Wisconsin’s Use of Full-Depth Precast Concrete Deck Panels Keeps Interstate 90 Open to Traffic

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The Wisconsin Department of Transportation (WisDOT) is facing future demands for highway bridge deck replacements on heavily used portions of its interstate highway system, particularly in the Milwaukee area. Typical bridge rehabilitation projects cause safety concerns and disruptions to traffic, and bridge closures have an adverse impact on the regional economy. WisDOT is focusing on prefabricated bridge systems for its highway bridge rehabilitation projects. The University of Wisconsin–Madison worked with WisDOT and Alfred Benesch & Co. to develop and design a prefabricated, full-depth concrete deck system for a major highway where minimal disruption to traffic flow is a requirement. In this article, the authors describe the research proposals, teamwork, design challenges, and construction of an innovative bridge redecking and widening project on westbound Interstate 90 over Door Creek in Wisconsin. The unique advantages of this hybrid prestressed, post-tensioned deck panel system are the result of an innovative design that essentially ties all the precast concrete deck panels together to minimize cracking, uses a novel longitudinal joint and unique strand coupling across the joint, and minimizes traffic disruption in a rapid erection scheme.

Highway agencies commonly use cast-in-place concrete for building new bridge decks or replacing deteriorated ones. Cast-in-place decks have a few drawbacks, however, primarily as a result of the construction time and cost associated with forming, placing reinforcement, and casting the new deck. All of these on-site construction activities can translate into long road closure times and traffic disruption.

An alternative to cast-in-place decks is prefabricated, full-depth precast concrete deck panels. These high-quality precast panels are constructed off-site under controlled conditions and are brought to the site ready to be placed and connected. Using precast concrete deck panels requires significantly less on-site construction activity and ensures minimum traffic interference. In many situations, a bridge can only be repaired using night or weekend closures or staged construction (some lanes remain open to traffic while others are under construction) to maintain traffic flow in both directions.

In this article, the authors explain how cross-discipline teamwork and ingenuity among University of Wisconsin–Madison (UW) researchers, the Wisconsin Department of Transportation (WisDOT), Alfred Benesch & Co. consulting engineers, The Spancrete Group Inc. (precast concrete producer), and Zenith Tech Inc. (general contractors) ensured the successful development of prefabricated deck technology in Wisconsin. The research proposals, innovative technologies, design, and construction used in the redecking and widening of the PCI award–winning I-90 bridge over Door Creek in Dane County, Wis., are presented in this article (Fig. 1).

I-90 BRIDGES DOOR CREEK

With its low unemployment rate, high number of college-educated residents, and many colleges, Madison, Wis. is often listed as one of the best places to live in the United States. Madison, the state capital, sits in the center of Dane County and has a population of about one-half million people. The major north-south interstate east of Madison, I-90, crosses Door Creek about 8 miles (13 km) from the city. The Door Creek Bridge carries about 61,000 vehicles daily. Deicing salts applied on the roads during Wisconsin’s harsh winters and heavy truck traffic had caused severe deterioration to the existing cast-in-place concrete deck.

Like many of its northern U.S. counterparts that experience harsh winters, WisDOT applies deicing chemicals on road surfaces to melt ice and snow. Freezing and thawing conditions and the use of deicing chemicals often lead to the deterioration of concrete road surfaces in northern climates. This condition is particularly evidenced on suspended concrete bridge decks that develop ice more quickly and undergo more frequent freezing and thawing cycles than do adjoining surface roads. The Door Creek Bridge comprises twin, single-span, 30-degree-skew, two-lane overpass bridge structures...
Fig. 2. Drawing of the bridge superstructure cross section. Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm.
that required deck replacement as a result of cracking and spalling of their cast-in-place concrete surfaces. Each bridge was originally a single, 83-ft-long (25 m) span that was widened for three lanes of traffic to 64.5 ft (19.7 m). The total deck area of each bridge is about 5350 ft² (500 m²). Originally, each bridge had four 60-in.-deep (1530 mm) steel plate girders spaced at 8.83 ft (2.7 m) on-center. In this project, three additional girders were added at 7.5 ft (2.3 m) on-center spacing to accommodate the deck widening.

The existing steel plate girders for both bridges are each constructed from Grade 36 (250 MPa) steel and consist of a 1.25 in. × 16 in. (32 mm × 400 mm) bottom flange, a 0.375 in. × 60 in. (10 mm × 1530 mm) web, and a 0.625 in. × 12 in. (16 mm × 300 mm) top flange (Fig. 2). The three added steel girders are each constructed from ASTM A709, Grade 36 (250 MPa) steel with a 1 in. × 16 in. (25 mm × 75 mm) bottom flange, a 0.438 in. × 60 in. (11 mm × 1525 mm) web, and a 0.75 in. × 12 in. (20 mm × 75 mm) top flange. The haunch between the girders and the bridge deck varies from 1 in. to 3 in. (25 mm to 75 mm) to adjust for camber in the girders and to obtain the required cross slope. Both bridges over I-90 use headed shear studs to achieve composite beam action.

**FHWA Demonstration Project**

The innovative rehabilitation of the westbound Door Creek Bridge is part of WisDOT’s participation in the Federal Highway Administration’s (FHWA) Innovative Bridge Research and Construction (IBRC) program to introduce full-depth, prefabricated bridge deck replacement technology to the state (Fig. 3). The purpose of the FHWA program is to increase construction efficiency and reduce road closure time. The Door Creek Bridge project consisted of three phases: conduct research and laboratory tests in order to complete the design, implement the tested design in a prototype bridge deck, and employ an extended monitoring program that will compare time, thereby minimizing disruption to highway traffic, and increase both erection crew and motorist safety with less worker exposure to highway traffic. WisDOT expects that use of this innovative deck panel system will lead to its use on other critical deck replacement projects in Wisconsin in which major traffic disruption is unacceptable.

Total cost of the WisDOT deck replacement was $1.8 million. The eastbound bridge deck was replaced using conventional cast-in-place concrete construction. The westbound bridge deck was replaced using the prefabricated deck technology. Table 1 shows the project timeline, from research to completion of construction.

**WisDOT Goals for Precast Concrete Deck Panels**

WisDOT is focusing on the use of precast, prestressed, and post-tensioned concrete bridge systems for highway rehabilitation projects to achieve the major benefits of prefabricated construction components: durable, high-quality materials; minimal on-site construction and traffic disruption; increased safety for road construction crews and the public; and minimal adverse economic impact due to road
closure. Greater demand for highway bridge deck replacements on heavily used portions of Wisconsin’s interstate highway system, particularly in the Milwaukee area, has caused WisDOT to seek innovative and cost-effective technologies for rapid deck replacement.

In addition to increasing safety and reducing costs and construction times, WisDOT’s goals for this demonstration IBRC bridge project include the following:

- Testing the durability and constructability of panel connection details and girder haunches;
- Comparing the cost effectiveness of a full-depth precast concrete deck system with a conventional cast-in-place concrete system on two bridges of similar construction on the same site;
- Demonstrating a load-testing and long-term monitoring program based on realistic in-service bridge behavior; and
- Promoting successful teamwork, with private bridge design consulting engineers, precast concrete manufacturers, and university researchers working together to develop innovative analytical methods, experimental procedures, designs, specifications, and construction practices for the use of prefabricated, full-depth concrete decks for highway bridge construction.

### University of Wisconsin–Madison: Proposed Innovations

In 2003, WisDOT provided financial support for preliminary engineering to UW to develop an innovative prefabricated, full-depth deck panel. UW worked closely with design engineers at WisDOT’s Madison headquarters and with Alfred Benesch & Co. to develop detailing and design procedures for the deck.

The feasibility study included conducting a number of tests at UW’s Structures and Materials Testing Laboratory to verify a variety of behavioral aspects of the precast concrete deck system and its connections prior to installation on-site. This important experimental research formed a basis for design and selection of connection details for the Door Creek Bridge and for other similar bridges that will be built in Wisconsin and proved the expected long-term durability of the construction. The research resulted in the proposal of three key innovative design concepts for full-depth precast concrete bridge decks.

#### First application of a longitudinal deck joint

The first innovation called for the design and construction of a longitudinal deck joint that was required for the staged construction. A system was developed in which the Stage 1 panels were fully pretensioned transversely. Half of the transverse pretensioning strands were left protruding from those panels. Stage 2 post-tensioning strand was then coupled onto the protruding Stage 1 strands. This detail allows the longitudinal joint to be post-tensioned with added integrity, making it less susceptible to deterioration (Fig. 4). The authors believe this is the first time that this type of tensioning system along a longitudinal joint has been used in the United States, and this application is a first for WisDOT.

#### Twice AASHTO’s shear stud spacing

The second innovative concept deals with using a wider shear stud blockout spacing for composite action between the deck and girders. Traditionally, shear studs are spaced at a maximum interval of 2 ft (0.6 m). The larger 4 ft (1.2 m) spacing was justified based on test results of a half-scale model. This detailing innovation simplifies panel and deck construction (Fig. 5 and 6). This is the first time WisDOT has allowed shear stud spacing to be twice the American Association of State Highway and Transportation Officials (AASHTO) limit.

#### More durable longitudinal joint (not located over a girder)

The longitudinal joint for the prototype bridge is not located over a girder but rather occurs between girders. When traffic is on the Stage 1 deck (during Stage 2 construction) the cantilevered portion of the deck at this joint has to resist moments from a temporary barrier wall. The moments induced by

<table>
<thead>
<tr>
<th>Table 1. Project Timeline from Research to End of Bridge Deck Monitoring</th>
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<tbody>
<tr>
<td><strong>UW deck research project begins</strong></td>
</tr>
<tr>
<td><strong>Project kickoff meeting with WisDOT and precasters</strong></td>
</tr>
<tr>
<td><strong>Identification of existing full-depth precast deck panel technology</strong></td>
</tr>
<tr>
<td><strong>Testing of deck systems at UW</strong></td>
</tr>
<tr>
<td><strong>Design of prefabricated deck system for prototype bridge</strong></td>
</tr>
<tr>
<td><strong>Plans, specifications, and estimates package to WisDOT District 1 office</strong></td>
</tr>
<tr>
<td><strong>Project let for bids by WisDOT</strong></td>
</tr>
<tr>
<td><strong>Deck construction</strong></td>
</tr>
<tr>
<td><strong>Load testing</strong></td>
</tr>
<tr>
<td><strong>Monitoring commences</strong></td>
</tr>
<tr>
<td><strong>One-year monitoring period ends</strong></td>
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</tbody>
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Note: UW = University of Wisconsin–Madison; WisDOT = Wisconsin Department of Transportation.
Fig. 4. Plan view of deck panel layout shows Stage 1 and 2 construction and deck dimensions. Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm.
Shear stud blockout plan and prefabricated, full-depth deck panel details.

Fig. 5. Shear stud blockout plan and prefabricated, full-depth deck panel details. Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm.

SECTION D-D

TYPICAL SECTION TRANSVERSE
AND LONGITUDINAL SHEAR KEY DETAIL

NOT TO SCALE

VERTICAL ADJUSTMENT

NOTES:
1. The slab shall be placed at the normal spacing shown on the plans with a 3/8 in. gap between the slabs. The width of this gap can vary due to slab tolerances.
2. Grout for shear keys shall be rodded or vibrated to ensure that all voids in the shear keys are filled.
For Spancrete, the most difficult portion of the Door Creek Bridge Project was addressing the design, alignment, and assembly of the precast deck slabs. In particular, a number of challenging problems were presented in the reinforcing steel design and in the connecting hardware. With over three decades in the precast design field and experience on hundreds of transportation projects throughout the Midwest, Tom Payne, the Spancrete project coordinator for the precast deck panels, was responsible for making everything come together. Payne provides drafting, engineering, and project management support for Spancrete’s bridge and transportation customers in Wisconsin, Michigan, and Illinois.

Reflecting on the project, Payne said, “The toughest part of this project was designing and manufacturing the decks so that they all fit together perfectly. We had to really focus on the details. The real thanks must go to our Spancrete plant production staff in Waukesha, Wis. for their attention to the engineering and manufacturing details. There were many areas that needed to be exact to make these slabs fit together. What we learned from this project will carry forward into other bridge projects.” The project engineer of record, Jay Carter of Alfred Benesch & Co., was very helpful in providing the engineering expertise to partner with Spancrete to redesign the interior reinforcing to accommodate the new alignment design of the deck panels.

Tom Payne is a project coordinator for bridge and transportation division in Spancrete’s Waukesha, Wis. office. Payne is a graduate of Madison Area Technical College and has over 31 years of drafting and engineering-related experience with The Spancrete Group Inc.

DIFFICULT DECK SLAB REDESIGN HANDLED BY SEASONED SPANCRETE PROFESSIONAL

INNOVATIVE FULL-DEPTH PRECAST CONCRETE DECK DESIGN

The bridge deck designed for this project is composed of full-depth precast concrete deck panels that are pre-stressed in the load-carrying direction (transverse to the bridge centerline) and post-tensioned for load distribution (parallel to the bridge centerline). Welded wire reinforcement (WWR) was added in the short direction during transport and erection for strength prior to longitudinal post-tensioning. Deck panels are 8 ft (2.4 m) wide for transportability by truck, and the panel length is half the bridge width (because half of the bridge was constructed in each stage).

Because WisDOT mandated that the I-90 bridge over Door Creek re-

Fig. 6. Cured shear stud blockouts show 4 ft (1.2 m) spacing, greater spacing than that of typical American Association of State Highway and Transportation Officials–approved design.
main open to traffic during construction, one row of panels (the length of which matches the Stage 1 construction width) connected to a second row of panels under traffic (Fig. 7). Both rows contain 10 panels laid side by side to traverse the length of the bridge, plus closure pours at the abutments to cast in the expansion joints. Each row of panels was then post-tensioned longitudinally, from abutment to abutment, across each transverse joint between panels (Fig. 8).

The transverse joints are female-to-female in shape and are filled with grout such that the post-tensioning creates a sandwiched cementitious mass under compression. This mass transfers shear and moment across the joint without developing significant stress concentrations or cracking. After the first row of panels carried traffic while the second row was placed, grouted, and post-tensioned longitudinally, the longitudinal joint between the rows was grouted and post-tensioned transversely. This configuration, as noted previously, was accomplished with the following design scenario:

- Half of the transverse pre-stressing strands in the first row of panels were left protruding at the longitudinal joint. These were then coupled into transverse post-tensioning strands in the second row of panels across the longitudinal joint (Fig. 9). The ducts in the second row of panels are designed to line up with the protruding prestressing strands in the first rows of panels to facilitate this coupling.
- The longitudinal joint is located between the girders. Therefore, the full positive moment of the deck must be carried over the joint. Half of the transverse prestressing strands in either row of panels carry the loads due to handling, transporting, and placing. The other half of the prestressing strands, coupled across the joint and post-tensioned at the outer deck edge of the panels—along with any remaining capacity from the uncoupled strands (carrying load in the cantilevered condition)—carry vehicle-induced bending (Fig. 10).

Full-depth pockets were precast into the panels to allow for the installation of shear studs after the panels were in place and longitudinally and/or transversely post-tensioned. The pockets and the haunch were grouted after installing the shear studs. The deck panels were first ground flush for appearance and rideability (Fig. 11), and then a thin epoxy membrane overlay was

![Fig. 7. The Door Creek Bridge, shown under construction during Stage 1, has full-depth precast concrete panels set on steel girders.](image)

![Fig. 8. Longitudinal post-tensioning.](image)

![Fig. 9. The coupling of post-tensioned strand to pretensioned strand at longitudinal joint.](image)
installed over them. Based on previous projects with cast-in-place concrete decks on steel girders, the maximum shear stud spacing, or distance between shear stud blockouts, is 2 ft (610 mm), which conforms to AASHTO. In most circumstances, this spacing is based on the fatigue capacity of the studs and not their ultimate capacity.

With precast concrete panels, however, it is beneficial to place the shear connector blockouts at the largest spacing possible. Previous research showed that the stud blockout spacing could be increased to 4 ft (1220 mm) without adversely affecting the composite structure’s strength and stiffness. This increased spacing allows for fewer blockouts in the individual panels, which in turn increases panel strength for shipping and decreases manufacturing time and cost.

The unique advantages of post-tensioning in this design result from tying all deck panels together. All joints are compressed together such that the joints rarely experience loads causing tension, which may cause cracking. Any cracking effects are reduced, as the cracks will close after the extreme load passes off the joint. In tying rows of panels together across the traffic lane, the post-tensioning also makes efficient use of the strand’s high strength for vehicular, dead, and construction loads. The post-tensioned longitudinal and transverse joints have significantly improved shear and bending resistance, and this design will increase the life of the deck.

**PRECASTER USES SCC IN CONGESTED FORMS**

For the precaster, the job was fairly straightforward. The precast concrete deck panels were cast in a typical fashion with a self-consolidating concrete (SCC). The structural section of the deck was congested with reinforcing bars, WWR, and ductwork (Fig. 12). An 8.5 in. (215 mm) ground section held one layer of longitudinal post-tensioning between two layers of transverse post-tensioning, WWR, and edge reinforcement, along with skewed anchor blockouts, skewed shear pock-
ets, and lifting lugs. SCC was used to increase the workability and feasibility of casting all these different layers with complicated hardware within the 8.5 in. section. This was the first use of SCC for bridge construction by WisDOT.

Spancrete had one main production challenge with the Door Creek Bridge project: post-tensioning duct alignment. Spancrete paid special attention to forming and jiggling details in order to maintain tight tolerances and to minimize the potential for tendon misalignment. Even though this project had tight tolerances, Spancrete’s standard production process could easily meet them.

Spancrete supplied all of the precast, prestressed/post-tensioned concrete deck panels for the project: 20 trapezoidal panels, 8 ft (2.4 m) wide × 31.25 (9.5 m) long with a 30 degree skew at the ends. Structural materials included WWR, SCC, prestressing strands, post-tensioning strands and hardware, and post-tensioning strand couplers (Table 2).

**STAGED CONSTRUCTION KEEPS BRIDGE OPEN TO TRAFFIC**

In the staged construction for this project, half of the bridge was replaced while the other half was kept open to traffic (Fig. 13–15). Work zone safety was increased by reducing the exposure time as well as the number of workers operating near moving traffic, and environmental impacts were reduced by minimizing the site access footprint.

On the left side of the Stage 1 precast concrete deck panel, the reinforcing steel loops for a cast-in-place barrier wall extend above the surface (see Post-Construction Interviews, p. 00). Sets of three ducts, for longitudinal post-tensioning, exit from the edge on the near side of the panel. The longitudinal joint is configured on the right side of the panel, after traffic is moved from the existing deteriorated bridge deck, and onto the new precast deck.

Erection of the Stage 1 precast concrete deck went well, with speed and efficiency. The primary change that could be made in future construction of a prefabricated deck is in the use of flat ducts for post-tensioning carrying three strands, rather than the three individual ducts in groups. A single duct would significantly reduce the field time required to splice the strands and ducts at the panel joints.

**DECK SYSTEM PERFORMANCE EVALUATION**

As part of the IBRC project, UW and WisDOT are conducting a performance evaluation of the full-depth deck system on the westbound Door Creek Bridge. This evaluation will be conducted primarily by researchers at UW and include a real-time constructability study, post-construction load testing, and long-term monitoring.

For use in load testing and long-term monitoring of the bridge system, instrumentation has been installed on selected regions of the precast concrete panels and the connections. Load testing of the completed prototype bridge has been conducted to verify the system stiffness, to assess the load distribution to individual girders compared with design assumptions, and to check the effective transverse wheel-load distribution in the full-depth concrete deck panels. Initial load testing immediately after construction indicated that the bridge with prefabricated deck panels is stiffer than a bridge with a cast-in-place deck. The prefabricated deck bridge also has a larger wheel distribution width than a typical bridge and a larger width than that suggested by AASHTO design procedures.

On October 9, 2006, one year after construction was completed, monitor-

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### Table 2. Precast Concrete Components

<table>
<thead>
<tr>
<th>Precast Component</th>
<th>Number</th>
<th>Dimensions, ft</th>
<th>Weight, lb</th>
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<tbody>
<tr>
<td>Stage 1 interior panels</td>
<td>8</td>
<td>38.66 × 6.92</td>
<td>24,300</td>
</tr>
<tr>
<td>Stage 1 end panels</td>
<td>2</td>
<td>38.66 × 6.92</td>
<td>24,125</td>
</tr>
<tr>
<td>Stage 2 interior panels</td>
<td>8</td>
<td>43.83 × 6.92</td>
<td>28,100</td>
</tr>
<tr>
<td>Stage 2 end panels</td>
<td>2</td>
<td>43.83 × 6.92</td>
<td>27,925</td>
</tr>
<tr>
<td>Total number of pieces</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 1 ft = 0.3048 m; 1 in. = 25.4 mm; 1 lb = 0.4536 kg.
A post-construction interview was conducted by the University of Wisconsin–Madison (UW). The following responses came from seven Spancrete employees, the contractor’s supervisor, the resident engineer, and Wisconsin Department of Transportation (WisDOT) maintenance and inspection engineers.

**UW Researchers**

- A standard post-tensioning supplier should be called out in the plan documents. The choice of supplier should not be left to the precaster. All post-tensioning materials should come from one supplier. In future bridge deck projects, WisDOT should standardize details and materials.

**Precaster**

- Plan documents regarding post-tensioning should be detailed enough to allow easy preparation of shop drawings. Also, it helps to have one standard supplier.
- Use of self-consolidating concrete (SCC) is critical in precast concrete components such as this, where reinforcing and ductwork congestion exists. These panels could not have been cast without SCC.
- Use two separate bars for connection of barrier walls rather than a looped bar. It is difficult to insert barrier reinforcing between all the other inserts in the deck.
- Cost is related to number of pieces. Use larger sizes and fewer pieces.

**Contractor**

- The contractor needs to plan ahead. This deck project was different from typical rehabilitation construction. A separate post-tensioning contractor is required, and this complicates scheduling.
- Setting the precast panels was an efficient process. Size of panel and access, however, will need to be taken into account by the designers when applying this concept to larger structures.
- The designers may want to consider eliminating post-tensioning to reduce overall construction time. Implementing a system designed to fasten the panels together during the time of placement will reduce construction time.
- Implementing a concrete overlay would eliminate the need for panel grinding. This will reduce construction time. In addition, panel alignment tolerance could be increased.

**Resident Engineer**

- Use larger panel pieces. Larger pieces would require less handling to place and would reduce the number of grouted joints.
- Take more care in getting a smooth surface, without ripples, on the panels. This would reduce the amount of grinding necessary.
- Utilize a concrete overlay instead of grinding the panels in preparation for the epoxy overlay.

**WisDOT Maintenance and Inspection Engineers**

- Use a female/male key combination in joints to allow easier matchup and placement in the field.
- Install the expansion joints at the ends of the bridge below grade to allow the grinder to pass over the joint without causing damage.

**Engineer of Record**

- From an analysis of the time expended in constructing the deck, a large amount of time was devoted to the cast-in-place concrete closure pours. Casting the deck-side steel extrusion in the precast deck panel, leaving the longitudinal tendon pocket grouting and back-wall-side steel extrusion to be cast in the field, could save field time.
ing was conducted under the IBRC program to determine whether there are any characteristics in performance of the prefabricated deck that signal potential problems. At the one-year mark, the precast concrete deck bridge exhibited no signs of opening or leakage at any of the deck joints. The epoxy surface was in near-perfect condition. While concrete spalling had already developed on the approach slabs, the bridge deck appeared virtually new. Dane County road maintenance crews noted that the prefabricated concrete deck bridge did not exhibit icing during winter and required little salt, while the adjacent cast-in-place bridge has exhibited normal icing and salt demand.

Continued monitoring will include periodic investigation of cracking and recordings from permanently installed and embedded strain gauges and sensors. The WisDOT staff will assist in collecting data and in data evaluation for an additional three years following the IBRC project. After which, standard WisDOT bridge inspection procedures will be followed.

**WISDOT SATISFIED WITH PREFABRICATED DECK**

The success of the Door Creek re-decking project can be measured in its several practical and innovative applications. First, based on the structural research carried out at UW, the shear stud pockets for the precast concrete deck were able to be spaced 4 ft (1220 mm) apart. This design innovation simplified the deck manufacturing process and increased the speed of deck replacement.

A second successful new application was the design of the longitudinal construction joint to allow traffic flow during deck replacement. Construction-related inconvenience to the public was greatly reduced by this innovative design. A third major benefit was the secondary effect of the staged construction. After Stage 1 construction was complete, there was notably increased efficiency on the part of the contractor in deck placing and stressing activities for Stage 2 of the project.

Because everyone involved in this project was learning about the application of this new technology, the Stage 1 experience resulted in significant procedural improvements during Stage 2, demonstrating that with a little experience, the local contractor handled the novel design quite efficiently. Based on the successful application of the new precast concrete technologies in the Door Creek Bridge project, WisDOT has scheduled three major projects for 2007, and prefabricated, full-depth, precast concrete decks are an integral part of the project planning. WisDOT considers the redecking system used for I-90 at Door Creek to be a valuable tool in the agency’s arsenal of methods for rebuilding aging infrastructure as quickly and efficiently as possible (Fig. 16).

![Fig. 13. The erection crew from Zenith Tech Inc. of Waukesha, Wis., and a Stage 2, prefabricated, full-depth deck panel.](image-url)
CONCLUSIONS: “IT’S ALL HERE”

For the past several years, “Get in, get out, and stay out” has been the FHWA’s mantra for repairing the country’s transportation infrastructure. WisDOT’s expectation was that the precast concrete deck design used for I-90 over Door Creek would fully satisfy the FHWA’s goals. The agency’s expectations proved well founded. Recently, the project team met at the site to examine the deck on the one-year anniversary of the bridge’s opening to traffic. Half of the structure was closed to allow for a closeup inspection of the deck and joint conditions. No cracks of any kind, including at the panel joints, were found.

It has been said that every project revolves around three things: price, speed, and quality. Typical projects attain the benefits of two of these items, but not all three. Results at the Door Creek Bridge, however, clearly demonstrate that the benefits of price, speed, and quality can be obtained in one highly successful package. The fine work and high quality of the finished product is a credit to the ingenuity and hard work of the entire project team.

In bestowing the Harry H. Edwards Industry Advancement Award for 2006 to the Door Creek Bridge redecking project, the PCI jurists agreed with the project’s overall success: “This project is truly a prototype that lends itself to the specifics of a Harry Edwards Award; its concepts hold the potential for future growth of the industry. It showcases a completely new system with new components for bridge deck replacement projects and speed of construction and durability of the decks. It’s all here. It is a very simple addition to a simple landscape. There is a lot
of restraint in terms of the way it is detailed and designed.”

ACKNOWLEDGMENTS

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CREDITS

Owner: Wisconsin Department of Transportation; Madison, Wis.
Engineer of Record: Alfred Benesch & Company; Kenosha, Wis.
General Contractor: Zenith Tech Inc.; Waukesha, Wis.
Precaster: The Spancrete Group Inc.; Waukesha, Wis.
Research: Department of Civil Engineering; University of Wisconsin–Madison

REFERENCES


Fig. 15. Workers finish the cast-in-place concrete closure pour.

Fig. 16. View of I-90 deck at Door Creek after completion. Based on this successful installation, the Wisconsin Department of Transportation intends to use this deck replacement system in several planned projects for 2007.