The Highly Sustainable Kanchanaphisek Bridge—Thailand's Longest Span

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Summary

The Kanchanaphisek Bridge, with a 500-meter main span, has the longest bridge span in Thailand. The cable-stayed structure was designed to be a long lasting, sustainable and owner-friendly bridge. Two A-shaped towers with three anchor piers in each back span make the bridge torsionally stiff to resist high winds. A reinforced concrete deck slab and tower foundation tie beams provide for bridge longevity. Simple low cost ladders and platforms provide ready access to the cable top and bottom anchors for inspection and maintenance activities. Concrete counterweights, instead of tie-downs, were used to eliminate uplift. The bridge is also noteworthy in that it has no bearings, thereby eliminating the need for bearing inspection and replacement.

The 941-meter Kanchanaphisek Bridge over the Chao Phraya River

Keywords: Kanchanaphisek, cable-stayed bridge, stay cable, counterweight, cable anchor, bumper, deck replacement.

1. Introduction

The Kanchanaphisek Bridge, with a 500-meter main span—the longest in Thailand—crossing the Chao Phraya River in Bangkok, was opened to traffic on November 15, 2007. This bridge is part of the Southern Outer Bangkok Ring Road (S-OBRR). Thailand's Ministry of Transport & Communications, Department of Highways, retained a consultant team to carry out the feasibility study for the S-OBRR Project in 1996, followed by detailed design work in 1999. PB Asia, the local affiliate in Thailand of Parsons Brinckerhoff Inc. (PB), was responsible for the Chao Phraya River crossing. PB Americas provided technical support to PB Asia.

2. General Description

The Kanchanaphisek Bridge crosses the Chao Phraya River with a 500-meter main span. The longest bridge in Thailand, its 36.7-meter-wide superstructure carries three traffic lanes in each direction. The bridge provides 50.5 meters of vertical underclearance for busy marine traffic to and from Khlong Toey Harbor upstream of the bridge.

The bridge's two towers are located on land to provide an uninterrupted shipping lane and to avoid the hazard of ship collisions. The west tower was located behind an existing wharf to maintain the 100-meter-long wharf for harbor operations. The superstructure is a steel frame composite with a

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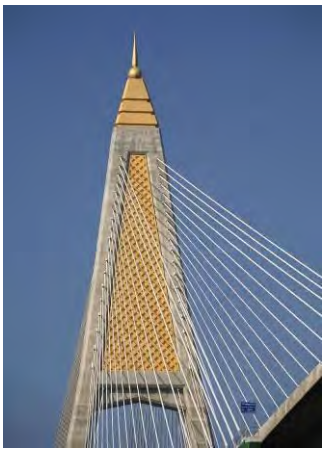
concrete deck. It is supported by 168 stay cables. Three anchor piers on each side provide stiffness and stability.

3. Design for Sustainability



Towers crowned by gold lattice-work, spheres and spires recall the tiered stupa form found on temples in Thailand

This bridge was designed to be highly sustainable, with an innovative design to ensure longevity. Noteworthy aspects include:

- Exclusive Use of Reinforced Concrete: The Kanchanaphisek Bridge is a major structure that will be a vital transportation artery in Bangkok for at least 100 years. Therefore, only time-tested reinforced concrete, instead of post-tensioned concrete (that may ultimately prove to be more difficult to replace or repair), was used for all major concrete bridge elements.
- Concrete Counterweights: Conventional cable-stayed bridges have tie-downs at anchor piers to resist uplift forces. Tie-down devices are difficult to maintain and replace. And the failure of any one tie-down can cause a complete collapse. The Kanchanaphisek Bridge does not have any tie-downs. Instead, concrete counterweights were used to eliminate uplift.
- Safe Box Interior Space: Traditional box girders usually have stiffeners inside the box. However, to provide a clean and safe work space for construction, inspection and maintenance personnel, no stiffeners were located inside the box-shaped edge girders of this bridge.
- Convenient Access to Lower Cable Anchors: A unique access system provides permanent easy access to the cable anchors located inside the edge girders. People can access any cable anchor from the ground by simply taking an elevator to the tower horizontal strut, walking along a catwalk to the top of the floorbeam bottom flange, and then stepping onto a platform equipped with safety railings in front of manholes to the box-shaped edge girders and cable anchors within.
- Convenient Access to Cable Top Anchor: A large chamber on top of the tower was designed to house cable anchors. The spacious chamber provides ample space for ladders and platforms for easy inspection of all cable top anchors. A 10-ton capacity ring along with a 1.5-meter x 1.5-meter opening is located in the bottom slab to enable heavy material, such as cable anchors, to be lifted from the deck level directly to their final locale.
- Integral Anchor Pier Design: the anchor piers were made integral with the superstructure. The integral design provides a strong connection between the superstructure and the substructure. It also eliminated commonly required expansion bearings and wind locks.
- No Bearings: Removing and replacing large, heavy bearings located more than 50 meters above ground is a major task. However, the sustainable design of the Kanchanaphisek Bridge requires no bearings at all. Therefore, energy required to manufacture, transport, inspect and maintain bearings will not be expended.
- Easy Horizontal Bumper Replacement: Four horizontal bumpers at the towers transfer wind loads from the superstructure to the towers. The bumpers consist of very simple elastomeric pads located at the deck level. They were designed to be lightweight and thereby removable by a single person equipped with only hand tools.
- Deck Replacement: The deck of a cable-stayed bridge is in compression. Failure of the deck would cause failure of the bridge. Because the deck of the Kanchanaphisek Bridge is not post-tensioned, its reinforced concrete deck slab could be replaced, if necessary.

4. Conclusion

The new Kanchanaphisek Bridge was designed as a single harmonic, sustainable system. It will be very easy to maintain thanks to the elimination of many frequently used, but troublesome, elements such as tie-downs, expansion bearings and wind locks. All major elements are easily accessible without the need for specialized equipment. It was an honor to have the opportunity to design this striking low maintenance landmark for the Kingdom of Thailand.