The Illinois Department of Transportation (IDOT) District Four had a major challenge. The eastbound McClugage Bridge, which carries U.S. routes 24 and 150 over the Illinois River in Peoria, needed major rehabilitation. This meant that the newer westbound bridge would have to carry two-way traffic while the older bridge was repaired. However, several construction and maintenance projects on these routes over the past 10 years, including a very recent project on the westbound McClugage Bridge, had just about exhausted the patience of commuters.

Nevertheless, there wasn't any choice. The monumental steel through-truss bridge, built in 1949, needed the complete replacement of the floor beams and stringers (which span the beams and support the deck) and repairs to the trusses above and below. This work could not be done with traffic on the structure.

To place both eastbound and westbound traffic on the adjacent, newer structure would require a positive separation of traffic, which would provide a maximum of three lanes. So the question became: "How can we best accommodate traffic?" Do we accommodate the morning or afternoon rush hour? Or try a scheme with reversible lanes? There were pros and cons to each option examined.

The final decision was made to use the Quickchange® Moveable Barrier (QMB™), a product of Barrier Systems Inc. QMB can be moved laterally by a transfer machine without disrupting traffic to allow for two lanes in the direction of the rush-hour traffic. QMB consists of connected 1-meter sections of safety-shaped concrete barrier with a T-shaped top to accommodate the lifting rollers on the barrier transfer machine.

### The Alternatives

One of the key pieces of information needed to determine the best alternative was the traffic data. In addition to the data gathered through the normal planning process, the district did a five-day, 24-hour-a-day count to get more accurate volume, speed, and truck data. They performed a capacity analysis and traffic movement studies to evaluate the current and expected traffic flow. They did not use the modeling program that they would typically use, QUEWZ, because it cannot handle merge points that are close together.

Using the data they gathered, they looked at the following alternatives and considered the positive (+) and negative (-) aspects of each alternative:

#### One Lane for Each Direction

+ Leaves shoulders for emergency vehicles.
Two Lanes Inbound, One Outbound

- Accommodates morning rush-hour traffic.
- Creates congested traffic in the evening.

Reversible Center Lane With Temporary Barriers on Either Side

- Accommodates both morning and evening traffic.
- Decreases capacity in the two-lane direction because drivers would be forced to choose their lane prior to reaching the bridge and they would not be able to change lanes while crossing to adjust for the lane volumes.
- Requires closure of some roadway ramps that are very close to the bridge, and does not permit entering traffic to choose a lane, contributing to the capacity/lane-use issue.
- Makes signing for lane selection especially critical because all traffic exiting the highway at the far side of the bridge would need to get into the right lane prior to getting onto the bridge. This would also contribute to the problem of capacity in the right lane.
- Restricts access for incident response.
- Reduces lane and shoulder width.

Reversible Lanes With a Moveable Barrier

- Accommodates both morning and evening traffic.
- Eliminates the capacity and lane-assignment problems mentioned above.
- Costs more.
- Poses potential problems in case of difficulties with the equipment/technology.
- Reduces shoulder width.

The Decision-Making Process

The district decided to pursue the project with a reversible lane using a moveable barrier because that alternative satisfied the most significant operational and safety needs. From an operational standpoint, two westbound lanes were needed during the morning rush period and two eastbound lanes during the evening rush period to prevent the same congestion problems that were experienced the previous year during the work on the westbound bridge. From a safety perspective, QMB provided a reversible-lane solution with minimal worker exposure to traffic while permitting access for emergency vehicles.

In addition, the district was interested in evaluating the technology to determine its potential usefulness on an upcoming project—the reconstruction of I-74 through Peoria.

Potential Problems

The district looked into some issues based on the previous experiences of IDOT. Many of the issues were related to QMB, but there were also some challenges with geometrics, public information, and emergency services.

The decision about whether to buy or lease the equipment was based on an analysis of the need for specialized maintenance and storage and the possibilities for future use. The maintenance issue was important because the district was concerned about delays to the project. The bid proposals required the contractor to lease or purchase the machine directly from the supplier so that IDOT would not be liable for delays caused by equipment problems. If QMB was successful, it was quite likely IDOT would use it on future projects in the area, but by then, an improved version would probably be available. In addition, because the district had a concern about the need to continue to store and maintain the equipment, district officials decided to go with the lease option.

This technology was tried in the East St. Louis area when it was new, and some problems with the equipment were encountered. In light of this, the district took a few precautions to ensure that the equipment used on this project would work as needed. Because several variations of the transfer machine are available around the world, the district developed a generic specification indicating the required capabilities to ensure that a newer version would be used. The specification also required that a minimum number of spare sections of barrier be available on site in case replacements were needed after a crash or other incident.

IDOT also had to consider the alignment of the roadway, which is offset from the bridge on the Peoria side. This required that the barrier must accommodate the appropriate curvature and must be capable of holding the correct alignment along the curve during the twice-daily transfers. To meet these requirements, the transfer machine had to accommodate an approximate 1,000-foot (300-meter) radius.

U.S. 24 runs parallel to the river in Peoria and joins U.S. 150 very close to the bridge. On the other side of the
river, U.S. 150 breaks off from U.S. 24 just past the bridge and heads south. A significant portion of the bridge traffic enters and exits on these ramps that are very close to the structures. Typically, traffic on the entering ramps must merge with through traffic. After analyzing the traffic data, IDOT engineers thought they could increase the capacity in the direction with two lanes by eliminating this merge maneuver, giving on-ramp traffic their own through lane.

On the east side, this was managed by funneling the westbound traffic on the through route (U.S. 24) down to one lane prior to the entrance ramp (U.S. 150), which then had its own lane when two lanes were open westbound. When only one lane of traffic was westbound, the merge still had to occur, but at least, it was separated from the lane closure merge of the U.S. 24 traffic.

On the west side (in Peoria), a similar system was used when two lanes were eastbound, but when only one lane was eastbound, the on-ramp was closed, and a detour for this traffic was provided.

Another concern about the use of QMB was the load that it would place on the structure. When the transfer machine is holding 50 feet (15 meters) of barrier as it makes the transfer, it is above the legal load limit on the McClugage Bridge. The bridge engineer leading the project design checked the integrity of the structure to ensure it would not be compromised, and appropriate permits were secured.

The lane-changing process took about 30 minutes. The transfer machine moves at about five miles per hour (eight kilometers per hour), and after the barrier was moved, some drums had to be moved to complete the process.

So that regular users of the bridge could anticipate whether one or two lanes would be open in their direction of travel, the district decided that the lane changes would take place at specific times each day. A $1,000 per hour penalty was levied against the contractor whenever the change was not completed within the specified one-hour window.

Based on the history of public input from projects in the area over the previous decade, IDOT knew that congestion would be a prominent issue. Even with QMB providing two lanes in the rush-hour direction, IDOT was concerned that excessive congestion would create a need to reroute traffic at certain times. To deal with this, the district decided to implement two other new technologies. One was a real-time traffic control system called ADAPTIR that uses both Doppler radar to...
The barrier-moving machine has just completed moving the barrier and is now moving toward its parking space between the permanent barrier and the moveable barrier on the west side of the McClugage Bridge.

detect reduced traffic speeds and strategically placed variable message signs to display delay or diversion messages. The second technology was a surveillance system.

Emergency service agencies were very helpful in anticipating potential problems and in taking steps to alleviate or eliminate them. For example, the police stated publicly that they would be enforcing the no U-turn regulation. Tow trucks were on site, one on each side of the bridge, during rush hour. Sites were built nearby to which disabled vehicles could be quickly towed to minimize any disruption of traffic.

Results

The use of QMB on the project was a tremendous success. The transfer equipment worked well without any significant interruption to traffic. There was some minor kinking of the barrier rail and some longitudinal creep, but the operator of the equipment quickly learned how to avoid these problems. Actual traffic counts during the project showed that about 20 percent of the preconstruction traffic was not using the bridge. The backups that did occur were less than anticipated. In fact, there were so few problems that the automated real-time traffic control system was never put to full use.

One of IDOT’s goals was to minimize workers’ exposure to traffic. The QMB transfer machine does most of the work during the lane change, but at the ends of the barrier, some drums had to be moved.

Also, the eastbound on-ramp had to be closed for the morning lane configuration and opened for the evening lane configuration. The inspectors and the work-zone crew worked out a system to make the daily changes quickly, orderly, and accurately by painting orange circles around the drum location for the morning configuration and white circles for the evening configuration. This allowed the entire lane-change process to be done in approximately 30 minutes.

Moving the transfer machine across the outside traffic lanes to get it out of the way when not in use would have required stopping traffic. However, this problem was eliminated by safely storing the machine in the median. When parked on the east end of the bridge, the machine was shielded from traffic by the moveable barrier on one side and a line of temporary barriers on the other side. On the west end of the bridge, the moveable barrier on one side and an existing permanent concrete barrier on the other side separate the machine and traffic.

IDOT aggressively informed the public about work-zone conditions. The department held a press conference prior to closing the bridge and provided news releases and articles to the media to keep the public properly informed during the project. IDOT provided a safe vantage point from which media could film and photograph the bridge and traffic. In addition, the local newspaper mounted a video camera on its nearby high-rise building, and the video was webcast for anyone who wanted to check the traffic situation at the bridge site. Because the project went so smoothly, virtually all the press was positive.

Lessons Learned

• Get all the necessary traffic data and analyze the benefits and cost of temporary traffic control. When appropriate, the data should be analyzed using traffic flow models such as CORSIM or QUEWZ.

• Get public input on how the project will affect the community and examine alternatives that address the issues raised.

• Talk with the supplier/manufacturer about your specific needs and make sure that the equipment you specify meets all your requirements, including such items as: loading of structures, radii on curves, ability to shift the needed lane width in one pass, and timing.

• Look at options for leasing or purchasing in light of liability for delays and future uses of the equipment, as well as cost.

• Consider where the transfer machine will be stored while not in use and how the driving public be protected from its non-crashworthy presence if it is within the clear zone.

• Work with emergency services in the area. They will need to know about the operation and will probably be able to anticipate problem locations.

• Address the public relations/outreach effort to explain the purpose of the project and its impact on traffic flow.

Be proactive so that correct information is published and broadcasted.

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