

SECOND VIVEKANANDA

On July 4th, 2007 the Second Vivekananda Bridge Tollway (SVBT) was opened to traffic, three years and two months after Notice to Proceed was issued to the Design/Build Contractor, Larsen and Toubro (L&T). The Honorable Transport Minister of the Government of West Bengal, Shri Subhash Chakraborty was one of the first to drive through the new tollway.

General Project Description

The SVB Tollway is a 6.1 km-long integrated six-lane bridge and approach roadway network, with the main river crossing located 50 meters downstream of the existing bridge. The existing bridge, originally built in 1931, carries twin railroad tracks and is equipped with 5.5 meter-wide carriageways on either side for vehicular traffic. All vehicular traffic is now moved to the new bridge.

The main structure across the Hooghly River is an 880 meter-long, 29 meter-wide "Extradosed Bridge". Approaching the main structure on both sides are six-lane viaducts connected to approach ramps and access roads on embankments on either side. The total length for the approach viaducts is 724 m for the Howrah side and 2240 m for the Kolkata side. The approach viaducts consist of a combination of two-lane ("D2") and three-lane ("D3") precast segments erected by the span-by-span method with a combination of overhead and underslung trusses. Typical approach spans are 35 m-long.

With the 29 m width of the roadway, the choice of cross section was between a three-web and a "D6" box girder (single cell box girder with internal stiffening struts). The D6 section was found to be lighter and easier to build. The sloping webs allowed for an efficient transfer of loads between superstructure and substructure with a significant reduction of the pier shaft dimensions. It was also well adapted for anchoring the stay cables along the bridge centerline. The segment length was set at 3.37 m resulting in a maximum segment weight of 150 t.

Unlike other extradosed bridges, this bridge has a constant depth. This allowed for the use of "D6" segments with sloping webs, and simplified casting operations, with the additional advantage of enhanced appearance for the river crossing. This was made possible by increasing slightly the depth of the box girder to 3.4 m (L/32), and adding some stay cables close to the pylons to reduce shear.

The eight stay cables at each pier vary in size from 63 to 73 x 15mm diameter strands and are placed inside steel pipes filled with cement grout. The stay cables are designed to be replaceable with double pipes through the pylons and at the deck anchorages. Due to the low variation of stresses under live loads in the stay cables and consequently low fatigue loading, the stay cables are designed for a maximum stress of 60% GUTS in service, and 75% GUTS under ultimate loading.

Main Bridge Construction

The pier tables were made of two precast segment shells placed on top of the piers with a catamaran barge and strand lifting system. The pylon base was cast in place inside the segment shells. The pylons were then cast with self climbing forms.

JURY COMMENTS

Constant depth slender profile for 110 m spans combined with single cable planes present a very attractive structure. The use of single cell strutted box girder is very efficient for a wide deck, the single-plane extradosed design minimized the pylon height to avoid overshadowing the adjacent Dakshineswar Temple, and provided significant economies in construction of the 40 m-deep foundations.

The superstructure segments were precast with three casting cells in the casting yard located near the Kolkata side abutment. The segments were then loaded on a barge with a gantry and erected in balanced cantilever using a beam and winch system. Special procedures were used for the two end spans on land: segments were placed in lifting position on the ground with a combination of rails and turning tables.

The stay cables were pulled through the deck pipes and pylon saddles in a single bundle of strands and stressed with 1000 t hydraulic jacks inside the box girder.

The steel beams were installed at the expansion joints after completion of parapets and deck overlay.

As required by the IRC code, the bridge had to be load tested at the end of construction with the full design live loads. The load test was successful with actual deflections meeting the calculated deflections, and full rebound of the superstructure after removing the test loads.

BRIDGE TOLLWAY

CREDITS

Owner: Second Vivekananda Bridge Tollway Company in Partnership with National Highways Authority of India

Engineer of Record: CES-PB Consortium in Association with **International Bridge Technologies, Inc.**
(main bridge design)

General Contractor: Larsen & Toubro Limited



CONCLUSION The Second Vivekananda Bridge completion represents an outstanding accomplishment in many ways:

- Unique application of Public Private Partnership project delivery in India.
- Largest bridge Build-Operate-Transfer project in India
- Critical link for the eastern India roadway network.
- State of the art precast segmental "extradosed" bridge.
- Cost efficient design: construction cost for main bridge US \$170/sq. ft.
- Design and construction completed on schedule.
- Bridge blending harmoniously in the environment (existing bridge, temple).