The State of Our Highways & Bridges:

ACCELERATED BRIDGE construction

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From coast to coast, bridges connect the intertwining ribbons of our national transportation network in a safe and efficient manner.

While the average motorist may be aware of the heavy loads and high traffic volumes that our bridges carry, most might not consider how many of these bridges exist, what it takes to maintain them, and more importantly, how the work to keep them maintained can impact our nation.

The U.S. is challenged by an aging infrastructure and increasing traffic volumes. Consider the following:

- Transportation for America reports that almost 70,000 bridges in the U.S. are classified as “structurally deficient,” requiring significant maintenance, rehabilitation, or replacement."
- The average age of an American bridge is 42 years, and the expected lifespan of most bridges is 50 years.
- Nearly 200,000 of the roughly 600,000 highway bridges are 50 years old or older, and by 2030, that number could double.¹

In response to these ever-increasing needs, transportation agencies throughout the U.S. strategically perform the required maintenance, rehabilitation, and replacement activities to maintain the integrity of our transportation network and the safety of the traveling public.

However, as the country’s departments of transportation carry out their duties, the mobility of this network becomes reduced due to the work zones that are created.

Whether traveling through the Fort McHenry Tunnel or the towers of the Golden Gate Bridge, it is easy to take for granted all the benefits and efficiencies the U.S. transportation network provides to our nation – both for personal use and for the many businesses that use it to transport goods.

Take for example our current National Highway System (NHS). With more than 160,000 miles of roadway, it only represents about 4% of the nation’s roads, yet carries 40% of the traffic and 75% of heavy truck traffic. A 2003 Federal Highway Administration (FHWA) report revealed that in 2001, there were an estimated 3,110 highway work zones on the NHS during the summer months, which corresponded to more than 20,000 miles of roadway – or a 12.8% reduction in capacity.

These reductions can result in traffic congestion, which in turn impacts productivity and reduces quality of life. Based on the Texas Transportation Institute’s 2007 Urban Mobility Report on the 437 urban communities located throughout the U.S., congestion causes:

- 4.2 billion hours in time delays per year
- 2.9 billion gallons of wasted fuel per year
- $78.2 billion in cost to travelers (based on 2005 gas prices)

Every Day Counts Initiative

To better help address these increasing needs, the FHWA rolled out a series of initiatives under the purview of the “Every Day Counts” (EDC) initiative in 2010.

The EDC program is a collaborative effort among the FHWA, the American Association of State Highway and Transportation Officials, state departments of transportation, local agencies, and other industry members to reduce overall project delivery time frames.

Because our mature transportation network is continually being used, highway and bridge construction techniques have to undergo a paradigm shift from conventional construction methods in order to make a meaningful dent in these timelines. However, the work activities that are required to maintain it must be carried out in a manner that minimizes the disruptions to traffic.

To help the departments of transportation, bridge authorities, and other agencies quickly become familiar with innovations that can help address this need, the EDC program provides a national focus on certain technologies and innovations that have been successfully used in the past.

By increasing the awareness of these methods on a national level, departments of transportation can build upon each others’ experiences, resulting in increased implementation and continual refinements of the concepts being used.

Some process-based EDC initiatives include planning and procurement strategies that provide greater flexibility for permitting, right-of-way acquisition, and utility relocation, which can help clear a site prior to the start of any major bridge construction activity.

A technology-based initiative promoted through the EDC program is prefabricated bridge elements and systems (PBES), which can enable the onsite aspects of bridge construction to be performed in a safer and more efficient manner.

What Is PBES?

PBES is an accelerated bridge construction (ABC) technology that comprises the structural components of a bridge built off-site or adjacent to the existing highway alignment. It includes features that reduce onsite construction time and mobility impact time compared to conventional construction methods.

Examples of prefabricated elements include decks, beams, piers, and abutment and walls. Prefabricated systems consist of an entire superstructure, superstructure and substructure, or bridge that, once placed, allows traffic operations to resume soon afterwards.

Benefits

PBES is a key enabling technology that reduces overall project delivery time when combined with additional ABC technologies (such as high-early strength concrete for closure pours for precast bridge element connections, horizontal bridge slides to place complete bridge systems into place, or grouted coupler connections that are embedded in precast columns, footings, cap beams, or pile shafts to complete permanent connections).

Bridge projects that have traditionally taken one, two, or more construction seasons to complete can be completed in weeks or weekends.

PBES can also address differing site constraints, improve worker and public safety, and reduce liability exposure from traffic accidents in the work zone. Improvements in quality can also be realized because the bridge components are built off the critical path and under controlled environmental conditions.

For example, when concrete is poured onsite, restraint of concrete can occur, which is when concrete that is poured adjacent and connected to previously poured concrete...
shrinks and the previously poured concrete does not, leading to internal tensile stresses that can ultimately cause cracking during the cure. Precast concrete elements have significantly less cracking than site-cast concretes.

Using the most current full-year data from 2010, fatalities in motor vehicle traffic crashes in work zones were 576. By using Self-Propelled Modular Transporter (SPMT) bridge moves, horizontal slides, longitudinal launches, and other heaving lifting equipment and methods, lives could be saved, injuries avoided, and costs reduced with less frequent public construction interfaces. (See ABC Structural Placement Methods on the last page for more information.)

Because of its adaptability to address differing site constraints, the efficiencies realized with onsite construction, improvements in safety, and the intrinsic benefits in quality that PBES can offer, the FHWA’s goal is for PBES to become the preferred method of bridge construction.

**Cost Factors to Consider**
Total project costs are a function of many factors, including:
- Terrain
- Design options
- Proximity to precast plants (if off-site fabrication is considered)
- Traffic flow
- Material and labor availability
- Urgency of work
- Type of work
- Familiarity with key regional suppliers and contractors

**Measuring Success**
Financial success is often the lead metric in determining the success of a project; however, public perceptions can also communicate a loud and clear message to public officials.

For example, the Utah Department of Transportation (UDOT) has led the country in ABC after its need to rapidly expand its transportation infrastructure to host the 2002 Winter Olympic Games in Salt Lake City. Since then, ABC has been Utah’s primary way of rehabilitating, redesigning, and building bridges.

Every year, UDOT surveys the public’s satisfaction of roadway projects conducted in the state. In previous surveys, UDOT typically found that one-third of respondents were satisfied, one-third did not care, and one-third were not satisfied. The 4500 South Bridge project, which was built in an accelerated manner using PBES technologies, tells a different story: Of the 71 respondents that were surveyed, 94% were satisfied with the project.

**Case Study: The I-85 Bridge**
When the car company Kia was building a manufacturing plant that would bring 6,000 workers to the area, the
Georgia Department of Transportation (GDOT) used PBES to reduce the time and cost of construction on the I-85 bridge in Troup County, GA.

On this project, use of prefabricated pier columns and caps was selected. If GDOT had used conventional bridge construction practices, then the project would have required 30 months to complete; by using PBES technologies, GDOT was able to complete the project in 16.5 months.

GDOT also found that using PBES improved safety and increased traveler satisfaction. In terms of costs, the state was able to save $1.98 million – or 45% – of what the interchange would have cost if it had been built with conventional construction practices.

Because the prefabrication technologies and processes allowed for the pier elements to be constructed off-site and away from traffic, there were fewer disruptions to traffic, leading to safety improvements for both the contractor’s personnel and the traveling public.

Conventional construction practices would have increased trip time by 25%, but GDOT found that travel delays using PBES were rare. When they did occur, they were typically less than 90 minutes. Scheduling deliveries and construction activities during nonpeak traffic hours further minimized lane closures and inconvenience to the traveling public.

Coming to a Bridge Near You

With ABC, partial or complete bridge moves can be done with quality and efficiency. Contractors that continue to solely pursue conventional work will still have access to jobs, but over time may experience limited growth opportunities. Adopting more robust planning processes will facilitate success in ABC implementation, and the benefits of reduced job time frame, safety improvements, and quality enhancements make the process worthwhile.

Endnotes:

The accelerated bridge process uses three major methods of placing the components or entire bridge, also known as structural placement methods. The most impressive method is Self-Propelled Modular Transporters (SPMTs). Although they are massive in size, their computer-controlled synchronized movements resemble that of a ballet dancer. SPMTs are capable of moving entire bridges, rotating them, and then lifting them into place with precision.

The total initial cost for using SPMTs can range from $50,000 to more than $500,000, depending on the job location and requirements. While that may seem like a large expense, the ability to work away from traffic in a setting that may present less of an environmental footprint may be worth it. The equipment may need a substantial staging area, so thoughtful advanced planning is required. The use of SPMTs can offset the need for temporary roads, median crossover diversions, and other methods used with conventional construction.

Another choice for total bridge moves is the “horizontal slide” (also called horizontal skidding or lateral sliding/skidding), where the new superstructure is built in its entirety immediately adjacent to the structure to be replaced. When the bridge is complete, the road is typically closed over the course of a weekend. In that time, full demolition precedes sliding the new structure into place.

At a project on I-15 in Mesquite, NV, last January, Dawn® dish soap was used to lubricate the Teflon rails that served as the tracks for the horizontal movement. No SPMT was needed as job circumstances allowed replacement to be built on grade with the final position. By Sunday night, the new overpass was in place with new approach pavement and was ready for traffic.

A third technique for component placement is a horizontal launch that uses a variety of configurations. Using a longitudinal gantry frame, deck sections are received, lifted, and transported to the exact placement site overhead.