Wichita Riverfront Pedestrian Bridges

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Summary

As part of the riverfront development program in Wichita, Kansas, two cable-stayed pedestrian bridges were constructed as part of a bike and pedestrian transportation system that is a component of the urban infrastructure. HNTB was responsible for the preliminary and final design of these two unique pedestrian bridges, which spanned 97.5 m and 73.15 m to provide access across the confluence of the Arkansas and Little Arkansas Rivers.

Keywords: design build; precast; capbeams; prestressed; piles; post-tensioning; spliced girders.

1. Introduction

To enhance the City of Wichita's bike and pedestrian transportation system, a cable-stayed bridge design concept with asymmetrical tower locations was chosen to link the paths on each side of the river. Between the two bridges lies the "Keeper of the Plains," a 45-foot, raised statue that is one of the city's icons. The bridge's tapered tower pylons and unique stay-cable configuration are reminiscent of feather shapes and patterns found in some Native American headwear. HNTB provided the preliminary and final design of these two unique pedestrian bridges, which span 97.5 m (Bridge #1) and 73.15 m (Bridge #2) to provide access across the confluence of the Arkansas and Little Arkansas Rivers. The total construction cost for both of these signature bridges was $6.8 million.

2. Substructure Design

The substructure for each bridge consists of a fixed abutment, an expansion abutment, and a river pier with accompanying steel tower. The river pier and expansion abutment (at end of the main span) are founded on steel H-piles. The fixed abutments for both bridges are founded on a combination of two 1370 mm diameter drilled shafts and battered steel H-piles. Because the main anchor cable tension results in uplift at the fixed abutment, the superstructure is post-tensioned to the anchor abutments. As a result, the drilled shafts are actually designed for an uplift force of approximately 2560 kN per shaft. To resist the horizontal component of the anchor cable tension, steel H-piles are battered in the longitudinal direction (away from the bridge) and are also designed in tension.

3. Superstructure Design

To allow for both an aesthetically pleasing superstructure depth of 1.22 m and minimal construction in the rivers, the bridge superstructures feature a segmental box girder with four longitudinal post-tensioning tendons in each bridge. The typical segment is 9.75 m long and includes the embedded lower cable anchorage plates. Because of the slenderness of the superstructure, the bridge design also included consideration for lateral and vertical pedestrian-induced excitation. The design live loading is 4.07 kPa and an AASHTO H10 truck (89 kN).

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The stay cables are typically 50 mm diameter galvanized structural strand with standard open strand sockets at upper anchorages and standard anchor strand sockets at the lower anchorages. Stay cables located nearest the anchor abutments are 86 mm diameter structural strand with similar socket types.

4. Conclusion

The design of these bridges proved to be very challenging and unusual in many different aspects: drilled shafts anchored in tension, upper cable anchorage assembly, lower cable anchorage plates, and pedestrian vibrations. All of these challenges were overcome successfully and allowed the City of Wichita to have two "signature" structures as part of their enhanced riverfront park. The construction of these two pedestrian bridges was successfully completed in May 2007 (see Figure 1) and they have been well received by the community.