The innovative William Natcher cable-stayed bridge

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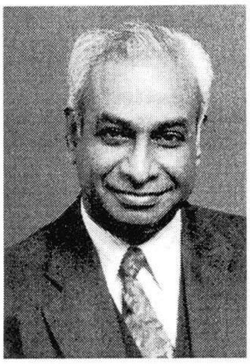

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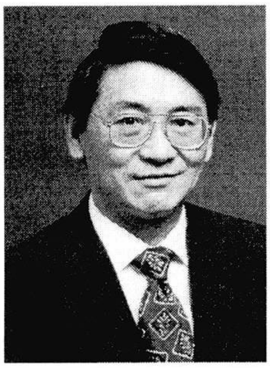
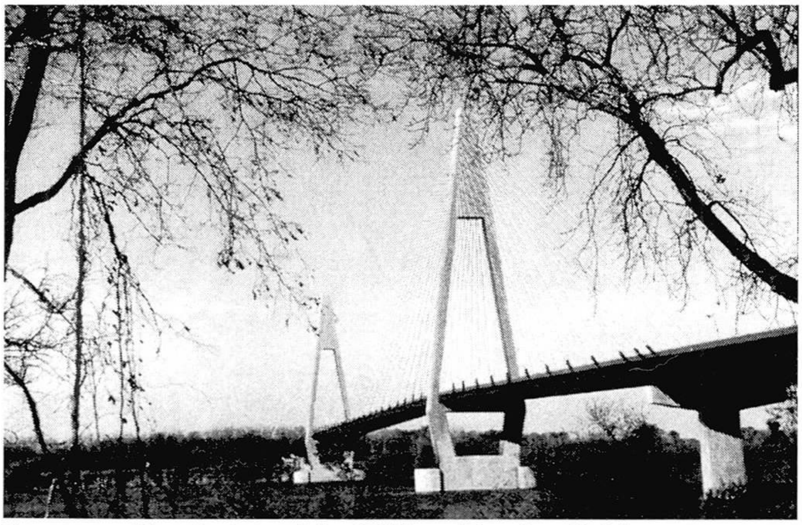


Abstract

To compete effectively with an economically designed concrete alternate bridge crossing of the Ohio River, required an innovative steel alternate cable-stayed bridge. Just such a structure, designed by Parsons Brinckerhoff Inc., is presently under construction. This paper discusses the many noteworthy and unusual aspects of the William Natcher Bridge.



Computer Simulation of the William Natcher Bridge

The Ohio River at the project site is approximately 6.4 kilometers wide between the states of Kentucky and Indiana. Most of the area is a floodplain, which gets inundated at least once a year. As a result, the main bridge, which is 1,373 meters long, requires a long approach on the Kentucky side. This approach consists of embankments and relief structures to allow for the passage of flood waters.

The main bridge consists of the 134-meter composite, precast, prestressed concrete and 276-meter composite steel Kentucky approaches; cable-stayed spans (152-366-152 meters); and the 84-meter composite steel and 209-meter composite precast, prestressed concrete Indiana approaches. The substructure consists of a combination of pile bents and T-shaped piers, while the foundation features large diameter drilled-in caissons (drilled shafts). The bridge will accommodate two lanes of traffic in each direction with a center median.

Innovative items considered and implemented during this project included:

- **Hydraulic Study:** A state-of-the-art 2-D finite element model covering approximately 89 square kilometers of the Ohio River floodplain was developed to address the 5-, 10-, 50-, 100- and 500-year flood events; the critical location and size of Kentucky approach flood relief structures; and scour and ship impact forces on bridge piers.

- **Superstructure Continuity:** The composite steel superstructure of the approaches was made continuous with the cable-stayed spans to reduce congestion at the anchor piers. This resulted in many benefits, but complicated design of the approach girder to cable-stayed span connections.

- **Efficient Tower Piers:** A careful study resulted in diamond-shaped (A-shaped) towers. This configuration provides for a user-friendly tower top where the cables are anchored, allowing easy access during construction and subsequent inspection and maintenance.

- **Cable Connections:** For the first time in the US, stay cables will be anchored into steel elements inside a concrete tower. These prefabricated elements, composite with the tower concrete, will efficiently resist cable forces—even under cable loss and replacement conditions. The cable-to-edge girder connection is simple and direct, and all cable connections will provide for maximum flexibility by the contractor during assembly and erection. This arrangement will also facilitate future inspection and maintenance.

- **Wind Studies:** A detailed wind tunnel study was performed using sectional and aeroelastic models. Results indicated that the bridge exceeds specified requirements both during construction and when complete.

- **Construction Sequence:** To avoid the pitfalls of construction change orders and claims, a detailed step-by-step construction sequence was evaluated and provided on project plans.

- **Smooth Transition between Design and Construction Phases:** A close working relationship among designers, advisors, steel organizations, erectors, contractors, and fabricators has provided for a positive, productive work environment.