IAP States Overall Implementation Summary Report

Innovative Bridge Design for Rapid Renewal: ABC Toolkit (SHRP2, R04)

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Definitions

ABC– Accelerated Bridge Construction

AASHTO– American Association of State Highway and Transportation Officials

Caltrans – California Department of Transportation

CIDH– Cast in Drilled Holes

CMGC– Construction Management General Contractor

FHWA– Federal Highway Administration

GRIC DOT– Gila River Indian Community Department of Transportation

GRS– Geosynthetic Reinforced Soil

KYTC– Kentucky Transportation Cabinet

MEDOT – Maine Department of Transportation

NEXT Beams–Northeast Extreme Tee Beams

PDA–Pile Dynamic Analyzer

RIDOT – Rhode Island Department of Transportation

R04-SHRP2 Research Project– Innovative Bridge Designs for Rapid Renewal: ABC Toolkit

SHRP2– Second Strategic Highway Research Program

TRB– Transportation Research Board

UHPC – Ultra High-Performance Concrete

WisDOT – Wisconsin Department of Transportation

SHRP2 R04 IAP States Overall Implementation Summary Report

Executive Summary

The SHRP2 ABC Toolkit is a systematic approach to replacing existing short to medium span bridges using accelerated bridge construction (ABC) techniques. The Toolkit contains standard drawings, calculations, design specifications and construction specifications needed to facilitate an ABC replacement project. The Toolkit includes details for precast abutments, piers, concrete superstructures and steel superstructures. These systematic approaches to rapidly bridge replacement can be applied at the state, county, and local level. There is a cost advantage to being able to replicate the process and larger systems that can reuse the details will see a reduced cost per square foot of bridge built. As models for implementing the SHRP2 ABC Toolkit, eight demonstration projects were chosen across the country in a variety of circumstances. The following report synthesizes the experiences of the eight demonstration projects along with experiences collected from the remainder of the SHRP2 R04 project activities. It documents the key lessons learned for owners, designers, and contractors in each project description. In addition, it provides a general overview of state perspectives on using the SHRP2 ABC Toolkit and their status moving forward with ABC bridge techniques.

Project Descriptions

The following projects were included as recipients of SHRP2 Implementation Assistance funds to use the SHRP2 ABC Toolkit in determining and designing bridges incorporating ABC techniques. Each location had unique challenges that specific ABC techniques were chosen to address. Lessons learned varied per project and are described below.

- Fort Goff Creek Bridge, Siskiyou County, California
- IR7 Gila River Bridge, Sacaton, Arizona
- Warren Ave, On Ramp, Bridge 465, East Providence, Rhode Island
- KY-6 over Stewarts Creek, Knox County, Kentucky
- Kittery Overpass Bridge, Route 1, Kittery, Maine
- Bridge A-0087, Boone County, Missouri
- Five bridges on I-39/90 corridor south of Madison, Wisconsin
- Seney National Wildlife Refuge, J to H Bridge Replacement, Seney, Michigan

Fort Goff Creek Bridge, Siskiyou County, California

Photographs provided courtesy of Caltrans

Before:

After:

Photos by Caltrans

Background

The existing structures at the Fort Goff Creek locations was a 60-year-old 15-ft-diameter corrugated metal single steel pipe culvert. Caltrans applied SHRP2 Implementation Assistance led by Bridge Engineer Dorie Mellon, for the replacement of a Fort Goff Creek Bridge located on Fort Goff Creek, approximately 400-500 feet (ft.) upstream of its confluence with the Klamath River, where flows are conveyed under State Route 96 at Post Mile 56.0. Fort Goff Creek is located approximately four miles west of the community of Seia Valley in Siskiyou County. The bridge location and sensitive environmental issues necessitated the use of ABC and the SHRP2 ABC Toolkit was instrumental in choosing the techniques and design. California law requires unimpaired passage for all anadromous fish at stream crossings. The project replaced a 60-year old culvert with a 60' long single span bridge. The bridge location is in severe climate area and subjected freeze-thaw cycles which requires heavy application of deicing material. The bridge is located in a remote area where the nearest batch plant is located 90 minutes away.

Acquisition Method and Cost

The new bridge construction cost was $1,400,303 ($660/ft) while prefabrication costs were $540,000 and the whole project costs came to $2,390,000. This was a design-bid-build project with the plans being produced by Caltrans.

Planning, Design, and Specifications

The new bridge is 60-ft-long, single-span, precast concrete voided slab bridge with precast concrete abutments and wingwalls was both a visual and practical improvement over a conventional cast-in-place concrete bridge. The PBES structure design utilized nine adjacent 2-ft 1-in.-deep, 4-ft 1-in.-wide precast, prestressed voided concrete slabs; precast concrete abutments; precast concrete wing walls; and prefabricated steel barrier rail (California ST-70 bridge rail). To further enhance durability, epoxy-coated steel reinforcing bars were used in the voided slabs and for the top layers of reinforcement in the abutment back wall and precast concrete wingwalls. The riding surface was provided by a 1½-in.-thick polyester concrete overlay. The plans eliminated falsework that kept construction activities out of the stream and allowed the channel section and the stream bed beneath the highway to be restored to a natural state allowing unimpaired passage for anadromous fish and opening miles of habitat for migration, spawning, and rearing of threatened and endangered species. Construction began May 30, 2014 and work was completed with traffic shifted to the permanent structure on November 12, 2014 having been closed for 21 days. The bridge was awarded a 2015 PCI Design Awards Honorable Mention: Bridge with a Main Span Up to 75 Feet. Overall the project was deemed successful as the bridge was completed in one construction season without interrupting the cycles of nature.

Construction Issues and Solutions

A minimum of 90 days from notice to proceed to the start of construction was suggested to allow for submittal review and approval. On this project, approval time was compromised when some submittals had to be redone. Post tensioning shop drawings should be submitted with the precast shop drawings so all aspects of assembly can be compared and accepted. Additional staff time should be provided to process the submittals in an expedited fashion. Design team members must be made available to review shop drawings and source inspection of precast elements. But both the design team and the construction team should review abutment seat grades to make sure the precast beams will seat correctly on the abutments. Between the structures skew and the vertical grade line the beam seats can be problematic.

The contractor appreciated the bridge completion in one construction season for such a remote location. Forest fires in the area due to drought also interrupted the process and delayed the schedule on several occasions although the bridge site was not directly affected by fires.

Best practices from the ABC Toolkit that were incorporated into the Fort Goff Creek Bridge project included: using a single row of piles under the precast concrete abutment, using repeatable elements, keeping pick weights under 100 kips, pre-assembling substructure elements prior to shipping, and incorporating fabrication and erection tolerances in the plans and special provisions. Additional items added to improve implementation included: a cement slurry as a leveling pad for the abutment stems, prefabricated rail, rail curb included in the precast exterior slab elements, a construction sequence included on the plans, and extra overlay thickness added to accommodate differential camber and fabrication tolerances.

In technical terms there were several lessons learned. The extensive use of precast elements precluded the issues of getting ready-mixed concrete to this remote site. The bridge was in a remote, high elevation location where delivery of concrete was over 90 minutes per batch.

Cast in Drilled Holes (CIDH) concrete piles were time consuming, particularly since the contractor did not initially have the right equipment and considerable time was lost resolving this issue. Steel piling driven in or the use of spread footings work better when trying to accelerate a bridge project. As stated by the overall project manager, the use of CIDH piles slowed the process. Agreement on the form liner and stain used should be made by the contractor and owner before construction. Because this wasn't clear, the required concrete test panel for the form liner was not cast. This caused confusion determining if it was acceptable to use the form liner for the wings. Close attention is needed regarding materials used (in this case rebar) since there is no time to recast or reorder bar steel in an accelerated project.

Lessons Learned

- Coordinating seven different funding sources to compete the projects was a project challenge. Meeting each sources rules and time took significant management time.
- It is critical to have the entire Caltrans team on board with the ABC process ahead of the project to make sure the accelerated project schedule is met by the various Caltrans shop drawing review teams.
- Early in the project the construction team should work with the contractor to make sure they understand the needed project approvals long before the time line comes along.

- The precast fabricator made several errors and frequently requested changes to the plans and specs. Consistent inspection at the fabrication site is required to assure compliance with plans, specs, standards, and QA/QC practices. The fabricator continually tried to use ABC as justification for not taking the time to correct errors. It is critical that Design, Construction, and METS send a consistent message to build it right the first time. Accelerated construction is not justification for lowered quality.
- A mandatory pre-bid meeting should be held with potential contractors to make sure they understand the additional expectation and timing of an accelerated bridge project.
- Elevation differences of the precast superstructure elements due to dimensional tolerances and camber variations were accommodated by a polyester concrete overlay. The plans called out a 1 ½ ” thickness which was set over the lower girders and allowed to reach a minimum of ¾” to 1” over the higher ones. If a ¾” minimum overlay is called out on the plans any additional quantity required to smooth out dimensional differences will require a change order. Precast superstructure projects should go with the 1 ½” overlay to avoid a change order
- The success of the project was due to the enthusiastic, dedicated and innovative spirit of the project team.
- Caltrans learned not to underestimate the impact of remote locations on price. The cost implications of the site ended up being higher than estimated.
- Caltrans recognizes that adoption of R04 processes requires the buy-in and adoption of the contractors and contracting community.

IR7 Gila River Bridge, Sacaton, Arizona

Photographs provided courtesy of Arizona DOT

Before:

After:

Background

Built in 1961, the IRR BIA Sacaton Road (Route 7) over the Gila River 1.5 miles north of Sacaton in Pinal County, connecting the Phoenix area with the Gila River Indian Community (GRIC) in Arizona had reached its design life and needed to be replaced to comply with current bridge and highway standards, as well as to add a sidewalk for more realistic pedestrian access. The existing 140-foot bridge was a 4-span structure built with a cast-in-place slab on precast rectangular beams, that were pre-stressed 35-foot spans. The bridge had no sidewalk although there is significant pedestrian use. It spanned a mostly dry river channel – though during flood events the water sometimes overtopped the bridge decks due to a 45-degree skewed substructure. By 2008 the sufficiency rating was eligible for replacement and deteriorating rapidly. Upon being granted funds through the SHRP2 R04 project, GRIC consulted the R04 Toolkit to determine the best course of action to complete the project.

The hallmarks of the IR7 Gila River Bridge project led by Gila River Indian Community (GRIC DOT) Transportation Engineer Steve Johnson, were extensive teamwork and creative innovation. With a conventional build, the nine-mile stretch would have required a four to six-month road closure, causing significant detours to the public using the road. With the bridge slide, the project only shut down these nine miles for 11 total days. The new 2-span prestressed girder bridge opened to traffic in early March 2015 having had a single weekend closure plus a nine-day closure.

Acquisition Method and Costs

The bridge costs included $840,000 in prefabrication, with total construction costs of $2,700,000. The community received $2.2 million from the FHWA's Tribal Transportation Bridge Program, while the SHRP2 Implementation Assistance Program provided an additional $500,000. The results from a cost standpoint were also favorable, particularly to the community. The overall cost was $2.7 million with $0.4 million of that being the slide related operations. This equates to about a 15% cost for the deck slide. The project applied the Construction Manager General Contractor (CMGC) process where the contractor and designer work together from start to finish.

The central approach to the project construction was to keep it simple. This philosophy helped to limit the need to buy or bring in expensive slide equipment and keep expenses down. Some of the cost control methods employed included: use available tools vs. buying expensive new/ unique ones, extend the pier cap temporarily with a cap that is removable later, create permanent temporary support abutment eventually incorporated into a wing wall, grease and slide the bridge deck steel on steel. (lithium grease, no polytetrafluoroethylene (PTFE), and use standard post tensioning hydraulic jacks for the bridge slide.

Planning, Design, and Specifications

Although 90% of initial plans for a conventional bridge were completed, the project had stalled due to insufficient funds and concerns that it would have closed the road for approximately 6 months which would have significant impact on the small community. It was critical to accomplish this project in the most efficient way possible. The new bridge was built as a two-span bridge, 145’ X 53’ 2” with precast abutments, pier cap and columns, modular beam, and deck which continues to be a model for both the state of Arizona and the nation regarding successful ABC projects. ENR Southwest named the project with their regional 2015 Best Projects merit award reducing the impact of construction on traffic by 22 weeks. A project website http://www.sacatonabc.com/project-updates.html details how the contractor demolished the old bridge and slid the new bridge into place on Feb. 22-24, and captures the slide process in a video and progress photos.

The SHRP2 ABC Toolkit provided ideas on what the final product would be and how best to achieve it. The results of having applied the Construction Manager General Contractor (CMGC) process where the contractor and designer work together from start to finish were very successful. Trust between owners and contractors has not been evident on many past projects. CMGC worked for the Gila River Bridge because the owner, designer, and contractor were fully vested and provided good synergy throughout the process. After the decision to go CMGC, a reassessment of the entire plan was critical to getting the whole team on board. The bridge as originally redesigned conventionally was over budget, so all possibilities went back on the table in the CMGC process including the possible reconstruction of the existing bridge.

Construction Issues and Solutions

The contractor’s expertise was a great benefit in evaluating various possible construction solutions along with sorting out the project risks early among the involved parties. Both tasks were daunting, but both were worthwhile to the success of the final product. ABC options were evaluated with true “risks” including river flow, materials, techniques, safety, need to minimize throw away construction, and risk allocation. The gravity of these issues was a challenge particularly having the entire team at the same table. Figuring who is responsible for what and how much it will cost is the real backbone of the CMGC method and is the litmus test for the success of such a project. The team was very successful at resolving these questions and moving forward. Designer and contractor input should be sought out before and after the ABC project for improvements for future projects.

The results from a cost standpoint were also favorable, particularly to the community. The overall cost was $2.7 million with $0.4 million of that being the slide related operations. This equates to about a 15% cost for the deck slide. Cost savings was primarily realized in the reduced traffic impacts. The original concept would have closed Sacaton road for 4 to 6 months. The ABC slide closed the road for one weekend to build an abutment and then 9 days to demolish the old bridge and slide the new one into place. Besides cutting construction time, there was a savings in user costs since at a construction project issues including traffic controls, rerouting vehicles, delays due to detours, gas costs and freight delivery costs all factor into the value. This was an efficient process and slide when considering the tremendous improvement in mobility to the community.

This bridge-slide process had been used in other states including Nevada, Utah and Iowa. But the Gila River Department of Transportation was hesitant to consider a bridge slide until discovering the available SHRP2 funding that they then applied for and received.

Lessons Learned

- The team needs to open to new technologies and ready to implement the concepts of ABC. The ABC approach worked well for this project.
- The SHRP2 R04 Toolkit was useful on this project as it was not overly restrictive in the possible ABC process and allowed useful modification.
- Trust between the owner, designer and contactor was critical to the success of this ABC project
- The public was a partner in the process and brought into the project from an information standpoint early on
- True partnering was a key element to the process and success of the project
- The slide in process cut the road closure time down from 4 months to only 11 days
- GRIC credits many of the successes they had in the Gila River Bridge replacement project to the contract mechanisms employed. This project utilized a Construction Manager / General Contractor (CMGC) agreement

- By including contractors in the initial discussion under the CMGC process allowed the project team to assess the method in which they would approach the bridge slide.
- The CMGC process allowed the project team to take advantage of materials the contractor had on hand and greatly reduced project costs
- GRIC credits the partnerships with on the American Association of State Highway and Transportation Officials (AASHTO) and FHWA for the project's success. The outside expertise was greatly appreciated.
- While there aren't ways to measure for sure, there were also likely lives and injuries saved throughout the construction process by using the bridge slide approach. Nationally, there is an average of three deaths in construction work zones each day, so by shortening the construction closure from four to six months down to 11 days, there's no telling what lives may have been saved in that capacity.

Testaments to the success of this endeavor can be seen in the following two quotes.

"I had the impression that to qualify for the SHRP2 funding, we would have to use the SHRP2 ABC Toolkit by applying its standard plans," said Mark Chase, VP AZTECH Engineering. "Instead, the toolkit provides central concepts – it includes standard plans, but it doesn't force the design to use them. That way we could modify them to meet our needs or create our own. The intent of the toolkit isn't so much to provide a recipe, but rather a philosophy."

Of the process Steve Johnson, GRIC Transportation Engineer, stated, "It's been a dream job, gone very smoothly. It's been an honor to work with these guys!"

Warren Ave, On Ramp, Bridge 465, East Providence, Rhode Island

Photographs provided courtesy of Rhode Island DOT

Before:

After:

Background

The Warren Avenue Bridge carries traffic over Warren Avenue from Veterans Memorial Parkway onto I-195 West in East Providence, Providence County, Rhode Island. 0.4 miles East of JCT RI 103. The existing bridge was a badly deteriorated three span 123-foot prestressed girder bridge with extensive cribbing underneath the concrete column piers. As it was built in 1959, the existing bridge was in a state of advanced deterioration with timber supports alongside the structure's piers to maintain traffic loads. It had a sufficiency rating of 12.4 (out of 100) and needed replacement in an expedited fashion due to traffic impacts. The replacement bridge is a single span steel structure.

The state of Rhode Island led by John Preiss and Jessica Rodas, used SHRP2 Implementation Assistance to replace the existing Warren Avenue Bridge using the SHRP2 ABC Toolkit to speed construction from October thru November 2014. The bridge was completely replaced in less than one month, and its reopening is approximately one week earlier than projected. Had the bridge been built using conventional construction methods, it would have taken a full construction season to replace it.

Acquisition Method and Cost

The 84-foot simple span bridge of modular construction with 2 beams and a concrete deck, totaled $800,000 in prefabrication, with total construction costs of $1,900,000. The procurement method on this project was by design-bid-build.

Planning, Design, and Specifications

The project was built using precast abutment footing resting on crushed stone, grouted bar splicers for abutment stem and used the same method for abutment wing walls, and precast approach slab. Concrete barriers were precast to modular deck units ahead of erection. Using the SHRP2 innovative design package significantly shortened what would normally be a full-year construction period. The innovations included using two sections of precast "superstructure," knitted together by a closure pour. Real-time video of the bridge along with an animation of the entire process can be found on the Rhode Island DOT website.

The original bridge built in 1959, carried an on-ramp to I-195 West, had a sufficiency rating of 12.4 (out of 100) and needed replacement in an expedited fashion due to traffic impacts. It was too narrow to allow for staged replacement. By using ABC, the state met these challenges while reducing the public’s exposure to the construction activities and improving safety. The ABC process reduced the closure time from a year to 21 days and allowed for Warren Avenue to be closed for two short times only: one closure for the demolition of the existing bridge and a second closure for erection of the new bridges superstructure. Both closures where done over weekends to minimize impact. Incentives/disincentives were applied to both closure windows. The Warren Avenue Bridge was an excellent location to showcase ABC techniques and build credibility with the public since the state had only recently replaced a similar bridge adjacent to the current project. The adjacent bridge took over 400 days to complete.

Construction Issues and Solutions

Contract documents should clearly address whether precast elements will be manufactured at a precast plant or if the contractor will be allowed to precast the elements onsite. Ultimately the Rhode Island contractor was allowed to self-pre-form the precasting of the superstructure onsite, saving time and money on transportation of the large superstructure elements. Educating precasters to the expectations of the project before letting should make the timing and project flow smoother.

To mitigate the issue of substandard existing bridge clearance, shallower steel beams were used while shortening the bridge from three spans to one. Deeper beams would have caused a clearance issue for the roadway under the bridge. These beams were ideal for picking and swinging into place with a crane from their deck casting position just off the roadway. The bridge footings were placed on spread footings on top of geogrid-reinforced crushed stone pads. This eliminated the need for piling and pile driving which saved money and sped up the construction process.

The abutments were cast in multiple pieces and grouted together with rebar splicers to eliminate closure pours and keep the precast concrete sections manageable. Using “modular construction” fit the site needs better than a side slide or a SPMT move, making it a good cost solution. The grouted rebar splicers performed well for the abutment connections.

Finalizing issues/shop plans and schedule before field work starts could reduce pressure during work. Clear expectations from the owner would allow precasters to prepare before the project is let. Precasters must have time to be prepared and the precaster struggled to complete the work. Tolerances on precast units were critical and more allowance would have helped, as more time was needed for the submittal process. Tolerances need to be evaluated on precast elements as frequently as reasonably possible.

Adequate construction space should be provided at the project to avoid the scenario of needing to rent adjacent space. The lay down area for construction onsite was very limited. More space would have been beneficial and would have eliminated costs of renting a parking lot.

Unknown risk will always be an issue for the contractor. There was an untimely crane breakdown. Inclement weather cost the schedule 1.5 days, although the stone sub-footing helped with drainage in recovering from a rain storm. Placing the footing on geogrid-reinforced crushed stone saved time and money compared to placing over a deep pile foundation.

Lessons Learned

- An experienced project engineer on site with the power to make ABC related decisions kept the project moving and on schedule
- Good project planning lead to consideration of possible risk scenarios before the project started
- Good communications were a key as always to the smooth progress of the project
- The chosen demolition subcontractor was not the one with the lowest bid, but did an outstanding job of removing the existing structure quickly
- Planning and understanding the actual risks were key to bidding the project by the contractor.
- Shortening the road closure from a year or more to 21 days was well received and “built” credibility with the public for RIDOT
- Reducing project time enhanced safety by reducing the public’s exposure to construction activities.
- Despite the cost premium, the project was considered a good investment
- The FHWA ABC decision matrix worked well when applied on this project.
- Clear communication with everyone working together made the project come together.

- Taking additional time to work through the details and the needed submittal before construction in the field is crucial along with balancing risk and speed to account for variables including weather.

KY-6 over Stewarts Creek, Knox County, Kentucky

Photographs provided courtesy of Kentucky Transportation Cabinet

Before:

After:

Background

The two existing two span bridges, *KY-6* over Lynn Camp Creek and over Stewarts Creek in the town of Woodbine in Knox County were replaced with single span steel bridges installed in two or three longitudinal sections. The longitudinal sections were knitted together in the field with grouted joints. The ABC process was employed to greatly reduce the roadway closure time that would have a long mountain detour in this rural area. The A+B bid required a 38-day maximum closure and conventional methods could take up to 5 months.

Kentucky Transportation Cabinet (KYTC) used their SHRP2 Implementation Assistance funds on the KY-6 Bridges over Lynn Camp Creek and over Stewarts Creek in Knox County.

Acquisition Method and Cost

Bridge Engineer Kevin Sandefur led the project that cost $400,000 in prefabrication, with total construction costs of $700,000.

KYTC used an A + B bidding (cost + time value). The "A" portion is the bid for the actual construction activities in the traditional sense. The "B" portion is a value in dollars placed on each day the construction is taking place. The two items totaled equal the bid value of the project. The lowest total is used to select the winning bidder. This method reduced the contract time to what a contractor can reasonably accomplish. The A + B bidding process worked as expected with a 38-day total length project and a 14-day maximum closure period for KY-6.

Planning, Design, and Specifications

The new bridge is a 45' long simple span bridges, Super in two manageable sections, with longitudinal joints, and steel pile end bents with precast concrete cap. It has galvanized steel rolled girders and galvanized reinforcement used in the deck for longer life. The project demanded a maximum 3-week closure because in this mountainous region, bridge closure created a major detour. The owner/designer and the contractor worked well together to solve project issues and kept this highly accelerated project on track. The bridge was completed with a 14-day total closure period. The expected total length of the construction project was 38 days.

Construction Issues and Solutions

The precast abutments were placed over the previously driven steel "H" piles. The H pile pockets were formed with galvanized steel culverts as is standard procedure for this type of construction. A unique addition to the process was running three reinforcement bars horizontally through the culverts to guarantee composite action between the piles and precast abutments. These bars turned out to be very useful in leveling up the precast abutment pieces as shims were placed on top of the cut-off H piles and under the rebar's to hold the elements in the correct location. The abutments were also leveled by shimming off the concrete mud sill poured under the abutments.

Kentucky used the same techniques on another nearby bridge where some minor fit-up issues were present where the precast superstructure elements fit with the precast abutments. To guarantee the superstructure would fit on the abutments, the contractor did something unique when they first cast the abutments and then set them to the proper line and grade off-site. The steel beams of the superstructure were then placed in position on the precast abutments. The deck concrete was cast onto the beams, including the end diaphragms. This process did not only guarantee the alignment of the superstructure bars in each of the two precast superstructure elements, it also assisted with making sure the end concrete diaphragms would seat properly on the abutment elements. Cork filler was added by the construction team between the superstructure and abutment vertical faces to gain a 0.5-inch tolerance for fit up when the super would be set on the abutments in the final location.

Clear specifications are required on the galvanizing process and experts are needed to address galvanizing-related questions that arise during an ABC project. The galvanized specifications must be clear on the process and expected results. The silica content allowed in the steel beams to be galvanized must be specified. This can make the galvanizing process go smoother and does not cost anything additional to specify. Galvanizing the steel beams and the bar steel reinforcement was new to KYTC, although it is routine in other parts of the country. The original galvanizing process in this project caused zinc to pool on parts of the beams, making it difficult to paint. The company that did the galvanizing ended up having to blast the first galvanized surface off and re-galvanize the beams. The second round of galvanization produced better results and the beams were then painted. The galvanized and painted beams should last the 75 years of predicted life of the bridge. This is significant improvement over needing to repaint normal steel beams every 30 years. The cost of the galvanized rebar was high and needs to be lower if used on multiple projects. (At this point stainless steel rebar would have cost about the same as the galvanized.) The bid price on the galvanized rebar cost $3.50 per pound. The epoxy-coated rebar that normally would have been used costs approximately $1.30 per pound. At this point, stainless steel rebar costs approximately $3.50 per pound nationally. Stainless rebar is the best product and is normally used for special applications. Unless the galvanized rebar can be procured in the $2.00 per pound range, its added value may not be worth the investment. It is expected that the galvanized rebar’s bid price would come down if it were used on a more regular basis.

Large timbers were unexpectedly discovered in the areas of the new abutments. These timbers were part of the support structure of the previous bridge and were not documented in the old plans. They had to be removed to place the new steel piling, taking valuable time in an accelerated project. This was handled by the contractor who still managed to maintain the schedule.

Lessons Learned

- Precasting in the contractor’s yard worked well with good results. The contractor precast the abutment and superstructure elements in their yard before placing it in the field. KYTC allowed this precasting procedure with reasonable oversight by inspection personnel.
- Casting the deck elements next to each other and on the actual substructure units worked well to guarantee proper fit up of all the elements in the field.

- Transporting the superstructure in two longitudinal pieces did not present any issues to the contractor
- Bar couplers are expensive and should only be used when needed.
- The 21” diameter culvert pipe worked well for the pile pocket at the abutments.
- The reinforcement bars placed horizontally through the abutment pockets turned out to be very useful as shimming points during abutment placement.

Contractors should be aware of materials ahead of time to make sure the elements are reasonable. Bar couplers are expensive and should only be used when needed.

Kittery Overpass Bridge, Route 1, Kittery, Maine

Photographs provided courtesy of Maine DOT

Before:

After:

Background

The Kittery Overpass Bridge, Route 1 over Route 236 in the town of Kittery, in York County, Maine was completed the summer of 2014 led by Bridge Engineer Leanne Timberlake.

The existing bridge carried US Route 1 bypass (4 lanes) over Route 236 (2 lanes), immediately northwest of the traffic circle at the intersection of Route 236 and Route 1. The existing bridge structure was constructed in 1942 and is approximately 47-ft long and 71 to 74-ft wide. The bridge structure is a single span, supported on approximately 19-ft tall abutments supported by shallow "footings" bearing on bedrock. These footings appear to have been constructed by placing concrete in depressions or trenches in the rock. Approximately 25-ft long wingwalls retain embankment fill behind the abutments. Maine DOT used the R04 ABC Toolkit and FHWA assistance to use precast concrete abutments, wings, approach slabs, and NEXT-D precast prestressed concrete beams during the restoration of the Kittery Overpass Bridge. Maine DOT not only completed the project on time in spite of having the CFCC strands delivered late from Japan, but they also completed the project within their budget. They experienced no delays due to bad weather, and experienced excellent teamwork between all players, which they believed to be critical. This was an A + B project. (Cost plus time)

Acquisition Method and Cost

The project that totaled $1,350,000 in prefabrication, with total construction costs of $2,560,000. The bridge has a significant ADT of 7740 (a heavy tourist route as well as 14% truck traffic) and it serves as a detour route for I-95. This project consisted of a single span bridge using north east double tee prestressed extreme beams commonly known as NEXT Beams. The abutments were cast-in-place and founded on rock. Precast abutment walls were used with a precast abutment body place on top to receive the tee beams. A precast gravity wall was used for abutment wings running back along the roadway. The job was contracted through A + B bidding and the bridge was closed for 29 days. Being a tourist destination with heavy weekend traffic, there was local concern about the effects of the bridge closure, but the project was well received and supported in the local community. Closure of US Route 1 Bypass lasted 29 days and the contractor earned $10,000/day incentive for a total of $60,000. Closure of Route 236 lasted 11 hours where the contractor earned $5,000/hour incentive for a total of $65,000.

Planning, Design, and Specifications

Traffic handling was a real issue on the project. The Kittery area is a major tourist destination and during the summer months traffic intensifies from Friday through Sunday. The contractor commented that any material they wanted to use or install on Friday or Saturday had to be on site by Thursday night or it would not be available. This reinforced the need for an ABC approach on this project. The Maine Project Engineer and the contractor commented on how helpful the local police chief, Ted Shaw was during the whole process. Knowing the local streets and allowing some creative detours improved the traffic plan dramatically from what was first planned. The early traffic backups were reduced to minor issues, gaining additional support from the public.

It is helpful for an owner to bring their first successful team on board for several ABC projects, to transfer experience and confidence. The Kittery project was very successful due to good planning, communication, and a solid team.

Construction Issues and Solutions

Northeast Extreme Tee Beams (NEXT Beams) were unique to this project. These shallower beams were pre-tensioned with carbon fibers instead of steel strand. The carbon strand will not rust and should last well into the future on this bridge that is exposed to deicing salts from above and below. DOT also used “Z” bars for reinforcement. “Z” bar is a proprietary steel reinforcing bar that is first galvanized and then epoxy coated for added durability. It is expected to be functional for 75+ years, making for a longer-life bridge. The AASHTO design guide for the carbon strand and it was applied on this project. Between these two products it is expected the NEXT beam should never become the reason the bridge needs to be replaced in the future. This will be a good long-term durability test for both these materials.

Another change requested by the contractor before the existing bridge was demolished was to allow the contractor to redesign the connection from the cast-in-place footing to the precast abutment wall. The plan detail called for the use of bar slicers to minimize the length of rebar sticking out of the footing and connecting to the abutment wall. The contractor proposed going to a nested rebar pocket detail (see Maine DOT Bridge Manual) to simplify the placement of the rebar and reduce the risk of not having all the cast-in-place rebar in their exact locations and causing fit up issues when the precast abutment walls were lowered on to the footing. This detail was reviewed by the designer and Maine DOT and found acceptable after some minor modifications. The pocket detail was used and found to work well at the project site. This should be considered on future ABC projects.

The bridge’s full retaining abutments were built with precast elements. The cast-in-place footing for the abutment worked well as the rock was uneven and several feet deeper than expected in some areas. Cast-in-place concrete allowed the footing to be leveled up easily and made a good foundation for the precast abutment walls.

Lessons Learned

- The extensive use of precast elements (abutment body, abutment wall, wing walls and super) made for an efficient ABC project. Thorough quality control of the precast concrete.
- The contractor was working 6 days a week and felt the allowed time was reasonable to keep the quality of work high yet move the project along quickly and not burn out their workers. Communicating expectations to the team as the schedule required long work hours, a skilled work force, and proper equipment to complete the work on time
- Maine DOT team believes that the success of the project was due to the collaboration and dedication of the project team. Teamwork between all parties involved from the Maine DOT and FHWA Team, to the contractors, and the Kittery Police department who played a critical role in detour traffic control on Route 236. The Contractor management of all subs was critical in meeting the project schedule milestones and was responsible for the project finishing on time.

- The contractor proposed an alternate connection detail for the footing to abutment back wall connection. The alternate connection was reviewed and accepted and is now part of the Maine DOT Bridge Manual on ABC.
- Ensuring that the team is aware of the accelerated schedule which requires long work hours, a skilled work force, as well as providing information to ensure that proper equipment to complete the work is available are key components in the success of ABC projects.
- Maine DOT noted that having cooperation with the local police force is valuable in the reroute of traffic to save time, money, and ensure safety of travelers during road closures and re-routing.
- Normally a project like this would take 5 to 6 months to complete. Using the R04 Toolkit and the ABC approach the project was completed with only 29 days of closure.
- The Contractor management of all subs was critical in meeting the project schedule milestones and was responsible for the project finishing on time.
- Proper survey of the layout location of the Kittery Overpass Bridge was critical for fit-up of all the precast elements.

Bridge A8165 (replaced A0087), Boone County, Missouri

Photographs provided courtesy of Missouri DOT

Before:

After:

Background

Missouri DOT, under the direction of State Bridge Engineer Dennis Heckman and Research Administrator Bill Stone, completed the construction of Bridge A8165 in the fall of 2014. The bridge carries Route B over Business Loop 70. The existing three span concrete slab structure A0087 was 124 ft long and 29 ft wide with concrete piers and abutments. It had 2 12-ft-wide traffic lanes and 2 3-ft-wide shoulders. Built in 1958, the bridge was deteriorated and required replacement. It was replaced with a single span precast box beam bridge. ABC was employed to get the existing bridge replaced during the summer season to avoid the extensive University of Missouri student population that uses the bridge during the school year.

Acquisition Method and Cost

The project cost of $514,000 was about $150,000 more than the conventional single span bridge on piling with MSE walls. This was a design-bid-build project.

Planning, Design, and Specifications

The new urban bridge in a high traffic area had a two-week closure and included Geosynthetic Reinforced Soil (GRS abutments. The contractors had a choice of two superstructure options. The first option had units of two steel wide flange girders with precast deck panels that were then linked together with Ultra High Performance Concrete (UHPC). The low bidder chose the second option which consisted of adjacent prestressed concrete girders topped with a reinforced cast-in-place concrete deck. Overall the project was successful with all involved learning from the experience.

New technology should be presented to the design and contracting community as early in the process as possible. Plans and specs must be understood and clear to all stakeholders before the project is let. All parties (designer, contractor, and stake holders) must work closely as the project is being developed to gain both a constructible and economical bridge.

Construction Issues and Solutions and Lessons Learned

- There are good design and construction guides available for the GRS abutments from the FHWA, use them.
- Any contractor can build a GRS abutment as they are not complicated and do not require special equipment, but access is a real issue for the contractor and effects their risk and hence the price
- The local block suppliers must show the ability to produce dry cast blocks that will satisfy the ASTM saline test before the project is let
- Wet cast blocks will work if dry cast blocks that meet the specs are not available.
- Once the contractor installs a few layers of blocks the efficiency of the process dramatically improves and the construction speeds up.
- Scour concerns with GRS abutment will have to be considered on water crossings.
- Access to the front of the wall during the early stages of construction would have sped up the process (prevented by traffic).
- A 7-day wet cure of the concrete deck overlay actually takes 7 24-hour days, and this is real added time to an ABC project.
- Material testing (compaction) slowed the construction process. The frequency of tests should be reviewed to make sure that what was required is reasonable.

Five Bridges on I-39/90 Corridor South of Madison, Wisconsin

Photograph provided courtesy of Wisconsin DOT

Background

Wisconsin DOT's Bridge Engineer Bill Oliva led the project to construct five work horse bridges on the Interstate 39/90 corridor south of the city of Madison in Dane County (specifically IH 39/90 SB over LRD Sigglekow Rd and B-13-702, B-13-703, B-13-707, B-13-709) as part of the Interstate Highway 39/90 Expansion (Illinois – Dane County, IH 39/90). This project covers the precasting and installation of median piers on 5 bridges on I-39/90 south of Madison, WI. One contracted in the first year, two in the second contract, two in the last contract (2016). The main driver for using ABC was to get in and out of the traveled way in the median of the interstate as quickly and safely as possible on this heavily traveled route.

Acquisition Method and Cost

The pilot bridge cost $502,000 in prefabrication, with total construction costs $6,897,000. This project was completed using the design-bid-build process.

Planning, Design, and Specifications

WisDOT developed pre-cast piers, associated details and provisions to support construction that took place in March 2015. The bridges include prefabricated pier column and caps and the SHRP2 ABC Toolkit was referenced in the development of detailed drawings now incorporated into the WisDOT Bridge Manual. Wisconsin had experimented with precast elements on previous projects and had receptive contractors ready to use precast elements. Details and specifications were developed and implemented by the WisDOT ABC team working with FHWA, other DOTs, and consultant support.

The main incentives of applying ABC techniques were to allow the contractor to quickly get in and out of traffic, to reduce traffic impacts and to increased safety for the public as well as the contractor. Repeating the process five times reduced the cost premium for the elements. The main push from an ABC standpoint is to get in and out of the traveled way in the median of the interstate as quickly and safely as possible on this heavily traveled route. The first bridge design was designed by a consultant. The 4 following bridges were done by WisDOT. This mega project runs through 2019 so many more precast bridge pier projects are possible going forward. There was positive reaction to this project from the public, despite little public outreach on the use of ABC technology particularly because it significantly minimized any adverse impact to the public.

An estimated 2 – 3 weeks' time was saved using the given ABC procedure over conventional bridge construction per structure. The premium cost associated with the use of PBES-Piers over conventional Construction was estimated at $290,000. The repetitive nature of the precast concrete pier designs resulted in the second two bridges having only half this much for a markup on costs. The last two bridges were approximately the same cost as cast in place option. This reduced construction time minimized the impact on the traveling public and reduced safety risks for construction workers and the traveling public in the work zone adjacent to traffic operations areas.

Construction Issues and Solutions

Regarding placement of grouted couplers to minimize conflict with other reinforcement it is important to consider the overall weight of precast elements and what will be required for the erection as well as the associated impact to traffic lanes. Couplers that are 1 – 2 bar sizes greater than bar size (as allowed by coupler type/specification) should be used to aid in erecting tolerances. Three dimensional templates should be used for aligning couplers and bar steel during fabrication. Beam seats detailed low leave room for field adjustment as needed and shims used to adjust bearing elevations are easier than grinding the concrete surface at the beam seat to achieve the expected plan elevations. Comprehensive survey control should be used during erection.

Using a bar slicer one or even two sizes larger that the bar size allowed for better field fit up and does not affect the strength of the bar slice. WisDOT emphasized templates cannot be over used to making sure all the bars and bar splicers are located correctly to ensure good field fit up when assembling the precast concrete pieces.

Lessons Learned

- WisDOT received a time savings of around 2-3 weeks per structure
- The project minimized impact on the traveling public and reduced safety risk for construction workers and the traveling public in work zones adjacent to traffic operations.
- This project helped prove the constructability of the ABC innovation. For example, the project had the bridge contractor work on-site at the fabricator's plant to coordinate and streamline their communication process.

- The contractor should demonstrate grouting by doing a mockup coupler prior to grouting the pier couplers.
- Consider the overall weight of precast elements and what will be required to erect them as well as associated impacts to travel lanes
- Use couplers that are 1-2 bar sizes greater than the bar size, as allowed by coupler types and specifications, as this aids in erecting tolerances
- Use 3-dimensional templates for aligning couplers and bar steel during fabrication
- Detail beam seats low and shim up to the correct elevation in order to avoid the grinding of beam sets after erection
- Use comprehensive survey control during erecting.

Additional Observations

From these experiences, the WisDOT addressed their Bridge Manual and updated chapter 7 on ABC. The chapter addressed a decision-making tool for the implementation of ABC on specific improvement projects, providing guidance for internal designers and external consultants and contractors on how to evaluate a project and incorporate optimal technologies on improvement projects.

WisDOT saw cost savings using the methods in the ABC Toolkit. I-39 Corridor's revitalization project lasted over three construction seasons. In the first year, the cost of using the precast elements cost about double the price of casting in place. By year two, the cost was about 50 percent more than casting in place. By the third year, the cost of using the precast elements was nearly equal. WisDOT attributes these incremental cost savings to the contractors learning and repeating the project, therefore becoming more familiar with the precast capabilities. This reflects the costs agencies may face in standardizing and simplifying precast elements to get easier fabricated and erected versions.

WisDOT team saw an opportunity with the ABC Toolkit to improve worker safety on bridge construction projects. By using precast and prefabricated elements, contractors were separated from public traffic, instead of constructing directly beside them. The elements were installed, and contractors were able to get out of harm's way faster.

While WisDOT found that the agency supported the ABC Toolkit, contractors weren't as ready to adopt the process. Through outreach events, such as webinars and presentations at conferences, the agency has found that contractors aren't always in the audience. Being able to reach out to contractors, explain the benefits in time and costs saved, while also hearing why they might have hesitations, would likely encourage broader adoption of the ABC Toolkit and use of precast and prefabricated elements.

First and foremost, WisDOT attributes this project to have been a safety success. By using prefabricated and precast elements, workers spent less time constructing elements on the side of the road, thereby allowing them less time directly exposed to public traffic.

Seney National Wildlife Refuge, J to H Bridge Replacement, Seney, Michigan

Photographs provided courtesy of Michigan DOT

Before:

After:

Background

FHWA Office of Federal Lands, oversaw the replacement of the J to H bridge that took place in frozen conditions mid-winter 2015. The J to H Spillway Bridge is a replacement bridge between J and H Pools on the Fishing Loop in Seney National Wildlife Refuge in Schoolcraft County in North Michigan. The existing bridge was a multi span timber structure built in 1942. The ABC approach was used on this project to complete the entire bridge construction process while the water fall was not present during the winter months. This off season construction minimized the impacts of the project on this environmentally sensitive wild life refuge.

Acquisition Method and Cost

The construction costs totaled $1,180,000. This was a design-bid-build bridge construction project.

Planning, Design, and Specifications

The bridge is a single lane, three span (44’, 44’, 44’) continuous box-beam bridge with adjacent box beams, precast pile caps (abutment and pier), cast in place concrete overlay, and concrete rails precast to exterior beam prior to erection. Prefabricated construction was chosen to limit impacts and construction durations in the Refuge’s sensitive wildlife habitat. This pilot project provided details and specifications for future bridge replacements with similar constraints. Having the construction process lag into the middle of an Upper Michigan winter, while costly to the schedule also provided a model for completing bridges under harsh conditions using precast elements and ABC.

Construction Issues and Solutions/Lessons Learned

- The frozen environment provided added protection to the wildlife and the sensitive stream bed.
- The precast ABC methods used to do the project worked well.
- Significant waste of extra pile was produced as the precast prestressed concrete piles arrived from Virginia 60 feet long to guarantee they would not need to be spliced but the installed lengths came in between 30 and 40 feet.
- Piles were driven with a Pile Dynamic Analyzer (PDA) which allowed for very accurate pile bearing calculations.
- Precast concrete bridge elements arrived good shape and fit well together.
- The single lane road accessing the bridge site caused the contractor to need a special hauling rig for the last half mile to deliver the precast elements. Site access is an important consideration on an ABC project.

- The use of precast elements helped reduce the footprint of the new bridge project in this environmentally sensitive area as planned.
- Cold winter weather required various parts of the bridge to be ‘housed’ to keep the joints warm while the closure concrete was placed and cured. Worked well, but is an added cost.
- Reinforced concrete overlay went down well within the constructed warm housing.
- Epoxy grout was specified for the transverse post tensioning and longitudinal joints between the precast boxes. This grout was difficult to handle and get properly into the post tensioning ducks and joints. (Normally a cement grout is used)
- The new bridge was shifted slightly transversely to miss existing piles at the two new piers. (Given the gravel road approach this was not seen as a significant issue)

Summary of Lessons Learned

The reasons to consider an ABC project are as varied as the methods to build them and with each method comes a variety of lessons learned many of which are mentioned in the descriptions above, have been taught in the a series of training workshops funded by the R04 project, and were described in detail in the specific IAP Project update reports delivered earlier in the scope of this work which can be found on the [SHRP2 R04 web page](http://shrp2.transportation.org/Pages/Bridge-Designs-for-Rapid-Renewal.aspx).

http://shrp2.transportation.org/Pages/Bridge-Designs-for-Rapid-Renewal.aspx

Over an 9-month span starting in mid-December 2017 through the end of September 2018, twenty workshops were held in individual states with 1065 sets of workshop materials distributed to over 825 present attendees with the remainder distributed within the agencies. A synthesis of these lessons is as follows.

From an owner perspective, it is imperative that the entire team accepts the ABC concepts, costs, safety aspects, potential time savings and opportunities for positive public acceptance. They must understand that the needed reviews must be accelerated to keep the ABC project on schedule. They must be open to flexible and fast approval turn arounds. Policies that do not affect the quality of the final structure should be flexible with expedited approvals due to the short duration of the project.

New technology should be presented to the design and contracting community as early in the process as possible. Plans and specifications must be understood and clear to all stakeholders before the project is let. All parties (designer, contractor, and stake holders) must work closely as the project is being developed to gain both a constructible and economical bridge. From decisions on contract mechanisms and location of construction elements, to specifications of materials including galvanized steel, UHPC, sizes of steel beams, rebar sizes, and weights of materials required for crane operations, it is imperative to address these details at the beginning of the project. Bringing contractors and designers to the table during these decision-making processes can provide the opportunity to apply unique and efficient solutions. Once requirements for materials are established projects must determine how the needed resources will be ready and available to keep the accelerated process moving.

From a contractor perspective, it is important to ensure proper planning and consider all risk scenarios. Contractors benefit from establishing solid communication with both the owners and designers particularly when it is necessary to make decisive decisions in the field. Vetting quality subcontractors can dramatically improve the overall project and ensure schedules are held. Prior to bidding on the project, contractors should look closely at the project requirements to determine how it aligns with their competencies. Planning and understanding the actual risks are key to bidding the project. The incentives/disincentives can be challenging, but the short time frame for completion of ABC projects can be attractive to contractor schedules and staffing. Over a 5-month span starting in mid-November 2018 through the end of March 2019, two contractor focused workshops with comprehensive discussion were held in two states to heighten the awareness with the contractor community.

From an engineer/designer perspective specifications and details are imperative to clearly communicating expectations for implementation. Evolving state bridge manuals and peer exchange of resources will continue to provide designers with examples and guidelines to adapt ABC to their specific projects. Consultant designers when used can bring experience and resources to compliment projects.

Updates on Existing and Future Use of the SHRP2 ABC Toolkit by State

There is no doubt accelerated bridge construction techniques have continued to develop since the 8 IAP Implementation Pilot projects outlined in this report were completed. In addition, the SHRP2 R04 project has hosted 3 showcases, 3 peer exchanges, 3 national webinars, 2 TRB workshops and 36 state training workshops across the country including Hawaii and Puerto Rico. Interacting nationally with state bridge engineers, contractors, fabricators, designers and consultants the R04 team has seen tremendous momentum exposing stakeholders and decision makers to the concepts and realities of ABC techniques and providing the SHRP2 ABC Toolkit as a resource.

Many states are actively implementing ABC. Vermont, Wisconsin, and Utah have clear ABC processes in place while California, Washington, and Colorado are working toward the same goal. Most states are working to put processes in place including policies, procedures, standards, and contracting methods. Of the 34 states that hosted training workshops, approximately 1/3 or about 11 states were doing their own ABC designs and the rest were using design consultants. Presentations made by the states at their workshops were voluntary and those made available can be found on the SHRP2 R04 web page.

http://shrp2.transportation.org/Pages/Bridge-Designs-for-Rapid-Renewal.aspx

State designers and design consultants rely heavily on conforming to bridge manuals, so it is imperative for states to have clear guidelines regarding design, cost and risk analysis, parameters for applying ABC and available contract methods. Most states use internal teams to write their bridge manuals, but some use consultants to develop new components in their manuals. Utah and Wisconsin have both included ABC decision matrices in their bridge manuals and both resources were shared at the workshops. Even with a published tool, Wisconsin is not currently using their matrix as part of a formal design process. They are looking to incorporate it in the future.

A chart, which can be found in Appendix A, represents what was shared with the team regarding each state's intentions to use the SHRP2 ABC Toolkit and ABC techniques moving forward.

Conclusion

Innovation through accelerated bridge construction is necessary and implementable for many of the country's deteriorating bridges. The SHRP2 ABC Toolkit and corresponding team efforts in training and educating stakeholders regarding ABC concepts and applications, have been instrumental in moving the national dialogue and construction efforts forward. While some states are beginning to adopt these techniques, there is still considerable work left before ABC techniques and policy are found in all state bridge manuals.

FHWA and AASHTO might consider further promoting ABC techniques by continuing to provide incentive grants and additional technical assistance incentive funds that would cover the increased startup costs incurred in applying ABC techniques. They could provide states more guidance and tools for calculating and assessing ABC costs and risks and, provide best practices to assess and communicate costs to decision makers and users. More broad information is also needed to help states educate leadership and decision makers to understand the benefits of ABC to their agencies as well as to the traveling public. The CMGC method of project procurement is only legal in 12 states so more training and education is needed regarding contracting methods that compliment ABC bridges and encourage contractors and fabricators to pursue them.

The new AASHTO LRFD Guide Specifications for Accelerated Bridge Construction, 1st Edition,

https://aashtojournal.org/2018/10/26/aashto-releases-two-new-publications-and-an-update/, compiles the growing body of recommended design and construction specifications for prefabricated bridge elements and systems for ABC with a focus on constructability and durability. Corresponding technical assistance will be helpful to states that want to adopt these into their programs.

These types of activities will promote more projects that will in turn contribute to industry wide acceptance. The more experience shared among implementing states, the more experimentation will take place with the process. As owners seek designer and contractor input before and after ABC project implementations, more innovations will develop. Great publicity for agencies can be gained from successful ABC projects which may lead to better funding and increased public support as the nation works to replace deteriorating bridge structures faster and safer with better materials and efficient use of funds.

Appendix A: State Progress and Intentions Moving Forward

State	State's ABC work and needs going forward	What States Requested from SME
Arizona	Two recent bridge slides - modular deck unit project both for local agencies - Basic experiences. Bridge Slide in 1990. Want to invited Design, Construction, Policy and Planning staff. They are starting to develop ABC guidelines, looking at Wisconsin and Oregon matrix. May be able to roll out these preliminary guidelines at the training.	Design, Construction, Methods, Costs, Contractor interaction, Lessons learned, Decision Matrix - what is the decision-making process in choosing ABC to determine as early as possible whether it should choose ABC or not. Costs, lessons learned.
Arkansas	Terry Daniel our FHWA Bridge rep and AZ retired Bridge engineer put together a state committee of contractors, precasters, fabricators, consultants, city and local engineers and our staff about 3 years ago to put together a plan. First task was to come up with a selection process/spreadsheet with bullets and flow chart for ABC which has been approved by the administration. GRF/IBM grant was awarded to the city – but not started yet. Hit on seismic issues – half our state is in zone 2 or higher. Anything AZ will design is going to be seismic related. FHWA in AR want them to try lateral slide, (detour bridges are costly) prefab bridge elements and systems – cast, columns full and partial depth slabs, and GRS-IBS (scour issue).	Rick traveled to Virginia ABC conference, Echo Utah for the lateral bridge slide, Dec. Miami Conference, and the committee – Wants staff to have as much understanding and knowledge as he does regarding ABC comfort level, the 'Why, where, how, costs' and common techniques other states are using – what is useful and what resources are available.

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Appendix A: State Progress and Intentions Moving Forward

State	State's ABC work and needs going forward	What States Requested from SME
California	Between moderate and advanced. Just finished a longitudinal launch, a few slide in's and just completing a large project but haven't standardized the process yet. Have an ABC group and technical committee. Still have resistance and a lot of room to grow. Even the ABC group doesn't really understand ABC - a lot of confusion on what is and what isn't ABC - significant reduction in impacts or working days. Working on updating bridge policy. CA does not do a lot of bulb-ts and does not use GRS abutments, although local agencies can but they won't do it if Caltrans doesn't do it first. Goff Creek has been so successful - permitting agency offered a programmatic permit for a standard design.	Help deal with maintenance skeptics who think PBS is a maintenance risk because of joints. Help push UHPC benefits. Show data whether Pre-cast in a facility is better quality when steam cured. CA has 3 precasters and are trying to push the importance of taking fabrication and erection tolerances in the design process before the construction phase. Tolerances for slide ins and PMTs. Build forgiveness into the system. Focus of Contractor interactions and issues such as how to handle prep before closure in these rush jobs. T-15 wants GRS out of documentation. Show the importance of designing to constructability and embracing innovation. Help them communicate with stakeholders - ABC comes in many flavors and you want to pick the right one. Discuss goals and constraints.
Colorado	Moderate ABC work. Sponsored and led a seminar on their bridge sliding program. Created a guideline on bridge slides. Have done 4-5 slides and 1 SPMT. Now in a bit of a dormant situation.	Focus on construction and why ABC methods are useful options. Always interested in options - bridge sliding seems the least risky but would like to introduce other methods. Costs conversation would be good - 20-30% increase is scaring people off - Utah has made it actually cheaper/Montana too. Lessons learned are always good. To provide awareness of resources available so as not to re-invent the wheel. Want to know who is available outside of CO to pull advice from and technical help. (SME offered to provide technical assistance) Give encouragement so that we will consider new projects to implement ABC going forward.
Connecticut	Moderate 5-15 projects so far. Many projects with ABC components, some ABC highlighted projects, STMC on	Lessons learned and details of technology. Contractor interaction with bridge maintenance is a huge topic for CT. ABC methods/costs are important because designers are trying to put our standard

Appendix A: State Progress and Intentions Moving Forward

State	State's ABC work and needs going forward	What States Requested from SME
	major highway, another in Stanford. A slide in in Waterford on I-95.	costs to ABC. Would like national numbers and examples. Focus less on policy and level of effort. Provide construction perspective – expose District staff to basic design background and inspection tips.
Delaware	Historically have done culverts as precast for 15 years but now getting into bigger projects. They have a precast deck panel in construction, precast bridge coming up. This is timely, good information, can't come at a better time.	Certainly, understanding the design tools that are available and how they can be utilized considering issues not considered under traditional design. Benefits of ABC from all standpoints construction, speed, safety, shorter durations, e-costs… More about the Toolkit – what is available and how to use it. More prefab vs. bridge movements. We have modular steel units in design and working with precast deck panels.
Florida	Assistance with major bridge projects from the FHWA as it relates to ABC applications.	Answer ABC questions as they arise.
Hawaii	Very Basic -we have done in the past - precast elements, etc. maybe a few slides.	ABC methods, costs and lessons learned most helpful. Experience of ABC - stories and overview understanding of what ABC is. How can we use this practically - how will it benefit HI. Demonstrate and assist with implementation and funding.
Idaho	UHPC is consistent with our projects. Have one slide-in, no SPMTs. Between 5-15 ABC projects. Plan to train construction staff. Have some lessons learned from UHPC. Project programing and planning within bridge section will also be invited.	Sole source agreement with FHWA using UHPC - would like to hear the national perspective on this. Are their states that have tried their own mixes (NY, WA, etc.?) Discuss local materials and experiments with mixes. La Farge training to contractors is valuable to us. UHPC on design-build but need more data on UHPC - cost and applicability. Present slide in techniques as a method we have not looked at so far. Not interested in SMPTs.
Illinois	Developing ABC policies and standards for inclusion in the IDOT Bridge Manuel.	Support as requested by the State Bridge Engineer.

Appendix A: State Progress and Intentions Moving Forward

State	State's ABC work and needs going forward	What States Requested from SME
Indiana	Basic ABC -have done a few slide ins. Looking to train Project Managers, Technical services, consultants and contractors.	Curious about bridge maintenance as well as methods, Contractor interaction, Technologies, and Lessons Learned from others! Want to explore the level of effort to stand up a program - different relationships set up. Design details - maintenance concerns that design details address. Resources - where to go for more information. INDOT will want to do this. Provide the options - not all just sliding. Show how the site may dictate choices. Design point is a bit late to transition to ABC - need people in planning to consider this ahead of time.
Iowa	ABC in Iowa is no longer in the demonstration stage. Every bridge replacement project is evaluated for ABC. Currently, there are several lateral slide projects in various stages of design. We also continue to invest in research to support the use ABC.	Requested the SME to provide the following for the workshop held in Iowa: Promote to our districts but don't get too technical. Want to see them able to propose candidates for ABC as well as others in the process. Want participants to understand overall costs and considerations. Iowa does on-site detours with temporary bridges, but costs of a lateral slide are competitive saving 5 months of detour with less safety risk and better access. Show the many costs associated with temporary bridges. R19A is also in Iowa. Common interest between participants will be how to decide and how to spot a good candidate – and when will it work best.

Appendix A: State Progress and Intentions Moving Forward

State	State's ABC work and needs going forward	What States Requested from SME
Louisiana	Moderate (5-15 projects) precast systems, no slides yet, 2006 Katrina I-10 twin spans used STMPs on barges to move spans that were underwater. Prestress spans and temporary paneling. 60 Million on repair projects. Inhouse design for complete replacement of twin span. A lot of vehicles hit overpasses – often need girder replacements from truck hits. Have given contractors alternates of replacement techniques but they are hesitant to use STMPs. Need to know when the best place to use these technologies is. Current curve 2 girder span – contractor is using STMP – with cut deck for repair. 10-12 STMPs in the past 6-7 years. Moveable bridges – US leader in moveable bridges. We had a moveable bridge vertical lift structure – fabricated off site with STMP to move it onto a barge and place it on new span. Precast elements – always used pre stressed on small bridges – we have some standards already for precast. Exceptions would be not using UHPC – but 2-foot closure poor with 180-degree bar and normal concrete with accelerators. FHWA encourages UHPC but they haven't decide to use it yet. Looking at a bridge program to replace 1000 small span timber bridges load posted – conducive to damage. Trying to develop an ABC program to group these timber bridges so we can close the road quickly and use precast to	Present the following: What is appropriate per site? How to cost out during design. Methods from cost standpoint. How to get contractors involved – Prebid conferences? Constructability issues. Local understanding of contracting issues and other aspects of construction.

Appendix A: State Progress and Intentions Moving Forward

State	State's ABC work and needs going forward	What States Requested from SME
	replace them in 1-2 months. No alignment changes – not a lot of traffic and ability to spot replace. Depends on funding issues – may rely on gas tax and truck permit fees or bonds. Unique applications for bridge hits. Some of these are reimbursable projects. Main thing is the joints. UHPC is cost prohibitive right now. Problems trying to estimate a job. How do we determine if it is a good project for the use. Familiar with SPMTs and precast we are familiar with. More about slides maybe. Specifications – examples. WI, Baton Rouge interstate thru town with congestion – considering widening. Existing bridge decks need replacement. Roll beam still beams might be a great candidate for ABC. Techniques. Navigational crossings – MS river – deepwater ports, barge traffic.	
Maine	Moderate. A few a year - when we see a true benefit. Comfortable with our experience with ABC. Looking to invite Design, Construction Staff (resident engineers), Policy, Management, Finance, Bridge Maintenance, and Consultants We have used the toolkit as one -of many tools - a source of information.	Lessons learned are always useful. We have some experience and are fairly comfortable with design and construction. Want to hear what contractors have to say about it. Costs are always a struggle. Lately getting push back from contractors. Contractors felt a conventional cast in place could have been as fast and cheaper to our most current project. Accelerated conventional process? This is an important discussion. Leave with ideas on techniques, considerations for ABC, design and construction aspects need to be taken into account.

Appendix A: State Progress and Intentions Moving Forward

State	State's ABC work and needs going forward	What States Requested from SME
Maryland (joint with MTA)	Moderate - class of bridges we do are mostly fabricated elements. Cutting edge we've only done a few STMPs - a basic level. Would expect a few construction people to attend but we want Counties to attend who are more owners than designers and need to understand the possibilities they have to push internally. Requested a workshop showing how to walk through a complete design of an ABC bridge. Focusing on steps particular to ABC. Want to know more specific details of what is allowed in MD regarding ABC, procurement, CMGC… This workshop reinforced many ideas we are already applying. Not every project requires ABC solutions but those that do realize significant benefits. We'd appreciate more case studies (<40 LF span) bridges and webinars thru the ASCE site. Present to local agencies. FHWA encourage state governments to be open to innovative contracting solutions.	Methods and Costs - important. What are other states doing? Lessons learned - we have definitely learned what not to do in the future! Realistic expectations - it's another tool but not applicable everywhere.

Michigan	Michigan is at a moderate – advance model. Several slides, a lot of pre-fabricated elements. Investigating for I-94 corridor project – not sure what elements will be added. Michigan did a workshop before their slide in. Ben Beerman also did a demo – with the slide in. Less on technical – basically presenting to contractors. We got bits and pieces while R04 was in development. Looking at capacity of cranes and some other applications. Some of our consultants are using the toolkit to do designs for us. Definitely want ABC lessons learned from past projects. Costs, methods, 5-9 are the top issues. Maintenance will be a hot topic down the road. (post tensioning etc.) We have met with contractors post-construction. We have some lessons learned documents created that we would like to present. Keep the overview of other states very high level – our push back is “other states have longer seasons, they don’t have the same restriction….” Don’t lose our ‘conventionally minded’ contractors. Show them how they can be involved. MI has to get permission from commission for CMGC.	Confidence in ABC – we run into snags and confidence waivers – contractors and construction staff in the field. Some go well – some are nightmares. Focus on Contractors – want Contractor feedback – want to get feedback on their ideas. Cost efficiencies – lessons learned. Always a deciding factor. If we can get it on par with conventional builds it would help. Risk – and confidence will reduce risk, reduced risk reduces cost. When it is the right decision to use ABC? We have tried it on a lot of projects but received push back from industry – pick the killer app on when we deploy ABC elements. Some projects go as planned others are completely process engineered. Could you focus on advancements and innovations on ABC instead of introduction? We have already had multiple presentations on Keg Creek (if you do mention Keg Creek – can you talk about the maintenance side and how it’s holding up over the past 4 years) – we are definitely interested in I-84 instead. Pre-fabricated elements – deck beam structures, bulb tees, how other states have done this will help. We’ve done 4 slide ins, one with rollers – don’t keep it too basic, you can discuss actual designs. Steel on Steel with grease and 20% friction. (Arizona) Part of the confidence we are looking for has to do with contractors understanding some of the design influences. We have had good representation from heavy equipment people as well. Can talk about availability. Risk and discussion with Contractor – may want to spend some time on this. Want to know how other states are managing pre stress element – specifications? Two pour sequence – are others doing similar work – who is taking the risk – contractors or fabricators or both. What works in other states? Deck pre-stress beams poured twice – some contractors are doing it in the

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		fab yard, others doing a mock erection. Want to talk about mixes for the decks.
Minnesota	Moderate - Went thru a process where pm's from the district need to drive this if it should be a priority or not. Have filtered our bridges - determined whether they should look at ABC techniques - so the Project Manager has to go thru the process with us. District Project Managers will be invited. We know who we will invite.	Construction is a good piece of this - challenges of size, access, setting up casting yard or if contractors do it themselves… touch on ABC methods available and relative costs. District PMs will want cost info. We've been telling contractors - if they feel there is a way to reduce days on project - push us - propose and even if it's more expensive we'll take a look. Life cycle perspective is important. No need to focus on movements. Lessons learned from past projects is always important. Don't need bridge maintenance as an issue other than design upfront unless there is a lesson learned. Policy we have a good handle on - more an issue of nuts and bolts of specific bridge instead of policy side. ABC has to be done early! Department is supportive of ABC - especially in high volume areas - seen national benefits and want to serve the public. We want to do this efficiently - so projects need to be understood early CHIP - 5 years before letting. Understand from contractor standpoint that we need to allow them enough time to do their work - planning building, appropriate let dates for contractors to do their work. Dept needs to be clear and look for opportunities - clear communication with contractors to look at all options. PMs don't have to understand nitty gritty but how the process develops and what to consider. Pieces needed to consider during design phase. What is next generation and where are we going? Is this how we finish?
Montana	Develop ABC policies and applications.	Have SME available for questions.
Nebraska	Basic (less than 5 projects) We have done a lot to get where we are	When, what and how ABC works. ABC is okay for Rural Areas

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	– pre stressed. Our philosophy for the future – not interested in SMTP/ in design build probably not even a maybe. CM/GC is something we are involved in. Design build is not for us. For delivery methods – we just announced an expressway pavement projects with a few bridges (standard) but people will perk up if you discuss CM/GC and Design Build but how does it help with ABC? Slide in may be of interest to our contractor – how we can facilitate this with our contractors. Please discuss slide in – we have mixed feelings about slide in. We are doing more precast. We are looking at bread and butter bridges. WE have rural areas with potential long detours – slides do make sense because we have cheap right of way, plenty of room. Urban areas around Omaha and Lincoln but rural actually has a better argument for ABC. About to let in 1 year – prefabricated elements, prefab abutments, precast transverse deck panels. 3rd time doing deck panels but looking at how to attach bridge rail – currently designing right now. The NY pilot project will be a good example for Nebraska's needs.	ABC isn't a crazy new thing – pretty common and something we can adapt.
New Hampshire	Several projects have been completed with plans for several future projects with bids out. The first 3 we have in the books - one has a 3 mile detour over an Amtrak line. One is 400 cars a day One has a very	The biggest issue we have is in construction - how do you grout? Joints from the front office. One of our projects is using UHPC next summer. Glad maintenance folks will be attending. We want to accelerate and understand the issues. It's been done successfully elsewhere

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	good detour - so we have good examples to start with and hope to build momentum. Currently designing a slide in for 2019. Construction, bridge maintenance, will invite roadway, consultants. Need to get roadway people on board to ABC. It's new and they need to understand impact of traffic. We typically accommodate the exact lanes with crossovers and temp bridges, we have not done a lot of ABC stuff but now we are pushing to close a major route in 2019 for 14 days. The first 3 we have in the books - one has a 3-mile detour over an Amtrak line. One is 400 cars a day One has a very good detour - so we have good examples to start with and hope to build momentum. Doing a 3-month closure to replace a bridge in cold weather Jan 2-April 1.	Where you can find details of success stories What changes in the design and what to worry about when doing this vs. conventional design.

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New Jersey	More than 15 projects. Started doing ABC in 2006-07. Superstructure Unit – steel beams with recast slab. (not a positive point between units – reflective cracking….) Replaced Superstructure of 3 bridges in one weekend. (this was our initiation). Since then, weekend superstructure change has continued. Not guidelines for ABC per say, but when we analyze traffic issues we tend to go to ABC projects quite often. Precast deck project – deck replacement. Concern is with all bridges are composite, so sheer studs and closure pour in pockets over weekend is a challenge. Would like course to cover high strength concrete materials list – this is always a concern with our closure pours. UHPC is great but curing and hardening is minimum 12 hours – always a challenge to finish over the weekend. We have also done a week replacement – (one project so far). Also have used Next Beam – double Ts and concrete. Preliminary engineer process – consultant needs to look at alternates and recommend which ways we go. Most of our projects are weekend or week long projects – because of traffic. We don't like asphalt only – recently using concrete overlay but there are delays. The day will be centered on speed of construction the in a weekend approach. We don't like upside down pour	Decisions that result in good joints, different types of grout, decision on materials for closure pours, detailing and getting a good fabricator. Please discuss tolerances as well. If you have examples of deck projects – using post tensioning rods and grouts, issues, lessons learned (like Utah) Please discuss approach slabs. Time for curing issues. Is there study on long term… GRS Abutments – question: How long these bridges last – and what they are losing? Can we discuss this in the Missouri example. We are reluctant to use it and might discuss this, but we don't want to take away from the rest of it. Materials are important ABC methods – we are already pretty aware don't spend too much time. haven't always supported – touch base on it but don't spend too much time on it. ABC costs – if you have suggestions we are open to hearing it. Contractor interactions/issues – Yes and No – NJ traffic leaves us no choice. It's not a design build – we tell them it has to be done this way. Do not over emphasize. Include modification to abutments and piers before ABC issue. – please add. If you have good examples of this done elsewhere please share. Have done 3 kinds already. Better solutions are welcome. ABC lessons learned from past projects – DEFINITELY.

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	fabrication design – future deck replacement – beam needs to be designed for future replacement. If may want to add this? Steel girder related issues are all replaceable. If you go the bulb T route – there are replacement parts. We do have Next-T beams with slab, but you can't replace the slab.	
New Mexico	Develop ABC policy and gain support of District offices in applying ABC principles.	Answer ABC questions as New Mexico develops policies.
Oklahoma	A bit - first SPMC move was a few months ago - 2 railroad trusses in one weekend. Videos on ODOT channel. Huge success with Public Awareness. 2 spans unconstructed - viewing stands for the public over the weekend. Bridge slide on location - 1-week closure in a controlled location. Main issue was replacement structure using concrete - bird nesting was an issue. Had to wait 3-4 months for nesting season to finish. Old bridge was steel beams without nests. It was in a wildlife management area. Project coming up in July with options for precast peer caps vs. cast in	Design, Construction, and all the rest are valuable. Main deal is to get people aware of this early in the process and how this will benefit us as an agency. Looking at 2 Urban areas, OK City and Tulsa and a few locations of bridges over lakes or arms of lakes build by Corps of Engineers - certain lakes the Corps wants to be compensated for flood levels. Looking to do bridge slides in several areas to maintain the existing causeway. 404 permit issues. Want to look at possibilities at project imitation phase when scoped - evaluate for traffic impacts and how to build out. Instead of managing traffic while building bridge - these techniques need to be considered. Ways to quantify costs?

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	place and partial depth precast deck panels. 2 more projects for full depth UHPC connections in design stage currently. One full depth longitudinal Keystone Lake Spill way with State Highway - Corp of Engineers. Plan to invite Internal Bridge Staff, Chief Engineer, Director of Design, Field Division People, Rep from 10 most common contractors. (want them to talk about their experiences).	
Oregon	Advanced over 15 projects.	Costs - we are working on concepts that ABC should consider other factors besides raw $ costs in weighing benefits. Hope to have gone through our OR manual and will have more questions prepared. Want to promote using ABC (and our spreadsheet) and looking at all impacts. Would like Vermont success story. We are heavy Precast state with good quality. Main issues are time to develop pre cast for more elements. Oregon is set up for pre cast girders, others they can do but not really set up to go full into others. Pre cast piles were hampered by seismic issues and needs to be addressed again. Interested in what other states are hearing regarding other substructure pre-cast pieces. Want to do more precast decks but need more projects and increase size of program. Costs, What is important to have in our design manual? Things to clarify? Importance of ABC Policy What are good ways to do connections and what to avoid.

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Pennsylvania	Advanced work - 15 projects or more.	1. Lessons learned on design and detailing so that we do not make "bad" designs. If there is a detail that didn't work – examples, integral abutment (u wings) it wasn't a huge piece but we figured out the fabricator used 3-D modeling software that the wing gets slid in and grouted – cantilevered. Needed a crane till the bar came up – we came up with threaded rod to hold it in place. Want examples like that. 2. Guidance on determining realistic timeframes for construction. Including guidance on minimum timeframes. It seems like 7 days is the absolute minimum unless you uses SPMT, need confirmation you can't go less than 7 days- ?? Demo in New York with new sub/super structure. Site specific when you go under the bridge. 3. Tool to evaluate cost benefit of using ABC methods
Pennsylvania (2nd)	We are using ABC - detours over 7 miles.	People get hung up on costs. Why should we spend the extra money? How do we sell local contractors on this? Have done 5 since 2016 - one contractor has done the most of them - others are not willing to participate. Slide In project on an interstate project. SPMT - we are planning one for next year - so info would be helpful. Case studies are helpful. Ways to do things quickly is good.
Puerto Rico	Arrange funding for future ABC projects. Work with the FHWA to get projects started.	Be available for future ABC related questions.

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South Carolina	They have used core slab construction for years but currently approaching start of construction on a research project using BIRD funding that allowed Clemson to create modified Next-D beams to use with unified pours. A main goal is to help resolve reflective cracking issues. They are using UHPC for the longitudinal joints between elements. They will have an update by the time of the training. Specific Requests to Focus on in Training: They would like to walk away with lots of resources to apply. They need us to focus on the Intro or Elements of ABC to give their audience a basic understanding of everything involved. They would also request some emphasis to discuss how ABC impacts seismic designs, approvals, and testing and how this relates to their state seismic guidelines. They may use their presentation time to initiate a discussion on this so the audience leaves with an understanding of the state's challenges and opportunities.	They specifically requested to leave knowing how best to implement ABC technologies, where they can access technical resources and clear understanding of the benefits of using ABC.
South Dakota	Haven't done a lot – not a lot of need but most designers who attend won't have a lot of background either. Want an introduction for all our designers. Basic intro to techniques, intro to tool kit, We've tried a few things – some successful, some not so much. It's the detour lengths. Sioux Falls has done a few structures of ABC. They have higher traffic numbers than the rest of the state. Farther out west the detours can be quite long.	What is ABC? Toolkit and resources available Costs – what is the economy of ABC and how it works for us?

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

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	They moved a 300 ft. trestle bridge 30 years ago using Slide-In Just finished a project last year – had optional precast and the contractor chose not to – they can present on this and to throw out for discussion.	
Texas	Moderate Want to bring Planning, Contracting and procurement, design, policy Design, construction, and maintenance staff to the training. There is currently a state wide TXDOT accelerated project.	Lessons learned, Contractor interactions Methods done Costs Exposure to the document and tools provided. Communicate to districts that ABC needs to be consider at the very beginning and not an afterthought.
Virginia	High basic/low moderate. Haven't done ABC around the state - but hit or miss a bit. Intend to invite Design, Construction, Maintenance, Policy invited so far but may revisit the others as well - had a project where the ABC was taken out.	Design, methods, costs, lessons learned Projects have gone well but have been expensive - most was on I-95 - not cheap to work on an interstate. Trying to gauge - how and when to translate this into other projects when the traffic demand isn't quite as evident. (One lane of traffic on I-95 puts everyone at a dead stop). Open people's minds to re-think several times to make things work on multiple products. Can't shoehorn solutions. Multi-disciplinary approach Cross implications Planning resources for ABC
Washington State	Apply ABC principles to future projects. WSDOT currently has good ABC policies in place.	Answer future questions on ABC projects as additional ABC projects are being developed.
West Virginia	West Virginia Department of Transportation, Division of Highways has done 7 ABC Projects, and they are as follows: 1. Honey Creek Bridge was completed in 2006 at a construction cost of $2.6 Mil. This project was a design-bid-build in which the contractor selected to use	Assist with future ABC projects. Past Projects include: 5. Rodney Staton Bridge was completed in early 2015 at a construction cost of $5.1 Mil. This project was a design-build where the contractor proposed to use precast deck panels. The project had to be constructed using staged construction. Longitudinal post-tensioning of the

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	precast pier caps and abutments. The bridge was closed to traffic for 60 days during construction. Simple span for DL and continuous for LL design allowed the contractor to complete the project on time. 2. 16th Street Interchange Bridge was completed in 2009 at a construction cost of $26.0 Mil. This project was also a design-bid-build project and the contractor selected to construct precast pier caps and abutments. Staged construction utilizing precast and CIP deck options were specified in the contract plans, but the CIP deck was selected by the contractor. 3. Robin Hood Bridge was completed in 2010 at a construction cost of $2.5 Mil. This project was a design-bid-build where precast pier caps and abutments were specified and constructed. Bridge was closed to traffic for a total of 70 days during construction. Simple span for Dl and continuous for LL design allowed the contractor to complete the project on time. 4. Dry Branch Bridge was completed in 2013 at a construction cost of $1.7 Mil. This project was a design-bid-build where precast abutments were specified. Bridge was closed to traffic for 2.5 months during summer break while the bridge was being replaced. Prefabricated beams (hybrid composite	deck panels and semi-integral abutments were used in this rehabilitation project. 6. Martin Luther King Jr. Memorial Bridge was completed in 2015 at a construction cost of $7.2 Mil. This project was a design-bid-build where full-width precast deck panels, abutments and wingwalls were constructed. The bridge was closed to traffic for 2 months during construction. Longitudinal post-tensioning of deck panels and fully-integral abutments were used on this 167 ft. span. 7. Basnettville Bridge was completed in 2016 at a construction cost of $2.1 Mil. This project was a design-bid-build where precast bridge elements and lateral slide were specified, but was valued engineered to cast-in-place abutments, sleeper and approach slabs, and lateral slide, and shorter span bridge using rolled beams. The bridge was closed to traffic for 4 days during demolition, lateral slide and completion of the approach work. A time-lapse video of the construction was provided.

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	beams by John Hillman) were specified in the contract.	
Wisconsin	Current ABC: Have used core slab construction for years but currently approaching start of construction on a research project using IBRD funding that allowed Clemson to create modified Next-D beams to use with unified pours. A main goal is to help resolve.	Continued support as ABC related question come up. Assistance with bringing CMGC contacting methods to Wisconsin DOT.
Wyoming	Basic – they have done a few slide ins. Looking to train Project Managers, Technical services, consultants and contractors. Will invite design for sure, maybe construction, and contract administration. They don't have separate maintenance program, bridge operations and maintenance and internal design. Contractors on the bridge side. Maybe some consultants. Would like to see this from outside of the design perspective. Would like to use some as a post construction review from one of our past projects. Will invite fabricators too.	Core group will be designers but they still need a good handle on construction methods and alternatives. How to evaluate the alternatives will be important. Methods of ABC How can this benefit your project and the outcomes. Construction advantages - giving contractors benefits and incentives. How does this make their lives easier - mobility, timeliness, buy-in. Keeping the contractor and public separated.