conference preview

SLIDE-IN SOLUTION

How quickly can a 425-ton bridge move 92 ft? Pretty quickly, actually.

BY THADDEUS KOSMICKI, PE

ONCE CONSTRUCTED, BRIDGES typically stay in a single location. And when it comes to short-span bridges, their movement is generally limited to live load deflections and the effects of thermal forces.

But that's not always the case. Slide-in bridge construction (SIBC), which involves constructing a bridge in one spot then moving the entire assembly into place, is suitable for some projects. In fact, this tactic was recently employed for a multi-bridge project on Interstate 70 in Columbia, Mo. Three of five total bridges (replacing six existing bridges) were designed and built off-alignment in a temporary location—two of them were used for maintenance of traffic (MOT) in their initial location—and were then laterally slid into their final locations to match the existing alignment.

The team employed the design-build project delivery system to replace the six structurally deficient bridges while maintaining traffic on I-70—more than 80,000 vehicles per day—during construction. Although the lateral bridge slide required a short-term traffic diversion, the public experienced limited inconvenience when compared to the extended traffic impacts associated with traditional phased construction. Further, using SIBC and constructing temporary bypasses allowed construction crews to work uninterrupted and away from the traveling public, ensuring safety for all. The project approach also minimized the amount of closure time of local city streets and improved traffic flow through the entire corridor.

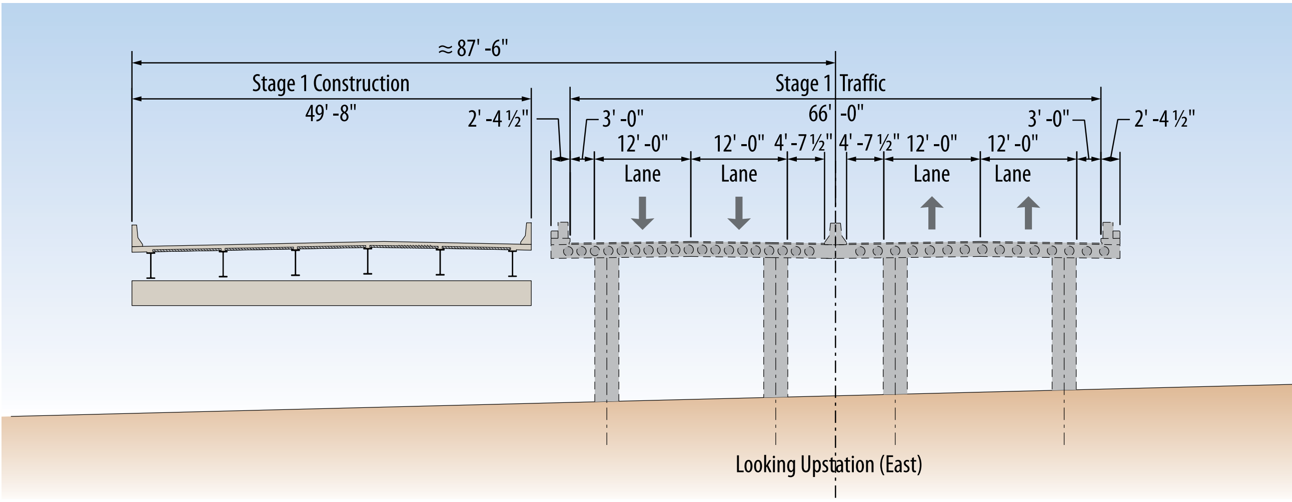
The Missouri Department of Transportation's (MoDOT) decision to use the design-build procurement method allowed the engineer and contractor to work in collaborative environment to detail, design and construct the bridges. Along with developing the bridge sliding procedures, there were several distinct structural elements that required close partnership to facilitate the slide as well as address MoDOT's long-term durability requirements.

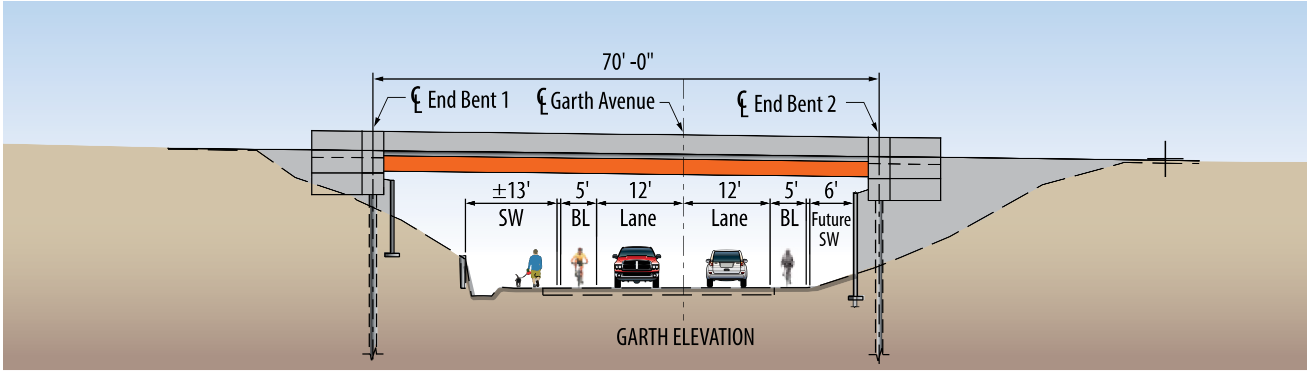
The three I-70 bridges employing the SIBC technique were located at the Route 763 (Rangeline), Garth Avenue and Business Loop 70 (West Boulevard) interchanges.

End Bent Considerations

With respect to the substructures for the SIBC bridges, the end bents were designed in a manner that supported the temporary condition, the bridge slide, the final permanent state of the bridge and future widening. Throughout the duration of the slides, the end bent cap experienced a transient loading across the entire length of the cap. The end bent cap design needed to accommodate not only the maximum dead load at any given point, but also any loading attributed to vertically jacking the bridge to install bearings. In addition, the end bent pilings need-

A typical section of the westbound I-70 bridge over Garth Avenue in the temporary alignment, with existing I-70 bridges shown.





▲ The 355-ton westbound I-70 Bridge over Garth Ave. was slid 36 ft.

▼ Slide in progress for the westbound I-70 bridge over Rangeline.

ed to resist the lateral forces transferred through the end bent cap, generated by the hydraulic jack used to slide the bridge into the final position. A concrete anchor block was detailed at the ends of the end bents to provide a structural element to pull or push the bridge, if necessary. An embedded plate in the top of the end bent provided a level surface and a means to restrain the slide bearings and final bearings.

Unique to MoDOT bridges—and vital to the slide—was the incorporation of semi-integral end bents. Providing continuity between the end bent pile caps and superstructure, the semi-integral end bent was the best approach to accommodate sliding the bridge from a temporary location to the final alignment. The solid end diaphragm of the semi-integral end bent provid-

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An aerial view of the I-70 bridge over Business Loop, which replaced two existing bridges.

ed a large, rigid member to lift the superstructures vertically to install sliding bearings, and it also served as an anchorage point to pull the bridges into their final horizontal alignments. To facilitate vertical jacking and to slide the bridges, additional shear and moment reinforcing, anchorages for high-strength bars and stainless steel shoes (to provide a sliding surface for the lateral move) were all incorporated into the design of the end diaphragms.

In the case of the bridge over Business Loop, the slide itself used two Enerpac hydraulic jacks, which were located at each end bent and attached to the anchor block that pulled the bridge a total of 92 ft to its final location. The total slide time was approximately 11 hours and included the time needed to vertically lift the bridge to install the temporary PTFE (polytetrafluoroethylene) sliding pads as well as the permanent bearing pads once the bridge was in place.

Weathering the Slide

Not all of the bridges were identical, but the design approach and bridge slides were similar. The superstructures of all of the bridges were comprised of a composite steel and concrete deck system that featured precast concrete deck panels on welded weathering steel plate girders and a partial-depth cast-in-place deck slab. The I-70 bridge over Business Loop, at 89 ft long and 83 ft wide, was the widest and heaviest single-span bridge in the whole project. It replaced two bridges: the east- and westbound structures on I-70. The 11 weathering steel plate girders with 36-in.-deep webs were spaced at 7 ft, 7 in. With a total steel weight of 143 tons, minimizing the dead load of the bridge was key to sliding it effortlessly at approximately 9 ft per hour.

Weathering steel plate girders were selected for the superstructure thanks to the following advantages:

- Economical means to minimize structure depth and improved vertical clearance
- Lightweight structure, which allowed for a faster bridge slide
- Reduced construction costs because erecting the girders only required one crane
- Competitiveness with other methods on a cost basis
- A conventional structure type that provides long-term durability and minimizes necessary maintenance

The entire project—including the I-70 roadway, construction of a "dog bone" roundabout at Route 763/Rangeline and dual-lane roundabouts at the I-70-Business Loop interchange and five new bridges, three of which used SIBC—was completed in 13 months, including design and construction. The combination of SBIC and design-build delivery comes at a most opportune time when our nation's rapidly aging bridges are in urgent need of repair or replacement, and our highways are already congested even before the added strain of road closures. This approach has the potential to be an instrumental part of the solution. ■

*This article is a preview of Session B4 "Long-Span Steel Bridges" at NASCC: The Steel Conference, taking place March 22–24 in San Antonio. Learn more about the conference at **www.aisc.org/nascc**.*

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