

Full recovery

As economy improves, I-74 span to handle the masses

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Contributing Authors

The current state of American infrastructure improvements is rife with opposition and delay. Many vital projects are postponed or cancelled for lack of meaningful foresight, communication, compromise and support.

Which is why the I-74 Bridge project stands as a shining example of one region's commitment to forward-thinking, strategic transportation planning, infrastructure improvements, increased safety, economic development, land beautification and long-term cost savings.

The Quad Cities region is in the midst of a population and economic upturn. The area is centrally located between Minneapolis-St.

Paul, Chicago, St. Louis and Kansas City, Mo., and focused on Davenport and Bettendorf in Iowa, and Rock Island, Moline and East Moline in Illinois. In 2005, over 172,000 vehicles per day (vpd) crossed the Mississippi River in the Quad Cities area. This number is expected to increase to 239,000 vpd by 2035.

Riverfront areas of the Quad Cities, once home to industrial businesses and shipping warehouses for river barges, are being redeveloped into pedestrian-friendly promenades, retail and housing opportunities, and entertainment destinations in an attempt to attract additional residents and visitors to the area. Public, private, local and state actors on both sides of the river, on their own and as part of the Bi-State Regional Commission, have championed collective growth efforts and lobbied for improved infrastructure.

Central to this redevelopment plan and future growth potential is the I-74 Bridge connecting Moline, Ill., and Bettendorf, Iowa. Currently, the crossing consists of two parallel suspension bridges. Both were designed by Modjeski and Masters, the first in 1935 and the second in 1959.

While iconic in their appearance and important in establishing the growth of the Quad Cities, the bridges are functionally obsolete. Built without shoulder lanes and with 11.5 or 12-ft-wide lanes (depending on the span), they don't meet current interstate highway design regulations. They can't handle the increase in vehicle traffic or modern vehicle size, which leads to increased congestion for local commuter, interstate commercial and trucking traffic. It's estimated that without improvements, the current bridge will cause continuous traffic delays from 7 a.m. to 5 p.m.





True to their arch

In order to combat these functional, safety and congestion issues, spur development and improve the region's infrastructure, the Iowa Department of Transportation and the Illinois Department of Transportation embarked on a project to replace the existing I-74 Bridge and improve 8 miles of approach corridors at a total program cost of \$1.25 billion (in 2015 dollars). In a display of regional unity, the project was funded, in part, by both states.

The project team is composed of, among others, Alfred Benesch & Co. as the prime consultant, responsible for the overall project and the design of the main-span substructure and foundations. Modjeski and Masters was selected as the designer of the project centerpiece, the new bridge's main channel spans. Construction of the central and south sections

of the project has an estimated completion date of 2020.

The project's main bridge spans will consist of parallel, twin basket-handle true arches. This configuration reduces the space between the respective apexes to just a few feet by angling the arch ribs in towards each other.

This true arch design is unique for several reasons. First, there are no other true arch bridges that span the Mississippi River. The new bridge will serve as an iconic focal point for the region, help attract visitors and spur economic development.

Second, true arches are unique in a river environment. With soil and bedrock conditions to consider, a tied arch bridge is more often built in these conditions. But, a thorough geotechnical investigation found that the lower-than-average river levels and relatively shallow location of the bedrock at this point

in the Mississippi River made true arches a practical and economical consideration.

Crossings of all kinds

A main project goal was to help increase economic development by stimulating pedestrian and bicycle access to the Quad Cities' waterfront areas. The current bridge lacked any form of pedestrian or cyclist access. To correct this, provide easy river crossing for foot and bicycle traffic and serve as a destination in itself, a pedestrian walkway is a prominent feature of the new I-74 Bridge.

The walkway extends off the westward facing side of the eastbound span. It includes an overlook located at mid-span. This overlook offers beautiful downriver views of Rock Island and the setting sun. It also includes a glass oculus that provides a bird's-eye view of the mighty Mississippi rushing below the bridge.

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The essential functionality of the cantilevered walkway is complicated by several structural challenges. Because the arches and hangers are inclined, any additional vertical load on one of the arches results in unbalanced lateral loads as well. As a result, the floor system (and arch ribs) must carry

the resulting lateral force to the substructure. To combat this, chevron-pattern bracing was included in the floor system to transfer the load to the substructure via wind tongues.

The walkway also serves as a type of wing-let that prevents vortex-induced vibrations

to the structure when the wind blows from its predominant westward direction. Wind tunnel studies revealed, however, that an east wind of just 37 mph created vibrations with a peak acceleration of over 30% of the acceleration from gravity. While posing no danger to the structural integrity of the bridge,

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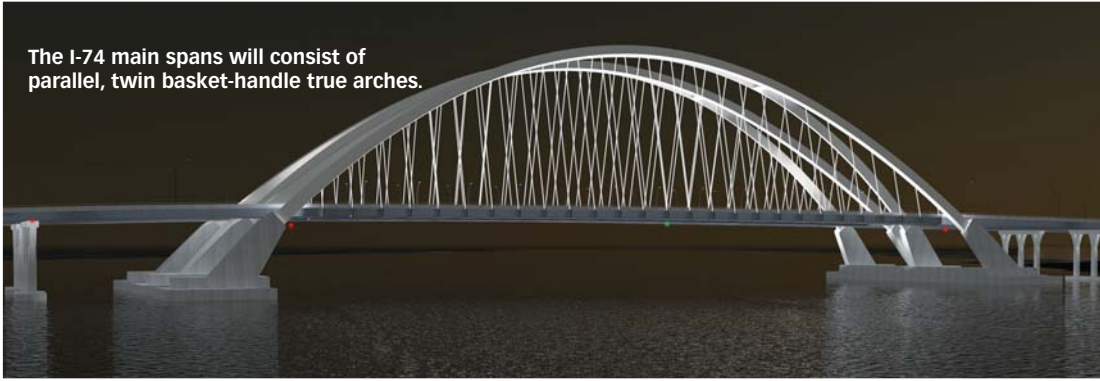
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The I-74 main spans will consist of parallel, twin basket-handle true arches.



A pedestrian overlook will be located midspan, featuring a glass oculus allowing a bird's-eye view of the river below.

these conditions were in excess of the comfort criteria of 10% acceleration.

To combat these vibrations, winglets were used along the eastern, or windward, edge of the westbound structure. These winglets were in the shape of a NACA 0012 airfoil, which incidentally is the same airfoil used on the legendary Boeing B-17 Flying Fortress bomber aircraft of World War II. These lessen the vibrations and produce comfortable conditions for vehicular and pedestrian bridge traffic.

The angled arches will present a new iconic look to replace the current bridge's design. While functionally obsolete, the current suspension bridges, with their Statue of Liberty-esque color and majestic towers, are a point of civic pride. The new I-74 Bridge will bring smoother lines and styling to the crossing, in support of the project's overall aesthetic theme of "reflection." After all, an arch has the same shape of a suspension cable, just turned upside down. In effect, the new bridges will be a reflection of the old. This style highlights the region's evolution from an industrial to a modern metropolis.

Just like the rolling current

Beyond the centerpiece of the main bridge span, the I-74 project covers approximately 8 miles of approach roads and interchanges. This corridor was not designed to current interstate highway standards. The challenge was to convert a stretch of four-lane rural highway to a six-lane urban interstate.

Current design requirements recommend spacing interchanges .75 miles apart. Some of the interchanges approaching the I-74 Bridge are as close as .38 miles apart. There is a heavy volume of traffic merging and exiting at high speeds in a very short section of roadway. This results in a higher-than-average accident rate for the corridor and/or increased congestion

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as drivers are forced to greatly reduce speeds in order to successfully and safely enter or exit the highway.

To alleviate these safety and congestion issues, interchanges were reconfigured to allow for more space between them. Auxiliary lanes were added to elongate the merge area. These lanes will allow drivers to maintain or gain safe merging speeds and allow the I-74 Bridge to retain a posted speed limit of 55 mph. Currently, it is posted at 50 mph.

Mirroring the reflection aesthetic of the main span, the approach corridor draws heavily on curved or wavy elements, inspired by the rolling current of the Mississippi River. The 8-mile corridor will have unified design elements on both sides of the river that will apply to interchanges, interstate and local roads. Landscaping for the stretch will include environmentally friendly native plant species. LED lighting is specified for the approach and arch aesthetic as well as the advanced local road lighting. This will help emphasize the striking visual nature of the project, even at night, while controlling energy costs and reducing light pollution in the adjacent communities. It's also envisioned that LED will replace ceramic discharge metal halide lamps for the entire corridor prior to letting in 2017.

The main span approach piers were designed to meet both the aesthetic and functional needs of the bridge. While matching the reflection theme, the approach piers had to be able to withstand the possibility of impact from renegade shipping barges.

The new approach piers include an outermost concrete layer that shields the structural supports of the approach in the event of a collision. The only damage would be superficial and no part of the bridge would have to be closed for repairs. Furthermore, this layer of protection extends upwards to a

height above flood stage, when the possibility of rogue barges is most likely.

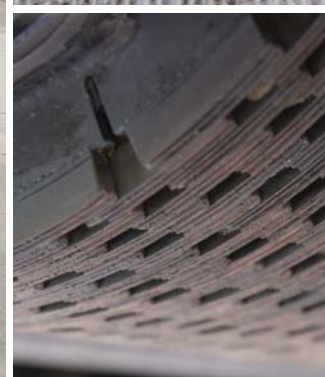
Around 800 people attended a recent public meeting on the I-74 Bridge project. Almost all of their feedback was positive. This demonstrates the unity and commitment the Quad Cities community has to this project.

They know that the economic and cultural future of the region relies on improved infrastructure. They know that the new bridge will make commutes shorter and safer. They

know it will save money on fuel and wasted productivity. And, in what has become an all too rare occurrence, they are willing to come together and act to ensure these improvements happen. **R&B**

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For more information about this topic, check out the Bridges Channel at www.roadbridges.com.



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