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Self help

The ultimate in speed and flexibility for removing and installing bridges—that's how self-propelled modular transporters (SPMTs) are described by those familiar with their capabilities.

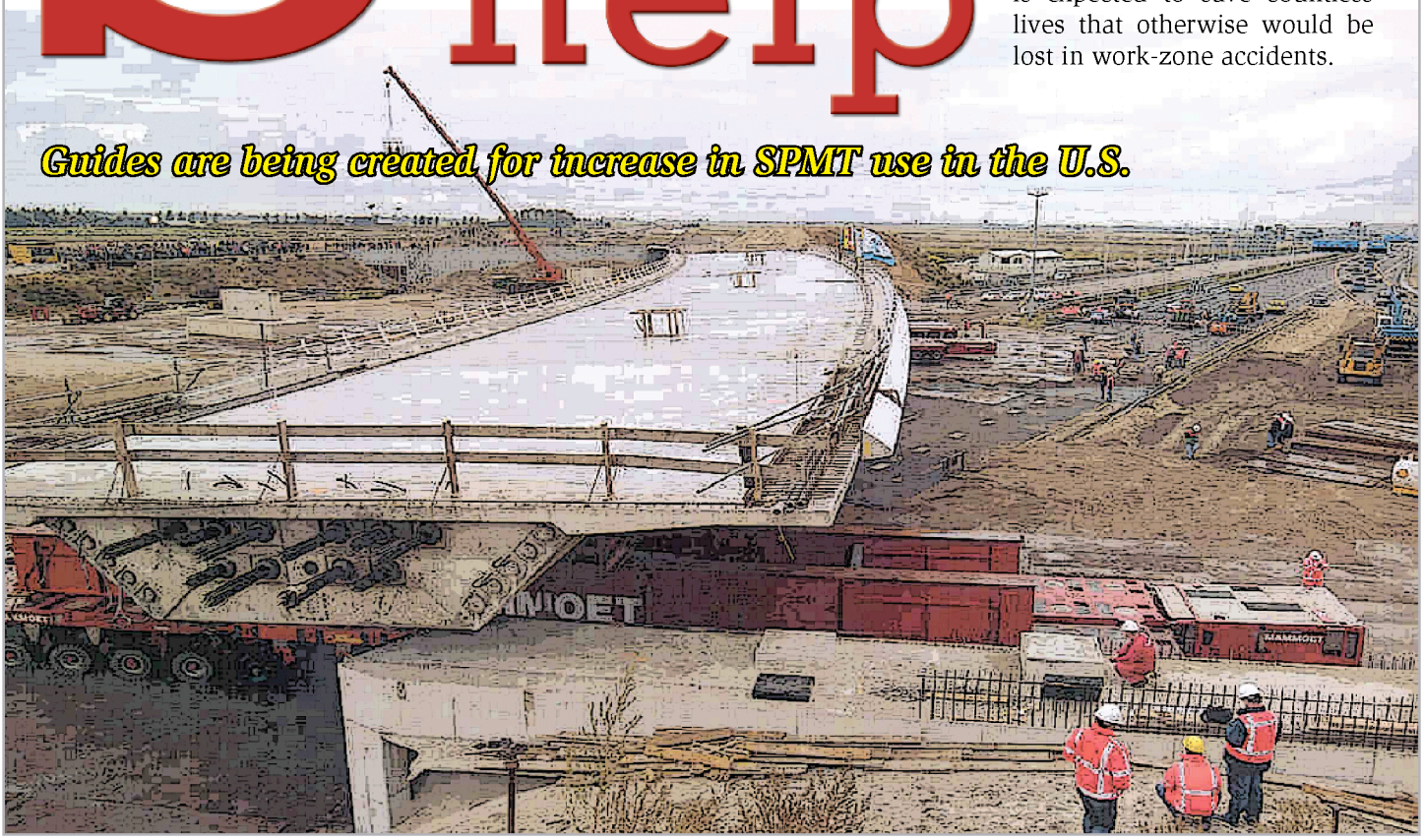
The use of SPMTs fits well with the national vision for rapid renewal of the nation's aging bridge inventory, which must be upgraded while maintaining traffic flow. The SPMT is a powerful machine in the repertoire of innovative construction equipment now available.

SPMTs are computer-controlled, multiaxial platform vehicles that can move heavy loads at walking speeds and place those loads precisely, within fractions of an inch using 360° pivoting capability. Loads of several thousand tons can readily be lifted, transported and placed with SPMTs.

A number of bridge spans have been moved with SPMTs in the U.S., including both the removal of deteriorated spans and the placement of new spans. Typically they have been used at high-traffic-volume locations. The required move time can vary from minutes to hours, sometimes necessitating only a rolling roadblock of the underneath roadway—no detour or closure.

The use of SPMTs opens the door to bridge replacements at speeds never before seen. Getting out of traffic at such speed is expected to save countless lives that otherwise would be lost in work-zone accidents.

Guides are being created for increase in SPMT use in the U.S.



Far away, far more complex

The Europeans are ahead of the U.S. in the complexity of SPMT bridge moves. In 2004 representatives from the American Association of State Highway & Transportation Officials (AASHTO) member states, the Federal Highway Administration (FHWA) and others saw SPMTs in action in Europe during their international scan of prefabricated bridge elements and systems. Two of the scan team's European hosts were SPMT companies, Mammoet in the Netherlands and Sarens in Belgium, both providing heavy lift and transport services for various industries such as petrochemical, power and civil engineering. Tours of these companies included their engineering departments where staff develops detailed plans for moving the heavy loads.

During its scan, the team toured the site of the PRA 1309 Railroad Bridge in France, which had recently been moved complete with substructure. A new highway under construction was to cross the rail line, necessitating a bridge at the intersection. The four-span bridge was built on a temporary slab adjacent to its final location. Its construction included temporary crossbeams between the columns for lifting by the SPMTs. Rail traffic was then temporarily stopped, excavation for the intersection was completed, the 2,200-ton bridge was lifted with SPMTs and driven into place, earthwork completed, track connections were made, and the rail line was back in service within 48 hours.

The scan team also learned of a multispan, curved, post-tensioned concrete highway bridge superstructure in the Netherlands that was moved with SPMTs. It was built on temporary supports near Amsterdam's Schipol Airport alongside the A4/A5 expressway that it was to cross.

The two-span, continuous unit was then moved over a weekend to avoid an extended detour of the expressway.

The use of SPMTs opens the door to bridge replacements at speeds never before seen in the U.S.

Returning to the U.S., the scan team ranked the use of SPMTs to replace bridges as its top implementation recommendation. State departments of transportation, the FHWA and other scan team members took action to implement this technology across the nation. Team members began sharing what they saw in Europe to provide a vision of the potential in the U.S.

To date in the U.S. no multispan superstructures or bridges complete with substructures have been moved with SPMTs. The scan team report is available on the FHWA website at www.fhwa.dot.gov/bridge/prefab/pbesscan.cfm.

In need of some company

Bridge moves in the U.S. to date have been done by prime contractors that either subcontract the bridgework to bridge contractors, who then hire SPMT companies, or that directly subcontract with SPMT companies. Work done by the prime contractor's construction crew includes building the staging area and preparing the path for the move. The bridge contractor builds the temporary support and the bridge, and then the SPMT companies handle the actual bridge moves.

It may be time for bridge contractors that focus on rapid bridge replacements to consider changing from being bridge constructors with large construct-in-place construction crews to being bridge construction managers with a smaller number of direct employees. Some employees would then be on construction crews while others would manage the subcontractors and specialty engineers that do the fabrication, engineering and erection of these larger prefabricated bridge systems.

They will be your guide

A number of resources are available to bridge owners and contractors interested in the use of SPMTs to move bridges, as described below.

FHWA manual

FHWA, AASHTO, the National Cooperative Highway Research Program and the Florida Department of Transportation (FDOT) sponsored the development of a manual on the use of SPMTs for bridge moves in response to a recommendation from the prefabricated bridges international scan team. The "Manual on Use of Self-Propelled Modular Transporters to Remove and Replace Bridges" describes SPMT capabilities and availability as well as benefits and costs. Planning, design and contracting issues also are discussed. Planning issues include project selection criteria, traffic impacts and project site and staffing requirements. Design issues include ground-bearing capacity, temporary supports, prefabricated systems, the bridge moves and possible design efficiencies. Contracting issues include construction scheme, staging area, equipment payment

and strategies for reduced onsite construction time. A number of examples are available in the appendices, including example calculations, diagrams, plan sheets and specifications. Also provided is an extensive case study of the 2006 FDOT Graves Avenue Bridge replacement over I-4 as well as summary case studies of several other SPMT projects.

This manual, published in 2007, is available on the FHWA website at www.fhwa.dot.gov/bridge/pubs/07022. It will be updated as lessons are learned from projects.

UDOT manual

The Utah Department of Transportation (UDOT) has moved bridge spans with SPMTs on multiple projects. To provide guidance for these moves, UDOT developed its "Manual for the Moving of Utah Bridges Using Self Propelled Modular Transporters." This manual provides design guidance for simply supported slab-on-girder spans with skews up to 20° and a 3-in. maximum anticipated twist in the deck during the move, for example, due to uneven supports. It also applies to spans with greater skews when the SPMT supports during the move are parallel to the final end supports.

The manual describes the roles, responsibilities and qualifications of those involved in the bridge move. These include the FHWA, the owner, the engineer of record, the prime contractor, the bridge contractor, the bridge specialty engineer for the bridge contractor, the SPMT company and its engineer, the contractor's geotechnical engineer and the construction engineering and inspection representative.

Submittal requirements are included for different project delivery methods. Structural considerations that are discussed include design requirements and calculation of stresses and deflections.

Guidance to the contractor's specialty engineer includes construction of the span on temporary supports and analysis of the span during lifting and the move.

Guidance to the bridge contractor includes a checklist for submittals with discussion on traffic-control plans, bridge staging area, travel path of the move, temporary support structures and geometry control for deflection and twist. The appendices include guidance on deflection and twist monitoring.

To date in the U.S. no multispan superstructures or bridges complete with substructures have been moved with the assistance of SPMTs.

The UDOT manual, published in 2008, is available on the UDOT website at www.dot.state.ut.us/main/f?p=100:pg:2251581588913156:::1:T,V:2174,. It also will be updated as lessons are learned from projects.

AASHTO guidance for temporary works

The "AASHTO Guide Design Specifications for Bridge Temporary Works" and the "AASHTO Construction Handbook for Bridge Temporary Works" provide minimum requirements for bridge temporary works.

The guide design specifications were developed for state agencies to include in existing standard specifications for falsework, formwork and other temporary bridge construction.

The construction handbook supplements the guide design specifications and was developed for bridge contractors and construction engineers and as an aid for falsework design engineers. These documents are referenced in the UDOT manual and may be purchased from AASHTO at https://bookstore.transportation.org/browse_bookstore.aspx.

AASHTO Lead States Team

In 2007 the AASHTO Technology Implementation Group (TIG), composed of high-ranking state DOT representatives, selected the use of SPMTs to move bridges as one of its market-ready focus technologies to promote for accelerated nationwide implementation. The TIG formed a Lead States Team to lead this effort. The Lead States Team includes DOT and industry representatives.

The team is available to offer free technical assistance to bridge owners and contractors over the next few years to move SPMT applications into projects. The team also can help the states complete their applications for FHWA Innovative Bridge Research and Deployment Program (IBRD) funds for SPMT projects, assuming funding for this program again becomes available in 2009.

Team members have hands-on experience in the use of SPMTs and are working with the contracting and consulting community to provide educational and technical resources to practitioners on SPMT moves from emergency bridge replacement to span relocation and reuse. Team activities have included personalized technical assistance and outreach and the development of a marketing plan, brochure and website content. The Lead States Team also is developing guidance on choosing the right applications for this technology and contract specifications to ensure that SPMTs are used as the owner agency intends.

Lead States Team contacts and other information are available on the TIG SPMT website at www.aashtotig.org.

The cost to move

First costs will always be a concern to bridge owners. Funds available for upgrading the nation's bridge inventory are limited, and public agencies must be good stewards of the public funds entrusted to them.

In the U.S., the Utah DOT has had the most experience with SPMT

bridge moves. Their experience with short construction windows is that the use of SPMTs to move bridges competes favorably with other methods. In fact, SPMTs are often preferred by contractors because they are now a proven technology for projects with short construction windows.

Total project costs are the combination of construction costs and disruption-of-service costs. Europe is ahead in the use of SPMTs to move bridges because they consider the economic and societal costs of projects and, therefore, specify short windows. The key for public applications is to acknowledge these costs are real.

The perception that the use of SPMTs to move bridges will be more expensive than conventional construction frequently occurs because mobilization needed to get the SPMT equipment to the jobsite can be a large upfront cost. However, a complete list of costs and cost savings should be developed at the initial planning stage to ensure the most cost-effective solution is chosen. Obvious cost savings include reduced days of traffic control and the possible elimination of temporary structures that would otherwise be required to maintain traffic flow. Less obvious savings may be eliminating the need to repair pavements on detours that may otherwise be required due to the longer onsite time of conventional construction. Savings related to improved safety due to the reduced time of work-zone exposure also are achieved, although those savings are harder to quantify.

Competition also reduces costs, and multiple SPMT companies are available for bridge moves in the U.S. SPMT companies that have experience with bridge moves include Barnhart and Bigge in addition to Mammoet and Sarens. A list of the heavy-lift companies with SPMTs is available on the AASHTO TIG website (www.aashtotig.org) and in the UDOT manual.

Bridge construction has changed from a focus on new construction to a focus on maintaining the existing bridge inventory. Needed are innovative ways to maintain traffic while quickly replacing deteriorated bridges with bridges that last longer. One such innovation that should be considered by bridge owners and contractors in the initial planning stage is the use of SPMTs for ultra-rapid bridge replacement. Multiple resources are available to assist in the use of this technology. R&B

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