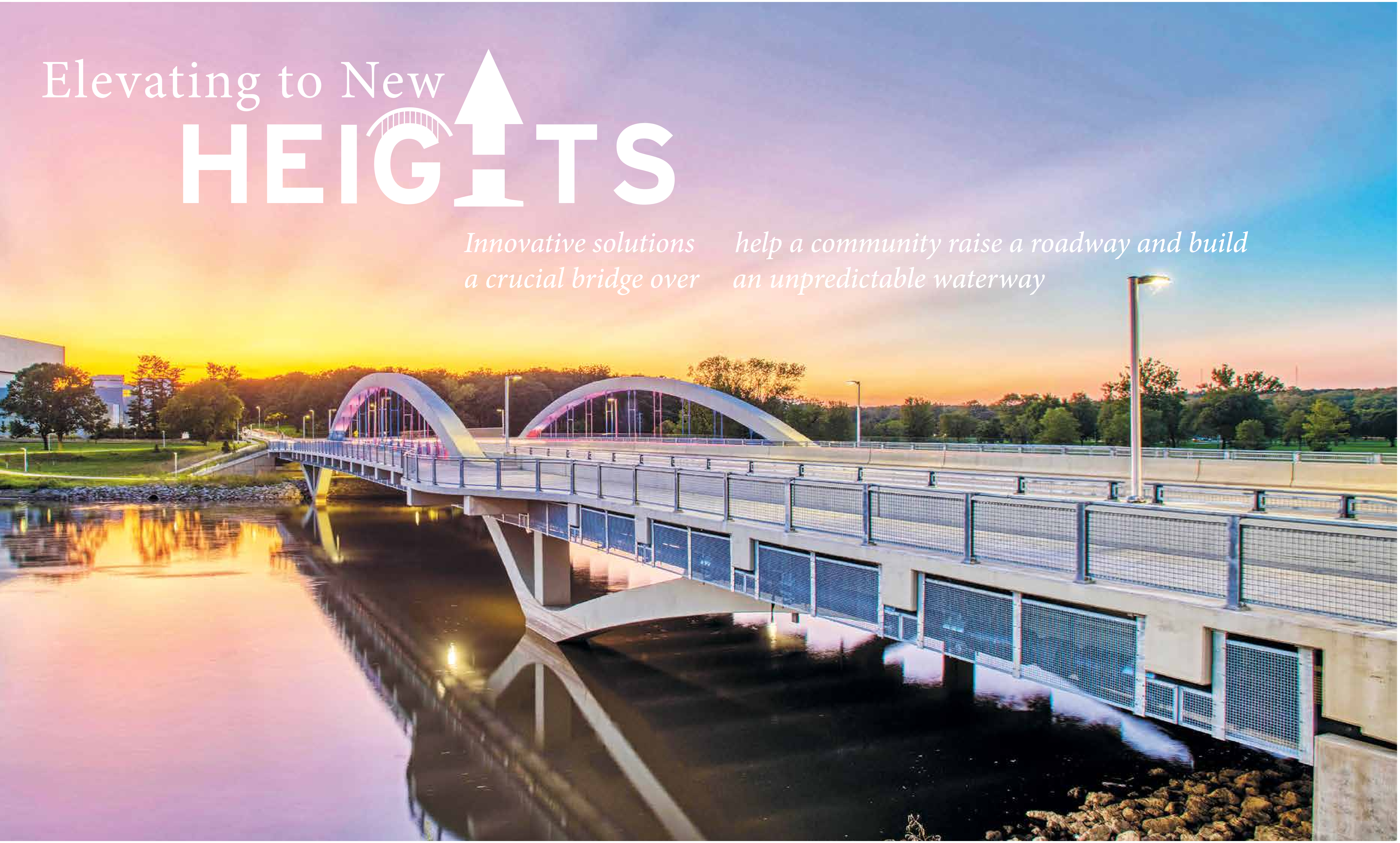
Elevating to New HEIGHTS

Innovative solutions help a community raise a roadway and build a crucial bridge over an unpredictable waterway



DUBUQUE STREET IN IOWA CITY, IOWA, runs parallel with the east bank of the Iowa River and serves as a primary north-south corridor from Interstate 80. Carrying around 25,000 vehicles a day it is, for all practical purposes, the "gateway" to the city and the University of Iowa.

Mayflower Residence Hall, home to approximately 1,000 University of Iowa students, is located on Dubuque Street and to the south is Park Road Bridge, the east-west link from Dubuque Street to the university's west campus. The street and bridge were major thoroughfares with serious reliability issues.

Flooding of the Iowa River has increased in frequency and severity during the last 26 years. The 1993 Iowa River flood forced Dubuque Street to close for more than 50 days and another larger flood in 2008 closed it for more than a month. The flood of 2008 also submerged Park Road

> *"We've received some really good feedback from the public, from the staging plans and throughout the entire process. The new efficiencies have reduced the backup that we had previously experienced, especially in the mornings. And we've been through a major flood since then and traffic was uninterrupted"*
>
> *- Melissa Clow, Special Projects Administrator, Engineering Division, Iowa City*

2,000 feet of Dubuque Street was elevated by nearly

8 ft

Bridge and destroyed the University of Iowa's Hancher Auditorium and Art Museum and severely damaged dozens of other facilities, including access to local hospitals. These disruptions not only affected access to the campus and downtown but also the safety, mobility and health of the community. Emergency response times increased, and the transportation network was strained by increased traffic on the remaining open roadways. Only two of six bridges in the area remained open during the 2008 flood.

Rectifying the problems presented a major challenge for the city, so HNTB was engaged to develop, design, produce and oversee a solution: the Iowa City Gateway Project.

Managing awareness, addressing concerns

"HNTB's experience with larger department of transportation projects and its knowledge of the NEPA process, which we needed to get a FONSI (Finding of No Significant Impact), was crucial to the process," said Melissa Clow, special

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projects administrator for Iowa City's Engineering Division. "Their people also were invaluable in helping us through the public comment period."

That was a potentially contentious stage, Clow said, with many voices to be heard. Besides the Department of Transportation and Iowa City, stakeholders included the Iowa City Historic Commission, the Iowa State Archeologist's Office, the State of Iowa Historic Preservation Office, the President's Advisory Council on Historic Preservation, and numerous neighborhood associations, all with points of view and concerns that had to be addressed and managed.

One public meeting attracted more than 200 people, and HNTB had 10 representatives on hand to address attendees' concerns.

"HNTB staffed the meetings with ample professionals," Clow said. "They gave us the opportunity to review comments to determine which ones were well-founded and which were repeated. That allowed us to rank them in importance and address them as we went through the planning process."

The existing bridge was a big part of the problem. With five substructure elements in the waterway and a low elevation, the bridge had acted as an impediment to the flow of water in 2008.

"When all this water came downstream, it was like running into a dam," said Natalie McCombs, HNTB's bridge task lead and engineer of record for the bridge. "In some of these major flood stages, it would overtop the bridge."

The decision was made to build a new, higher bridge, in addition to raising the elevation of Dubuque Street, an already complex undertaking that presented several unique challenges.

DESIGNING SOLUTIONS

The design of the new Park Road Bridge is distinctive and aesthetically pleasing, but it presented challenges. The structural behavior and force distribution of a partial-through arch is more complex than that of a true arch or tied arch. In addition, relatively stiff piers and the framed-in nature of the structure proved to be sensitive to standard design loads, such as temperature.

HNTB's solution was a staged erection sequence with post-tensioning tendons stressed in two separate phases. Tie girder lower tendons were stressed on the non-composite section, and upper tendons were stressed on the composite section. The sequence by itself could not bring the stresses to within code values. An additional step had to be included.

HNTB's innovative solution to control stresses induced a vertical load during erection at the abutments to help counteract the tensile forces in the deck. This essentially caused the bridge to pre-compress the deck in the approach span knuckle region where the thermal loading caused the most deck tension.

To achieve this, tie girders were supported on temporary blocking at the abutments during erection. After the slab was cast, all post-tensioned tendons on the floorbeam composite section were stressed. Next, one upper tendon was stressed in each tie girder, followed by an abutment jacking displacement of ¾ inch. These two steps were repeated three more times until all four tie girder upper tendons were stressed and a total abutment jacking displacement of 3 inches had been achieved. During the entire construction period, jacks were used to monitor actual tie girder reactions at the abutments, and maximum reaction force limits were specified at each abutment jacking step.

This construction sequence and HNTB's innovative design solution allowed the desired amount of force to be induced on the structure in a controlled manner, so that tie girder deck stresses stayed within the specified limits.

HNTB | DESIGNER | Issue 112

PROJECT FACTS

- Construction began in 2016 and was completed in August 2018, within schedule and the proposed budget of $40.5 million.
- The bridge is composed of a concrete partial through arch with spandrel approaches and spans of 97 feet, 250 feet and 97 feet.
- The new bridge is 10 feet higher and nearly 2,000 feet of Dubuque Street was elevated by as much as 8 feet through the innovative use of MSE walls.
- All project components were designed and completed to preserve and complement existing scenic vistas and views.
- Flooding in September 2018 that would have caused closures before the project had no effect on the newly raised bridge and street.

Staying open and on schedule

It was imperative that the existing Park Road Bridge and Dubuque Street remained open to traffic and provided pedestrians safe walking routes during construction. But before it could even begin, the existing piers were found to be home to an endangered mussel species, which then had to be relocated downstream.

Ultimately, though, the logistics of building the new bridge were relatively simple: construct a new bridge beside the existing one. That way, both foot and vehicular traffic remained unimpeded, and the only bridge closure was during the three months it took to construct new access points. That was intentionally scheduled during the summer, when school was out and traffic was at a minimum.

Raising Dubuque Street nearly 8 feet higher was not so simple. Like the bridge, it needed to remain open to traffic, and it required installation of a 48-inch trunk sanitary sewer line beneath the street.

“That meant extra coordination performed multiple times,” said Mark Pierson, HNTB pursuit champion and project manager for the NEPA and conceptual design phase. “That, plus the traffic in that corridor, meant a lot of activity that we had to coordinate before we could even begin to design and build.”

Design that reaches new heights

Several design options for the new bridge were presented but ultimately rejected based primarily on the visual impact they would have on the surrounding area. The city wanted to keep that vista as unobstructed as possible and have a structure that would complement the new Hancher Auditorium.

The solution was a design that visually minimized the elevation of the bridge in a unique and aesthetically sensitive manner. The new bridge is a three-span, reinforced concrete, partial-through tied-arch structure with a continuous post-tensioned tie girder supporting the deck and transverse floor beams. The arch ribs rise from footings that appear to float on the surface of the water near each bank, rising above the surface of the bridge and forming the upper arch above the tie girder in the main span. Additionally, the arch rib also rises from the footing and ties into the tie girder in the approach spans.

New bridge is elevated by

10ft

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The tie girder, along with the deck and floor beams, are supported by hangers in the main span and a column at the pier location. Instead of the previous bridge's five piers in the water, there are now only two. The new structure provides a subtle and elegant solution that is 10 feet higher than the old bridge.

Raised in twos

Dubuque Street runs parallel to the river for approximately 2,000 feet, and it needed to be raised as much as 8 feet in some locations, requiring a scour resistance solution that minimized impact on the river and the many underground utilities. A cantilever secant pile wall embedded in the bedrock would satisfy these requirements, but the square footage of wall would be higher than desired and increase construction costs. An anchored wall would be more affordable but would conflict with utilities. And, while economical, a mechanically stabilized earth wall alone would be undermined by the river.

The solution? An innovative use of MSE walls.

The riverbank below the walls was protected from scour by rip rap, or

25,000 Vehicles travel on Dubuque Street per day

$40.5M Completed on budget

Bridge opened on time in **August 2018**

revetment. Concerns around stability and settlement were addressed by supporting the walls on aggregate pier ground improvements and, in anticipation of future (and frequent) flooding, the walls were backfilled with free draining stone. The road was raised in stages, two lanes first; then upon their completion, the other two. This allowed two lanes to remain open to traffic throughout the project and prevented long-term closures of Dubuque Street.

Expertise on all fronts

HNTB's expertise in areas beyond the NEPA process, transportation planning and design were integral to the success of the Iowa City Gateway.

"Since there were federal dollars involved, there were a few more steps than Iowa City was accustomed to," said Marc Whitmore, HNTB project manager for design. "Our client looked to us to apply our experience, and we were able to educate them on the process. Working together, we delivered a project that meets the city's needs, and I think they really appreciated that."

The Iowa City Gateway project has already proven its worth in dealing with the issue that sparked the initiative in the first place. Not long after the official opening of the bridge, the river flooded to a point that would have closed Dubuque Street, if it had been left at its previous elevation. This time, though, the bridge and street remained high and dry while vehicles, pedestrians and bicyclists kept on moving.

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