SMEC DevCon ACE BANGLADESH In association with COWI

# Feasibility Study

## Dhaka - Ashulia Elevated Expressway including 2 separate flyovers at Nabinagar and Chandra

August 2016

# 1. EXECUTIVE SUMMARY

## 1.1. Project Overview and Description

The Dhaka – Ashulia Elevated Expressway Project (DAEEP) is proposed to be an elevated expressway to minimize the existing traffic congestion in the northern part of Dhaka more specifically in and around Dhaka-Ashulia area. The Bangladesh Bridge Authority also envisages that the expressway will be a part of Asian Highway route in Bangladesh and is vital for establishing an improved transport link on the Trans-Asian highways.

The Project (Construction of Dhaka-Ashulia Elevated Expressway) has been in-principle approved by the Cabinet Committee on Economic Affairs (CCEA) on 20 July 2011. A pre-feasibility study was carried out by BUET in 2012 for technical assessment of the project. On 22 January 2015, BBA signed a memorandum of understanding (MoU) with Chinese company China National Machinery IMP. & EXP. Corp. (CMC) to construct the elevated expressway under government to government basis.

The project addressed by this feasibility study is for a 24 km long elevated tolled expressway from just south of the Airport Roundabout to approximately 2 km north of Baipayl. With the exception of the first 4 km where the expressway is following the railway line, the expressway will follow existing main roads so as to minimise land acquisition. An integral part of the project is connection to the now under construction 19.7 km long Dhaka Elevated Expressway Project (DEEP) which will run from immediately south of the airport roundabout to the Dhaka Chittagong Highway at Kutubkhali.

Associated with DAEEP is the upgrading to four lanes of the existing at-grade road between Highway N3 at Abdullahpur and Baipayl.

The project envisages a major toll plaza development on flood-prone land between Dhour and Ashulia.

## 1.2. Surveys

Geotechnical, traffic and topographic surveys were undertaken as part of the feasibility study.

### 1.2.1. Traffic Surveys

An extensive series of classified traffic counts is undertaken regularly by RHD in the vicinity of the project and this data was available to the consultant. To supplement that data, weekday and weekend classified turning movement counts were undertaken at the following intersections

- Baipayl (intersection of N302 and R505)
- Nabinagor
- Chandra (intersection of highway N4 and R505)

## 1.3. Design Criteria

The design criteria used for the preliminary design were set out in the project inception report are the same as used for the Dhaka Elevated Expressway which is now under construction by the Italian Thai Joint Venture. Commonality of design standards is crucial because ultimately the projects will meet just south of the Airport Railway Station and vehicles will be able to travel from one expressway section to the next in making a journey from Ashulia to Mohakhali.

## 1.4. Preliminary Design

Preliminary design of the Dhaka Ashulia Elevated Expressway was undertaken as part of the feasibility study

The proposed route for the Dhaka Ashulia Elevated Expressway follows existing highways and main roads for the most part. The exception is the southern section which follows the railway line from the northern end of the Dhaka Elevated Expressway to just south of the Turag River at Tongi. At that point the elevated expressway turns west and follows Highway N302 / N501 R505 from Abdullahpur to Baipayl. An open tolling system is proposed for DAEEP.

##### *1.4.1.1. Connection to DEEP*

Discussions were held with the DEEP concessionaire regarding the form of structure being used for that project. This was done so that the structures proposed for DAEEP would match aesthetically those of DEEP even if not exactly identical.

##### *1.4.1.2. Crossings of Railway*

The DAEEP will have two crossings of the railway line. The concept design has allowed for the railway to be widened to four tracks by use of portal frames. The concept design allows for BR's required clearance of 11.0 m between rail level and the soffit which is consistent with that used for the contiguous DEEP.

##### *1.4.1.3. Crossing of BRT – Gazipur to Airport Roundabout*

The crossing of the BRT has been examined and it is found that with early design action and coordination with the BRT project, there is potential to reduce the structural depth of the beams crossing the BRT project if a pier can be constructed at the southern end of the Abdullahpur BRT station. That section of the BRT also comes under the Bangladesh Bridge Authority and there is high potential for a shorter span arrangement to be achieved.

##### *1.4.1.4. Toll Plaza / Construction across Turag River Flood Plain*

The preliminary design has been based on the elevated expressway being built on pier foundations across the Turag River flood plain from chainage 10 000 to 13 000. This requirement applies to the toll plaza, associated buildings and the road works for the at-grade road.

### 1.4.2. Connections

The following locations are proposed as connections between the Dhaka Ashulia Elevated Expressway and the adjacent road network. In addition to geometric and weaving considerations, the selection of interchange locations was constrained by the availability of land and the cost of compensation for assets that would have to be removed.

- Dhaka Elevated Expressway
- Abdullahpur
- Baipayl
- Highway N 302 (at-grade road) – Dhour and Ashulia
- Nabinagor
- Chandra

## 1.5. Tolling System

Consideration was given to both open and closed (distanced-based) tolling systems. An open tolling system is recommended for reasons of compatibility with the DEEP and for simplicity. The length of 24 km is similar to that of the 20 km long DEEP. Using an open system means each driver only has one transaction. It would be possible to go to free- flow tolling in future.

Collection of tolls can be electronic or cash with electronic being preferred for reasons of transaction speed and security of the funds received.

### 1.5.1. Number of Toll Booths

Having sufficient toll booths is essential for safe and efficient operation of the expressway. The design number of toll booths is driven by the need to provide sufficient cash lanes for the early years of operation.

## 1.6. Safeguards

### 1.6.1. Initial Environmental Examination

An Initial Environmental Examination (IEE) was prepared for the project. The IEE received in-principle approval at the government's Environmental Clearance Certificate Committee's 399th meeting held from 22 to August 2016 to 4 September 2016.

### 1.6.2. Environmental Impact Assessment

Formal notification Department of the Environment's approval of the terms of reference to be used for preparation of the EIA was issued in a letter from Department of the Environment (DoE) dated 8 September 2016. The Environmental Impact Assessment (EIA) attached as Appendix H has been prepared in accordance with the DoE terms of reference

### 1.6.3. Environmental Management and Monitoring Plan

An outline environmental management and monitoring plan (EMMP) is included in the EIA and is an update of the EMP contained in the initial environmental examination.

### 1.6.4. Consultations

There have been extensive consultations with key project stakeholders in the course of preparing this feasibility study. The most significant of these were:

- **Initial stakeholder consultation** An initial stakeholder consultation was held at the BBA conference room on 9 June 2016
- **Safeguards consultations.** Two community level consultation meetings were held on 30 July 2016; at Vatuliya, Kamarpara and later that day at Ranadola Beribadh. Five focus group discussions were held on 31 July with representative members of groups likely to be affected by the project. These comprise: landowners, business groups, wage labourers, residential land owners and female groups. The meetings were arranged to best suit availability of the local people.

### 1.6.5. Cutoff Date

The census survey was carried out on 23 July 2016 and this should be considered as the cut-off date for the project.

### 1.6.6. Resettlement Action Plan

A resettlement action plan (RAP) has been prepared.

### 1.6.7. Land acquisition

Including the existing highway, a total of 89.1 acres (36.07 ha) of fresh land acquisition is required for construction of the Dhaka Ashulia Elevated Expressway. The total impact on land acquisition compared to the development of this area is minimal and only 374 landowners will lose their land due to the project intervention. According to the census and inventory of losses survey, four main categories of land will be affected, these accounting for over 95% of the affected land *viz* homestead, vita/high land, crop land and commercial use.

| # | Type of Land | Area (acre) | | | | % |
|---|---|---|---|---|---|---|
| | | DNCC | Gazipur Sadar | Savar | Total | |
| A | Homestead | 0.3700 | 1.0395 | 8.7610 | 10.1705 | 17.60 |
| | Vita / High land | 0.5000 | 4.0000 | 4.7045 | 9.2045 | 15.92 |
| | Crop land | 0.5539 | 3.9030 | 10.3129 | 14.7698 | 25.55 |
| | Commercial | 0.4018 | 2.0000 | 16.7979 | 19.1997 | 33.22 |
| | Other | 0.8100 | 0.7330 | 2.9120 | 4.4550 | 7.71 |
| | ***Subtotal (A)*** | 2.6357 | 11.6755 | 43.4883 | 57.7995 | ***100*** |
| B | Existing land for highway | nil | 6.9309 | 22.8065 | 29.7374 | |
| C | Vita/High Land (Others GoB. office) | 1.5767 | nil | nil | 1.5767 | |
| | ***Total A+B+C*** | **4.2124** | **18.6064** | **66.2948** | **89.1136** | |

### 1.6.8. Displacement and Impact of the Project

The census survey showed a total of 1,299 households (5,440 persons) would be affected. The main adverse impacts of the project were loss of land and structures (residential and business premises).

The total estimated cost of implementation of the RAP is BDT20.43 billion which is equivalent to USD261 million.

| Category of losses | DC Budget (BDT) | Additional budget (BDT) | Total Budget (DC plus additional) | | % |
|---|---|---|---|---|---|
| | | | BDT | USD | |
| Total of IOKL including INGO budget | 8,181,215,491 | 12,819,812,009 | 21,001,027,500 | 269,243,942 | 90.2 |
| DC Contingency @ 2% | 163,624,310 | nil | 163,624,310 | 2,097,748 | 0.7 |
| ***Subtotal*** | ***8,344,839,801*** | ***12,819,812,009*** | ***21,164,651,810*** | ***271,341,690*** | ***90.8*** |
| Contingency 10% of the total | 834,483,980 | 1,281,981,201 | 2,116,465,181 | 27,134,169 | 9.1 |
| **Total** | **9,179,323,781** | **14,101,793,209** | **23,281,116,990** | **298,475,859** | **100** |

### 1.6.9. Grievance Redress Mechanism

Grievance redress is a very important part of resettlement project implementation. According to the grievance redress mechanism proposed in the RAP, grievance redress committees (GRCs) will be established at two levels: *viz* union/municipal level and project level

### 1.6.10. Land Acquisition Plans

Land acquisition plans have been prepared based on the concept designs.

## 1.7. Project Cost Estimate

Project costs have been estimated based on a detailed quantity take-off from the feasibility level designs, mostly using the RHD rates schedule (2015). Where there is no rate in the RHD schedule the cost has been estimated based on the Consultant's assessment of market rate for that particular item. The estimates include an allowance of 3% for physical contingency and 6% for price contingency.

| Item | Cost | |
|---|---|---|
| | BDT (million) | USD(million) |
| Four lane elevated expressway (23.971 km) | 60,386.5 | 774.2 |
| Ramps | 1,805.6 | 23.2 |
| Four lane at-grade road (15.28 km widening) plus two 2 lane bridges (2.74 km) | 7,769.0 | 99.6 |
| Toll plazas | 1,403.5 | 18.0 |
| Land acquisition and resettlement (36.07 ha private) including NGO and INGO | 23,281.0 | 298.5 |
| Drainage and duct for utilities | 2,705.2 | 34.7 |
| Four lane Nabinagar flyover with ramp (0.71 km) | 1,279.3 | 16.4 |
| Design | 2,070.4 | 26.5 |
| Construction Supervision | 1,380.3 | 17.7 |
| **TOTAL** | **102,080.8** | **1,308.8** |

## 1.8. Economic Evaluation

The following two alternatives and generated annual cash flows were over a period of 30 years:

- Base Case Alternative: Road user costs along the existing road network being the alternative to the Investment Alternative,
- Investment Alternative: Road user costs on the Dhaka – Ashulia Elevated Expressway and the road sections on N302 being widened from two lanes to four lanes.

### 1.8.1. Data Collection and Assumptions

The data used for the economic evaluation were obtained from various sources including from the bridge and road authorities. More data has been collected from similar studies recently carried out in the Dhaka region. The following inputs were considered for the economic evaluation.

- technical specification for investment and maintenance alternatives
- cost estimates for investments
- cost estimates for maintenance strategies
- vehicle operating costs
- time values for passenger and freight traffic
- vehicle characteristics
- traffic surveys and GDP growth forecasts
- traffic diversion scenarios
- travel speed observations and travel speed design
- accident records
- others including economic development perspectives
- AADT at Sub-sections along the Project Road Alignment (2016)

| | SECTION 1: (Six lanes -4.2 km) Airport - Abdullahpur Junction on R301 | SECTION 2: (Two lanes 5.4 km) Abdullahpur Junc. on N302 to R501 junc. | SECTION 3: (Two- lanes, 12.5 km) Junction N501 on N302 – Baipayl Junction N302/R505 | SECTION 4: (Four lanes, 2.0 km) Baipayl Junc. N302/R505 - Chandra |
|---|---|---|---|---|
| Total vehicular traffic | 29,799 | 10,281 | 16,629 | 27,000 |

### 1.8.2. Willingness to pay and time value

The toll rate as preliminarily determined for the financial analysis is based on an average BDT9.4 per km or USD0.121 per km for a medium-sized truck, however, coordination with the outcome of toll decisions from the DEEP will eventually be considered. Other vehicle types will pay more or less than this, depending on their size and subsequent toll multipliers.

### 1.8.1. Anticipated Diverted Traffic along the DAEE

To allow for the uncertainties of the eventual toll levels and the road users willingness to pay for using the tolled expressway, three traffic diversion scenarios were examined with respectively 40%, 50% and 60% diverted vehicular traffic.

### 1.8.2. Maintenance Strategies

The construction of the Dhaka – Ashulia Elevated Expressway and the widening of the road sections on road N302 from two lanes to four lanes are part of the economic analysis, where the future road user costs are compared to the future road user costs of the existing road network as a result of motorised and non-motorised travellers. Accordingly, maintenance strategies for the two scenarios are provided for the analysis and estimated effects made in the HDM model. The HDM model used estimated maintenance requirements and costs on the existing defined sub-sections, being the alternative to the widening of sections and the Elevated Expressway. The maintenance strategies for the existing sections (base case alternative) and the investment alternative are selected as responsive treatments, and their impact will ensure a sufficient quality of the road sections over the lifetime of the project analysis as compared to the initial physical stage.

### 1.8.3. Results of Economic Evaluation

A discount rate of 12% was applied for the calculation of the net present value (NPV) and all costs are measured in economic prices and expressed in USD. The economic evaluation period is set to 30 years. The economic evaluation has been carried out separately for each of the road four road sub-sections on the existing road network that form the alternative to the DAEE. The overall economic project viability of EIRR 11.4% is slightly below the threshold of 12% for the medium traffic scenario.

| Project | Traffic growth scenario | NPV (USD million) | EIRR (%) | NPV /COST |
|---|---|---|---|---|
| DAEE + Widening of existing road section on N302 from 2 to 4 lanes | High Traffic (+20% growth) | 106.0 | 13.1% | 1.13 |
| | Medium Traffic | -53.8 | 11.4% | 0.94 |
| | Low Traffic (-20% growth) | -226.1 | 9.4% | 0.73 |

| Component / Growth Scenario | NPV (USD million) |
|---|---|
| **Medium Traffic Growth** | |
| Net Investment Costs | -826.3 |
| Maintenance Costs | -2.96 |
| VOC | 173.3 |
| Travel time costs | 592.6 |
| Accident Costs | 2.0 |
| NMT | 7.6 |
| NPV | -53.8 |

## 1.9. Sensitivity and Risk Analysis

| Parameter | NPV (USD million) | EIRR |
|---|---|---|
| **Base Case Results** | -53.8 | 11.4% |
| Investment costs +20% | -219.0 | 9.9% |
| Investment costs -20% | 111.5 | 13.4% |
| Diverted traffic 60% | -47.5 | 11.5% |
| Diverted traffic 40% | -62.2 | 11.3% |
| Vehicle operating costs +20% | -17.6 | 11.8% |
| Vehicle operating costs -20% | -90.0 | 11.0% |
| Value of travel time +20% | 64.7 | 12.7% |
| Value of travel time -20% | -172.3 | 10.0% |
| Traffic growth +20% | 106.0 | 13.1% |
| Traffic growth -20% | -226.1 | 9.4% |

### 1.9.1. Economic Analysis Conclusions

The overall economic project viability of EIRR 11.4% is slightly below the threshold of 12% for the medium traffic scenario.

The DAEEP is for reasons of improved traffic management and corridor improvements for road user and trade etc. a considerable influencing factor for the future industrial development opportunities in and around Dhaka that is even further expected to generate additional benefits to the project thereby justifying its implementation. Furthermore, the DAEEP and the on-going DEEP should be seen as integrated projects with mutual benefits that even further justifies the projects.

It has been observed from other similar road and highway studies in Bangladesh that a discount rate of 12% has been applied, however such level is not specifically mentioned in the ToR of this project. Therefore, if lower discount rates are used for the economic analysis of e.g. 10%, the project would according to the quantifiable benefits alone automatically indicate economic viability.

| Project | Traffic growth scenario | NPV (USD million) | EIRR (%) | NPV / Cost |
|---|---|---|---|---|
| DAEE + Widening of existing road section on N302 from 2 to 4 lanes | High Traffic (+20% growth) | 106.0 | 13.1% | 1.13 |
| | Medium Traffic | -53.8 | 11.4% | 0.94 |
| | Low Traffic (-20% growth) | -226.1 | 9.4% | 0.73 |

## 1.10. Financial Analysis

#### *1.10.1.1. Proposed Toll Structure*

The proposed toll levels for the different vehicle categories have considered the experience from the DEE Project and the Dhaka – Chittagong Expressway Project. The toll rate as preliminarily determined for the financial analysis is based on an average of 9.4 BDT per km or USD 0.121 per km for a medium-sized truck, however, coordination with the outcome of toll decisions on the DEEP will eventually need to be considered. Proposed toll levels used for the financial analysis were as follows.

| Item | Car / taxi | Pickup / 4WD | Minibus | Medium bus | Large bus | Small truck | Medium truck | Heavy truck | Motor cycle / rickshaw |
|---|---|---|---|---|---|---|---|---|---|
| Toll multiplier between vehicles | 1 | 1 | 3 | 3 | 3 | 1.5 | 1.5 | 2 | 0.5 |
| Toll level per km (BDT) | 6.27 | 6.27 | 18.80 | 18.80 | 18.80 | 9.40 | 9.40 | 12.53 | 3.13 |
| Toll level per km (USD) | 0.08 | 0.080 | 0.241 | 0.241 | 0.241 | 0.121 | 0.121 | 0.161 | 0.040 |

These toll levels are tentative and, depending on the outcome of the final toll level negotiations, the impact on travel demand and subsequent financial viability will vary accordingly. Therefore, the financial analysis has provided viability indicators for varying toll levels and traffic diversion in order to show the break-even project viability for combinations of toll levels and traffic, and subsequently what will be required to make the DAEE Project financial viable and potentially attractive to private financiers and operators.

### 1.10.2. Results of Financial Analysis

The result of the financial analysis of the tolled is DAEE based on the assumptions taken with regard to toll levels and diverted traffic. The capital expenditure (CAPEX) used for the analysis is without the cost of land and resettlement which will be financed by the GoB. The results indicate that the project is positive financial viability reaching a FIRR of 6.5 % which is above the financial discount factor of 5 % initially assumed for the analysis. The results indicate that the project is showing a positive financial viability reaching a FIRR of 6.2 % before taxes, which is above the financial discount factor of 5 % initially assumed for the analysis. The FIRR is 3.8% after taxes.

**Medium Traffic Growth Rates and 50% Diverted Traffic to DAEE**

| Net Present Value (2016) | (USD million) |
|---|---|
| Cost of DAEE construction | -560 |
| Cost of construction of toll plazas | -13 |
| Cost of maintenance | -14 |
| Cost of toll operations | -10 |

| Medium Traffic Growth Rates and 50% Diverted Traffic to DAEE | | |
|---|---|---|
| **Net Present Value (2016)** | | **(USD million)** |
| Revenues from toll stations | | 755 |
| Total | | **158** |
| Revenues in % of total costs | | 126% |
| discount factor | Financial NPV | **158** |
| 5% | Financial IRR | **6.15% (before taxes)** |
| 5% | Financial IRR | **3.8% (after taxes)** |

### 1.10.3. Sensitivity Analysis

The financial viability of the DAEE Project is considered before and after taxes, and is still maintained after taxes if the some annual compensation by e.g. BAA is made to the toll operator or that a lower financial discount rate than 5% e.g. 3% is used for the financial analysis resulting from lower cost of finance. Still it is assumed that more than 50% of the estimated traffic needs to be diverted to the DAEE.

### 1.10.1. Financial Analysis Conclusions

Based on the available information, the conclusion of the financial analysis is that the DAEE Project is found financial viable showing an FIRR of 6.2% before taxes by further assuming that land and resettlement costs will be financed by the Government of Bangladesh, and the capital expenditures associated to the DAEE will be the responsibility of the private financer/operator.

After taxes, the financial viability is reduced to an FIRR of 3.8%. A lower financial discount rate of e.g. 3.5% would make the project financially viable to the operator after taxes.

Depending on the eventual project cost of finance, the financial project viability may consequently require annual financial compensation from e.g. BBA to make it attractive from a toll operator's point of view.

The after taxes considerations for the project is based on the requirements that more than 50 % of the existing road users decide to use the expressway in the future based on their willingness to pay an average toll fee of USD 0.147 per km or BDT 11.5 per km.

Driving the full distance on the expressway would for all vehicle types on average correspond to USD 3.5 or BDT 275, and this being less for cars and more for trucks and buses.

Different composition of vehicle categories may end up with traffic diversion scenarios most likely favouring heavy traffic rather than passenger vehicles. Such a proportion will also likely have positive impacts on the generated revenues from toll collections.