TECHBRIEF

U.S. Department of Transportation
Federal Highway Administration

Slide-in Bridge Construction

CASE STUDY • SPRING 2014

SLIDE-IN BRIDGE CONSTRUCTION

ABSTRACT

This technical brief summarizes examples of successful bridge slide-in projects in Nevada and Missouri. Slide-in Bridge Construction is a cost-effective Accelerated Bridge Construction (ABC) technique that has been implemented as part of a number of bridge replacement projects sponsored by State departments of transportation (DOT). In each case, the use of this ABC method reduced road closure times, road user costs, worker exposure to traffic, and construction times.

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DESCRIPTION

Slide-in Bridge Construction is an Accelerated Bridge Construction (ABC) technology that has been used by several State DOTs to reduce the time and cost required to replace an existing bridge. Using this technique, a bridge superstructure—often constructed using prefabricated bridge elements—is typically built on temporary supports parallel to the existing bridge structure. This enables the old bridge to remain open to traffic during construction. Once the new bridge superstructure is complete, the old bridge is closed to traffic and demolished. The new bridge superstructure is then pushed or pulled into place on the substructure and, once the bridge approaches are complete, the road is reopened to traffic.

The net result is that societal costs (traffic interruptions, congestion, emissions, and fuel consumption associated with road closures) are reduced during bridge replacement. In addition, worker safety is enhanced because the need to work in close proximity to traffic is reduced or eliminated. This technical brief describes examples of successful bridge slide-in projects in Missouri and Nevada. In each case, contractor teams worked closed with State DOT engineers to develop a construction strategy that successfully delivered a replacement bridge on a significantly accelerated schedule and with fewer road closures and reduced worker exposure to traffic during the construction period.

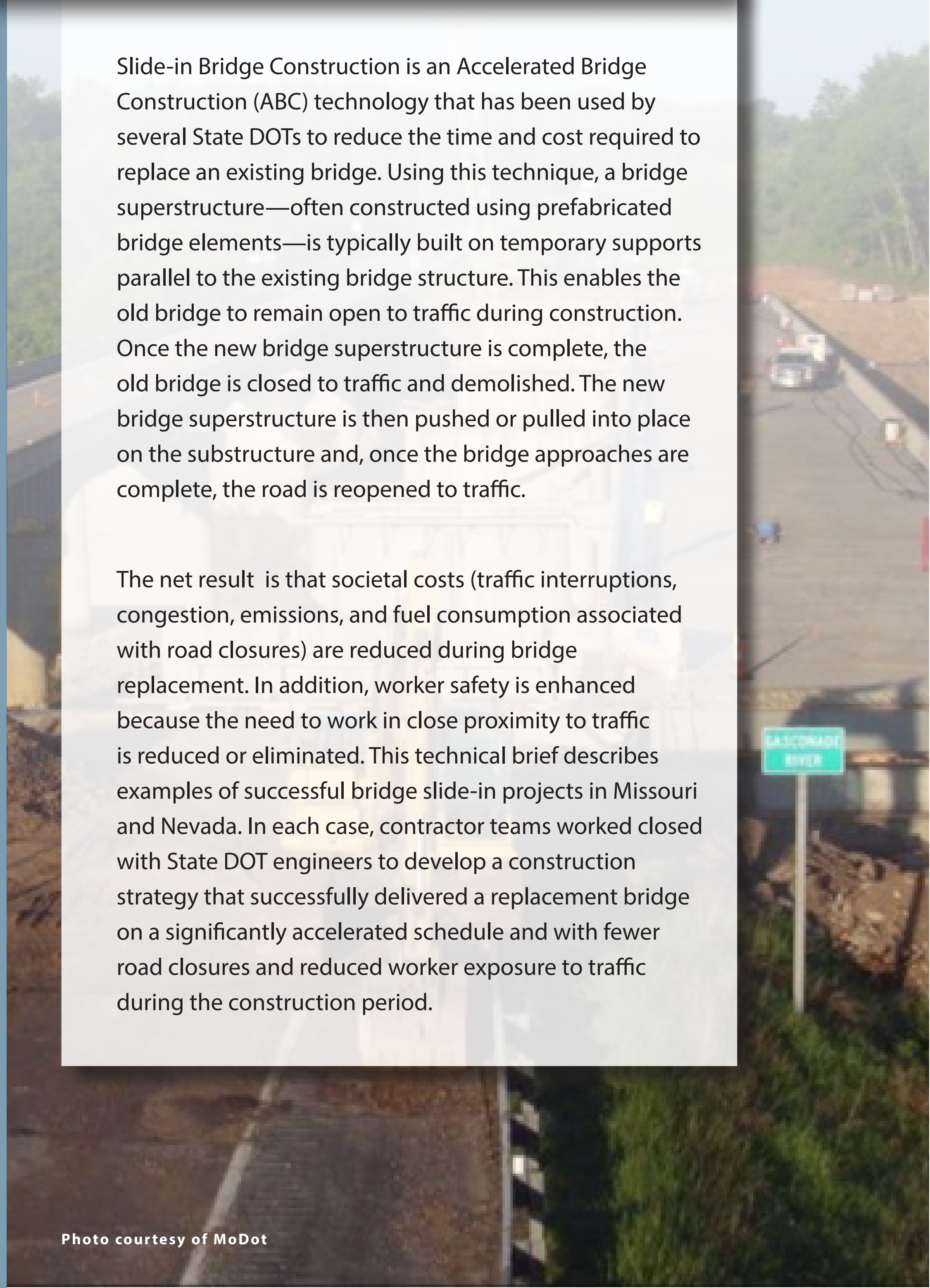


Photo courtesy of MoDot

I-44 OVER GASCONADE RIVER

The westbound bridge on I-44 in Missouri located over the Gasconade River was replaced by the Missouri Department of Transportation (MoDOT) in 2011 using slide-in bridge construction. For this particular project, MoDOT's primary concern was safety. The bridge carried an ADT of 12,000 vehicles, with a quarter of that volume being comprised of commercial vehicle traffic. MoDOT's original design was based on the expectation that the westbound lanes would be re-routed over onto the other direction of the interstate, putting opposing traffic head-to-head and closing the westbound lanes to remove and replace the superstructure. Due to the potential for serious crashes with traffic flowing in this pattern, the agency offered financial incentives to the bidders to encourage innovative options that would minimize the duration of the closure.

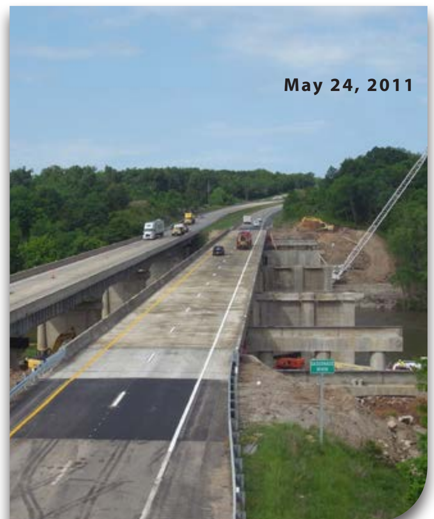
Photo courtesy of Parsons (Steve Haines)

Part of a larger resurfacing project for the corridor, the bridge replacement project cost about $3.75 million. The design-bid-build project was originally projected to cost about $2.7 million with a maximum of 60 days of closure time allowed. Because of MoDOT's concerns about having a temporary traffic pattern where traffic was moving side-by-side in direct opposition, the agency offered an incentive of $40,000 per day for up to 15 days to encourage the contractor to complete the project as quickly as safety allowed. The contract was awarded to the only bidder to submit a proposal that limited the total bridge closure to less than 60 days – in fact, the bidder projected a 35 day closure – at about $3.15 million. After the A+B award, the contractor developed an innovative slide-in construction scheme to replace the bridge on a greatly accelerated schedule in order to reduce the amount of time the road would be closed to traffic. As a result, the contractor completed the project in 20 days, earning the full incentive amount of $600,000.

Photo courtesy of Parsons (Steve Haines)

1 Haines, S. and Jones, C., "Sliding Bridge Speeds Delivery," Modern Steel Construction, American Institute of Steel Construction: Chicago, IL., September, 2011

On May 5, 2011, MoDOT shifted westbound bridge traffic to the eastbound bridge, the existing superstructure was removed, and repairs were made to the tops of the existing bent caps. On May 16, 2011, in in less than 12 hours, the contractor slid the 670-foot long, 2,050 ton bridge superstructure about 40 feet from the temporary columns onto the columns of the existing bridge. To accomplish the move, the contractor used seven 70-ton hydraulic jacks, one at each bent location. The jacks were interconnected to control the differential rate at which the bridge was pushed into place. Stainless steel sheets were placed on top of both the temporary bents and the repaired permanent bent caps. Elastomeric sliding pads were placed under each girder with Teflon sheets bonded to the bottom of each pad. During the sliding process, the new superstructure was moved approximately 3 feet per minute because of the 3-foot stroke of the hydraulic jack. Dishwashing liquid was used as a lubricant to ease sliding of the bridge.



Photos courtesy of MoDOT

On May 23, 2011, MoDOT opened one lane of the replacement bridge to traffic, and the bridge was fully opened to traffic the next day, which beat the contractor's goal of limiting the closure to 20 days. During the period from May 16 up until the May 23 bridge opening, workers replaced the Teflon bearing pads with permanent weight-bearing plates, removed the stainless steel sheeting on the permanent bent caps, laid asphalt on the highway approaches on each side of the bridge, installed new guardrails, cut-in rumble stripes and painted pavement markings.

KEY FINDINGS

Key Findings from I-44 Bridge Over Gasconade River, Missouri
• MoDOT originally let the project with a maximum of 60 days of closure time allowed. • Road closure time totaled less than 20 days as a result of using slide-in construction technology. • Bridge-slide activity was completed in 12 hours. • The sliding technique only required minor modifications to the original MoDOT bridge design.

WEST MESQUITE INTERCHANGE AT I-15 IN MESQUITE, NEVADA [2]

The Nevada Department of Transportation (NDOT) used the slide-in bridge construction method to improve the West Mesquite Interchange at I-15 in Mesquite, Nevada in January 2012. Here, two bridges were replaced as part of a project to widen Falcon Ridge Parkway under I-15 to increase capacity and accommodate future traffic demand. In addition to the bridge slide, which increased the lengths of the bridges, the $15 million project also added roundabouts at the interchange ramps, replaced 1,200 feet of existing mainline pavement, and added landscaping and lighting.

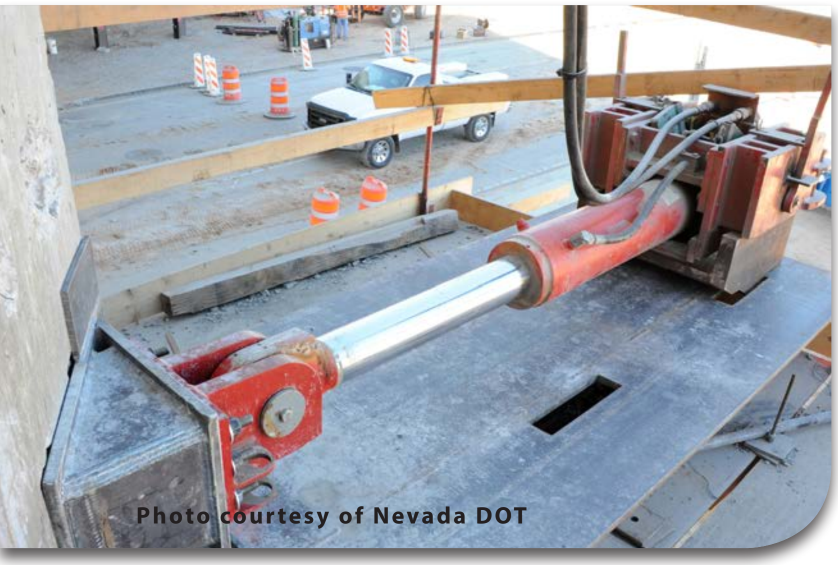


Photo courtesy of Nevada DOT

NDOT anticipated lane closures for up to a year on I-15 to construct the bridge. This would have significant impact on a corridor where about 25 percent of the volume is commercial vehicles. NDOT also anticipated that the interchange would be built in a new location, increasing costs. The winning proposal, however, presented a plan that used accelerated bridge construction (ABC) technology to realign the interchange and keep it in its existing location. These ideas reduced the original project estimate of $25 million to less than $15 million and decreased project time by nearly 6 months.

The contractor has since indicated that although they knew ABC would cost more, they felt they could make up the difference through the savings that would accrue due to reduced lane rental costs and decreased costs associated with building the crossovers, more limited excavation, and reduced time and overhead. Once the contractor was able to demonstrate to NDOT the savings, the agency saw that trying ABC for this type of project would be an opportunity to reduce user costs and decrease construction time. The following factors guided the agency's decision to use ABC:

- Sufficient land was available adjacent to the final location for building the bridges and temporary foundations;
- There were not viable alternative routes;
- Precast concrete components were available;
- The location featured heavy passenger vehicle and truck traffic;
- The location of the project allowed traffic to be re-routed down ramps and back on the mainline during closure;
- Traditional methods of construction would have required significant traffic restrictions on I-15 to construct bridges.

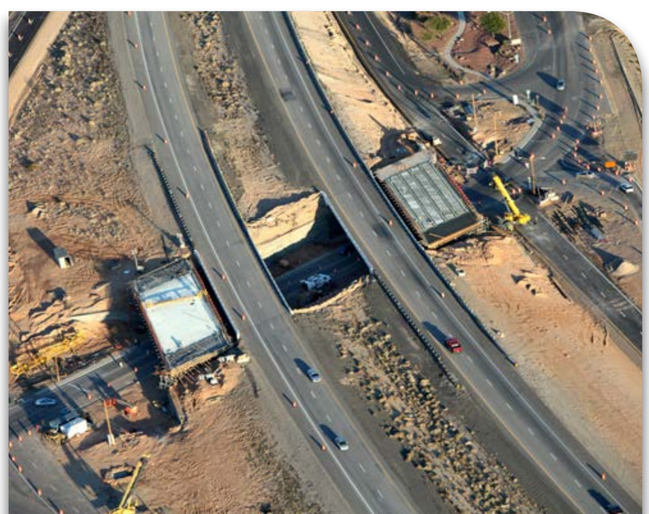
2 Searcy, Adam, "West Mesquite Interchange at I-15," *Aspire*, Precast/Prestressed Concrete Institute: Chicago, IL., Summer 2012, pp. 28-30

But ABC is not without its challenges. For example, as-built dimensions for all ABC projects must be precise. Unlike building in place, dimensions must be known and built exactly to specification for the substructure and superstructure to mesh correctly during the slide. In the case of Mesquite, a particular challenge was presented by the high skew angle on the West Mesquite bridges, which required the design team to thoroughly analyze and demonstrate bridge performance.


Temporary bridge elevation- Photo courtesy of Nevada DOT

The design and construction of the bridges and the slide required detailed planning and design. Bridge construction began in mid-November 2011 with construction of the replacement bridges occurring at a location parallel to the current structures. The plan called for construction to include the use of precast concrete girders and partial-depth deck panels to accelerate construction along with slide-in bridge construction. The approach slabs were built on temporary false work and moved along with the rest of the superstructure. By early January 2012, necessary bridge construction elements were pushed 60 feet into position on two separate 56-hour moves: one on the I-15 southbound lanes on January 10, and the other on the I-15 northbound lanes on January 24.


Overhead view of south bridge demolition
Photo courtesy of Nevada DOT


Overhead view of parallel bridge construction
Photo courtesy of Nevada DOT

To accomplish these moves, traffic first was rerouted off the interstate through the interchange ramps that had been temporarily widened to two lanes. Then, the existing bridge was demolished, a process that took approximately 12 hours. Crews then lifted the new bridge 3 inches into the air from its temporary foundations to clean and lubricate the Teflon-coated elastomeric bearing pads with common dish soap. The bridge was then locked into slide rails. The initial push required 800 to 900 tons with 8 to 9 percent friction, and it took 600 to 700 tons and 4 to 5 percent friction to continue moving the bridge. Two specialized hydraulic jacks, each controlled by a joystick, pushed the bridge 38 inches every 2 minutes until the bridge crossed the 60 foot sliding distance. Once into position, the bridge was raised to install bridge bearings. The slide on the southbound bridge was accomplished in 1 hour and 15 minutes. The northbound slide took 5 hours because the bridge positioning began to skew during the slide. However, back-up equipment and personnel were in place to deal with contingencies ranging from disruption of material delivery to equipment failure to the guardrail not being completed in time, so the construction team was well-positioned to respond when the second bridge slid out of position, moving quickly to reset the bridge and restart the slide.

KEY FINDINGS

Key Findings from West Mesquite Interchange at I-15 in Mesquite, Nevada
• The use of ABC meant that the bridge could be built 6 months faster than originally planned. • Having personnel and equipment in place and ready to respond to any machinery malfunctions or other unexpected issues is important for reducing risk. • Traditional construction would have required lane closures for up to a year on I-15 to construct the bridge. • Commuters saved nearly $13 million in time and fuel costs by eliminating the need for closures, detours, and speed reductions.

CONCLUSIONS

A number of bridge-sliding projects have been completed over the past several years. These projects have demonstrated the value of ABC technologies to delivering bridge replacement projects by

- Reducing or eliminating construction worker exposure to work zone traffic;
- Eliminating or reducing traffic congestion delays associated with construction lane closures;
- Reducing emissions and fuel consumption associated with work zone congestion;
- Eliminating phased construction thereby allowing the contractor more room to operate and fewer restrictions on work hours which led to increased productivity;
- Increased customer satisfaction with construction impacts.

AVAILABLE RESOURCES

Prefabricated Bridge Elements and Systems in Japan and Europe, Ralls, Mary Lou, et al., March 2005. Report No. FHWA-PL-05-003. *http://international.fhwa.dot.gov/prefab_bridges/pl05003.pdf*

Accelerated Bridge Construction – Experience in Design, Fabrications and Erection of Prefabricated Bridge Elements and Systems, Culmo, Michael P., November 2011. Report No. FHWA-HIF-12-013. *http://www.fhwa.dot.gov/bridge/abc/docs/abcmanual.pdf*

COMING SOON : FHWA's team is developing training materials including: web-based training modules, webinars, and workshops for state DOTs, local public agencies, construction contractors, and engineers. Look for this information starting in the Fall of 2013 continuing throughout 2014.

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Federal Highway Administration

FHWA-HIF-13-057