

ABC Innovative Projects

I-4 / Graves Avenue Bridge					
Location	Graves Avenue over I-4 in Volusia County northeast of the city of Orlando in Central Florida				
State	Florida				
Owner	Volusia County				
Year ABC Built	2006				
State ID #	790218				
NBI #					
Coordinates	Latitude:	28.948763		Longitude:	-81.259797
Contact Person	Robert V. Robertson, Jr., P.E. State Structures Design Engineer Florida Department of Transportation Phone: 850-414-4267 Email: Robert.Robertson2@dot.state.fl.us				
Mobility Impact Time	ABC:	Graves Avenue: 8-month closure I-4: 4 partial-night closures		Conventional:	Graves Avenue: 12-month closure I-4: 32 nighttime closures
Impact Category	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
	I-4				Graves Avenue
Primary Driver(s)	<ul style="list-style-type: none"> • reduced traffic impacts • reduced onsite construction time • improved work-zone safety • improved site constructability • improved material quality and product durability 				
Description	<ul style="list-style-type: none"> • 286-ft-long and 59-ft-wide two-span full-width decked prestressed beam bridge (143 ft – 143 ft); individual span roll-in; 1,300-ton self-weight per span • Urban location • Average Daily Traffic count: 21,100 (Graves Avenue, 2006); 67,800 (I-4, 2006) • Traffic management alternative, if constructed conventionally: extended use of 5-mile detour <p>Existing Bridge: The existing two-lane four-span prestressed concrete beam bridge was 215 ft long and 30 ft wide. It consisted of four AASHTO Type III beams in each of its 37-ft-long end spans and five AASHTO Type III beams in each of its 70.5-ft-long middle spans. Built in 1958, it was replaced with a widened structure and to accommodate the widening of I-4 from four to six lanes.</p> <p>Replacement Bridge: The replacement bridge has two 12-ft-wide traffic lanes, and a 10-ft-wide shoulder and 5-ft-wide sidewalk on each side. The cross-section in each span consists of eight 78-in-deep Florida bulb-tee beams at 7.61 ft spacing with 8-inch-thick composite concrete deck. The substructure consists of conventional cast-in-place reinforced concrete abutments and piers with pretensioned concrete driven pile foundations. The superstructure was designed for conventional construction; minimal structural design changes were required to field change the use of SPMTs into the contract</p>				

Construction Methods:

This project was the first use of SPMTs to move bridge spans that cross a US Interstate highway. The beams for the two replacement spans were pretensioned concrete beams fabricated offsite, shipped to the staging area a quarter mile from the bridge site, and erected on the temporary supports that were identical in relative elevation to the onsite pier configuration. The beams were designed as simple span for both dead load and live load. Intermediate diaphragms were added at midspan. The full-depth cast-in-place concrete deck was designed based on strip analysis and did not include post-tensioning. Because of the upward thrust due to beam rotation, additional longitudinal reinforcement was added across the interior support, as typically done in decks in Florida. Expansion joints were located at each span end of this bridge. Placement of the deck concrete was stopped 5 ft from each side of the interior support to facilitate installation of the spans; the closure pour provided a continuous deck with good rideability. Bridges in Florida are profiled, ground as needed, and transverse-grooved after the entire deck has been placed.

Removal of Existing Spans:


Before the middle span removals, the contractor removed the two end spans of the existing bridge using conventional means since they were outside the I-4 traffic lanes. SPMTs with 360-ton capacity were used to remove the two 250-ton middle spans over I-4. One six-axle SPMT unit was prepositioned in the median under one end of the existing span over I-4 East. On January 9, the outside lane of I-4 East was closed from 10 pm to midnight to position the second six-axle SPMT unit under the other end of the span. At midnight, a 20-minute rolling roadblock began.

A cross-frame connecting the two SPMT units was attached and the span was lifted six inches off its supports. The span was then moved a quarter mile down I-4 East to the staging area. From lift-off to arrival at the adjacent site took less than half an hour. The process was repeated two nights later for removal of the existing span over I-4 West. Its removal required two rolling roadblocks. A rolling roadblock on I-4 West provided the time required for the SPMTs to lift the span off its supports, drive it slightly west on I-4 West, and then rotate 90 degrees and drive into the median. At that point a rolling roadblock on I-4 East began. The span was driven onto I-4 East, rotated 90 degrees, and driven down I-4 East to the staging area while I-4 West traffic was opened. Less than an hour was required from the start of the first rolling roadblock until the span arrived at its demolition site.

Installation of Replacement Spans:

Concurrent construction of the substructures onsite and the superstructure at the staging area took place from January to June. The new spans were built five feet off the ground on temporary supports at the staging area while I-4 was widened and the abutments and interior bent were built conventionally onsite. Several days before the scheduled move, the span to go over I-4 West was lifted off its temporary supports by SPMTs, with each end supported by a set of four six-axle SPMT units. The centroid of the SPMT supports was about 14 ft from the end of each span to accommodate the width of two side-by-side SPMT units. The span was then jacked in stages to its setting height and supported on sectional barges atop the SPMTs. Incrementally lifting the span to setting height took 2.5 days, with monitoring to ensure temporary stresses remained within allowable stresses.

On June 3, both directions of I-4 were closed along a 4-mi length shortly before midnight, and traffic shifted to a 5-mi detour. In about 30 minutes the SPMTs carried the span along I-4 to the bridge site. As the SPMTs approached the substructure, the operator lifted the SPMT platforms to provide clearance over the neoprene bearing pads in position on the substructure bearing seats. Proper alignment of the beams onto the bearing seats took about two hours.

	<p>The process was repeated a week later for installation of the new span over I-4 East. The SPMTs again moved the new span to its final location in about half an hour, with proper alignment of the beams onto the bearing seats taking about 1.5 hours.</p> <p>Contracting Strategies: The contract specified conventional construction that required night work and rolling roadblocks. It allowed I-4 lane closures from 10 pm to 6 am only. Lane closures or rolling roadblocks were required for construction activities such as removal of existing beams, erection of new beams and stay-in-place forms, and casting of decks. The use of SPMTs to remove the two middle spans and install the new spans was field changed into the existing conventional construction project.</p> <p>The Graves Avenue Bridge required a short closure time because it is near a high school and needed to be open in time for the start of school in the fall.</p> <p>Stakeholder Feedback: See Chapter 7 of <i>FHWA Manual on Use of SPMTs to Remove and Replace Bridges</i> for case study with lessons learned (link provided under “Other Related Information”).</p>						
High Performance Materials	<ul style="list-style-type: none"> • 						
Photos	 <p>Additional photos</p>						
Project Planning	<p><i>Decision-Making Tools</i></p> <ul style="list-style-type: none"> • 	<p><i>Site Procurement</i></p> <ul style="list-style-type: none"> • 	<p>Procurement</p> <ul style="list-style-type: none"> • Design-bid-build 	<p>Contracting</p> <ul style="list-style-type: none"> • A+B bidding • Full lane closure • Incentive / disincentive clauses 			
Geotechnical Solutions	<p><i>Foundations & Walls</i></p> <ul style="list-style-type: none"> • 		<p><i>Rapid Embankment</i></p> <ul style="list-style-type: none"> • 				
Structural Solutions	<p>Prefabricated Bridge Elements & Systems</p> <table border="1" data-bbox="397 1472 1157 1608"> <tr> <td data-bbox="397 1472 667 1608"> <p><i>Elements</i></p> <ul style="list-style-type: none"> • </td> <td data-bbox="667 1472 870 1608"> <p>Systems</p> <ul style="list-style-type: none"> • Full-width decked beam unit (FDcBc) </td> <td data-bbox="870 1472 1157 1608"> <p>Miscellaneous</p> <ul style="list-style-type: none"> • CIP reinforced concrete closure joints </td> </tr> </table>			<p><i>Elements</i></p> <ul style="list-style-type: none"> • 	<p>Systems</p> <ul style="list-style-type: none"> • Full-width decked beam unit (FDcBc) 	<p>Miscellaneous</p> <ul style="list-style-type: none"> • CIP reinforced concrete closure joints 	<p>Construction</p> <ul style="list-style-type: none"> • SPMTs
<p><i>Elements</i></p> <ul style="list-style-type: none"> • 	<p>Systems</p> <ul style="list-style-type: none"> • Full-width decked beam unit (FDcBc) 	<p>Miscellaneous</p> <ul style="list-style-type: none"> • CIP reinforced concrete closure joints 					
Costs	<p>The overall budget for the conventional I-4 widening and Graves Avenue Bridge replacement project was \$27.6 million. The SPMT bridge move was field changed into the existing project. The supplemental agreement cost was \$568,175. The cost for the SPMT subcontractor was \$345,000 (61%) of the added cost.</p> <p>The Graves Avenue detour was reduced from 12 to 8 months for a time savings of 4 months and a delay-related user cost savings of \$2.18 million. Lane closures on I-4 were reduced from 32 nights to four nights, for a time savings of 28 nights and a user cost savings of \$50,000. Total savings to the traveling public was \$2.23 million.</p>						

Funding	<i>Federal only</i>	<i>State only</i>	Federal and State	<i>Other</i>
			X	
Incentive Program (\$)	<i>Highways for LIFE</i>	<i>IBRD</i>	<i>SHRP2</i>	<i>Other</i>
Contract Plans	Complete Set:	Not available.	ABC *:	
Specifications	Complete Set:		ABC *:	Supplemental Agreement (link to pdf)
Bid Tabs	Supplemental Agreement (link to pdf)			
Schedule	Engineer's:	Conventional Construction Schedule (link to jpg) ABC Schedule (link to jpg)	Actual:	
Other Related Information	2007 FHWA Manual on Use of SPMTs to Remove and Replace Bridges, Chapter 7 Case Study [http://www.fhwa.dot.gov/bridge/pubs/07022/chap07.cfm]			
Photo Credits	Florida Department of Transportation			

* Specific to the ABC used in the project.