Preserving the past while moving into the future

Computer-generated image of the completed Bellevue bridge

The historic Jackson County river town of Bellevue is home to many transportation resources with the adjacent Lock and Dam #12 on the Mississippi River, and the Iowa, Chicago and Eastern Railroad running down the center of North Second Street, just a block away from U.S. 52, known as the Great River Road, one of only two National Scenic Byways in the state. At the base of Bellevue State Park on the south end of town where the railroad crosses under U.S. 52, Iowa DOT historic preservationists, bridge designers, engineers, and construction professionals have been working together to design and build a new bridge that addresses several issues unique to the project site.

Historical significance

Many Iowa DOT offices are working together and collaborating with other state agencies and contractors on this project. Judy McDonald from the Office of Location and Environment is the DOT's contact with Iowa's State Historic Preservation Office (SHPO). Officials from SHPO review and comment on the cultural resource reports concerning properties affected by federally funded construction projects according to the National Historic Preservation Act. For the U.S. 52 bridge construction project, one property now used as a motorcycle shop was deemed historic and will be protected and monitored during the construction process.

"To provide protection to the historic motorcycle shop building, a precondition survey was conducted to document its existing condition. The consultant made a recommendation of a vibration limit that would provide protection for the building," said McDonald. "Prior to starting construction, a seismograph with an alarm system was installed along with a system to record the vibration activity during construction. The alarm system is set to alert the contractor and DOT resident construction engineer if vibrations near a predetermined vibration limit. Crack gauges were placed on existing cracks to monitor any changes that may be caused by construction vibrations. If the seismograph alarm should go off, or if a crack has opened up, vibration-causing activities would be halted, the contractor and resident construction engineer would evaluate the cause and makes modifications to the construction methodology to avoid further occurrences. Of course, the goal is for the contractor to work carefully to minimize risk to historical properties near the construction zone."

Engineering challenges

While preserving the historical value of nearby properties is one challenge on the project, an even more daunting task came with engineering the new bridge to straddle the railroad track with an acceptable amount of vertical clearance. Jim Nelson of the Office of Bridges and Structures, said, "There is a very tight angle between the road and railroad that caused some challenges. The railroad requires a minimum 23 feet of clearance under the bridge. Designers were challenged with how to provide the clearance without raising the grade of the road above. Steve Seivert of the Office of Bridges and Structures prepared the bridge layout and coordinated with the railroad. Nelson said, "To provide railroad vertical clearance without raising the grade, a straddle bent pier with an integral pier cap was used at the intersection of the railroad tracks and bridge. The straddle bent pier has a column on either side of the tracks with heavy construction to meet the railroad

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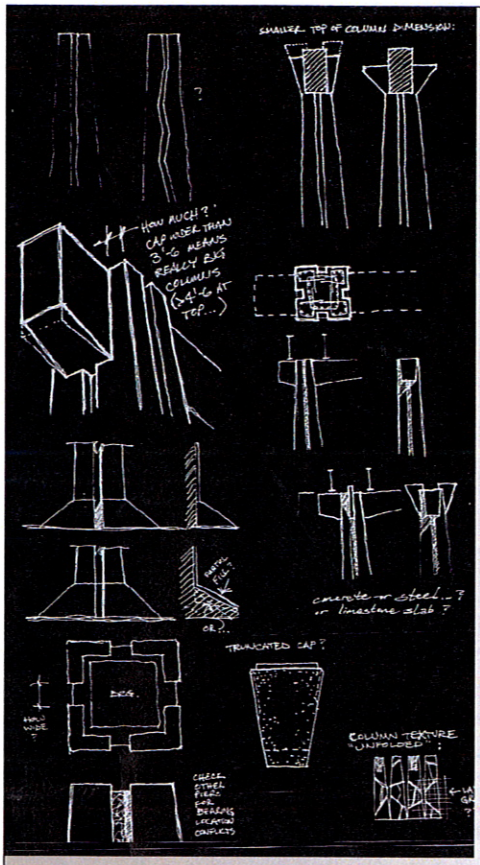
Straddle bent pier columns were used to provide adequate clearance for the railroad below the bridge



A few of Olson's original pier concept sketches

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requirements since the columns are in the horizontal clear zone. The bridge girders frame directly into a steel pier cap so that the cap and girders are at the same elevation, which maximizes vertical clearance under the pier cap and over the railroad. Other options, like using a very long span or raising the grade, would have been costly in comparison."

Aesthetics and imagery

Aside from the historic preservation and engineering challenges of the six-span, 657-foot long steel bridge replacement, the natural beauty of the area called for unique aesthetic treatments for the new bridge. Because of the bridge's proximity to scenic Bellevue State Park, the Iowa Department of Natural Resources expressed concerns about the appearance of the new structure and the roadway barriers that would flank the park's entrance. During discussions with park officials and representatives of the city of Bellevue in the planning stages of the project, it became clear that the structure's design should be sensitive to the site's natural surroundings and multiple viewing opportunities. The replacement of the current bridge would also be a chance to create an artistic statement that both complements the environment and celebrates its task of carrying the Great River Road through such a beautiful setting. "This is the prettiest bridge site I have ever been to," said Nelson.

A concrete texture mock-up of a bridge tower is given a water blast finish

Kimball Olson of the methods section of the Office of Bridges and Structures was tasked with developing the aesthetic elements of the new structure. He found his inspiration for features of the bridge in the limestone bluffs that rise above the south end of the site. Olson said, "In a typical scenario with this type of dominant physical context, a designer might simply make the bridge's concrete surfaces appear to be made from blocks of the local stone by using form liners that mold concrete to look like stone walls. Rather than build yet another bridge of this kind, we asked a question: Instead of making it appear to be MADE of stone, what would the bridge look like if it actually WERE the stone?"

Olson continued, "The quest to define this abstract notion became a driving force that helped to determine

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Olson's computer rendering of the new pedestrian facility on the Bellevue bridge

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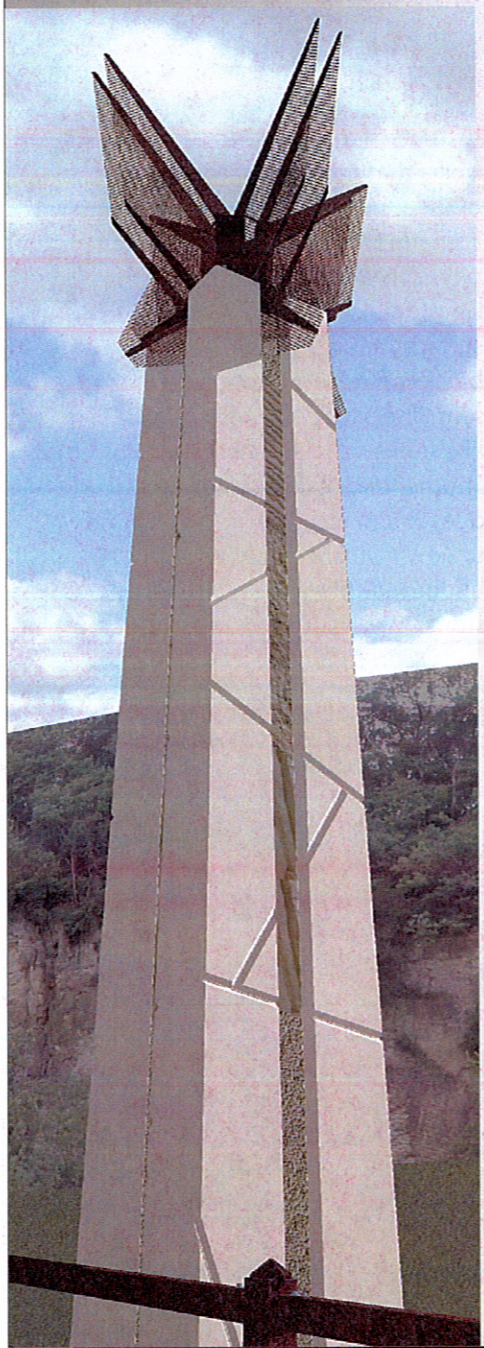
the form and finish of the bridge's piers, traffic barriers, abutments, and towers. Flat (and normally featureless) concrete surfaces exhibit erratic rustications, like fractures in weathered rock. Deep fissures run the height of the monolithic pier columns, exposing rock-like strata within. Multiple form liners were used in unconventional ways to create variegated layers of stone textures, as if laid down by natural geologic processes. The bridge's abutments appear as limestone outcroppings projecting from the landscape. There are even piles of broken limestone at the base of pier columns to suggest debris resulting from natural erosion."

Weathering steel butterflies will adorn the towers of the new bridge to connect the structure visually to the butterfly area in the nearby state park (below, computer-generated image; right, photo of steel butterfly)



The bridge's superstructure is constructed of naturally weathering steel which, over time, gains a protective, rich red-brown patina from exposure to the elements. The same material is used for the pedestrian railings, which will help the bridge blend with the scenic natural setting, and lends color to the railings without the maintenance concerns that a painted railing would have suffered.

Olson explained that the crowning feature of the bridge was inspired by a special place within nearby Bellevue State Park: "The 'Garden Sanctuary for Butterflies' is a unique area with flowers and other plantings especially chosen to provide food and habitat for many different species of butterflies," He said. "Each of the paired towers at the ends of the bridge have four abstract weathering steel butterflies perched atop, like a gathering of butterflies themselves appearing much like a flower. Their wings are made of perforated steel, which will make them appear to shimmer when viewed by motorists while they cross this new addition to their journey along the Great River Road."

Construction inspection

Cramer and Associates Inc. was chosen as the contractor on the project, with the Davenport construction office in charge of inspection. Steve Smithson, construction technician, is in his first year inspecting projects on his own. "I had a lot of experience inspecting in the shared worker program, but this is my first job on my own as a construction technician. If I have questions on the plans, I know I can always call Kimball or the construction technician seniors in my office for advice, and the Cramer people are a great group to work with; they go above and beyond what we ask of them."

Computer-generated image of bridge detail