1996 Merit Bridge Award: Long Span The Great River Bridge

Project Data

Steel wt./sq. ft. of deck: 53 lbs.

Cost: $29 million (cable-stayed unit only)

Steel tonnage: 2500 (cable-stayed unit only

Located only 75' from the outdated, two-lane bridge it was built to replace, the Great River Bridge carries five lanes of traffic across the Mississippi River at Burlington, IA. However, motor vehicles were not the only beneficiaries of the new bridge: Unlike the old MacArthur Bridge, the new bridge is long enough to span the river's natural channel and therefore provides improved river traffic navigation.

The Great River Bridge is comprised of cable-stayed main and side spans of unequal lengths, a single tower and a suspended span. Its asymmetrical configuration was designed in response to the site's geometry, providing the best "fit" with the I-34 interchange in Burlington and accommodating the river's navigation channel. The bridge's 660' main span was designed to reach westward from the tower completely over the navigation channel, while the shorter eastern span extends 405' to meet the 180' suspended section. In a compromise between the efficiency of a "fan" and the practicality and aesthetics of a "harp", the bridge's cables are arranged in a modified fan. The system was designed to have a relatively large number of cables to permit the use of an economical and attractive shallow deck structure.

The bridge's H-shaped tower is 325' tall and approximately 84'-4" wide at the strut of the H. In its tranverse direction, the tower behaves as a moment resistant frame, while in the longitudinal direction, the tower acts as a free-standing cantilever with some elastic support offered by the cable stays. The walls of the tower's reinforced concrete box section legs and strut are 30" and 15" wide, respectively.

The cable stays vary in length from 160' to 650' and each is comprised of between 27 and 77 epoxy-coated, seven-wire prestressing strands 0.6" in diameter. The designers departed from the normal U.S. practice of using wedgetype anchors with strand cables. Instead, they designed the bridges cables to have fixed-end sockets with strands anchored in a matrix of epoxy resin, zinc dust and steel balls. To allow the steel balls to contact and grip the stays directly, the epoxy coating is removed from the part of the stay in the anchor socket. This method not only had favorable fatigue characteristics, but also permitted the stays to be fully prefabricated in a controlled environment. In addition, prefabrication also makes it easier to control the lengths of the individual strands of the cables in an effort to obtain a uniform force distribution within the stays.

The deck of the cable-stayed unit was designed for simplicity. Its primary components are: steel edge girders about 84' o.c.; steel floor beams 15' o.c.; and precast deck panels. These components function together in a composite system in which the concrete deck works with the floor beams to resist, principally, live load bending moments and with the edge girders to resist both dead and live load axial thrusts. To eliminate the generation of primary torsional moments in the edge girders, the vertical planes of the bridge's 54 stay cables—14 pairs on the main span and 13 pairs on the side span—are oriented to be concentric with the edge girder webs.

Construction By Geometry

Cable-stayed bridge construction can be driven either by "forces" or "geometry". In the former, the cable stays must be jacked separately until they meet the desired load capacity. With this method, the forces in the cables are the primary criterion for acceptance of the system. However, since the deck is extremely flexible, small changes in force can make a large difference in the bridge geometry.

To avoid this problem, the Great River Bridge was designed for "construction by geometry." Using this method, the geometry of the bridge is precisely monitored as the stays are installed to insure the desired profile of the girder is achieved.

The final forces in the cable are then compared to the calculated values to confirm general force levels.

Judges Comments:

"The main tower and cables serve as a beautiful gateway across the Mississippi River"

Project Team

Designer:
Sverdrup Civil, Inc.
Maryland Heights, MO

Consulting Firm:
Leonhardt Andra & Partners
Stuttgart, Germany

General Contractor:
Edward Kraemer & Sons, Inc.
Plain, WI

Fabricator:
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Erector:
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Owners:
Iowa Department of Transportation
Illinois Department of Transportation

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