Engineering Challenges of Building Bridge on the River Padma

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Extended Abstract

Introduction

The Padma Multipurpose Bridge is the longest and most difficult bridge in South-Asia crossing the mighty river Padma, which carries the combined flow of the rivers Ganges and Brahmaputra. The Padma Multipurpose Bridge Connecting the southwestern part to central parts of the country and the two major ports by rail and road will provide a vital link in the transport network. In the regional context, the bridge over the river Padma is strategically located on the Asian Highway Route A-1 and Trans-Asian Railway Route. It will result in significant economic and social uplift of the country, especially in the southwestern part and will function as catalyst for poverty reduction. The additional GDP growth for the construction of Padma Multipurpose Bridge is estimated at 1.2 percent.

The Padma Multipurpose Bridge is a 6.15 km long bridge across the river designed to carry 4 lanes of highway traffic, a single rail track, a 760mm high pressure gas line and a 150mm dia Fibre optical and telephone duct. The 2-level bridge is a warren type steel truss composite bridge with a concrete upper deck level to accommodate two 10m wide roads and a lower deck level to carry a single railway track. The bridge has 41 spans, 150m each having expansion joints at 900m apart. The bridge is connected with approach roads and railways by a complex arrangement of viaducts. There are 4 viaducts, 2 on each side of the river to connect roads and 2 viaducts, one on each side of the river to connect railways.

The Engineering Challenges

The river Padma is located in the lower reach of the rivers Ganges and Brahmaputra, it is the third largest river in the world. The bed material is fine grained soil, which can go into suspension by relatively weak velocities and turbulence to cause scour. The scour depths are further increased by local scour around foundation. The stratified cohesive and loose to dense sandy bed materials having an estimated extreme scour depth 62m for the design discharge of 151,000 m3/sec and a design velocity of 5 m/sec requires a very deep foundation. The main bridge is supported by 42 piers and each pier is supported by a cluster of 6 piles driven at an outward inclination of 1 in 6 upto a depth of 120m. This is the deepest pile ever driven in the world to support an inland river bridge. Driving of 3m dia steel piles to such a depth requires huge energy. The world's largest hammer of 2400kJ and later another hammer of 3500 KJ capacity specially designed and manufactured in German The complex project has unique applications of structural, geotechnical, river, environmental, social and construction engineering. for this project are in use for driving of pile to the required depths. Unfortunately presence of a cohesive layer of soil at the tip of piles of 22 piers created bigger problem in foundation construction

The Padma river is known for its fury and ferocity in the monsoon and often termed as *Kirtinasa* (destroyer of monuments). This year the river has exhibited its ferocity by taking away a huge build up area within few days in Sariatpur district. Extensive river training works (RTWs) are required to protect the main bridge, viaducts, bridge end facilities, approach roads and resettlement sites. After considering alternatives, 2km RTW at Mawa end and 13km RTW at Janjira end were designed to protect the bridge and ancillary facilities. The RTWs were erected along relatively stable bank lines allowing the river to continue its usual movement. The major works involve establishment of designed river side slope by precision dredging to a depth of -25m PWD, placing of layers of sand filled geobags on the side slopes and then placing of 90cm stone riprap on geobags and finally establishment of falling apron at 25mPWD.

The construction of Padma Multipurpose bridge has significant environmental and social impacts The acquisition of 1100 ha land has directly and indirectly affected about 76000 persons including 13500 families by losing their homestead, agricultural land, business and employment opportunities. Comprehensive environmental management and resettlement action plans prepared to compensate and mitigate all environmental and social impacts are under implementation. A protected area has been designed to shelter the displaced wildlife during construction. Suspension of all construction activities during breeding and migration season of Hilsha in the section of the river having water depth greater than 7m.

There are many challenges in the construction of the bridge that include fabrication of 3m dia piles from steel plates, driving of large diameter piles to required depths, skin grouting and pile end grouting adopting innovative techniques, load testing of huge capacity piles, fabrication of steel trusses with precision, transport and erection of 3000 ton assembled trusses on pendulum bearings set on piers, geotechnical investigation in flowing river, placement of prefabricated deck slabs and rails for road and railways.

Concluding Remarks

The construction of Padma Multipurpose Brindge is a dream of the people of Bangladesh. The complex project has unique applications of structural, geotechnical, river, environmental, social and construction engineering. Construction of this bridge is also a challenge that Bangladesh can construct a complex megaproject of this size using its own professional and financial resources..