Padma bridge

1. OverviewPadma Bridgeis one of major outstanding infrastructure required for balanced economic development of Bangladesh. It is anticipated that the gross domestic product of the would increase by 2 percent once the bridge was constructed. The bridge, which would connect the southwest region with the rest of the country, could be used for the trans-Asian route; the minister said adding " The Bridge will help gear up industrialisation in the region too. Environmental impact of the bridge would be assessed during the preparation of design. Government is endeavouring to start construction of the proposed Padma Bridge in 2011 to comple it by 2014. The bridge to be built at an estimated more than twenty thousand crore TK would be, the longest bridge in the country with 6. 15km length and 25m width, he added. The bridge will have four lanes and a railroad in the middle. The bridge will also have a gas transmission pipeline, power transmission line and telecommunication cable.

The Jamuna Multi-Purpose Bridge Authorities (JMBA) that looked after large bridge projects, in a study in 2005 estimated that 918. 76 hectares of land would be needed to be acquired on both the sides of Padma Bridge. The land acquisition cost is estimated at 3. 2 billion taka (about 46 million U. S. dollars), said the study. According to a survey by JICA, nearly 30, 000 people will lose their lands due to land acquisition for construction of the bridge. The 6. 5 km long 22-metre wide, four lane bridge on the river Padma connecting Mawa (35km south of Dhaka) in Munshiganj with Jazira in Madaripur is also likely to contribute hugely to the functioning of the Mongla Port in Bagerhat, the second seaport of the country that fails to attract cargo ships owing to poor communications. The decision to construct the bridge was taken back in

2001 but dilly-dally over selecting the construction sites delayed the process.

2. INTRODUCTION

The three major rivers of Bangladesh - the Padma, Brahmaputra-Jamuna and the Meghna divide the country into four principal regions such as north-west, north central, eastern and south-west regions. The Padma River separates the South-west region from the capital city and requires time consuming ferry crossings to major destinations. At present, transportation of passengers and freight across the river is by ferries and to a lesser extent by launches and manually-operated boats, but their services are grossly inadequate in both capacity and service level.

The existing ferry services involve long and unpredictable waiting time at terminals lacking basic service facilities. They are prone to suspension orcancellation due to flood, fog and inclement weather conditions. The proposed Padma Bridge is expected to make cross-Padma transport more reliable and drastically reduce the travel time and cost across the river. The proposed bridge plans to build a multipurpose crossing with additional utilities like rail, telephone, gas and power lines across the Padma.

It is designed to remove the last major physical barrier in the road connection between Dhaka and the South-west region of Bangladesh, where about one quarter of the population of Bangladesh is living. The bridge will shorten the distance from the South-west to Dhaka by 100 km and travelling time will considerably be reduced. The project is viewed as a very important infrastructure and transportation network, which will hugely facilitate social,

economic and industrial development of this relatively underdeveloped region of the country.

The padma Bridge will help to stimulate economic activity in the SW region by providing a reliable and rapid transport connection. It is estimated in the feasibility study that the project will increase the GDP by 1. 2% and that of South-West Region by 2. 3%. The Padma Bridge is on the Asian Highway Route A-1 and Trans-Asian Railway Route. When the railway will be effectively connected, the Padma Bridge will contribute to the multimodal international transport network for the Eastern Region of the Indian sub-continent and substantial benefit to GoB for bi-lateral cargo movement between India and Bangladesh. 3. PROJECT COMPONENTS

Among the project components main bridge is by far the prime component of the project covering about 50% of the project cost. The main components of the Padma Multi-Purpose Bridge Project consist of: * A 6. 15km long two-level steel truss main bridge. (four-lane divided highway on top and single track rail on the bottom deck); * The Approach Road to the bridge consisting of a 12. 4 km four-lane divided highway and includes five minor bridges of 150~270m length over local waterways, 21 drainage box culvert and 8 local road underpasses. * Transition structures that includes the Approach Viaduct at Mawa length of 721. 50m and 756. 788m for the northbound and southbound carriageways respectively. The length of the Approach Viaduct at Janjira is 873. 250m and 797. 315m for the northbound and southbound carriageways respectively; * Bridge End Facilities on both sides of the river that includes Toll Plazas and Service Areas; * Access roads totaling about 8. 9 km and 14. 5 km of service road. * Four Resettlement villages (two on the

Mawa side and two on the Janjira side). 4. MAIN BRIDGE The total length of the main bridge is 6150m and the main bridge is connected to approach viaducts on both ends and overall width of the bridge is 22. m. The main bridge is in the form of composite steel truss with two levels, railway at lower deck level and highway at upper deck level suitable for fast track construction. Longitudinally, the main truss is in the form of a continuous warren truss and the concrete roadway slab is connected to the top chord by shear stud. The railway deck comprises longitudinal steel beams pning between lower cross beams and a concrete railway slab which is also compositely connected to the beams. The roadway slab is reinforced concrete in the transverse direction, and is a pre-stressed concrete structure in the longitudinal direction.

There are 41 ps each 150 m in length optimized in the computer program. It is sub-divided into 7 continuous bridge modules, and each module is comprised of 5 or 6 ps. At the interface between adjacent modules, a movement joint is present to accommodate the movement due to various actions. The major portion of the bridge is flat (0% vertical gradient) except at the two ends the bridge level decreases with approximately 0. 5% vertical gradient to match with the adjacent approach viaducts. The horizontal alignment of the bridge consists of straight sections, curved sections with onstant radius and short transition curves. The tightest radius is found in Module 7, where the radius is 3000 metres. 5. CROSSING REQUIREMENTS The bridge is to carry the following facilities: Highway The bridge is required to carry a dual two-lane carriageway road with a design traffic speed of 100km/hr. Each carriageway shall comprise two 3. 5 meter wide traffic lanes

plus a 2. 5 meter wide hard shoulder and 650mm wide median. The bridge is intended to carry motorized vehicles only. Railway Provision shall be made for future addition of a single track broad gauge railway along the bridge.

The railway is proposed to be an extension of the Indian Railways Dedicated Freight Corridor (DFC) and is likely to be part of the Trans-Asian Railway. The design rail speed is 160km/hr for passenger trains and 125 km/hr for freight trains. Power Transmission Line The bridge will be required to carry a high voltage power transmission line with a capacity of 400kV as part of the developing power supply network in south west Bangladesh. High Pressure Gas Transmission Line A 30 inch (76 cm) diameter gas pipe is to be carried by the bridge, which is expected to operate at a pressure of. 1135 psi.

The gas pipe shall be hydro tested to a pressure of 1710 psi in accordance with procedures approved by Petrobangla. The high pressure gas main shall be designed in accordance with the requirements of Petrobangla with reference to appropriate recognized international design standards such as the American 6. BRIDGE VIADUCTS The viaduct ps are separated into the approach road and the railway viaducts. The main bridge is a two level structure which required a challenging task in the arrangement of the viaducts to separate the railway from the highway and alternative options were considered during the Scheme Design Phase of the project.

There are a total of four viaducts supporting the highway, two on each side of the river. The length of the approach road viaducts ranged from 720m to 875m long and consists of 38m ps. The superstructure consists of precast, pre-tensioned concrete Super-T girders which will become the first Super-T

girder structure to be constructed in Bangladesh. The Super-T girder is an economical beam commonly used on highway bridges in Australia and is becoming more widespread on projects throughout Asia. The introduction of the Super-T girder to Bangladesh presents an opportunity for future use on other projects throughout the country.

There is a total of two viaducts supporting the railway, one on each side of the river. The length of the railway viaducts ranged from 2. 36km to 2. 96km and consists of 38m ps similar to the approach road viaducts. The superstructure consists of precast, post-tensioned concrete I-girders. The detailed design of the viaduct structures posed some major challenges in bridge engineering specifically involving earthquakes under soil conditions highly susceptible to significant depths of liquefaction. A multi modal response spectra analysis was used to analyse and the design the viaducts for a seismic event with a return period of 475 years.

This paper describes the dynamic analysis procedure and the design features of the structure to withstand these seismic events. A transition pier is located at the interface of the viaduct ps to the river ps and supports the end ps of the main bridge, the approach road viaduct structure and the railway viaduct structure. The transition pier also provided the location for the diversion of the gas pipe, power cables and telecommunication utilities located on the main bridge whilst also enclosing an access stairwell for inspection, maintenance and emergency evacuations. 7. SITE SELECTION

Four alternative bridge sites were identified as alternative locations in the following areas: Site-1: Paturia-Goalundo Site-2 : Dohar-Charbhadrasan Site-

3 : Mawa-Janjira Site-4 : Chandpur-Bhedarganj Four alternative locations were examined from the view points of existing transport of the project area, traffic demand forecast, preliminary river study and technical consideration in highway planning, preliminary bridge planning, environmental & social consideration. JICA study team considers site-1 and site-3 to be most advantageous for a new fixed crossing and recommends these sites for further study until Interim report.

Survey Results Estimated amount of land to be acquired is almost same (about 1, 250 ha) in both cases The number of affected households / structure varies due to differences in population density Current estimate suggests:- Mawa - Janjira 70, 000 to 80, 000 Paturia - Goalundo 40, 000 to 45, 000 Traffic Study and Economic Analysis (Main Work Items) 1) Traffic Surveys (Traffic counts, OD Survey) 2) Establishment of Future Socioeconomic Framework (Population, GDP, GRDP) 3) Traffic Demand Forecast (Target year 2025) 4) Confirmation of Economic Feasibility 5) Economic Impacts of the Padma Bridge) Improvement of Accessibility 2) Regional Economic Development 3) Formation of International Road Network Summary of Comparisons of Two Sites from traffic and Economic Point of View Evaluation Criteria| Paturia-Goalundo| Mawa-Janjira| Traffic Demand (2025)| 19, 850 vehicles/day| 41, 550 vehicles/day| Economic Feasibility| EIRR= 9. 6%| EIRR= 16. 9%| Financial Project Cost (Million US$)| 1, 260| 1, 074| Improvement of Accessibility| (Travel time) Dhaka - Mongla Dhaka - Benapole (Beneficiary Population) Within 3 hours from Dhaka Within 4 hours from Dhaka| 4. 5 hours 4. 6 hours , 791, 000 (9%) 12, 738, 000 (42%)| 3. 6 hours 3. 6 hours 10, 417, 000 (35%) 22, 247, 000 (74%)| Density of Feeder

Roads| No big difference| Formation of International Road Network| | Asian Highway A-1. Short distance to Benapole Land Port and Mongla Sea Port| Regional Economic Development| GDP of Southwest region will increase by 18% (1. 2% /year)| GDP of Southwest region will increase by 35% (2. 3% /year)| Growth centers around the bridge sites| No big difference| Indicative Cost Paturia - Goalundo| Mawa - Janjira| US$ 1, 260 million| US$ 1, 074 million| Evaluation of P-G & M-J sites

Evaluation Criteria | Paturia - Goalundo| Mawa - Janjira| Economic Feasibility| EIRR| 9. 6%| 16. 9%| B/C Ratio| 0. 71| 1. 81| | NPV (Mil. Taka)| -9, 857| 23, 140| | Regional Development| Increase of GRDP of Southwest Region| 18% up (1. 2% per year)| 35% up (2. 3% per year)| Environmental Impact| Result of IEE| No big difference| Social impact and Resettlement Issues| Households requiring relocation| 1, 842| 2, 635| Community structures affected| 18| 60 `| | Total population affected (both direct and indirect)| 40, 000-45, 000| 70, 000-80, 000| Preliminary RAP cost| 23. 7 mil. US$| 38. 79 mil.

US$| Traffic Demand Forecast of the Padma Bridge | Traffic Volumes across PadmaRiver (both ways 2003: From Traffic Survey)| | Paturia-Goalundo| Mawa-Jajira| Cross-Padma| Light Vehicle| 572| 128| 700| Bus| 687| 227| 914| Truck| 1, 217| 78| 1, 295| Total| 2, 476| 433| 2, 909| Launch Passenger| 15, 559| 9, 126| 24, 685| Present Traffic Movement Pattern At present, traffic at Mawa is lower than Paturia due to the following reasons: 1) Road condition of NH 8 is now very poor. 2) A narrow approach road to the Mawa ghat. 3) Quality of ferry services at Mawa is lower than Paturia in general.) No sufficient parking space for trucks. 5) Two hour river crossing time at Mawa is significantly longer than 35 minutes of Paturia. Future Traffic Movement

Pattern Future traffic movement pattern will be drastically changed if the Padma Bridge is constructed at Mawa with following reasons: 1) Improvement of NH 8 (Dhaka - Khulna Road Project by ADB) will be completed by the end of 2004. 2) Direct road link from Dhaka for the largest traffic demands to Khulna and Jcssore. 3) Elimination of two hour crossing time. Criteria for Final Site Selection

Preliminary results shows greater impacts In Mawa-Janjira over Paturia site Site selection should be more on technical - engineering grounds-future safety of the bridge infrastructure Major Impacts of the project - Irrespective of sites Selection of Final site Is critical to set the next agenda preparation of RAP Task would be to minimize Impact, develop Improved policy for mitigation of adverse Impacts, management and capacity building for resettlement management Experience of the Jamuna and other donor-funded projects will be used In the planning and Implementation of RAP for Padma . CONCLUSION The Padma multipurpose bridge is a long cherished dream of the people of the entire southern region. The bridge will link the greater Khulna, Greater Faridpoor and Greater Barisal region with the rest of the country. It will give tremendous boost to national economy as the direct driving travel distance between Dhaka and this region will be greatly reduced and hustles and harassment people face in moving tradeable commodities to and from this region will be removed.

The agro rich region of Barisal and Khulna can feed the rest of the country much easily. Mongla port can make greater contribution. Tourism industryin the picturesque mangrove forest Sundarban and marvellous sea resort Kuakata will get massive boost. Nepal, Bhutan and 7 sisters around

Bangladesh may utilise this bridge to use Mongla port which will give our economy a massive shot in the arm.