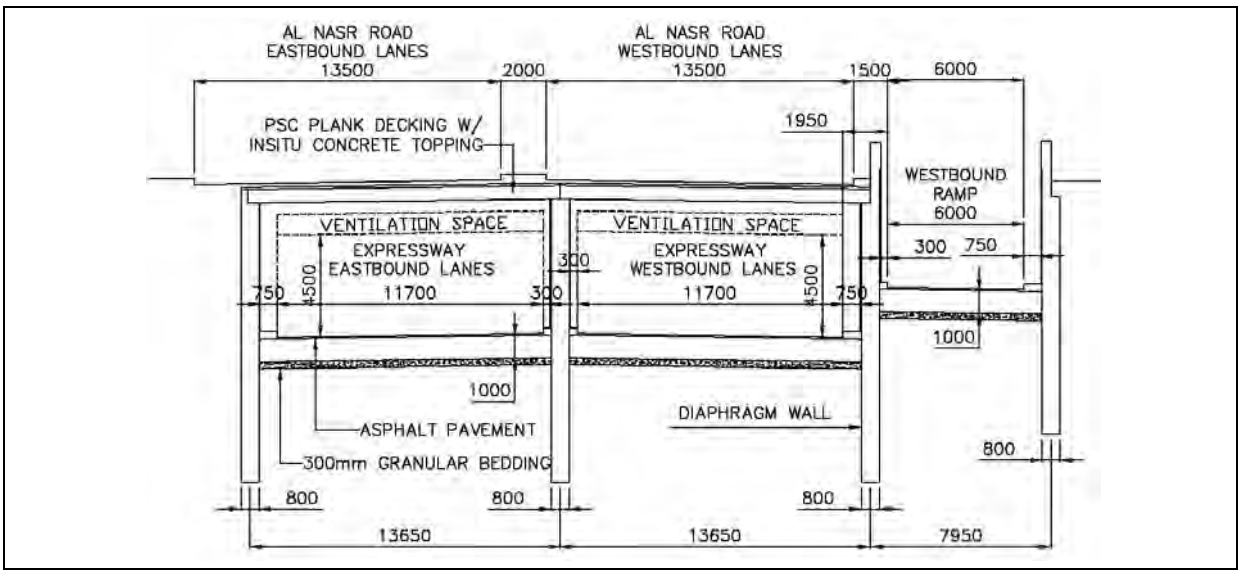
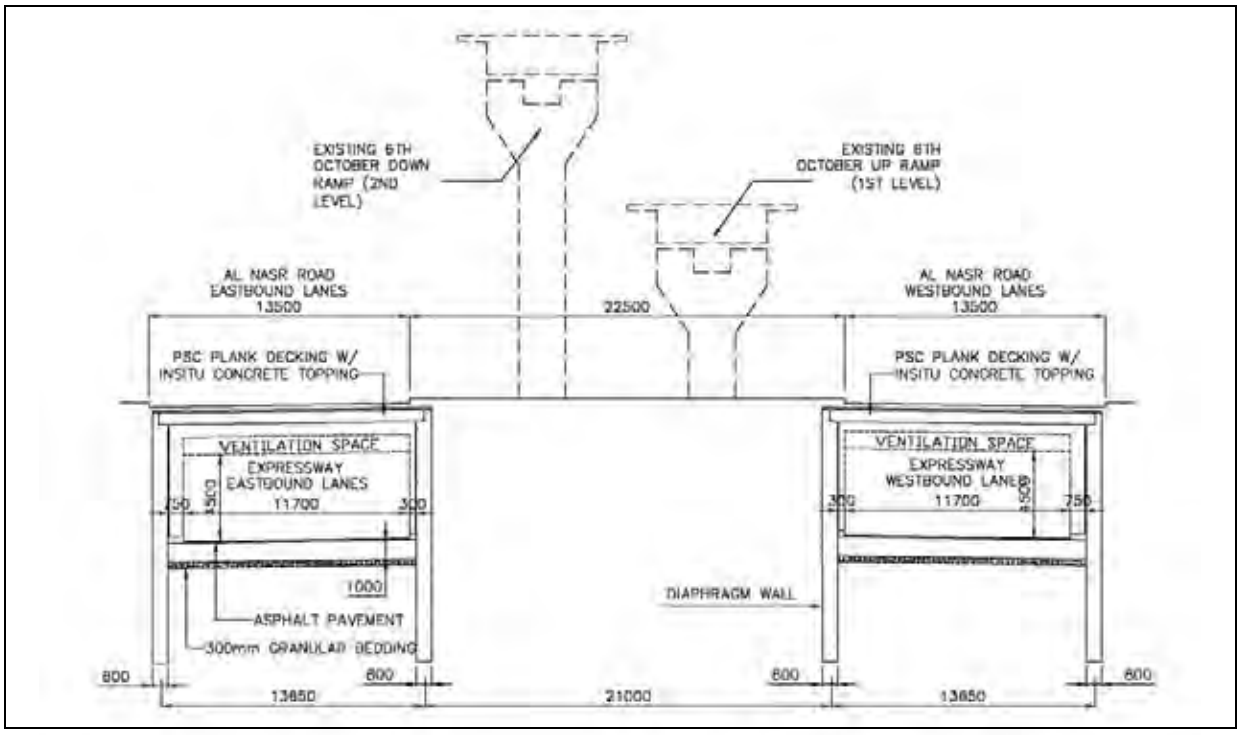


Schematic Plan of E3-1



Section at Sta. 3+200: E3-1



Section at Sta. 6+400: E3-1

Initial Stage

The initial stage will comprise the major part of E3-1 and will form an operational expressway component prior to the construction of the proposed E4 and E6 expressway structures along the Suez Desert Road.

Ultimate Stage

The ultimate stage will make a fully grade separated intersection with the future E4 and E6 expressway structures along Suez Desert Road.

The soil profile along Nasr Road shows a depth of collapsible clayey and silty sand down to a depth of typically 15m, with one section of length 300-400m where the collapsible soil extends to a depth of 18m. Below this horizon are stiff clay and dense sands to depth. Piled foundations therefore should extend at least 5 pile diameters below this horizon to avoid major problems settlement and loss of capacity. With regard to the cut and cover tunnel sections, depth of diaphragm walls should extend below the collapsible soil horizon and an embedment depth below the collapsible soil horizon of 3 times the wall thickness has been adopted. An overall depth of 18m has therefore been assumed to determine quantities.

The study on superstructure types is made for a span length of 25m. This is a typical span length for flyover and viaduct structures found in Cairo and will provide a good basis for cost estimation purposes. An in-situ pre-stressed concrete spine girder has been selected to illustrate the preliminary design.

Architectural pier and 800mm diameter bored piles have been selected to illustrate the preliminary design.

Given that 5.8km of depressed expressway structure is to be constructed, the bored pile curtain wall type method is considered too slow to be recommended for the main tunnel works. Diaphragm walls have therefore been selected to illustrate the preliminary design. The study on the top slab has been limited to pre-stressed concrete construction. Pre-cast PCS planks have been selected to illustrate the preliminary design.

The preliminary design has established a trumpet type grade separated interchange between expressway E3 and the proposed E4 expressway along Suez Desert Road.

Superstructure and Substructure Types: E3-2

Section E3-2 will extend the proposed E3 expressway south-west along El-Nasr Road from the junction with 6TH October Bridge and will transition onto Salah Salim Street in front of the Citadel. E3-2 terminates at the junction with E3-3 in the Southern Cemetery beyond the Citadel. The expressway section will commence as depressed structure, continuing the depressed E3-1 structure, will emerge above ground after approximately 1.3km and will then continue as elevated structure for the remaining length. The total length of the E3-2 section is 6.86km with approximately 5.2km of that on viaduct. The proposed expressway structures will provide 3-lanes in each direction. The on and off ramps provide single lane access/egress.

E3-2 Superstructure Types are as follows:

- PC Girders with flexible slab option for sections adjacent to El Nasr Road and ENR track (similar construction to Autostrad Flyover)
- Twin steel tub girder and pre-cast slabs for sections directly above ENR track or sections crossing El Nasr Road.

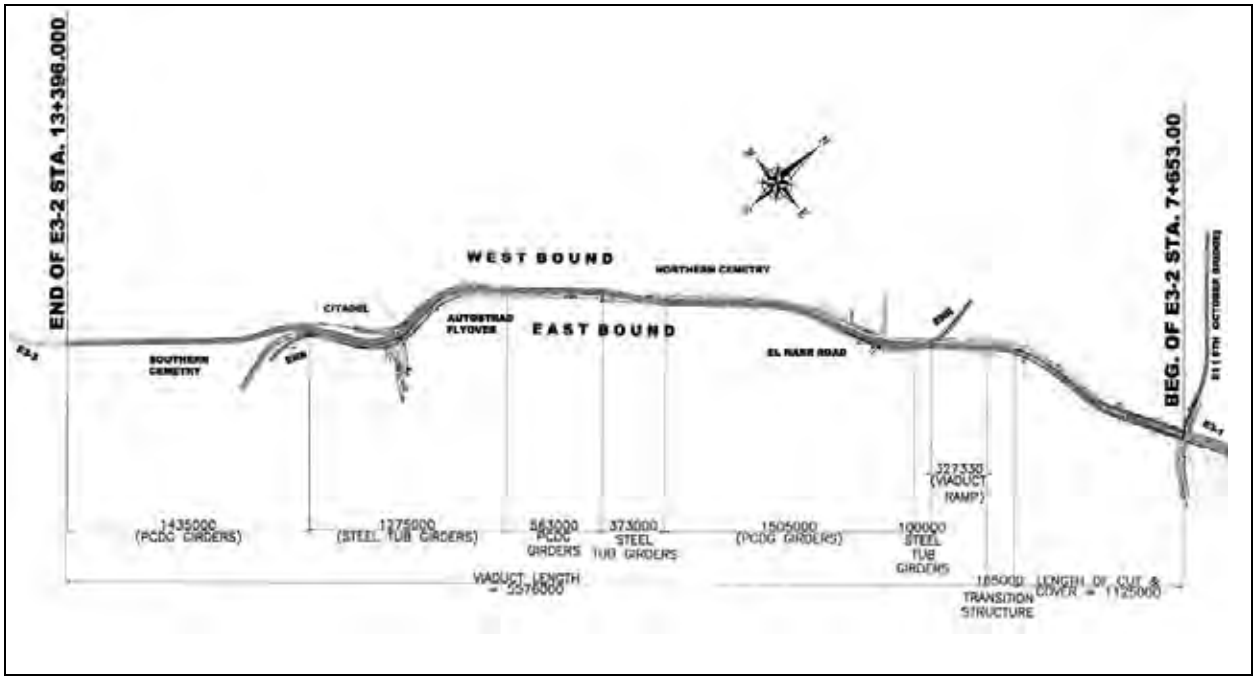
E3-2 Substructure Types are as follows:

Foundations

- Larger diameter bored piles and conventional pile caps, numbers of piles minimized to promote rapid construction
- Barrettes or single large diameter bored piles at the rock cut in-front of the Citadel.

Piers

- Single reinforced column piers (rotated type) to support the deck where possible
- Twin column reinforced concrete pier bents with structural steel copings across ENR track, El Nasr Road and Salah Salim Street.



Layout Plan E3-2

Superstructure and Substructure Types: E3-3

Section E3-3 will be the last section of the proposed E3 expressway, connecting from the continuation point with E3-2 in Cairo Governorate to the proposed E8 expressway in Giza and will require a crossing of the Nile River. Expressway section E3-3 will be elevated throughout its length, carried both on shorter span viaduct over existing roads and on longer span bridge structures over the Nile. The total length of the E3-3 section is approximately 7.2km. The proposed expressway structures will provide 3-lanes in each direction.

E3-3 Superstructure Types are as follows:

- PC Girders with flexible slab option for the section extending from the Southern Cemetery to the transition onto double deck.
- Twin steel tub girder and pre-cast slabs for long span sections, double deck sections and where the expressway is elevated along and above existing roads and structures

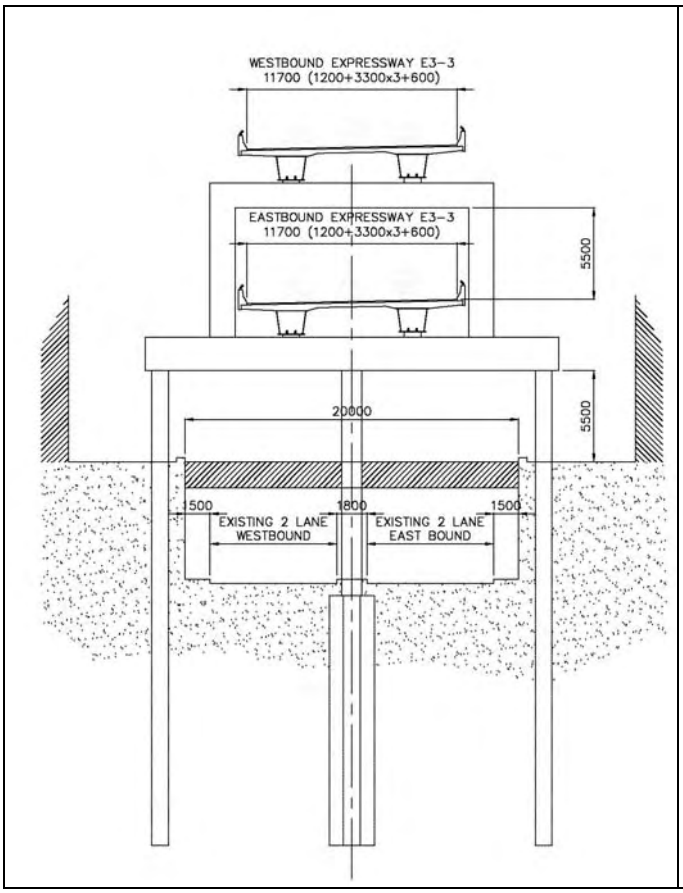
E3-3 Substructure Types are as follows:

Foundations

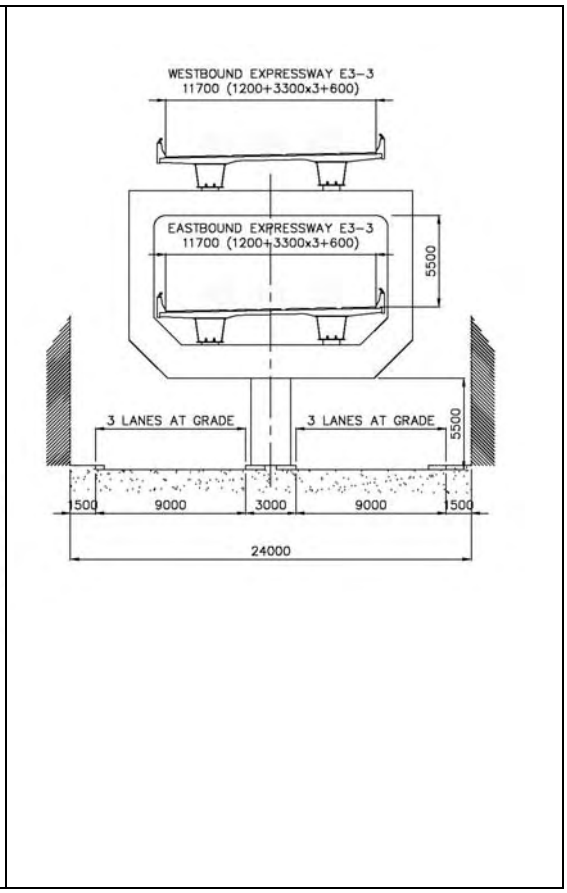
- Larger diameter bore piles and conventional pile caps, numbers of piles minimized to promote rapid construction
- Barrettes or single large diameter bored piles at locations where available space restricts the footprint of the foundation.

Piers

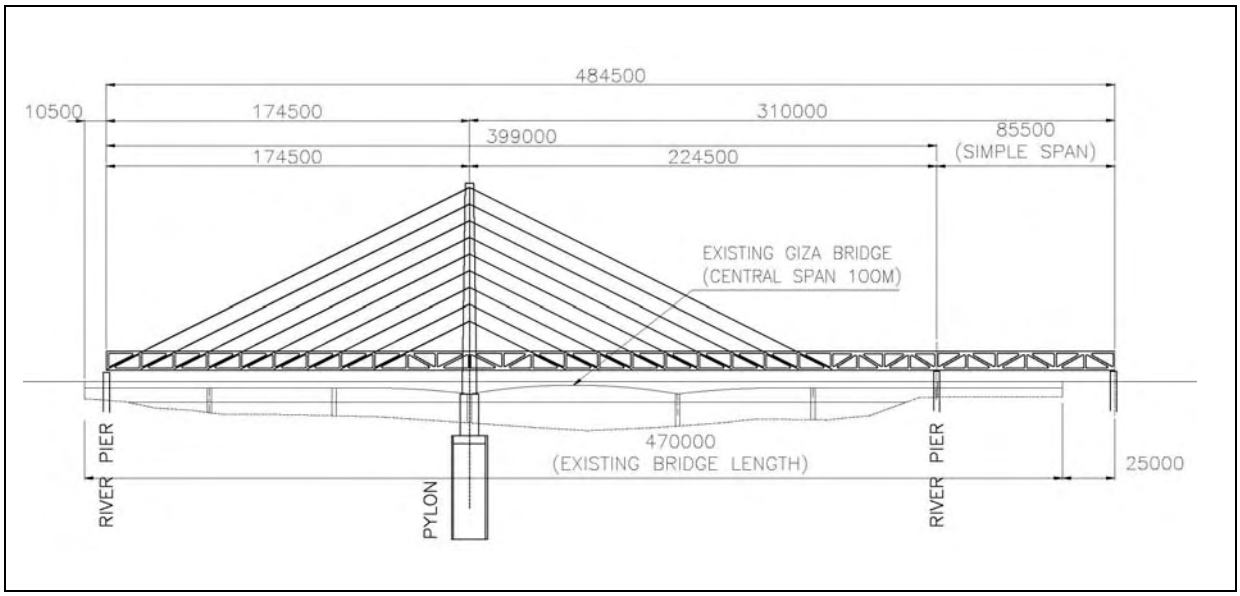
- Single reinforced column piers (rotated type) to support the single deck sections where possible
- Structural steel frames to support the double deck sections.
- Composite columns at locations where the deck is cantilevered off single column supports (locations West of the Nile).



El-Malik El-Salih Underpass: E3-3



El-Rawdah Street – Manyal: E3-3



Nile River Bridge: E3-3

The Pre-Feasibility Study undertook a basic cost comparison of alternative bridge solutions across the Nile:
From the basic cost comparison it can be seen that a cable-stayed bridge option is reasonably competitive to other schemes.

The preliminary design has established the location of "jump off points" where future connections can be made to link E3 and E8 both in the vicinity of Faysal Bridge and at Pyramid Street.

Impact on Existing Sections: E1-1 and E2-1

The following aspects are to be addressed:

- Widening of 6TH October Bridge to accommodate E1-1
- Widening of 15TH May Bridge to accommodate E2-1
- Toll plaza layout on E1-1 on 6TH October Bridge
- Toll plaza layout on E2-1 above 26TH July Street

The section of 6TH October bridge that runs across the Nile and Gazirah Island before connecting to the proposed E1-2 Expressway will require widening. The widening is required in order to accommodate both the proposed expressway traffic lanes (4-lanes) and local traffic lanes (6 lanes) i.e. 10 lanes total with 5 lanes in each direction.
The current capacity of 6TH October Bridge at this location is 4-lanes per direction, therefore an additional lane is required on each side. In addition, the expressway lanes have to be separated from the local traffic with longitudinal barriers and also the Eastbound and Westbound expressway traffic lanes must be divided with a barrier.

Options available at 6TH October Bridge are:

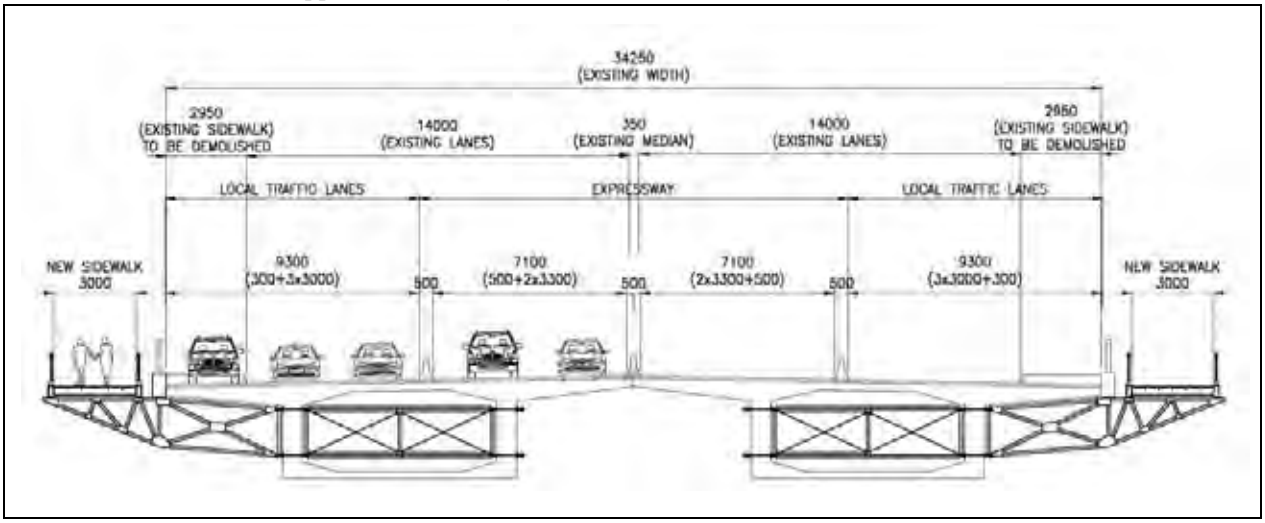
Option 1. : Strengthen the existing bridge to carry the additional traffic lanes and provide separate provision for pedestrians.
Provision for pedestrians can either take the form of:

- EITHER an independent structure or structures located adjacent to the existing bridge
- OR structures supported by the existing bridge with additional strengthening incorporated to carry the extra loading.

Option 2. : Construct an additional bridge or bridges to carry the additional lanes.
For the 6TH October Bridge on E1-1 the Study has focused on strengthening of the existing bridge to carry more traffic lanes.
Strengthening of the existing bridge will entail:

- External longitudinal pre-stress cables

installed on the main bridge box girders
- Transverse strengthening of the bridge deck cantilevers, possibly using epoxy bonded carbon fiber sheets applied transversely to the top surface of the concrete
- Bearing replacement



Widening of 6TH October Bridge: E1-1

The local traffic weaving movements on the existing 15TH May bridge at both Abu El Ela (Big Nile) and El-Bahr El-Aazam (Little Nile) preclude any options that would separate local and expressway traffic with barriers. Local traffic and expressway traffic have to share the same facility at and between these locations.

The requirements regarding widening of the existing 15TH May Bridge are dependant on final lane provisions over the existing bridge. Given the requirements to provide access for local traffic to these bridges from side ramps, it is envisaged that an additional 2-lanes in each direction are likely to be required.

Widening options for the 15TH May Bridge are in principle the same as for 6TH October Bridge if only one (1) additional lane only is required in each direction. However the required width of trafficable deck, for an additional 2 lanes in each direction, will be wider than that provided by the existing bridges between railings. Therefore additional structures to carry traffic loading at these locations are unavoidable if an additional 2 lanes are required in each direction.

Toll plazas are proposed at the following locations:
- 6TH October Bridge (E1-1): At a location above the existing car park at Midan Add al-Munim Riyad.
- 15TH May Bridge (E2-1): At a location above the existing car park near Sphinx Square

The toll plazas are envisaged to accommodate five (5) toll booths in each direction and therefore will extend each side of the existing decks across the entire car parking area. Given that the propose toll plaza structures are located above car parking facilities, there will be some flexibility with regard to form of construction. However it is anticipated that prefabricated beam and slab decks will be the preferred solution at each location.

Eligible projects suitable for STEP Loans

Section E1-2 and E2-2 are clear candidates for satisfying STEP Loan requirements given that advanced (shield-tunnel) construction technology is involved and steel structures, including double deck viaducts, are envisaged.

9 TOLL EXPRESSWAY OPERATION SYSTEM

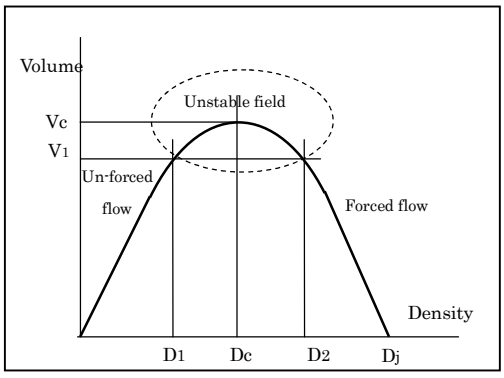
Traffic Management

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.

Concept of Traffic Management

Urban Expressway is a road facility having high traffic capacity to handle high traffic demands, and this function has to be maintained in any time. Once traffic demand exceeds its road capacity, congestion will occurs which has relatively low travel speed and last long time.



Traffic surveillance aims at collection of data and information on road and traffic using vehicle detector, CCTV, emergency telephone, patrol cars and so on. Traffic data collected are processed and the most suitable traffic control measures are selected. Urban expressway has high traffic volume, then once incidents occur their impact will affect wide area where a higher traffic management level of 3 will be needed. Also, demand for higher level of traffic safety, convenience and comfort will required, a new type of traffic surveillance and information presentation facilities have to be installed.

Facilities and devices to be installed are:

a. Vehicle Detector

- Location:

Vehicle detectors will be installed on roadway at interval of 500m to 1,000m, in addition, where traffic volume changes such as merging and diverging points of ramps and interchanges.

Also at every entrance ramp, traffic detector shall be installed, due to the requirement of toll managing section.

- Type:

Induction loop coil type is basically recommended, except the section where steel slab is employed, because induction effect will be weakened on steel slab. For these sections, ultrasonic wave type is recommended. In Cairo, parking meter with loop coil can be seen everywhere in down town. The technology used for parking meter is same as for expressway.

b. Emergency Telephone Set

- Location:

Emergency Telephone set will be installed at interval of 500 m to 1,000 m. The most suitable place to be installed is emergency parking bay. Vehicles can stop there and talk to telephone sets free from main line traffic.

- Function:

Unlike ordinal telephone sets, emergency telephone set is designed to have a speaker and a microphone, and once lid is pulled out, the users can easily talk with the personnel in Traffic Control Center.

c. Close Circuit TV (CCTV)

- Location:

To monitor the place where incident tends to occur, such as merging point of ramps and interchange, entrance point to tunnel section and sharp curve section. CCTV camera will be installed nearby higher place or installation post for that purpose.

- Function:

The camera will be remote controlled with function of tilt, pan, zoom and focus. Colour TV has been used, the amount of information is much bigger than mono-colour TV.

d. Weather Detectors

Anemometer, anemoscope, rain gauge, etc.

e. Variable Message Sing Board (VMS)

- Location:

VMS is installed at diverging points of interchange or major ramps, where the users can take appropriate option by reading the messages.

- Function:

Processed information is presented at variable message sign board. There are two types of VMS, a message that is conveyed by words and a message is conveyed by diagrammatic way.

Processing of Collected Data

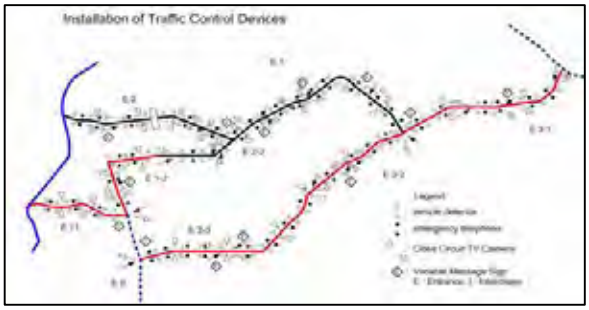
a. Vehicle Detector

The data from vehicle detector input to central computer via interface, then traffic related parameter such as volume, speed, and occupancy are automatically produced.

b. CCTV

By watching CCTV operator inputs to the computer the incidents as accidents or broken down vehicle. The computer also calculate and produce messages to be presented at variable message signs, and recommend traffic control actions such as ramp or main line closure.

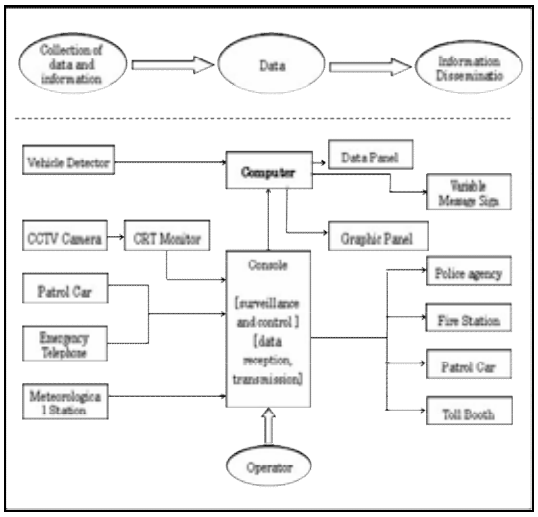
Traffic Control and Information System applied by Tokyo Metropolitan Expressways is presented in the figure.



Installation Plan of Traffic Control Devices and Facilities

c. Traffic Control Center

Traffic control center with operating room and computer room with interface shall be constructed in nearby appropriate place. It is convenient to have rooms for "highway patrol squad" and car pool for patrol cars and towing vehicles in this building.



Traffic Control System Configuration

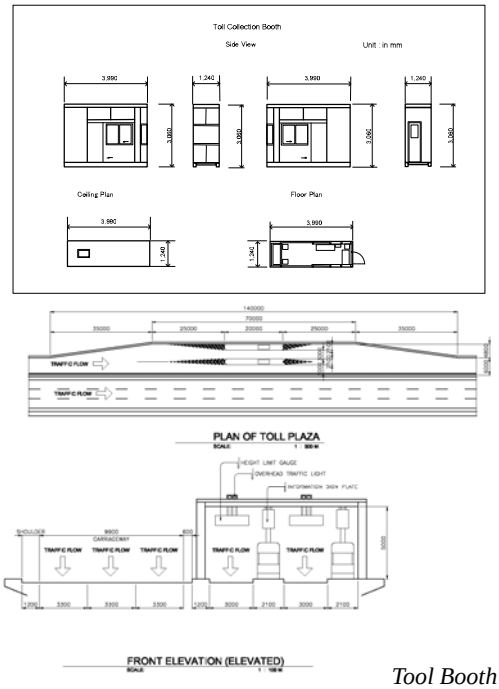
Expressway Facilities

Toll Booth

Toll collection works is conducted at toll booth. Toll booth is installed at on ramp or main line toll barrier. Toll collection work continues 24 hours, usually 2 or 3 shift. So, toll booth should be equipped not only facilities for collecting toll, but also facilities for toll collectors comfortable and resting. There are two kind of toll booth:

(i) Toll collection booth: equipped with toll collection desk and safe, shown below.

(ii) Toll collection and resting booth: equipped with toll collection desk, safe, toilet, kitchen and beds.



Tool Booth

Emergency Parking Bay: Viaduct / Tunnel

Tunnel section will be constructed along the expressway E3-1 and E1-2. Method of constructing will be cut and cover method or shield tunnel method. In case of shield tunnel, they will consist of two bores.

Emergency Parking Bay

Emergency parking bays in case of Tunnel recommended to be located opposite the vehicular cross connections in average every 500 to 1,000 m along the main tunnel to provide emergency parking in the event of vehicular breakdown or accidents and to provide additional space for vehicle moving in and out the cross connections.

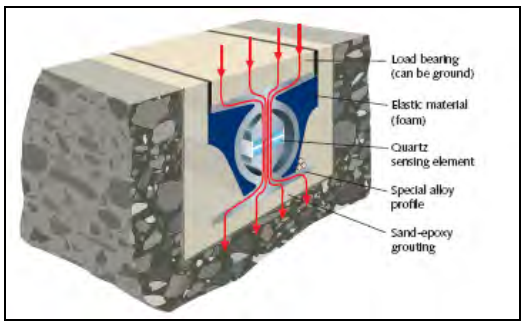
Escape Shelter: Viaduct / Tunnel

In case of shield tunnel pedestrian cross connections are designed, if possible to be small shelter spaces, and are constructed between the eastbound and westbound tunnels every 300 ~ 350 m along the main tunnel. In the event of an emergency, people inside the tunnel can escape to these cross connections and access the pilot tunnel for emergency evacuation.

Axle Load / Vehicle Load / Vehicle Height

Regulation to illegal axle load and height is very important to secure safety for expressway users and maintain the expressway structures.

Deteriorations of pavement and expressway structures can be minimized through the right regulation over excess loads and heights. To regulate overloaded vehicle will needs to construct a weigh scale. Since stopping of all heavy vehicles for checking will not be practical and will cause delays at the toll gates, it will be recommended to check only the large vehicles suspected to be overloaded. In this regard, using the weigh-in-motion (WIM) system will be the best alternative. By the WIM system all large vehicle will be subjected for checking. Only, the suspected overloaded vehicle based on the results of the WIM will be instructed to forward to the truck scale. Cell of WIM is shown below.



Weigh-in-Motion (WIM)

Sign Boards

Road sign is device to convey message for road users by words and symbols. The sign consists of regulatory signs, warning signs and guiding signs. The functions of those signs are:

- Regulatory signs: to give notice of traffic laws or regulations,
- Warning signs: to give notice of situation that might not be readily apparent,
- Guide signs: to show route designations, destinations, directions, distance, service, points of interest, and other geographical, recreational, or cultural information.

Installation of those signs usually follows installation manual of signs and markings of the country. If such manual is insufficient, Manual on

Uniform Traffic Control Devices (MUTCD by Federal Highway Administration, USA) can be good reference.

- Variable Message sign

Variable message signs are used to inform drivers of regulation or instructions that are applicable only during certain periods of the day or under certain traffic conditions. The need for and use of variable message signs have increased considerably over the past several years.

These variable message signs, which can be changed manually, by remote control, or by automatic control that can detect the conditions that require special sign message, have applications in each of the functional usage classification.

Sign Boards

Mini-Parking Spaces and Mini Way

Parking areas and other facilities on expressway are provided in Japan. The parking areas are equipped with road information terminals, restaurants, vending machines, public telephones and other facilities. Extra spaces on expressways have been used in Japanese expressway to create mini-parking spaces. At mini-parking spaces restrooms and public phones are installed. To keep roads in sound condition, ongoing maintenance work and inspection are required. As repair work can create traffic jams, one of a useful measure adopted in Japan (Hanshin) is a Mini Way that can provided a temporary overpass for through traffic, and maintenance works can be taken place underneath.

Mini Way

Intelligent Traffic System (ITS)

ITS is initialized to have the function of:

(i) Alleviation of traffic congestion
(ii) Improvement of traffic safety
(iii) Environmentally friend transport system
(iv) Reduction of CO_2 emission by saving fuel consumption
(v) Efficient freight distribution
(vi) Improving the quality of life.

ITS was promoted as a national project in European countries, USA and Japan in middle of 1990. Those areas that can be applied in Egypt in relation of feasibility study of expressway (support for public transport and commercial vehicle, etc. are omitted) would be:

- Electronic Toll Collection System (ETC)

This area further divided into:

- Electronic toll collection on toll road
- Electronic charge of fare collection of parking lot, ferry and others

Unification of devices to be used every toll road with one OBU in the Country to be introduced.

- Optimization of traffic management

This area further divided into

- Assistance for traffic management planning
- Assistance for traffic management

Wider area of traffic control optimization need intensive traffic data, in ordinary street. For expressway, as proposed traffic data collection devices are rather densely installed, traffic prediction system will predict traffic situation all over the extension of expressway, and suggest appropriate measures to be taken for the adversely affected sections.

- Increasing efficiency in road management

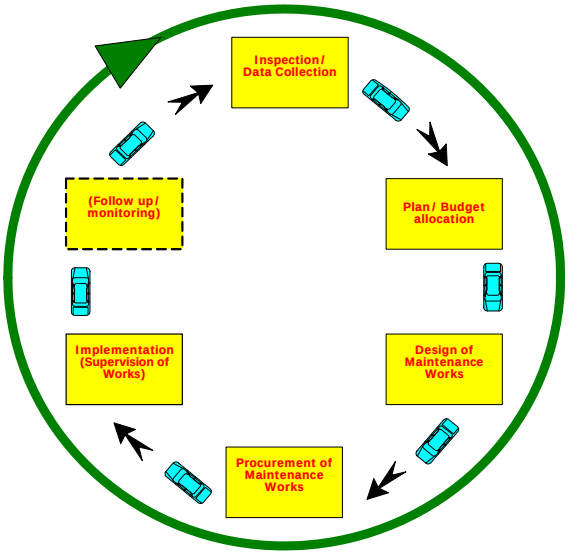
In order to increase efficiency of road management, asset management technology is applied to road facility management field. It needs intensive and precise data-base of road facility as structure, foundation and pavement. As first step, construction of these database of the objective expressway is crucial work to be undertaken.

10 MAINTENANCE SYSTEM

Maintenance works for toll expressways are basically same to those for ordinary, non-toll highways. However, higher level of works is required because of the high travel speed of the vehicles and the expectation of the road users for "return for the toll".

Cycle of Procedures and Types of Maintenance Works

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.

Inspection

Basic objective of inspection is to find out defects of road facilities and take necessary actions. This includes finding out the signs of future defects which are often found well before the actual defects occur. Inspection is often categorized into the following three kinds:

(i) Routine inspection
(ii) Periodic inspection
(iii) Emergency inspection

Procurement of Maintenance Works

Maintenance works for a toll expressway is usually contracted out. Force account is rarely adopted because it is not economically efficient. The following types of contract are often adopted.

(i) Routine maintenance
- Long-term contract with contract period 1 -3 years
- Unit rate of each work item is agreed in the contract, and payment is made based on the quantities of the works actually implemented.

(ii) Periodic maintenance
- Ordinary contract of civil works
- Contract packages are designed considering types of works, location and traffic regulation

(iii) Emergency maintenance
- Special form of contract, such as direct appointment, to urgently start necessary works.
- It is often effective to establish a system where by equipment and labour force of private contractor can be mobilized quickly when emergency occurs.

Performance Based Contract

In recent years, a new type of road maintenance contract called "Performance Based Contract" (PBC) is being adopted in some countries. (In UK, PBC has been used for more than 10 years.) In this type of contract, only the results, or "the performance" of the maintenance works is stipulated and the methodologies involved are left to the option of the contractor.

The expected advantage of PBC is that the know-how possessed by the contractor is fully utilized resulting in the cost reduction.

Maintenance Planning

As discussed in the preceding sections, maintenance of the expressways involves road inspection, cleaning, and minor repairs as daily work for preserving road functions and periodic maintenance works such as painting and reinforcing bridges, repairing/rehabilitating

pavements. An efficient and systematic maintenance work plan can be drawn out based on the frequency of activities required because they are usually performed on a regular time cycle depending on the type of work item. Thus, the budget for the maintenance works needs to be incorporated in the business operation plan of the expressway.

Traffic Regulation for Maintenance Works

As stated above, many of the maintenance works are executed on the carriageway and need some kind of traffic regulation. Such traffic regulation needs to be carefully designed to avoid any hazardous situation and to minimize the disturbance to the traffic.

Strengthening and Upgrading

The works included in this category are to increase or improve the function(s) of the existing expressway to cope with the change in the environment of the expressway.

These works are usually not foreseen at the time of planning or designing. The followings are some examples of such types of works:

- Strengthening of the structure to cope with the increase of vehicle weight (change in vehicle regulation).
- Installation of noise barrier needed to cope with the change in the roadside land use.
- Alteration from ordinary asphalt concrete (AC) surface to permeable, low-noise AC surface.

These works are similar with large-scale rehabilitation works from the viewpoint of the methodologies of planning, design and execution. Therefore, these works are usually planned together with the maintenance works. However, necessities for these works do not occur regularly or in a foreseeable manner, and thus, these works have to be planned on ad-hoc basis as the necessities arise. Accordingly, these works cannot be incorporated in the general program of toll road network development.

Asset Management

In the recent years, the viewpoint of "asset management" is emphasized in the maintenance planning of roads. As mentioned earlier, maintenance can be interpreted as the actions to preserve the functions or values of the road facilities. Construction of roads and especially that of expressways needs to huge amount of investment. On the other hand, little attention has been paid to the importance of maintenance and there are many cases where the road infrastructure suffered from deterioration caused by poor maintenance. Maintenance works implemented at appropriate timings allows the preservation of function/value of the road facilities with the minimum total expenditure.

To establish an adequate asset management system, the operator must have a sophisticated inventory system. Basic Data such as road name, road sections, nodes and location reference points should be designed to allow importing of such database items as inventory elements, and condition survey data.

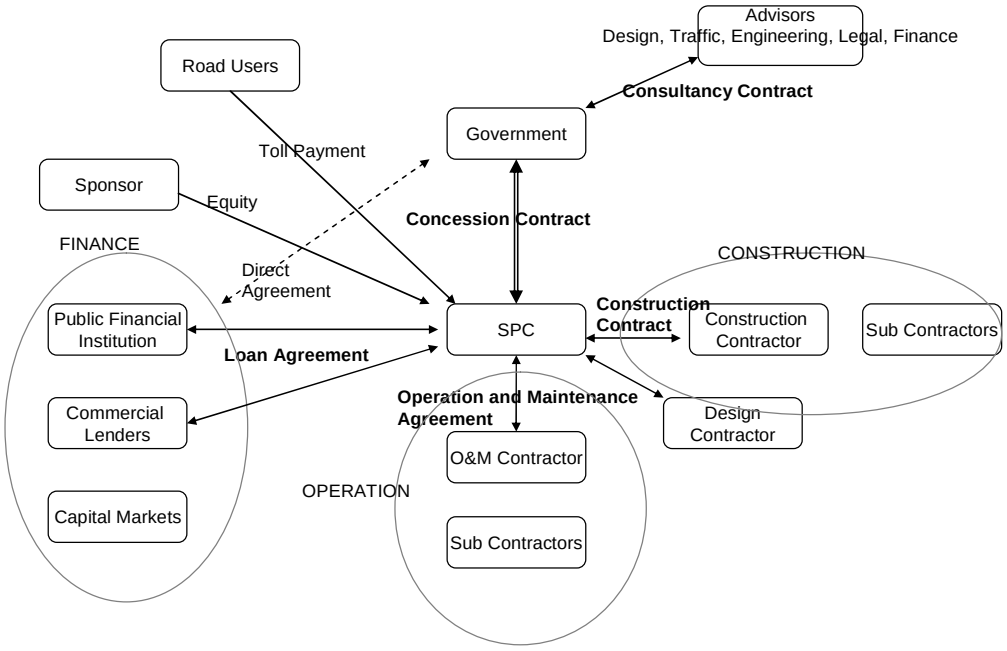
11 TOLL EXPRESSWAY LEGISLATION

Necessary Factors for Success of PPP

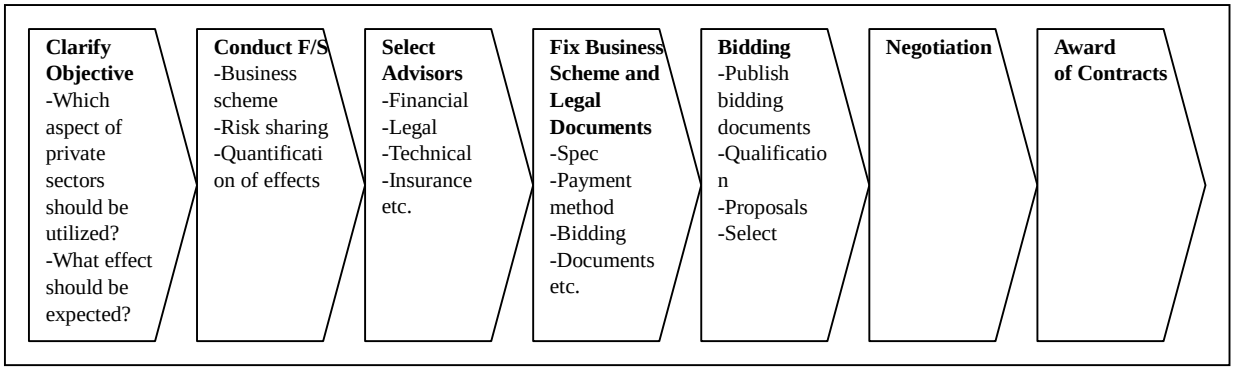
- On PPP structure, the private sector is in charge of design, construction, operation, maintenance, and management of public facilities. The public sector will have agreements with the private sector on service provisions and the private sector will allocate all the risks to consortium members who would 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.

General Guiding Principles for A Constitutional and Legislative Framework

- Transparency. A transparent legal framework is characterized by clear and readily accessible rules and by efficient procedures for their application. Transparent laws and administrative procedures create predictability, enabling potential investors to estimate the costs and risks of their investment and thus to offer their most advantageous terms.
- Fairness. A fair legal framework takes into account the various interests of the Government, the public service providers and their customers and seeks to achieve an equitable balance between them. The private sector's business considerations, the users' right to adequate services, both in terms of quality and price, the Government's responsibility for ensuring the continuous provision of essential services and its role in promoting national infrastructure development are but a few of the interests that deserve appropriate recognition in the law
- Long-Term Sustainability. The long-term provision of public services, with increasing attention being paid to environmental sustainability will need to be assured. It is important to ensure that the public sector has the institutional capacity to undertake the various tasks entrusted to entities involved in infrastructure projects throughout their phases of implementation.



ILLUSTRATIVE PPP PROCESS



WORK AND RISK SHARING IN THE PROJECT AGREEMENT

Proposed work sharing

◎: Main, △: Sub Transferred to the private

Work sharing		Current framework		Proposed PPP framework		
		GOE	Private	GOE	MEA	Private
Planning & Regulating	Establishing institutional framework	◎		◎	△	
	Overall planning	◎		△	◎	
Owning assets, Financing & Land acquisition	Financing	◎		△ (Subsidy)	◎	△ (Borrowing)
	Negotiation and monitoring private sector	◎			◎	
	Land acquisition	◎		△	◎	
Design, Construction & Upgrading	Design approval & Construction management	◎			△ (early stage)	◎
	Design & construction work		◎			◎
	Upgrading & rehabilitation management	◎			◎	
	Upgrading & rehabilitation work		◎			◎
Traffic Management & Maintenance	Traffic management	◎		△	◎	△
	Maintenance work		◎			◎
	Clearance of traffic accident	◎				◎
	Maintenance management	◎			△ (early stage)	◎
Toll collection		◎			△ (early stage)	◎

Proposed risk sharing

◎: Main, △: Sub Transferred to the private

Risk sharing	Current framework		Proposed PPP framework			
	GOE	Private	GOE	MEA	Private	Users
Political risk	◎		◎			
Legislative and regulatory risk	◎		◎	△		
Overall planning risk	◎		△	◎		
Force majeure	◎		◎	△		
Environmental risk	◎			◎	△	
Interest rate risk	◎			◎	△	
Devaluation and currency risk	◎		◎	△		
Inflation risk	◎			△	△	◎
Financing risk	◎		△	◎	△	
Design and construction risk	◎	△			◎	
Land acquisition risk	◎			◎		
Traffic demand and toll revenue risk	◎		△	◎	△	
Operational risk (MEA's responsibility)	◎			◎		
Operational risk (Private sector's responsibility)		◎			◎	

12 ENVIRONMENTAL AND SOCIAL CONSIDERATION

GeneralL

- This section summarizes results of Environmental and Social Considerations implemented for the Feasibility Study on High Priority Urban Toll Expressways in Cairo in accordance with Egyptian Guidelines for Environmental Impact Assessment and Japan International Guidelines for Environmental and Social Considerations.
- There is uncountable number of positive environmental impacts induced by the project. However there are some adverse impacts such as pollution of air, water, noise/vibration, loss of beautiful/important landscapes and social issues including dislocation of settlements and losses in economic activities. These adverse impacts shall be properly mitigated.
- Total length of study routes is about 14km in F/S section while it is about12km in Pre F/S sections.

Pre-EIA Activities

- As pre-EIA activities following were made:
  - Site reconnaissance, meeting with key persons and data collection
  - Monitoring of air pollutions, noise and vibrations were made at typical five locations for 24 hours
  - Above monitoring consists of measurements at foreground and background.
  - Monitoring of same item as above, but for one location for 1 weak.
  - In addition, other monitoring was made to know the effect of buildings and viaduct to concentration of air pollution and noise.
  - Prediction of air pollutions and noise in 2017 and 2027 were made to estimate the impact by the project at 5 sections consisting of E1-2, E2-2, E3-1, E3-2 and E3-3.
  - Social survey also was made to know the perception of the people about the project.
- As results, followings were revealed:
  - Air pollutions including PM10, CO, SO2, NO2 and O3 monitored near the study routes in November 2007 to March 2008 were within the allowable environmental limits
  - Noise levels monitored at the same locations were out of allowable limits in front of the study routes while they are a little less than that at background.
  - Air pollutions predicted for the both cases when project was implemented and not implemented, in 2017 and 2027 respectively, are within the allowable limits as well.
  - Noise levels, predicted in same traffic conditions as air pollutions, were always beyond the allowable environmental limits.
  - Air pollutions become worse at the same height of floors where viaduct is situated.
  - Noise levels reduce with height if the viaduct is there.

TOR approved for EIA

- Based on the results of Pre-EIA activities, Egyptian Environmental Guidelines and international rules of donors, TORs approved by the 1st stakeholders meeting are:
  - Traffic Congestion
  - Air Pollution
  - Water Contamination
  - Offensive Odor
  - Noise and Vibration
  - Resettlement
  - Local Economy
  - Unity of Community
  - Social Services and Facilities
  - Poor and Vulnerable
  - Confrontation between Benefited and Not Benefited
  - Gender
  - Right of Children
  - Landscape
  - Privacy of Residents near Proposed Viaduct

Public Participation

- Following public participation was made to disclose the project and obtain opinions from stakeholders/public
  - 3 times of stakeholders meetings with more than 100 peoples respectively
  - 2,000 interviews were implemented
  - 50 group discussion were held
  - 5 open houses were made
  - Web-site was set-up

Alternative Study

- Optimal infrastructure development and management was studied in Transportation Master Plan and Feasibility Study (CREATS) and Alternative "Optimal Core Network" has been chosen because of economical efficiency, equitable peoples' mobility and less CO2 emission.
- In each section, alternative routes were studied and chosen based on length, configuration, geometric, possibility of private land acquisition, community accessibility, traffic diversion, presence of public utilities, environmental impact, presence of other infrastructures and, among all, the opinion of the residents who be relocated.

Traffic Congestion

- Present traffic congestion in GCR is the greatest environmental issue. This situation is considered to be moderately improved by the implementation of the project. However, further congestion may be caused at the construction stage if not properly mitigated. To solve this, proper detour planning and control during construction and awareness raising campaign shall be undetareen.

Air pollution

- Present conditions of air pollution are:
  - SO2, CO, NO2, and O3 are within allowable environmental limits respectively at least for these years
  - PM10 had been higher than the allowable limit set for 1 year average. However it has become within permissible range according to most updated monitoring results
- Ministry of Environment is primary agency for planning while ministry of interior related for supervising vehicles' emission. Followings are being implemented to reduce Air Pollution:
  - Provision of Unleaded Gasoline:
  - Use of Clean Natural Gas (CNG)
  - Vehicle Emission Testing
  - Replacement of old taxis with new ones operated with CNG
  - Limiting Motorcycle Emission.
  - Monitoring of Air Pollution and Early Warning System.
  - Awareness promotion campaign not to carry out open burning of agricultural waste is being implemented and emissions from factories are also being controlled.
- Proposed Environmental Target
  - Primarily, the environmental standard shall be fulfilled during construction and while operation respectively and secondly, the conditions of air pollution shall not be worsened by the construction of expressways at operation stage in average.
  - During construction, effort is required to reduce the emission level of pollutants through proper environmental management plan.
  - At the time of operation, it is proposed to monitor the PM2.5 at traffic congested areas

Vibration

- There had been no vibration measurement taken before since there is no vibration standard. No people raised the vibration as present environmental issues. However, the importance of vibration's impact to environments and human health is being recognized and the environmental standard for vibration is being established. Study team implemented the vibration measurement.
  - The results of vibration levels monitored were a little less than 70 dB(A) which is

equivalent to the recommended vibration level in the maximum caused by the traffic, and are not so serious level.
  - In the operation stage in the future, no big vibration can be expected since number of heavy vehicles traveling in Cairo is very small (1% only) and the ground is quite firm.
- Nevertheless, for the purpose to improve present condition further more, cares should be taken not to cause unnecessary vibration during construction.

Water Contamination

- Regarding Nile River water quality, the concentration of ammonia (NH3) is higher than the environmental limit, origin of which can be human activities. PCB has been detected with quite high level. The major issues of irrigation canal water are (1) increase salinity, (2) deterioration of quality due to fertilizers and pesticides and (3) eutrophication of water bodies due to an increase in nutrients from fertilization. As for groundwater, there are two issues such as (1) contamination by leaking from sewage (coliform) and irrigation water with high fertilizer (nitrogen-oxides) and (2) excessive exploitation.
- The institutions involved with water quality management in Egypt are generally line-management ministries with responsibilities in areas that are related to, but not necessarily coincident with environmental protection. A legal basis for controlling water pollution exists through a number of laws and decrees such as Law 4/1994 which mandates that the EEAA is the responsible agency to preparing laws and legislations, Law 48 of 1982 deals with discharges to water bodies and so on. Many efforts are being made by various agencies to improve and monitor the water quality.
- An environmental target is to fulfill the guidelines set for drinking water. For this, proper environmental management plan shall be prepared and strictly followed during construction. While operation no water pollution is assumed.

Waste

- It is estimated that huge volume of construction waste, while tunneling and demolishing existing structures, will be generated during construction and they shall be proper treated, recycled, and dumped in accordance proper planning beforehand.

Cultural Heritage

- Whole city Cairo is appointed as the world heritage by UNESCO. Among them there are two cultural protected areas as:
  - Historic Cairo (ancient to medieval monuments protection area)
  - Khedivain Cairo (modern building protection area)
- It is forbidden to demolish historic heritage by law. It should not touch any structures appointed in these protected area above as the environmental target of this study. Close to study route, there are two important items;
  - Citadel in Historic Cairo
  - Buildings in Khevian Area
- Citadel was erected on the firm limestone hill and no impact is considered during construction. The ramp to E2-2 is to be located at the corner of Khevian Area. The study examined and confirmed the potential of liquefaction of the underlying ground below these old building so that they are not affected during construction as a conclusion.
- Regarding the underground heritages, there is no confirmed information so far. It is necessary to let an archaeologist to witness excavation work to stop excavations, in case of new heritages or any archeological items were found.

Landscape

- Not to block the landscape followings are proposed:
  - Depression/tunneling method has been chosen for Unknown Soldiers' Monument.

- Height of viaduct around Citadel has been suppressed not to affect the Citadel landscape
- The viaduct is to be constructed in Kevian Protection Area. The study investigated these impacts through montage photos and it has been concluded that the impact is not singnificant.

- Some people expressed their fear that their privacy of life can be invaded if vehicle drivers passing over the new viaduct and may peep into their room inside. For this mitigation measures, construction of noise barriers of non-transparent type on the deck is studied.

Safety and Health

- Proper safety and hygiene plans shall be prepared for workers and local people surrounding.
- To prevent offensive odor, incineration of waste in the construction site shall be prohibited, and food residues and toilet of camp shall be properly controlled.

Socially Sensitive Facilities

- Distribution and type of socially sensitive facilities, such as schools and hospitals located within 100 meters from the study routes are identified. Presently, there is no environmental standard to protect above facilities in Egypt. All of these facilities require the peace and quiet. Following are recommended:
  - Operation of heavy equipment near these facilities shall be minimized.
  - Diversion route, construction office and workers' camp are to be situated not too close to them.
  - Installation of noise barrier and other mitigation measures.
  - Monitoring of noise and air pollution is implemented periodically.

Preliminary Environmental Management Plan

- Basically, proper detailed environmental management plan shall be established after the details of construction area, method and procedures have been clarified at the detailed designing stage.

Global Warming

- The study estimated the change of global warming gas in case project is implemented (With) and in case not implemented (Without) in 2017 and 2027 respectively along the study routes. As the results, the global warming gas decrease 60,000 ～70,000 ton/year
- Further reduction can be expected in case total network in GCR is taken into account

Description of Social Study Site

- Social impact survey was implemented for 6 areas where poor vulnerable people are concentrated.

Major Social Impact

- The resettlement/land acquisition and other social impact possibly caused are summarized as below:
  - Dislocation of 100 households (informal settlers) inside government land in E1-2 Section
  - Temporary business losses for vendors and shopkeepers in E2-2 area during construction
  - Acquisition of private land (vacant presently) of about 1 ha.

Socio-economic Studies

- About half of the sample gets between L.E. 500 and L.E. 1,000 per month.
  That indicate the samples are poor, with half of average income of Cairo citizens.
  - As a total, 54.9% are with the project while 27.6 % are against the project. The rest 17.5% is in neutral position.
  - As positive impacts, interviewees believes that the project might (1)save time, (2) reduce traffic congestion and (3)alleviate the over concentration of downtown.
  - As a negative impact they fear (1) land acquisition, (2) congestion during construction and (3) reduction of sales due

to access problem during construction

- Strategies to change negative perceptions are (1) awareness raising through media, (2) to make the toll fees cheap and (3)appropriate compensation for affected people.

Legal Framework

- The Egyptian laws have following problems under the light of international donors' safeguard guidelines:
  - Compensation is not paid until the affected people are moved/displaced.
  - Compensation is traditionally below market value due to a lack of experience on property appraisal, absence of real market rate, and exaggeration of property value by its owner.
  - Basically, informal settlers are not compensated.
  - The vendors and illegal salespeople do not receive any compensation.
  - Same amount of compensation is made regardless in old housing law or new housing law.
  - Affected people do not have access to full information about the resettlement process and options for compensation.
  - It is not accepted to object the alternative residence provided, except for very minor thing.
  - Participatory planning and decision-making is not applicable in resettlement options and compensation.
  - Disputes may take years to be resolved and only the rich can endure and win.
  - No allowance is provided
  - No support for vulnerable people.

Institutional Framework

The executing body is GARBLT and GARBLT would be responsible for compensation payments to PAPs through the implementation authority, offering alternative resettlement options, and implementing the resettlement activity. The proposed authority is Resettlement Committee that would be responsible for the implementation of resettlement activities. RC shall be sub-divided as:

- Valuation subcommittee for assets,
- Administrative auditing subcommittee that is responsible for revising all paperwork as well as monitor,
- Regulatory and religious for consultation about laws and to check if compensation is abiding law and
- Community support subcommittee. NGOs are essential to support the people.

Resettlement Action Plan

- All of followings are critically important for proper implementation of resettlement.
  - Information dissemination
  - Perception-socio-economic survey
  - Evaluation of assets as market price
  - Consultation throughout resettlement activities
  - Grievance redressing mechanism
  - External monitoring
  - Proper compensation policy including special support to vulnerable groups.

Other Social Issues Highlighted

- Children, Vendors and Poor People are classified as vulnerable group and special care shall be taken for them.
- Gender is the quite critical issues in Cairo. Households headed by female are much older than those of male and the monthly income of female householders is quite less compared to that of male. In these unfavorable situations for directly affected female headed households, they shall be supported with further assistances than male headed household.
- Conflict may be caused if the value of properties along the study routes has sharply been raised up by the implementation of the project. GARBLT is responsible for direct impacts only and such indirect impacts are covered by whole of government.
- Local economic condition of overall GCR will be activated by the project.

13 PRELIMINARY COST ESTIMATION

CONSTRUCTION COST

Any construction cost is comprised of two components, viz. direct and indirect costs.

Dependable prices of basic commodities that can be used for construction unit cost are not available in Egypt as prices increase by 2~10% every year because of inflation.

The data has been gathered by sending out questionnaires to local contractors and consultants through GARBLT. Data on Previous projects have also been gathered and converted to the current unit costs considering the escalation rate. The data on similar projects in the other countries have likewise been gathered and converted to Egyptian Pound using appropriate exchange rate. The adequate unit costs for each pay item are adopted after comparison of gathered data.

Unit costs for pay items which are not available have been estimated based on the Construction Cost Estimation Standard Book (Ministry of Land and Transportation, Japan).

SUMMARY OF CONSTRUCTION COST

As of Jun 08

Section		Length	Foreign Currency	Local Currency	Tax	Total	Remarks
FS Section (E1-2, E2-2, E3-1)							
A	E1-2	5,430 m	915,903	1,334,526	397,489	2,647,918	Shield Tunnel, Box Tunnel Single Deck Steel Girder and PC Girder Viaduct
	E2-2	1,880 m	92,505	178,659	46,047	317,211	Double Deck Steel Pier and Steel Girder Viaduct Maspero Station
	E3-1	5,700 m	711,939	1,259,620	334,364	2,305,923	Cut & Cover Box Tunnel Single Deck PC Girder Viaduct
	Sub Total	13,010 m	1,720,347	2,772,805	777,900	5,271,052	
B	**Engineering Cost** (A x 5%)		184,487	52,711	26,355	263,553	
C	**Contingency** (A+B) x 5%		95,242	141,276	40,213	276,730	
Total (FS Section)			**2,000,076**	**2,966,791**	**844,468**	**5,811,335**	
Pre-FS Section (E3-2, E3-3)							
D	E3-2	6,900 m	469,551	833,941	225,368	1,528,860	Cut & Cover Box Tunnel Single Deck Steel Girder and PC Girder Viaduct
	E3-3	5,500 m	715,605	848,236	289,299	1,853,140	Double Deck Steel Girder Viaduct Cable Stayed Bridge over the Nile
	Sub Total	**12,400 m**	**1,185,156**	**1,682,177**	**514,667**	**3,382,000**	
E	**Engineering Cost** (A x 5%)		**118,370**	**33,820**	**16,910**	**169,100**	
F	**Contingency** (A+B) x 5%		**65,176**	**85,800**	**26,579**	**177,555**	
Total (Pre-FS Section)			**1,368,702**	**1,801,797**	**558,156**	**3,728,655**	
TOTAL (FS & Pre-FS Section)			**3,368,778**	**4,768,588**	**1,402,624**	**9,539,990**	

(Unit : 1,000 LE)

TRAFFIC INFORMATION AND TOLL COLLECTION SYSTEMS COST

The Traffic Information and Toll Collection Systems shall cover the entire expressway network in Cairo. These are integrated systems consisting of several subsystems with different functions which vary from basic and simple to the most advanced and sophisticated ones.

COST OF TRAFFIC INFORMATION AND COLLECTION SYSTEMS

Item		Unit	Unit Rate	Component			Quan-tity	Cost			
				Foreign	Local	Tax		Foreign	Local	Tax	Total
1. Cost of Traffic Information System											
1-1	Vehicle Detector Ensing Head	no	5	90	0	10	838	3,771	0	419	4,190
	Vehicle Detector Computing Unit	no	400	90	0	10	112	40,320	0	4,480	44,800
	Vehicle Detector data concentrator (Center)	no	2,050	90	0	10	1	1,845	0	205	2,050
	Installation Cost (Gantry)	no	125	47	36	17	112	6,580	5,040	2,380	14,000
	Sub Total							**52,516**	**5,040**	**7,484**	**65040**
1-2	CCTV Camera,Road side Equipment	no	220	90	0	10	44	8,712	0	968	9,680
	Camera Control(Center)	no	4,750	90	0	10	1	4,275	0	475	4,750
	Monitor	no	150	90	0	10	1	135	0	15	150
	Installation Cost (Pole)	no	50	47	36	17	44	1,034	792	374	2,200
	Sub Total							**14,156**	**792**	**1,832**	**16780**
1-3	Variable Message Sign（VMS）	no	2,000	90	0	10	10	18,000	0	2,000	20,000
	VMS Control（Center)	no	1,750	90	0	10	1	1,575	0	175	1,750
	Installation VMS (Gantry)	no	150	47	36	17	10	705	540	255	1,500
	Sub Total							**20,280**	**540**	**2,430**	**23,250**
1-4	Fiber Optic Cable Network	km	500	90	0	10	84	37,800	0	4,200	42,000
	Key Station（Center)	no	1,750	90	0	10	1	1,575	0	175	1,750
	Fiber Optic Cable (42km*2)	km	100	90	0	10	84	7,560	0	840	8,400
	Sub Total							**46,935**	**0**	**5,215**	**52,150**
1-5	Emergency Telephone	no	50	90	0	10	84	3,780	0	420	4,200
	Automatic Changer（Center)	no	1,500	90	0	10	1	1,350	0	150	1,500
	Console（Center)	no	750	90	0	10	1	675	0	75	750
	Sub Total							**5,805**	**0**	**645**	**6,450**
1-6	TIS Center System	no	36,500	90	0	10	1	32,850	0	3,650	36,500
	Installation	no	1,000	47	36	17	1	470	360	170	1,000
	Sub Total							**33,320**	**360**	**3,820**	**37,500**
2. Cost of Electronic Toll Collection											
	Roadside Equipment	no	1,000	90	0	10	16	14,400	0	1,600	16,000
	Operation Center	no	15,000	90	0	10	1	13,500	0	1,500	15,000
	Installation	no	500	47	36	17	16	3,760	2,880	1,360	8,000
	Sub Total							**31,660**	**2,880**	**4,460**	**39,000**
3. Cost of Installation of Fiber Optic Cable											
	Installation of Fiber Optic Cable	km	130	47	36	17	84	5,132	3,931	1,856	10,920
	Sub Total							**5,132**	**3,931**	**1,856**	**10,920**
4. Freight & Inland Transportation			1,500	70	20	10	1	1,050	300	150	1,500
	Sub Total							**1,050**	**300**	**150**	**1,500**
5. Control Center Building		m2	1	29	56	15	1,000	232	448	120	800
	Building Facilities	ls	240	29	56	15	1	70	134	36	240
	Sub Total							**302**	**582**	**156**	**1,040**
6. Toll Booth											
		no	2,500	60	30	10	58	87,000	43,500	14,500	145,000
	Sub Total							**87,000**	**43,500**	**14,500**	**145,000**
	TOTAL							**298,156**	**57,926**	**42,548**	**398,630**

(Unit :1,000 LE)

LAND ACQUISITION COST

As a result of the field study, it is anticipated that portion of land area will required for the right-of-way.

LAND ACQUISITION COST

		Land							
		Government Land			Private Land			Sub Total	
		Area (m2)	Unit Price (LE/m2)	Amount (1,000LE)	Area (m2)	Unit Price (LE/m2)	Amount (1,000LE)	Area (m2)	Amount (1,000LE)
E1-2	Near Pedestrian bridge	400		0			0	400	0
	NAT Dormitory	1,500		0			0	1,500	0
E2-2	Ramses			0	800	4,000	3,200	800	3,200
E3-1	Interchange	220,000		0			0	220,000	0
E3-2	Arab contractor			0	9,000	1,000	9,000	9,000	9,000
E3-3	Southern cemetery			0	19,000	1,000	19,000	19,000	19,000
	Giza			0	2,000	4,000	8,000	2,000	8,000
Total		221,900		0	30,800		39,200	252,700	39,200

		Building			Household			Total (1,000LE)
		Area (m2)	Unit Price (LE/m2)	Amount (1,000LE)	House (no)	Unit Price (LE/no)	Amount (1,000LE)	
E1-2	Near Pedestrian bridge	400	300	120	50	60,000	3,000	3,120
	NAT Dormitory			0	50	60,000	3,000	3,000
E2-2	Ramses			0			0	3,200
E3-1	Interchange			0			0	0
E3-2	Arab contractor			0			0	9,000
E3-3	Southern cemetery	19,000	300	5,700	50	60,000	3,000	27,700
	Giza	2,720	300	816			0	8,816
Total		22,120		6,636	150		9,000	54,836

(Unit : 1,000 LE)

OPERATION AND MAINTENANCE COST

The operation of an expressway and the corresponding maintenance works are divided into two items; (1) Expressway Maintenance, and (2) Traffic Management.

ANNUAL COST OF OPERATION AND MAINTENANCE

Item		Foreign	Local	Tax	Total
1	Maintenance Cost	2,400	12,000	1,600	16,000
	Sub Total	2,400	12,000	1,600	16,000
2	Operation Cost				
	Traffic Management	19,019	5,743	2,572	27,334
	Toll Collection Management Office	540	950	90	1,580
	Toll Collector	0	17,971	0	17,971
	Sub Total	19,559	24,664	2,662	46,885
TOTAL		**21,959**	**36,664**	**4,262**	**62,885**

(Unit : 1,000LE/Year)

ANNUAL COST OF TRAFFIC MANAGEMENT

Item		Qty.	Unit Cost	Component			Cost			
				Foreign (%)	Local (%)	Tax (%)	Foreign	Local	Tax	Total
Personnel	General Manager	1	90	0	100	0	0	90	0	90
	Deputy General Manager	2	63	0	100	0	0	126	0	126
	Supervisor	6	45	0	100	0	0	270	0	270
	Operator	15	32.4	0	100	0	0	486	0	486
	Clerk	3	27	0	100	0	0	81	0	81
	Secretary	3	27	0	100	0	0	81	0	81
	Driver	9	18	0	100	0	0	162	0	162
	Janitor	4	13	0	100	0	0	50	0	50
	Sub Total						0	1,346	0	1,346
Purchase & Maintenance for Supply, Utility, Housing Machinery, Car, etc		1	1,500	60	30	10	900	450	150	1,500
Traffic Information System 5 % of Maximum System Cost		1	19,932	75	15	10	14,949	2,990	1,993	19,932
Sub Total							15,849	3,440	2,143	21,432
Overhead 20 %							3,170	957	429	4,556
Total							**19,019**	**5,743**	**2,572**	**27,334**

(Unit :1,000LE/Year)

14 PROJECT IMPLEMENTATION PROGRAM

CONSTRUCTION PLAN

Construction planning for the work will require due consideration of the following:

- Appropriate and well designed traffic management plan to minimize traffic congestion along the existing roads during construction.
- Appropriate construction methodology to minimize impacts on traffic, road user, environment, and public in general.
- Appropriate construction methodology for the limited working space
- Safety of motorists, pedestrians and other road users, protection of existing adjacent structures, i.e., houses and operating railway lines.
- Relocation and protection of overhead and underground utilities.
- Least time consuming construction methodology

Construction Method

The expressway is comprised of the following structural components;

(a) Cut and Cover Tunnel (E1-2, E3-1 and E3-2)
(b) Underground Road Crossing Box Tunnel (E1-2)
(c) Shield Tunnel (E1-2)
(d) Elevated Structure (E 1-2, E2-2, E3-1, E3-2 and E3-3)
(e) Bridge over the Nile (E3-3)

The outline of each component are discussed hereunder.

(a) Cut and Cover Tunnel (E1-2, E3-1 and E3-2)

Execution usually has huge effect on road traffic because of the area that will have to be occupied during construction. To minimize the traffic interruption the PSC Plank Method has been proposed.

After the construction of bored pile curtain wall or diaphragm wall, the PSC Plank will be immediately installed, and then the area can be opened to traffic. Therefore the underground structure can be constructed without traffic interruption.

(b) Underground Road Crossing Box Tunnel (E1-2)

There are various advanced technologies applied in the construction of underground road crossing tunnels in Japan. The Endless Self Advancing Box Tunnel Method and URUP Shield Tunnel Method are introduced herein for construction of the underground road crossing tunnel at E1-2 in front of the Agricultural Museum.

(c) Shield Tunnel (E1-2)

The Shield Tunnel (twin bore) will be adopted along the 2.5km narrow street and existing railway at E1-2. The influence on existing road traffic is extremely small except at the vicinity of vertical shafts. The impacts of noise and vibration will also be confined within this area.

(d) Elevated Structure (E1-2, E2-2, E3-1, E3-2 and E3-3)

Execution usually has large effect on road traffic because of the area that will have to be occupied during construction. To minimize the traffic interruption the following rapid construction methods are proposed:

- Fully fabricated steel pier
- Concrete pier with high-early strength concrete
- Precast concrete pier
- Fully fabricated steel girder
- Precast concrete girder
- Precast concrete deck slab

(e) Bridge over the Nile (E3-3)

For the bridge over the Nile, steel truss bridge, steel arch bridge and cable-stayed bridge were studied and rough cost estimation have been done for each.

The bridge over the Nile will be a landmark of Cairo City. Based on the estimates, construction cost of cable-stayed bridge is reasonable compared to the other types of bridges, and hence is

recommended under this study.

Estimation of Non-Working Day Ratio

An annual rainfall in Cairo is only about 24mm, hence, rainfall will not be considered in the computation of non-working days ratio. A total of five(5) non-working days due to other weather conditions such as sand storm (Hamaseen) has been considered, however.

Total number of Egypt's national holidays for 2008 is 15 and non-working days falling on Friday is 52days. In addition to the above, further reduction in the number of effective working days due to Ramadan shall be considered.

Construction Schedule

The overall construction schedule are presented in Figures 14.1.

Item	1st Year	2nd Year	3rd Year	4th Year	5th Year
(Overall Construction Schedule)					
A. Feasibility Study Sections					
E1-2 Section	━━━	━━━	━━━	━━━	━━
E2-2 Section	━━━	━━━	━━━		
E3-1 Section	━━━	━━━	━━━	━━━	
B. Prefeasibility Study Sections					
E3-2 Section		━━━	━━━	━━━	━━
E3-3 Section		━━━	━━━	━━━	━━━

Traffic Management Plan

E 1-2

During the construction of E1-2 major six (6) traffic movements will be affected as presented in the figure shown hereunder. Based on the results of traffic count surveys the design hour volumes along these six major traffic movements are calculated. The detour plan for each movement is investigated based on the proposed construction plan. The capacities of the selected detour roads are estimated. The existing traffic volumes along the proposed detour roads are obtained based on traffic count survey results or generated by the JICA STRADA Program. The capability of the selected detour roads to accommodated the shifted traffic volumes during construction are assessed based on the calculation of the traffic Volume over Capacity (V/C) ratios. Finally, it can be concluded that the selected detour roads can accommodate the shifted traffic volumes during construction under prohibition of on street parking along the selected roads. It is also recommended that during the detail design stage that further assessment should be undertaken including traffic counting survey along the selected detour roads.

E 2-2

The proposed detour plan during the period of closing the road at Maspero Station is presented hereafter.

However, during detail design stage proposed plan should be reassessed based on actual traffic survey results.

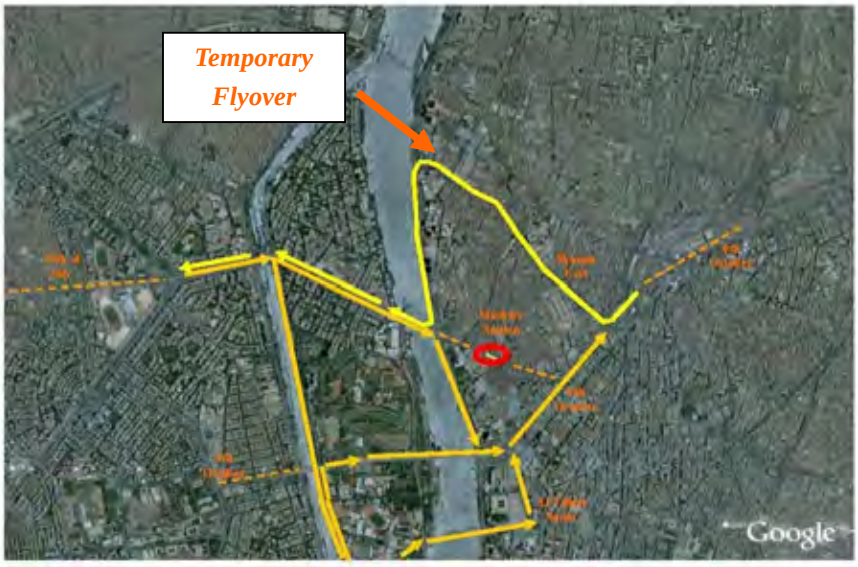
E 3-1

Based on the assessment of the construction plan and construction technique, it can be concluded that traffic flow can be maintain along E 3-1 corridor during the whole period of the construction and only readjustment of accessible traffic lanes based on the progress of construction will be required.

Road	Width (m)	Capacity (PCU/hr)	Diverted Traffic Due to Movement 5	Diverted Traffic Due to Movement 6	Diverted Traffic Due to Movements 1,2,3&4
El Cornich	28	12,000	0	0	919
El Tahrir	30	12,000	687	671	2,802+2,759= 5,561
Wizart Al Zeraah	33	13,500	687	671	1,839+2,011= 3,850
Al Batal Ahmed Abd Al Aziz	33	13,500	0	336	2,758+3,101= 5,859
Al Said Al Ali	16	6,000	686	0	1,090
XYZ	18	7,500	0	336	460
Al Mathaf Al Zirai, (6 Oct.)	12	4,800	1373	1343	0
El Nile	32	13,500	1373	672	4,983+2,758= 7,741

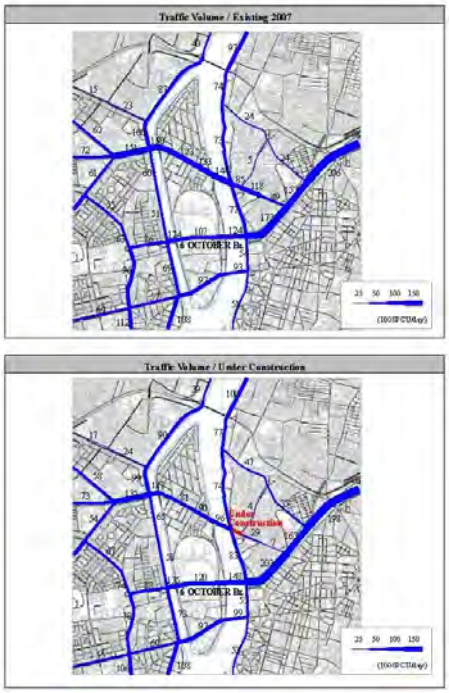
E 1-2 Detour Roads Width, Capacity and Diverted Traffic Volumes (PCU/hr)

Major traffic Movements that will be affected During Construction of E 1 -2



Detour Plan during Construction of Maspero Station (E 2-2)

E 1-2 Existing ADT versus to Under Construction ADT



E 2-2 Existing ADT versus to Under Construction ADT

The figures show the results of the ADT assignment on the concerned area of E 1-2 and E 2-2 under the existing conditions versus to under construction conditions obtained by STRAD Program are presented. As can be expected the parallel bridges (6th of October and El Tahrir) will be subjected to additional traffic volumes.

15 ECONOMIC AND FINANCIAL ANALYSIS

Major Assumptions

- Project Period: 30 years of operation
- With residual value of 25% for main lines (40 years of economic life)
- Demand: Demand forecast between 2008 and 2027 is based on the social and economic framework described in the "The Strategic Urban Development Master Plan Study for Sustainable Development of the Greater Cairo Region in the Arab Republic of Egypt" (Please refer to Chapter 9.).
  Demand after 2028 is assumed to increase to the extent that Capacity/Vehicle ratio at expressway reaches to 1.5 times in 2042.
- Toll Setting: The toll will be charged on the basis of two vehicle sizes (light vehicle and heavy vehicle) at the fixed rate per one-time usage regardless of the distance travelled.
  It is assumed that tolls will increase gradually, by about 1.5 LE every five years, which mostly coincide with increases by assumed inflation up to 2027.

Toll Setting (Unit: LE)

Section	Type	2012	2017	2022	2027	2028-42
New Expressway	L	4	5	6.5	8	8
	H	8	10	13	16	16
Existing Expressway	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

L: Light Vehicle; H: Heavy Vehicle

- Proposed toll level described above is not set out at the level either maximizing the financial returns of the project or enabling cost recovery of the project. It is discussed that the revenue maximizing toll setting will not suitable at this stage, considering the willingness to pay and affordability analyses.
- Project Cost: Project costs in Chapter 13 are used as base costs for the economic and financial analyses, and some adjustments for economic and financial costs are calculated as below.
  - Economic costs = Base costs – transfer items (tax and import duties)
  - Financial costs = Base costs + price contingency + tax
- Discount Rate: 12%
  Cost of capital in the country is assumed as 12%.

Economic Analysis

- Economic analysis uses the following measures: (i) the Economic Internal Rate of Return (EIRR); (ii) benefit cost (B/C) ratio; and (iii) Net Present Value (NPV).
- Cost-benefit analysis compares the benefit and cost under "with" and "without" project.
- Economic Benefits consist of Vehicle Operating Costs (VOC) savings and Travel Time Costs (TTC) savings.
- Economic Costs are converted from financial costs by eliminating price contingency, taxes, and custom duties on imported materials.
- 2 scenarios were tested.
  - Scenario 1: All Toll Case
    A toll is charged on all expressways and Ring Road.
  - Scenario 2: Existing Free Case
    A toll is charged on newly constructed expressways, but existing expressways and Ring Road remains free.

Results under Scenario 2: All Toll Case

	F/S Route	F/S + Pre-F/S Route
EIRR (%)	12.8%	14.0%
B/C (times)	1.1	1.3
NPV(LE in million)	424	1,619

Results under Scenario1: Existing Free Case

	F/S Route	F/S + Pre-F/S Route
EIRR (%)	14.2%	15.8%
B/C (times)	1.3	1.6
NPV (LE in million)	1,072	3,199

B/C (times): Discounted Benefits Divided by discounted Costs for 30 years.

- Project will be considered economically viable under costs of capital of 12%.
- More benefits will be expected under the wider network.
  Results of each route are in the table below.

EIRR and NPV 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

- Economic viability will improve from Scenario 1 due to a higher demand with no toll applied for existing routes.
- More benefits will be expected under the wider network.

Sensitivity Analysis

- Sensitivity analyses were conducted with major risk factors that may affect the results of economic analyses. These factors include cost overruns and lower traffic demand reducing the benefits from travel cost reduction. Summary of the sensitivity analysis is shown in the table below.

Summary of Sensitivity Analysis

		F/S Route		F/S & Pre-F/S Route	
		EIRR(%)	NPV	EIRR(%)	NPV
	Base Case	12.8	424	14.0	1,619
a	Cost +20%	11.6	-249	12.7	701
b	Benefits -20%	11.3	-334	12.4	340
c	a + b	10.1	-1,007	11.2	-765
d	Benefits +20%	14.2	1,182	15.4	3,273
e	a + d	12.8	509	14.0	2,168

(Unit: LE million)

- Under current estimates, cost increase by 20% or demand decrease by 20% will deteriorate economic viability. EIRR will be lower than estimated cost of capital, but still over 10%.

Preliminary Analysis under Whole Network Scenario

- The proposed project, F/S route and Pre-F/S route, is the first step of the network and it only amounts to 25 km in the length which consist of about 30% of the all network proposed at the PPP study. It would be legitimate to assess the proposed project assuming connection to exiting network and a further network will be developed in due course.
- Preliminary result of scenario with whole network development was calculated.
  - Whole Network includes from E1 to E13
  - All expressways are assumed to be tolled
  - Project period is assumed up to 2052
- As the detail information on the technical design of each route is not available, costs are estimated based on the unit costs of F/S and Pre F/S section.
- Economic costs of about LE 30 billion and EIRR of about 18% are estimated.

Financial Analysis

- Financial profitability of the project is assessed with three revenue streams of project toll revenues: revenues from (i) F/S route and/or Pre-F/S route of the New Expressway; (ii) existing expressway; and (iii) Ring Road. Capital costs for upgrading existing expressways and Ring Road are included in the analysis, since the traffic information and toll collection system will be required for toll collection.
- Financial Benefits consist of toll revenue and advertisement revenue.
- Financial Costs include price contingency, taxes, and custom duties on imported materials.

Summary of Project Costs in Nominal Term

	CAPEX a	Foreign b	Local c	b/a (%)	c/a (%)
E1-2	3,755	1,323	1,891	35	50
E2-2	468	154	250	33	53
E3-1	3,276	1,066	1,753	33	54
F/S	7,499	2,543	3,893	34	52
E3-2	2,332	761	1,244	33	53
E3-3	2,773	1,051	1,315	38	47
Pre F/S	5,104	1,812	2,560	35	50
F/S & Pre-F/S	12,603	4,354	6,453	35	51

(Unit: LE million)

- Total costs for F/S route and F/S plus Pre-F/S route amount to about LE 7.5 billion and LE 12.6 billion, respectively.
- Foreign portion will be about 35% of the total costs.

Results by Section

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

- IRR and NPV are less than those of economic analysis due to a gradual increase in toll rates despite high initial capital costs.
- Since the project is the first urban toll expressway, installing toll rates as high as economic benefits is considered not socially acceptable at the initial stage.

Analysis as a Network of Existing Expressways and Ring Road

- Additional costs includes:
  - upgrading costs for toll collection system and traffic information system of existing expressways and Ring Road; and
  - additional operating and maintenance costs.
- Additional benefits include:
  - incremental toll revenue from existing expressways and Ring Road.

Results of FIRR

Section	Base Case Scenario 1	Including Existing Expressway	Including the Ring Road
F/S	4.0%	4.4%	11.6%
F/S & Pre-F/S	3.1%	3.4%	9.1%

- If the network development is evaluated in the wider context with an option to start collecting tolls from the existing expressways and Ring Road, the FIRR will improve significantly.

Financing Plan

- If a project with socially acceptable toll is not able to generate enough cashflow to cover its capital and operating costs, funding gap must be covered by other sources.
- Possible funding source for initial capital expenditure include: general budget; concessional loan; and domestic loan.
- Following assumptions were set out to develop a financing plan.
  - Concessional Loan - An annual ceiling of soft loans for the country is considered to be US$1.2-1.5 billion (or about LE 6.4-8.0 billion) and concessional loans from international financial institutions will be limited to finance a foreign portion.
  - Domestic Loan - Since the project implementation entity has not yet been determined, loan term of 10 years and interest rate of 11% are assumed in the analysis.

Summary of Financing Plan for F/S Route

	Case 1		Case 2		Case 3	
Initial Capital Cost	7.5	100%	7.5	100%	7.5	100%
General Budget	3.7	50%	3.7	50%	3.0	40%
Foreign Loans	2.3	30%	1.9	25%	1.9	25%
Domestic Loans	1.5	20%	1.9	25%	2.6	35%
Additional Loans during Operation	0.9	Up to 2014	1.3	Up to 2015	2.6	Up to 2018

(Unit: LE billion)

- Case 1 and 2 show that decrease in a share of concessional foreign loans of 5% will increase additional borrowing for repayment and interest payment, from 0.9 billion to 1.3 billion.
- Case 2 and 3 show that decrease in general budget amount of 0.7 billion will significantly increase additional borrowing, from 1.3 billion to 2.6 billion.

Summary of Financing Plan for F/S +Pre-F/S Routes

	Case 1		Case 2		Case 3	
Initial Capital Cost	12.6	100%	12.6	100%	12.6	100%
General Budget	5.7	45%	5.0	40%	4.4	35%
Foreign Loans (ex. JBIC)	1.9	15%	1.9	15%	1.9	15%
Foreign Loans (ex. AfDB)	1.9	15%	1.9	15%	1.9	15%
Domestic Loans	3.2	25%	3.9	30%	4.4	35%
Additional Loans during Operation	5.4	Up to 2021	8.5	Up to 2023	12.9	Up to 2025

(Unit: LE billion)

- Financing of initial capital costs of 12.6 billion is a challenge.
- Decrease in general budget amount from 5.7 billion to 4.4 billion will significantly increase in additional borrowing for repayment and interest payment, from 5.4 billion to 12.9 billion.

16 PPP IMPLEMENTATION

PPP Project in Egypt

- Egyptian government implemented 21 projects with the private sector participation according to the Private Participation in Infrastructure (PPI) database (http://ppi.worldbank.org/).
- The projects' contract period ranges between 4 and 50 years, and the sector of projects/type of participation of these projects are summarized in the table below.

Type / Sector	Management / Lease Contract	BROT (Concession)	BOO (Geenfield)	BOT (Greenfield)	Merchant (Greenfield)	Divestiture	Total
Telecom	-	-	2	-	2	2	6
Energy	-	-	-	4	-	-	4
Transport	2	2	-	6	-	-	10
Water and Sewerage	1	-	-	-	-	-	1
Total	3	2	2	10	2	2	21

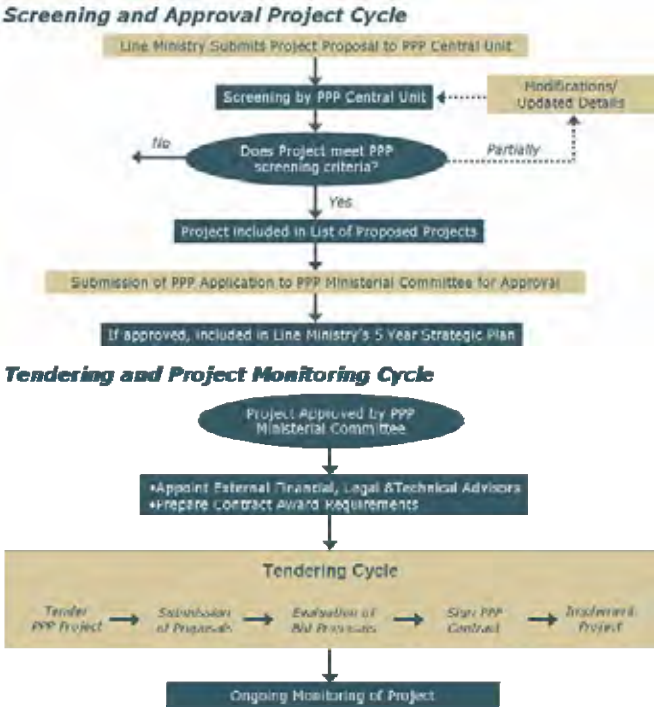
PPI Projects in Road Sector

- Road projects amounting to L.E. 7 billion are planned in the national five-year plan for 2007-2012.
- With these projects, it is expected that roads of 4,138 km, which is 20% of the existing network, will be added to the current network.
- Considering a huge budget required for such investments, several projects are planned to be implemented with private sector participation.
- List of road projects with private players (except this project) is shown in the table.

No	Project Description	Length	Cost
		km	M.L.E
Current Concession Agreements			
1	Cairo – Sokhna	175	350
2	Helwan – Al Korimat	85	300
Ongoing Projects			
1	Cairo - Alex. – Matrouh Roadway	467	1,700
2	Upgrade of Port Saeid – Alexandria Northern Coastal Road	285	1,600
Planned Projects			
1	Shobra - Banha	45	710
2	Toukh - Zaghazeig	45	750
3	Khafr Zayat – Hosh Eisa – Alexandria.	110	750
4	Al Bagour - Defra	40	550
5	Cairo Ring Road	106	1,500
Total		1,358	8,210

PPP Situation

- Legislative aspect: There is a law on BOT , but no PPP Law exists in Egypt. The GOE is currently preparing PPP Law. The draft PPP
- law was prepared, but it has not been implemented yet.
- Institutional aspect: There are two key organizations that are involved in the implementation of PPP projects in the road sector: PPP central unit of MOF and PPP unit of MOT.
- Screening and approval of PPP candidate projects and tendering / project monitoring cycle are shown in the chart below.



Technical Support for the Implementation of PPP

- Two-day seminar titled 'Lecture on PPP for GARBLT' under JICA 'Feasibility Study on High Priority Urban Toll Expressways in

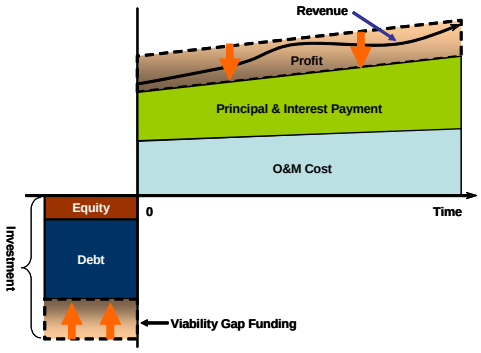
Cairo' was held on 6 & 7 February, 2008 in Cairo.

- It was attended by 8 government officials from various departments in GARBLT such as engineers in road investments, roads, bridge, as well as accountant.
- Most of the participants felt mostly understood the contents for most of the topics. It seems that some attendees had difficulties understanding on Value for Money (VFM) and private players.
- The seminar consists of the following four modules :
  - Module 1: Introduction
  - Module 2:Understanding Private Players
  - Module 3: Risk Control for Transport Specific Topics
  - Module 4: Design Procurement Process and Bid Documents

Measures to Promote Private Sector Participation

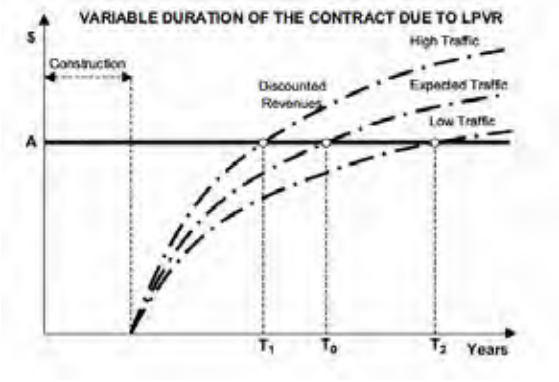
- In order to solve issues such as low tariff and optimistic demand estimates, measures to promote private sector participation including 'viability gap funding' and 'Least Present Value of the Revenues (LPVR)' were discussed with GARBLT staff.

Viability Gap Funding



- As for a tariff level, affordability of general public can not cover the cost recovery tariff of the project.
- This service delivery gap should be covered by some government assistance with justification. The study team suggests that public assistance is not merely a subsidy but also an output based aid or gap funding support (Please refer to the diagram below).

Least Present Value of the Revenues (LPVR)



- Firm that bids the least present value of revenue from tolls (LPVR) wins and the franchise ends when that amount has been collected.

Options of Project Scheme

- Phased approach is recommended to implement PPPs, and possible scenario is described in table below.

Comparison of possible PPP options from PPP Study

	Traditional Procurement	Outsourcing O&M	DBFO
Planning	PUBLIC	High Priority Route	
Land Acquisition			
Finance			
Design	Existing	E1-2	Future Network
Construction	E1-1	E2-2	
Traffic Management	E2-1	E3-1	
Maintenance		PRIVATE	
Toll Collection			

- In the early stage, while GARBLT/MEA will strengthen operational capacity and organization by operating existing E1-1, E-2 and Ring Road, GARBLT/MEA will implement priority routes such as E1-2, E2-2 and E3-1 by itself.
- In later stage, MEA would attract private sector to finance, construct and operate remaining routes (from E4 to E13). Possible three schemes (BOT, DBO and DBFO) will be chosen by GARBLT/MEA based on project economics of planned routes, how much competition would occur, toll system, required level of engineering and so on.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Expressway Project Justification:

- Cairo urgently needs an increase in its road network to accommodate the sharp increase in traffic demand and to alleviate the severe traffic congestions that residents suffer every day. An urban toll expressway with high capacity/lane compared with ordinary roads is the solution that was concluded long time ago with the formulation of CREATS urban transport plan in 2002.
- The realization of Cairo urban toll expressway network has several objectives, including:
  - To provide a high level-of-service alternative to other roads
  - To reduce traffic congestion in Cairo
  - To contribute to the provision of preferable social and urban environment
  - To contribute to the national, regional and urban socioeconomic development
  - To promote planned urban development and new communities
- The early implementation of high priority sections under this feasibility Study is expected to stimulate project benefits. Even with sharp increase in the unit cost of construction materials, the project shows high values of economic parameters, even for the less-demand all-toll case, as follows:

	EIRR	NPV (LE million)
F/S Routes:	14.2%	1,072
F/S + Pre-F/S Routes	15.8%	3,199
Whole Network	18.1%	12,283

Urban Toll Expressway Network Development:

- This Study is a feasibility study on high priority sections; however, with the final target is developing the whole network, prioritization was revised and some modifications were applied based on the ongoing related large-scale projects. E8 has high priority now since it will increase the efficiency of the network, and a connection (E13) between E3-2 with Al-Azhar Tunnel will provide better accessibility to downtown.
- A Feasibility Study on E8 and E13, together with the pre-F/S sections of E3-2 and E3-3 is the highly recommended next step toward optimizing the use of the urban toll network. To keep the project moving with its high momentum and to optimize its benefits this F/S should start as early as possible.

Structural Design Policy:

- Selection of Structure Types to Minimize Construction Period with Rapid Bridge Construction Techniques and Reduce Impact on Traffic During Construction
- Cost Competitive Construction
- Focus on Structure Types that will result in Minimal Maintenance Obligations in the Future
- Pre-cast or prefabricated construction over railway lines
- Foundation Types selected to Minimize Disruption During Construction
- No Detrimental Effect on Existing Structures
- Minimize Expansion Joint and Bridge Bearing Locations
- Clean Structure Lines where possible to Enhance Visual Impact
- The preliminary design is undertaken based on Egyptian standards, supplemented where necessary by AASHTO and Japan Road Association (JRA) standards.

Alignment and Structural Description:

E1-2: This section, with a length of 5.56km, is basically to connect the existing 6th of October elevated road with E11 (Saft El Laban) being constructed by MoH. Five alternatives were investigated based on the geometrical possibilities along this corridor. Based on the comparative analysis and discussions with SC members, a 2 Lane +2 Lane shield tunnel option was selected. It has several advantages such as less utility

relocation, minimum land acquisition, less social and environmental impacts and less landscape disturbance. On the other hand, the construction cost of a shield tunnel is much higher than other elevated options.

E2-2: This section of 1.88km is to provide a facility for the opposite direction (West to East) of traffic in a one-way section between 6th of October and Zamalek Island. This section is basically designed as a double-deck due to the limited width of the at-grade street beneath the existing viaduct. However, another case of a single deck is also included, to be used in case that the government can solve any land acquisition and resettlement issues.

E3-1: This section is located in the most congested areas of Nasr City. It is the long awaited project by residents of Nasr City and new urban communities East of Cairo. It was agreed upon to cancel the viaduct option and go into a cut-and-cover tunnel. The tunnel is accommodating 6 lanes for the two directions, while the at-grade level will keep the present 8 lanes in total. The existing ramps of 6th of October will be extended down to join the tunnel body so the expressway accessibility to the city center will be assured.

E3-2: Under this section of the expressway, the 6 lanes tunnel of E3-1 will be up as a 6-Lane viaduct along the Autostrade. Alignment of this section will pass over the existing railway for which coordination with ENR and MoD is done. Another critical issue is the landscape in front of the Citadel. In this regard, requirement by MoC is justified by maintain the highest level of the expressway lower than the level of Salah Salem road.

E3-3: This section continues from the Citadel Area along Salah Salem, and then it goes over the newly MoH implemented shifted Salah Salem into the cemetery area south of Al Sayeda- Aishaa Over-pass. The 6-Lane single-deck viaduct will be transferred to double deck structure that can pass through the limited width of El Rawdah Street at El-Manyal. It will continue as a double deck structure, and then a double-deck cable-stayed Bridge over the River Nile and Giza square.

Full EIA:

- 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

Physical Environment:

- Improvement in the physical environment of Cairo as a whole is expected. Air Pollution survey results and future predicted results are all within the environmental standard. "With Project" case may give some higher values at particular locations near the expressway.
- Cairo is a noisy city, either with expressway project or without project, noise measurements and prediction values are all higher than standards. Slight improvements are noticed in "With Project" case at higher floor level to be less than 70 dB(A), while at at-grade level in residential areas, it is reduced to less than 60

dB(A).

- Vibration caused during construction can be minimized by selecting proper construction equipments and methods. Vibration caused during operation stage is basically due to the use of improper expansion joints.
- Possibilities of water contamination are only during construction stage, as there will be no water to be contaminated after construction.
- Waste management procedures will be applied during construction for solid and liquid generated waste.
- Traffic detour schemes show no serious impact during construction, when applying rapid construction methods and night-construction techniques. The most critical location comes when extending 6th of October to the tunnel section as several ramps will be out of use.

- Social Environment:
- The basic concept in alignment selection is to minimize any negative social impact. regarding land acquisition or resettlement
- With 3 Stakeholders meetings, 2,000 interviews, 50 Group Discussions, 5 Open Houses installations and website, the project is well disseminated and informed to all involved groups
- Out of the total length of the high priority sections under the Study, about 200m for each of the 3 F/S sections are subject to land acquisition. With a total length of 26.340km for the whole study routes, Land acquisition will be required for only 2.3% of the total length.
- In the EIA, however, another 500m on E2-2 are covered for the case of a single viaduct instead of double-deck. In addition, the EIA covers also the cemetery land that will be used by the Ministry of Housing to shift Salah Salem Street far from the black-spot and heavily populated area of Sayeda Aishaa at E3-2 and E3-3. Adding this area to the EIA is supporting to MoH and can facilitate their plan to shift Salah Salem by the time of constructing the expressway.
- The perception of people to the project is in favor side, except people who may be subject to future allocation (about 100 households' informal dwellers in ENR/NAT land) are the only group opposing the project.
- Cultural heritages will not be touched or affected, and their landscape will not be seriously affected as well.

Project Cost:

- Compared with the cost estimated during the previous PPP Study, the new cost estimation is much higher; partially due to sudden increase in the prices of construction materials; and partially due to changes in the number of lane and design.
- E1-2: was supposed to be 4-L viaduct, but it was changed to a shield tunnel 2L+2L. In addition, the total length increased due to the location and design of E11 (Saft El Laban) as the super-elevation provided for E11 ramps doesn't allow safe connection without extending E1-2 to a section without super-elevation. In future, if this problem can be solved, a shorter E1-2 can be provided.
- E2-2: requires steel sections for a double-deck structure. If the at-grade street can be widened, the construction cost for a single deck structure will be lower; however, the cost of land acquisition and resettlement will be high.
- E3-1: was supposed to be 4-L viaduct, but this option was excluded based on instructions from MoD. A cut-and-cover tunnel (3-L+3-L) becomes standard carriageway width for E3-2 and E3-3 as well. E3-2 will be shifted from Sayeda Aishaa area south to the cemetery where the Ministry of Housing has a plan to shift the alignment of Salah Salem.
- The total cost, which is about LE12 billion is summarized in the next Table for F/S sections and Pre-F/S sections separately.

	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:

- Basically, this Study follows the previous PPP Study that recommended applying toll on all sections of the expressway network including existing elevated roads and the Ring Road.
- A toll adjustment mechanism that considers inflation rates, foreign exchange rates and the transport costs of other modes was established. In addition, the total length of sections under the network was considered in this mechanism.
- In the financial analysis, applied toll values are based on the Willingness-to-Pay survey, as presented in the table below:

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

Financial Evaluation:

- Values of FIRR are far low, as shown below in the case of applying toll on the new sections only. With low toll levels, the revenue is also expected to be low. When adding the high cost required, FIRR is low with negative NPV.

Section	FIRR	NPV (LE million)
F/S Routes	4.0%	-3,346
F/S & Pre-F/S Routes	3.1%	-5,738

- Applying toll on other existing elevated roads (6th of October and 15th of May) improve the performance of FIRR to some extent. When applying toll on the Ring Road as well, higher values of FIRR are determined.

Section	Including Existing Expressways	Including Cairo Ring Road
F/S Routes	4.4%	11.6%
F/S & Pre F/S Routes	3.4%	9.1%

- To increase FIRR to a viable level, that means an increase in the revenue based on a higher toll levels.
- Governmental subsidy in early stages of expressway construction is required in order to keep the toll level affordable. In later stages, the collected revenue can be used in developing the network together with private sector investments.

Recommendations

Political Commitment:

- The authorization of Cairo Urban Toll Expressway Network by the Cabinet is a vital systematic implementation process of the planned expressways as scheduled so that all efforts can be integrated toward the same targets at the optimum timing.
- The Institutional set-up toward the establishment of MEA is a very important issue because building the institutional framework obviously needs huge coordination, negotiation, consultation and documentation with timely decision making. The MEA secretariat should be led by a high ranking official who has sufficient power delegated

from the Minister of Transport with experts of different related fields on full-time basis as a core for future MEA. This Secretariat should be provided with appropriate initial budget that allow it to efficiently handle all the required activities, and to join all future Studies.

- Projects of the Expressway Network should be included in the 5-Year Development Plan to secure required funds and to assure the sustainable development of the network based on the established schedule for the smooth implementation and maximum efficiency.
- Capacity development of MEA is required during different implementation and operation stages on the network. Training of MEA staff on urban expressway issues should be provided on regular basis in such fields of assets management, design management, maintenance management, traffic management and information, toll setting and toll collection systems, PPP structuring schemes, PPP negotiation and contracting, transport economy, financing and accounting.

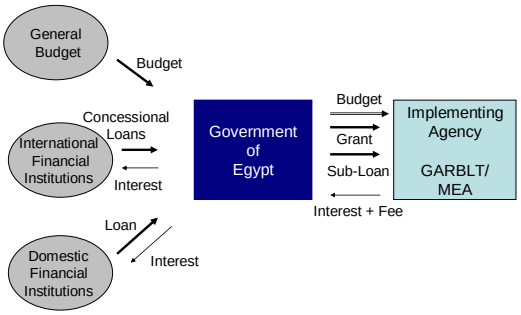
Early Implementation of High Priority Expressways:

- For the sustainable development of the expressway network, it is important to maintain the momentum of this Study and continue in required steps and studies toward the implementation of high priority expressways as scheduled.
- To implement projects as scheduled, feasibility studies and other social and environmental studies should be conducted few years before the project schedule in order to secure required financial resources and to avoid delay.

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

Financing Plan:

- The government will provide an implementing agency with budgets as grants and/or sub-loans to cover the capital investments for the networks. The financing plan is developed in consideration of fiscal constraints for the Government. At the same time, the project shall be reasonably profitable to cover the interest rate in order to assure sustainable financial conditions of an implementing agency. Concessional international loans and Ring Road revenues will be major factors to improve project finances.



Summary of financing plan for F/S route only

	Case 1		Case 2		Case 3	
Initial capital cost	7.5	100%	7.5	100%	7.5	100%
General budget	3.7	50%	3.7	50%	3.0	40%
Foreign loans (ex. JBIC)	2.3	30%	1.9	25%	1.9	25%
Domestic loans	1.5	20%	1.9	25%	2.6	35%
Additional domestic loans during operation	0.9	Up to 2014	1.3	Up to 2015	2.6	Up to 2018

(Unit: LE billion)

Summary of financing plan for F/S and Pre F/S route

	Case 1		Case 2		Case 3	
Initial capital cost	12.6	100%	12.6	100%	12.6	100%
General budget	5.7	45%	5.0	40%	4.4	35%
Foreign loans (ex. JBIC)	1.9	15%	1.9	15%	1.9	15%
Domestic loans	1.9	15%	1.9	15%	1.9	15%
Additional domestic loans during operation	3.2	25%	3.9	30%	4.4	35%

(Unit: LE billion)

PPP Implementation:

- Under current condition, the legislation for the implementation of expressways by GARBLT/MOT is not easy to proceed, although the aforementioned Presidential Decree was issued in April 2007. Before the establishment of MEA, it is necessary to resolve the situation involving different agencies. For this purpose, MOT plans to request the Prime Minister to include the management responsibility of urban network under MOT.
- Phased approach is recommended to implement PPPs. Possible scenario is described in the following Figure.