The Signature Cable-Stayed Bridge in New Delhi

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Summary

The Yamuna crossing in New Delhi, a single-pylon cable-stayed bridge with a main span of about 250m length will be India´s longest-span bridge of this kind. The bridge is presently under construction and will be opened to traffic in 2014. In the paper the authors will elaborate on design and analysis of the superstructure of the bridge, and will put it in the context of other such long-span bridges in India and worldwide.

Keywords: cable-stayed bridges, conceptual design, signature bridges, context, bridge construction, India.

1. Introduction

Whenever designing engineering structures we seek to minimise material quantities by a logical design and reduce the cost by indigenous construction. These ideals have been challenged during the recent years when more and more clients explicitly asked for "iconic" structures and "landmarks". The "Bilbao effect" is a wide spread expression and especially in Great Britain many Millennium Projects were promoted, also in the field of bridges. Since then "Signature" bridges have become a frequent request. This development also affects the design of cable-stayed bridges since naturally they are perhaps the most economic and elegant way to bridge long spans.

In general it is a positive development that the request for signature bridges in specific locations is growing. It shows that bridges are now in the public awareness as structures which influence, shape or even improve our built environment. Bridges are acknowledged as a part of building culture turning infrastructure into civilisation. We, the engineers, should use this trend and prove that good design can generally be achieved with little extra cost.

2. Second Hooghly Bridge or Vidyasagar Setu

For the Second Hooghly Bridge, now Vidyasagar Setu, in Kolkata with a main span of 457m the client requested the bridge to be built with local labour, local skills and materials, i.e. indigenous construction. Since weldable steel and HSFG bolts were not available at that time, only a riveted structure was possible and an orthotropic steel deck, the international standard at that time, was not possible. Thus, Vidyasagar Setu was not only record span at the time, it also became the first cable-stayed bridge with a composite deck. A steel grid acting compositely with a concrete deck slab on top. Another special feature of this bridge is the parallel wire cables made in India, that connect to passive anchorages at the deck and that can be retensioned in the pylon head.

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Fig. 1: Second Hooghly Bridge (Vidyasagar Setu), Kolkata, India (© Roland Halbe)

3. Signature Bridge Delhi

Almost 30 years after Second Hooghly Bridge the client of the Yamuna Bridge at Wazirabad in New Delhi, Delhi Tourism and Transport Corporation (DTTDC), explicitly opted for a signature bridge. The solution is a bridge with a dynamically shaped pylon that symbolises modern India, and that makes structural sense at the same time. The weight of the backwardly inclined pylon compensates part of the dead weight of the deck, thus reducing the number of backstay cables. The pylon body is shaped so that the forces of the cables entering in two planes from the front and leaving in one backstay plane are transferred in a direct way. The top of the pylon is formed by a steel-glass structure that houses inspection platforms, which can also be illuminated at night, thus converting the pylon head into a beacon seen from afar.

The result of the conceptual design process for the Yamuna bridge is a structure that tries to combine robustness and structural sanity with the expectations that come with a signature bridge. Only after the concept was approved by the Delhi Government and the Delhi Urban Arts Commission, was the detailed design of the Yamuna Bridge developed.

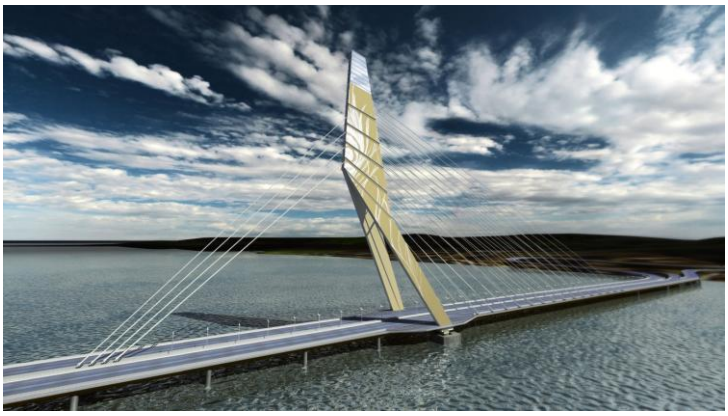

Fig. 2: Virtual image of Signature Bridge Delhi with ornamental painting on the pylon

The Yamuna Bridge at Wazirabad is an asymmetric cable-stayed bridge with a main span of 251m and total length of 675m. Its composite deck carries 8 lanes; 4 in each direction. It is approximately 35m wide and is supported by lateral cables spaced at 13,5m intervals. Towards the approaches the same deck section continues with piers supporting it at 36 m intervals. The height of the steel tower is a approximately 150m.

Only thanks to the persistence of the client DTTDC the Signature Bridge Delhi is finally becoming a success. The design was finished 2007 but then the project had to face the tremendous increase in steel prizes in 2007, when suddenly many signature projects, like the Olympic stadium in Beijing, absorbed the whole steel production worldwide. Thereafter it survived the global financial crisis and land acquisition problems. Now, with most of the steel fabrication finished, the bridge project is consistently moving forward to its completion in 2014.