

SUMMARY OF TRAININGS

SHRP2 INNOVATIVE BRIDGE DESIGNS FOR RAPID RENEWAL (R04) STATE TRAINING REPORT

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Overview

This summary report includes the following sections:

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Purpose

The purpose of the 16 training events held nationwide was to familiarize states with the SHRP2 R04 Toolkit and to discuss all aspects of Accelerated Bridge Construction (ABC) as applicable to the current and future activities planned for each state participating in the training. A preliminary agenda was provided and then tailored to address bridge advancements relative to each state along with any specific area of interest expressed by that state. The goal was to present detailed training on using the SHRP2 R04 Toolkit, present and discuss lessons learned from the pilot projects, and present detailed information about the 8 State Implementation Assistance Projects funded by SHRP2. The content presented included contracting methods and designs for state specific projects, as well as goals to improve processes and delivery within each specific state.

Attendees

A list of specific attendees for each state training is available on the [SHRP2 R04 Share Point](#) site. The average number of attendees per training was 51 with a total of 819 participants. The specific number of participants per training is included in the chart on page five.

Executive Summary

AASHTO initiated this ongoing R04 implementation by sending a request to all state DOTs to gauge interest in hosting this training in their respective state. Once replies came in, the team determined the top 15 states and later included one additional state. The Subject Matter Expert, Finn Hubbard, held conference calls with each state to walk thru the preliminary agenda (see below) and from those discussions, tailored a specific agenda and approach to emphasize focus areas that were requested or would be beneficial for each specific state DOT. The state DOTs were also invited to share with the attendees a presentation on their state's current experiences with accelerated bridge construction, outstanding issues and their future plans in using ABC in the future. All state presentations have been collected, uploaded, and can be found on the [SHRP2 R04 Share Point site](#).

Evaluations were very positive from each state experience and nearly all scores were at the highest ranking possible (8-9-10 level) for each evaluation question. There was, however, one exception to that high ranking. It was the question asking of prior knowledge of the Toolkit and accelerated bridge construction techniques. The scoring for this question was the lowest ranking (1-2-3 level) within the entire survey evaluation. Through specific comments contained in the evaluations, many participants urged the continuation of a library of ABC resources and recommended an update to the Toolkit as ABC progresses. They also recommended documenting the creative design and construction techniques used around the country (and even the world). Participants expressed an interest to read about success stories and emerging technologies in magazines and other printed mediums. It was recommended repeatedly there be a separate code manual or additions to current bridge design specifications as well as more technical guidance for design. Many participants requested recorded trainings or online courses for those who could not attend the actual training. Individual evaluations are available on the [SHRP2 R04 Share Point](#) site. Below are a few highlighted comments taken directly from individual evaluation sheets:

- *It was probably one of the best, most beneficial and informative presentations I have ever been part of here at AHTD. I have already received many positive responses from those who were able to attend. I am confident it will be beneficial in our quest to build better bridges, faster. Finn Hubbard was an excellent presenter. If there are any other states considering this workshop, I highly recommend it. This is especially true for any states that are in a similar position as Arkansas. **Rick Ellis, Division Head, Bridge***
- *I just wanted to thank you all for the time and effort in providing this workshop in Puerto Rico. All my folks told me how complete and valuable it was. **Christian Berríos Soto, PE***
- *As a Geotechnical Engineer, I found this program, although structural oriented, to provide me with better perspective on items that I design, foundational substructure that are directly affected by ABC techniques. **Paul Moffit, Senior Geotechnical Engineer, AECOM***
- *I highly recommended that as AASHTO and FHWA move forward with the SHRP2 Training, an emphasis on reaching out to the planning and project development (roadway project managers) should be part of the planning for each of the future trainings. **Bill Olivia, WisDOT***

General Observations

Every state found value in the R04 ABC training, whether it was totally new to them or they had some ABC experience. The response from the attendees was very positive toward the training. By allowing each state to host and invite their own attendees, key internal staff including front line bridge designers and builders were able to attend. This provided a unique opportunity to influence younger engineers who may be future leaders promoting ABC methods into standard practice. States who may be nationally perceived as more mature in ABC deployment still found great value in the training by including a variety of participants who had not previously been exposed to Accelerated Bridge Construction activities. Several states commented on how timely the training was as they were trying to get an ABC effort started and this was the “push” they needed. It was also highly recommended AASHTO and FHWA move forward with additional SHRP2 training, with an emphasis toward the planning and project development (roadway project managers) staff.

Discussion and questions varied from state to state, and in some cases, the *after session* questions were quite lengthy and robust. The interest in the subject of ABC is profound and multifaceted. One state requested help with getting legislative approval of the Construction Manager/General Contractor (CMGC) method of project procurement. Several new states have expressed interest in this training. Two states that received training have requested additional training sessions recognizing the value of the training in institutionalizing their ABC efforts.

Outcomes and Recommended Future Activities

The SHRP2 R04 Toolkit was new to the majority of states. State saw value in the material contained in the Toolkit and in all cases, every printed copy was taken by the participants including the extra copies for others “back in the office”. In most cases, the state DOTs have not used the Toolkit, but are planning to in the future.

As somewhat expected, most states were not aware of the SHRP2 R04 implementation project. Getting out to the states and particularly the front line bridge designers and builders is a valuable step to implementing ABC in a real, tangible way across the country. There was also enthusiastic interest in presenting ABC to environmental agencies as an opportunity to minimize impact and improve the environment.

The list of recommendations for future activities and/or programs (by FHWA/AASHTO/Others) include:

- Additional R04 ABC training for additional states.
- A version of the R04 ABC training designed for contractors and available to states for distribution.
- A shorter “high level” version of the R04 ABC material suited for the executive level of a DOT considering the value of ABC in their state.
- Funding to help introduce ABC to their state similar to the 8 R04 implementation projects.
- Webinars covering ABC projects. (It was pointed out that [Florida International University Accelerated Bridge Construction University Transportation Center](#) does this on a monthly basis).
- Additional training concentrating on alternate project delivery methods including Design Build, Construction Manager/General Contractor, A + B Bidding, Alternative Technical Concepts, and Value Engineering.
- Training on how to determine the appropriate size of incentives and disincentives on ABC projects.
- Technical assistance with specific ABC projects.

Photos or video links or website links

- The R04 ABC Keg Creek Iowa time laps was shown at most of the training sessions during lunch.
- Other photos are available on the [Share Point Site](#).

Preliminary Agenda

Agendas for all trainings are available on the SHRP2 R04 Share Point site and this is an example of what they include:

<p>Draft Agenda</p> <p>SHRP2 Solutions: <i>Innovative Bridge Designs for Rapid Renewal</i></p> <p>Accelerated Bridge Construction (R04) Toolkit Workshop</p> <p>Date XXXX</p>
<p>State XXXX (with logo)</p>
<p><i>This workshop is designed to introduce the attendees to the Innovative Bridge Designs for Rapid Renewal ABC Toolkit. The Toolkit presents differing methods for the rapid replacement of exiting bridges in order to reduce the effects of bridge replacements on the traveling public and transportation system. The attendees will learn means and methods to accelerate the replacement of bridges to weeks or even less than a day depending on the needs of the project. The material is intended for those in design, construction, maintenance, and planning. All transportation professionals are encouraged to attend.</i></p>
<p>Room Location - XXXX</p>
<p>Welcome & Introductions</p>
<p>SHRP2 Overview and Experience using R04 Toolkit to Advance ABC Techniques</p>
<p>State ABC Background/Presentation (Optional)</p>
<ul style="list-style-type: none"> • Lesson 1: Introduction to ABC • Lesson 2: Prefabricated Elements and Systems • Lesson 3: Bridge Movement Technologies • Lesson 4: ABC Toolkit for Designers from SHRP2 – Part 1 • Lesson 5: ABC Toolkit for Designers from SHRP2 – Part 2 • Lesson 6: ABC Keg Creek Project & I 84 • Toolkit Discussion, Participant Questions
<p>Case Studies: 8 Projects Completed thru SHRP2 Implementation Assistance Program (IAP)</p>
<p>Procurement, Costs, Savings and ABC</p>
<p>Contractors, Fabricators and ABC</p>
<p>Improved <i>Service Life Design</i> of ABC Projects (SHRP2 R19A)</p>
<p>Status of States DOTs Institutionalizing the Use of PBES/ABC</p>
<p>Technical Resources Available</p>
<p>Group Discussion and Questions</p>
<p>Wrap Up and Adjourn</p>

Logistics by State

State	Date	Number of Participants	Training Location
Pennsylvania	24-Oct-16	40	PennDOT Harrisburg, PA 17104
Wisconsin	31-Oct-16	35	Wisconsin DOT Madison, WI
South Dakota	16-Nov-16	30	Becker/Hansen Building Pierre, SD
Illinois	18-Nov-16	82	IDOT Headquarters Springfield, IL
Nebraska	22-Nov-16	45	Nebraska DOT Lincoln, Nebraska
Iowa	28-Nov-16	60	Iowa DOT Ames, IA
New Jersey	30-Nov-16	60	New Jersey, DOT Trenton, NJ
Arkansas	6-Dec-16	65	AHTD, Materials Annex Building Little Rock, AR
Michigan	8-Dec-16	71	Michigan DOT Lansing, Michigan
New Mexico	13-Dec-16	45	New Mexico DOT Albuquerque, NM
Florida	15-Dec-16	50	Orlando Turnpike Office Orlando, FL
Louisiana	5-Jan-17	76	Transportation Research Center Baton Rouge, LA
South Carolina	18-Jan-17	35	South Carolina DOT Columbia, SC
Montana	8-Feb-17	30	Montana DOT Helena, MT
Puerto Rico	23-Feb-17	60	Vilella Government Center San Juan, PR
Delaware	7-Mar-17	35	Delaware T2 Center Newark, DE
Total Participants		819	

Appendix A – Attendee Lists

[Please find all attendee lists here.](#)

Appendix B – Evaluation Report Results

[Please find all evaluation sheets here.](#)

Appendix C – Questions Raised During Trainings

The following were questions or comments brought up in the training sessions and voluntarily recorded for our records.

Lesson 1 - Introduction to ABC

- How do the various ABC methods might fit with the following contracting techniques? (asked at several different times throughout the training day)
 - Design Bid Build (Normal practice)
 - Design Build (Not yet allowed in Wisconsin)
 - Construction Manager / General Contractor (CMGC, Trying to get this authorized)
 - Cost + Time (A + B)

Answer: It was pointed out that all of the above methods work with ABC. Some better than others. In particular CMGC takes great advantage of the strengths of the designer and contractor to produce a high quality economic structure. The R04 Arizona slide in project was done under the CMGC approach and was very successful from all standpoints. The owner, designer and contractor were all satisfied with the process and final structure.

- How much room do you need for a bridge slide? **Answer:** Approximately two times the width of the bridge. Slides don't work very well for bridges over heavy traffic.
- How are your numbers in your ABC selection formc determined? **Answer:** Total to 100. See scale on side of form.
- Why not build another bridge? **Answer:** You can do that. All bridges in Iowa have ABC scores. The ABC score comes from available information and allows for a quick assessment as to whether or not further evaluation is needed.
- How are the guidelines put together for the "grading an ABC opportunity" flow chart/score sheet? **Answer:** Not using an empirical method, this was put together by Wisconsin as a time-saving way to go through and evaluate a project opportunity without spending too much time.
- Regarding I-93 Fast 14 Project Example:
 - How did construction get completed in 3 days to open bridge to traffic by Monday? **Answer:** Used high performance concrete. Also do as much as you can before you close for construction, everything was precast.
 - Was there any approach work? **Answer:** No approach work and no approach slabs on this project. (Audience noted that locally here in NJ most bridges have approach slabs).
 - How were joints formed in the Fast 14 Project? **Answer:** Forms were hung from rebar and later removed.
 - Were loads from cranes considered? **Answer:** Yes. Lots of preliminary work was done. Need to know where cranes will sit. Pic plans were used.
 - Were pieces stockpiled at the site? **Answer:** No. Pieces never touched the ground at the site.
 - How about durability? **Answer:** Durability is a big deal. Still being studied.
 - How do you account for the elevation differences when erecting the precast girders and spans? How smooth is the ride of precast structures? **Answer:** Elevations are corrected with the use of precast risers, and by adjusting with grout. Grinding is suggested to make the ride smoother, especially on higher speed roadways.

- What do you think about a project where the contractor only had so many staff personnel resources to spread out over duration to use enough staff to perform magnitude of accelerated work over a short time, especially during weekend and night work? **Answer:** This will be discussed more in future modules during workshop, however this is where subcontractors come in and the importance of establishing good working relationships.
- Do you use a small committee to make decisions/score an ABC opportunity? **Answer:** Not always, but it should be considered for every project.
- (Regarding the Flow Chart of ABC Process) How does this take into consideration the cost of ABC vs. bypass? **Answer:** Shorter project times cuts other costs such as permits, traffic closure, etc. So the cost of ABC may be higher but the other savings can help even it out.
- For an ABC project – do you do a “dry run” on site before starting the project? **Answer:** No we do a desktop exercise to run through the project before beginning.
- With a weekend closure when around the clock work is to be performed, are construction crew changed to avoid fatigue included in the contract? **Answer:** Normally yes. Although it is a good idea to coordinate with the contractor to discuss crew changes before construction begins.

Lesson 2 - Prefab Elements and Systems

- Regarding Ultra High Performance Concrete:
 - Is UHCP workable? **Answer:** It is very workable. In fact it will run everywhere until it is set. Typically a specialty contractor will install it until an area has experience in its use.
 - Does it flash set? Do you need special tools to machine it? **Answer:** It is more like liquid than cement, it wants to run so you will need to use top forms. It will set very quickly, once it starts to set, but it doesn't set right away. There are no special tools needed to machine it.
 - Will a diamond grinder work on UHPC? **Answer:** It grinds fine. It is normally grinded before it completely cures with a normal grinder.
 - Any problems grinding UHPC? **Answer:** No. It grinds ok.
 - Does UHPC shrink? **Answer:** Not much. It seals up well.
 - How long does UHPC need to cure before you can put an epoxy overlay on it? **Answer:** It would take about 3-4 days, much less than the 20 days normally required for concrete.
 - If UHPC is water resistant can we eliminate epoxy coated rebars? **Answer:** No, you still have regular concrete on the rest of the deck. You could eliminate epoxy coating in the UHPC areas.
 - What equipment needed and where is the UHPC mixed? **Answer:** It is usually mixed with a high energy mixer on site.
 - What is the long-term performance of UHPC? **Answer:** UHPC has a better performance than normal concrete for preventing salt/water intrusion. This is due to the superior properties related to water migration.
 - What is the unit weight of UHPC? **Answer:** I am not sure of the exact unit weight but it is similar to normal concrete. The unit weight is slightly more but not really an issue unless large sections are used.
 - Is UHPC proprietary? **Answer:** No. There are up to 3 suppliers now.
 - What are your state's experiences with UHPC? **Answers:**
 - We are trying to have the University research a local UHPC mix using local aggregate. We hope to get the cost down significantly.
 - We have a bad experience grinding UHPC after set up. It takes a different type of grinder and can take more time.
 - Wear gloves when handling UHPC.
 - New Jersey State staff noted they just had a workshop last week on HPC (high performance concrete).
 - HPC is currently being used on Pulaski Skyway project – noted by the State project PM.
- What about shear connectors when rehabbing decks? **Answer:** Plan on removing old shear connectors.

- What are the pieces you look at when sizing a crane? **Answer:** Find the controlling piece for the entire job. Contractors are really knowledgeable with this. Crane restrictions could control elements of design.
- Have you seen the use of polyester concrete? **Answer:** No
- Is there a size limit on Grouted Splice Sleeves? **Answer:** No.
- Do overlays count as adding days to construction? **Answer:** You can wait until after the bridge is open to add overlays. Possible to phase overlays to keep bridge open to traffic.
- How do drilled shafts affect precast caps? **Answer:** A large cap will span two drilled shafts. This can end up being the heaviest element and will control crane size.
- Nebraska no longer uses back walls and has moved the joint to the grade beams. How can we incorporate this detail? **Answer:** Connect the back wall to the approach and move the joint to the grade beam.
- Do you have any restrictions on skew limits? **Answer:** It depends on site restrictions. On any small skew or small curve it would be beneficial to either lengthen or widen the bridge to square it up. Skews can be done. The highest bridge skew in Iowa is about 65°.
- There are two NCHRP projects just completed in the past month related to Accelerated Bridge Construction – both will ultimately become AASHTO documents in some form. The Guide Specifications for Design and Construction will be balloted in 2017.
- Was steam curing used on the beams in Philippines? **Answer:** I don't want to answer a questions I'm not sure about, but will look into it.
- Regarding the modular composite steel elements example - Was this project constructed inverted? **Answer:** No. (Audience noted that NJ does a lot of Inverset projects in the state).
- (Regarding the Modular Composite Steel Elements) Are there no diaphragms? **Answer:** Usually not, but I have seen it both ways. It is a matter of expense/time.
- When you Re-deck do you use diaphragms? **Answer:** Usually a few.
- (Regarding Deck Bulb Tee Superstructure) Can you run direct traffic on top of it? **Answer:** Yes – no problem.
- (Regarding Abutments on H-Piles) Is it not true that several states place extra pockets between w/ self-consolidating concrete for weight? **Answer:** Yes, that is often done.
- What is the advantage of hidden pockets over open shear stud and grouting pockets on precast slab units? **Answer:** No structural advantage, simply an aesthetic preference.
- Are there many vendors for grouted sleeve couplers and are they rated for seismic? **Answer:** There are many vendors for the grouted sleeve couplers, they are not proprietary. They are rated for certain seismic zones but currently undergoing more extensive testing.
- What is the durability of grouted joints in columns? Are they vacuum grouted? **Answer:** These joints should be a concern and must make sure a high quality grout is used. They are not vacuum grouted. Simply grout from the bottom in order to push all of the air out during the grout process.
- Who designs the sliding system? **Answer:** The contractor almost always designs the sliding system used to cater to their means and methods. It should be stamped by their PE.
- If you use precast girders with a top flange that is the deck already, how do you redeck? **Answer:** You can't redeck, you must replace the entire superstructure section.
- How long does it take for contractors to get used to the precast bridges and bid prices to come down similar to cast-in-place costs? **Answer:** Vermont for example has had extensive use in precast bridges and it took about 40 – 50 bridges before contractors really got used to them and there was competitive bidding.
- Deck replacements over water on 1000 ft. bridge with 200 mile detour. Can we do this in segments and night closures with precast elements? Would like more info on this type of project.
- Why doesn't Keg Creek have water? **Answer:** The water is running through several precast culverts. It is not a typical site (EPA approval). The positive issue was the contract had no access issues around the site.

Lesson 3 - Bridge Movement Technologies

- Are removed structures or portions ever reused? **Answer:** Not usually. Normally replaced due to service life ending.
- What speed do SPMTs move? **Answer:** 3-4 mph. Walking speed. Dynamic forces are large.
- How is design/bid/build affected? **Answer:** More later. Come up with one reasonable solution and let them decide logistics. Let them redesign.
- How long did the lateral slide at I-84 take? **Answer:** The I-84 bridge was built adjacent to the existing bridge in 6 weeks then the slide into place was completed in 20 hour segments on two different weekends.
- Load factors for moving precast pieces prior to installation were mentioned. How about during a slide-in installation? **Answer:** Those are generally really smooth and there is not much vibration. The comment was referring to when a precast section is moved down the road for ten miles via a truck.

Lesson 4 - ABC Toolkit for Designers from SHRP2 Part 1

- How much time does camber leveling take? **Answer:** It is a challenge of using pre-stressed. It is likely a half-day to full-day operation
- Don't contractors like to cast in place approach slabs as opposed to precast? **Answer:** They will always want to cast in place if there is enough time. If the schedule allows for it, they will ask if they cast in place x, y, and z. I'm not against cast in place, but it depends on timeline. If they can cast in place using ABC, and make your schedule, I'm ok with it.
- What about ABC diaphragms? **Answer:** Steel is great for precast. Cast in place is not preferred.
- What are the additional elements in ABC that a designer is involved with? **Answer:** Lifting points for example. Watch any changes in the methods used by contractors
- What do you do in camber leveling if one girder is high? **Answer:** Try to weigh it down using barriers or other additional weights.
- Do people use double-Tee girder in Midwest? **Answer:** Yes.
- Do designers consider camber leveling force into bridge design? **Answer:** Yes
- Do you allow precasting in the field without a prequalified precasting contractor, or does it need to be done in a certified precasting plant and then moved to the site? **Answer:** The state notes that is illegal in New Jersey, noted that must be careful with instructions in project specifications.
- What is the maximum skew permitted for an integral abutment? **Answer:** Wisconsin limits to up to 45 degrees. **Participant noted that:** New Jersey usually goes up to about 30 degrees.

Lesson 5 - ABC Toolkit for Designers from SHRP2 Part 2

- Can you discuss the current availability of specifications for ABC? **Answer:** A new ASHTO guide spec will be out in about a year for ABC construction. It takes AASHTO a few years to make changes, but it is for good reason. It has to be tested and validated by the States before it is approved.
- Are there SHRP2 load factors? **Answer:** Yes, all suggested numbers are documented. AASHTO will put out specifications in Jan 2018.
- How long does camber leveling take? **Answer:** Can take up to a day.
- Cost of Grouted couplers? **Answer:** Approximately \$30 each.
- What is function of diaphragm when camber leveling force was applied? **Answer:** All the transverse force should go through the cast-in-place joints.
- What if one of the girders get very high camber compare to others in field? **Answer:** The camber can be pushed down by the weight of deck.
- Do box girders have camber difference issues? **Answer:** Not much and they generally work Ok.
- Do you have to do anything special with the bearings for accounting for deck cross-slope? **Answer:** We used half-inch elastomeric pads
- For arching concept for the deck was steel incorporated? **Answer:** No temperature steel was not used on the deck, steel only in the overhangs.

Lesson 6 - ABC Keg Creek Project and I-84

- What about the look of the bridge when it was completed? The pictures appear to show some color disparities. **Answer:** The UHPC will look different color wise from the other concrete. The public tends not to pay attention to the looks. They care more about ride quality issues (there was a bump, or the ride was rough). Grinding helps, but there will be some issues with smoothness.
- Did the bridge have any camber? The pictures do not appear to have any. Will it sag? **Answer:** No. It was pretty flat. It likely has a little sag that has developed overtime, but it is sound. Engineers like camber. We want the bridge to bow instead of sag in the middle. It is not a structural issue.
- Why did they install a culvert under the bridge? **Answer:** The EPA allowed it, surprisingly. It allowed them to keep the water out of the site, which gave the contractor complete access.
- What was the weekend ADT (on I-84) project? **Answer:** I'm not sure, but it was significantly lower than the weekday ADT.
- What is the reason for the slide-in versus the drop –in? **Answer:** If we drop it in, we have to have time for the concrete to cure and the placement can take longer. The slide-in allows the bridge to be completed and cured, and just slid into place after it is ready. It could be the difference between a few hours to a few days.
- Are columns grouted before setting? **Answer:** Sort of. Column bottoms are grouted and columns and cap placed before grout sets up.
- Can we use empirical deck design? **Answer:** ABC has no problem
- Why did they add anchors along the pier to post tension? **Answer:** Eliminate crack over the pier. It may have not been necessary and added cost. Owner preference.
- How did they compute those savings numbers? **Answer:** Cost of crossovers, conventional construction, etc.
- Who designed the temporary supports for the bridge slide? **Answer:** The contractor.
- Regarding the Keg Creek project example -Is there a limit to the use of UHPC? **Answer:** No limit really, however there is a limit to how fast you can pour how fast those mixers can kick out the concrete.
- How many people within your division do you think it's best to dedicate to field problems in order to get them fixed in a timely manner? **Answer:** I would designate someone to be on-site to make decisions to cut down on the calls into the division.
- (Regarding Pre-cast Piers – Straddle Bents) Have many states done these on skewed bridges? **Answer:** No, not many because this process is still so new. Only a few hundred in total have been done at all.
- (Regarding Precast Piers – Straddle Bents) Are these made with normal steel or pre-stressed? **Answer:** Normal steel for the camber and better predictability.

Case Studies and Lessons Learned

- What about durability? **Answer:** It is about getting the joints right. Precast is as good as cast in place, but the joints are critical to get right. Durability is always question number two; cost is number one
- What about utilities? **Answer:** Utilities do not play well with ABC. Best case is to move the utility before the project and not put it back.
- Lafarge (contractor) recommended using stainless steel instead of epoxy coated rebar for ABC. Is that true? **Answer:** Yes. Stainless will work better, and the cost has come down significantly over time. It is the Cadillac of bars. Follow-up: Is it overkill? **Answer:** Yes, it is overkill. The stainless bars will outlast the bridge.
- Do you have any horror stories from ABC projects? **Answer:** No real horror stories, but lot of lessons. The most important is planning, planning, and planning. Work with your contractors.
- What are the white lines (besides the traffic lane) used for? **Answer:** The areas marked by the white lines are left for future use.

- Is there any ABC project built without UHPC? **Answer:** Yes, a lot. UHPC has been used since 2009. Most projects are built without UHPC before and after 2009. The regular joint filled with normal concrete is about 18 in. wide.
- Regarding the Gila River sample project in Arizona - how do you choose a contractor without plans? **Answer:** NJ & Wisconsin doesn't allow Design Build or CMGC delivery method either. You have the issue of how do I come up with a price. You negotiate the price with the contractor. You have state-wide averages for materials and labor, so you can come up with an estimate knowing the contractor's means and methods. If it doesn't work out then you might change procurement and let the job out for award to the low bidder. Well how do you choose the contractor in the first place to start negotiations? **Answer:** This is where relationships come in and you have to do an interview process. Although the politics and relations vary from state to state and different regions.
- What is the "normal" cost comparison with ABC? **Answer:** There is no "one size fits all" answer – it depends on the project.

Procurement, Costs, Savings, and ABC

- We have issues building new substructures and cutting time off the project. Would it be ideal to use existing substructures or build outside of the existing bridge? **Answer:** There was a case in Colorado where they removed the existing road, dug a trench and built in abutment, then put a "lid" over the abutment and allowed traffic back on existing bridge. Then abutment was there when they were ready for it.
- What is the lowest number you have used ABC construction on using Wisconsin's scoring rubric? **Answer:** The metric just gives you a feel for it. The example we gave today was between 32-35 points. It's possible for one item to be so important that ABC is used. This is a tool to start the discussion very early in the project.
- What is overall reduction on total duration of ABC project? **Answer:** Globally speaking, ABC makes it quicker. But not always quicker. In most instances, quicker project overall time is not required – the goal is to reduce the traffic impact duration.
- ATCs (Alternative Technical Concepts) was discussed.
 - When can the contractor decide ATC? **Answer:** They have a couple weeks to months to do that.
 - Can you explain how ATCs work with contractors engineering a revised design and if owner agrees, use the revised design into the contractor's project bid, with the ATC being proprietary only to the contractor who submitted it? (i.e. other contractors bid blindly with no knowledge of each other's ATC submittals). **Answer:** The contractor gets paid by the owner to do additional engineering work.
 - How might claims during construction result from the incorporation of ATCs? **Answer:** The onus is on the contractor as the modification in design was initiated by the contractor.

Contractors, Fabricators, and ABC

- Have you put warranties on bridges? **Answer:** Not a big fan of warranties. My opinion.
- When do you involve fabricators? **Answer:** In Nebraska fabricators have been involved and there is lots of outreach with new ideas.
- How do you manage disincentives? **Answer:** You can scare contractors away with disincentives. Allow more leeway with new concepts.
- How important is contractor relationships? **Answer:** If you want bridge open to public earlier without accidents, you better have an experienced partner. Erector set of precast parts is one thing – but more innovation and acceleration makes ability to work with contractor very important. What works for Contractor A may not work for Contractor B.
- Bridges are often designed for 100 years, what if the capacity of the roadway is reached in 15? **Answer:** Not every bridge should be built for a 100 year design life. May need to replace a structure with a larger

bridge in 30 years due to capacity needs so design for a shorter design life. If the bridge is in a location which is difficult to replace a longer design life is necessary.

Improved Service Life Design of ABC Projects

- How do you determine a cost of life cycle? **Answer:** We are trying to put numbers on that. There are many variables.
- Is maintenance cost included in cost? **Answer:** Yes, things such as overlays are included.
- Weathering steel use – is it used underneath as well as overhead trusses usually? **Answer:** In Wisconsin it is used whenever we can but not used in locations with significant traffic underneath or over salt water. As far as trusses I would have a hard time using it for them especially in “high salt” areas.

Status of States DOTs Institutionalizing the Use of PBES / ABC

- Who designs loads for SPMTs? **Answer:** The contractor is responsible but SPMT will do it. They pick their vehicle based on loading. They are aware of dynamic loading.
- Regarding Oregon DOT ABC Project, is the bridge post-tensions. **Answer:** Yes, longitudinally.
- Regarding Indiana ABC Milton Madison span, project schedule went from 11 months to 12 days, what was the incentive cost to contractor? **Answer:** Somewhere in the millions.
- Regarding the Rhode Island I-95 Southbound SPMT project, was it just the deck replaced or also the beams? Is it cost effective to replace the beams as well when the need is just to replace the deck? **Answer:** The deck and beams the entire superstructure; regarding cost have to prioritize what makes sense when implementing ABC options.

Other Questions / Discussions

- What was the goal of the Driver First Initiative from NY 2012? **Answer:** The goal of the initiative was to minimize disruptions to the driver (from projects). It shows the pressures being placed on DOTs to get projects done quickly and efficiently to minimize impacts to drivers.
- How might we introduce ABC concepts during the Planning and Scoping phase of projects? **Answer:** Perhaps the concept that needs to be perused is getting the overall project and planning groups aware of ABC, not just the Bridge Design Engineers.
- Would the instructor consider attending a few meetings with contractors and some politicians to explain the positives of the CMGC method? (WisDOT had asked permission to try up to five CMGC projects during the last state budget cycle. One of the last items removed from the last state budget was the authorization of WisDOT to try CMGC. The Department was in the process of asking for this again in the next budget.) **Answer:** Finn said he would be more than happy to give an independent view of how CMGC works and talk about the Arizona projects successes. (Larry and Finn talked for over 90 minutes after the training was over about alternate contracting and ABC).
- Does bundling of similar bridges save cost? **Answer:** Good idea. Can save on costs when appropriate.
- Do other states have a number for increased safety using ABC? **Answer:** Not really.
- Regarding challenges to ABC - Student noted that state has actually been doing increasing seismic design incorporation, although overall audience mindset is that it is not very applicable in New Jersey.
- It was noted that South Dakota does have a process for evaluating all projects with structures for potential ABC. However, we have not yet found a site where ABC would be appropriate.
- At NDOR we use FHWA’s Monte Carlo simulation to find most probabilistic outcomes. It’s a program they provide called “Real cost”.
- Also discussed was the fact that SDDOT allows precast sleeper slabs in an attempt to speed up construction somewhat and introduce ABC, however, no contractor has chosen to use them yet.
- Initial direct cost of ABC can be competitive in some cases (i.e. lateral slide vs. staged construction or temporary on-site detour).
- Concrete mix with high early strength is commonly available in Iowa.

- Local contractor generally agrees with the role of incentives on ABC projects as presented by Finn.
- It was discussed that New Jersey is actually already using the NEXT beam on regional projects.
- It was noted that the NEXT beam is designed for AASHTO criteria which allows for some tension. However, State of New Jersey regulates for zero tension, so you have to size your beam up to account for camber leveling.
- It was noted that with the NEXT beam, you can increase life cycle of your deck. Instructor noted this is something we are trying to get closer to perhaps with stainless steel bars. NJDOT Pulaski skyway PM noted that the state is actually currently using stainless steel bars on the skyway project.
- New Jersey will go up to a 200 foot span bridge without introducing a joint (for prestressed integral)
- It was noted that NJ typically designs up to 90 foot max span using NEXT beam approach.
- NJDOT Project slide – State provided some insight on the project: location appears to have a photo taken from the I-287 Eastern Avenue project, state noted that grouted longitudinal joints were used so potential for leaks, might be lessons learned in the future, project is about 6 years old, was constructed in 30 days deck and approaches.
- Discussion during break period: State staff noted that Precast/prestressed bridges in New Jersey are very expensive, usually about \$400/SF in New Jersey which is double out what is in Wisconsin/Iowa. Answer noted that then ABC might actually be more applicable in this region cost-wise, as the cost markup may not be as much percentage wise as it would be in states where standard bridges have much less cost that in New Jersey.

State Presentations

- What is your estimate of time the road is closed to traffic? **Answer:** Looking to cut time in half from conventional construction. We are open to ideas on how to speed things up. We estimate conventional construction time of 80 days so an estimate for the project is 40 days.
- Are you looking for input from the contractors and fabricators? **Answer:** Yes, both today and in the future
- Is a movable bridge a viable candidate for ABC? **Answer:** It presents more of a challenge, there have been some lift bridge sections done where sections have been brought in on a barge and lifted to set superstructure in place. Would definitely want to work with contractors to see what they have in mind. Depends on what you are trying to replace, if it's an entire swing bridge for example versus just a section of the bridge. Have seen a few done on the east coast.
- When using SPMT, not only do you have to check any structures you are going over with the SPMTs, but also make sure any underground utilities you cross over can withstand the increased loads.
 - We do a lot of epoxy overlays in our state and have found it works well at sealing the deck. We have found the most critical step with this system is deck preparation.
 - We held a discussion on disincentives and identifying risks which may vary from contractor to contractor.
 - LADOTD has not had any CM/GC projects in the state yet but we plan to in the near future. The trainer explained how this allows the design to be geared more towards the contractor's means and methods and the project can still go to general bid if an agreement cannot be reached.
 - LADOTD experience with ABC:
 - Several SPMT projects, mainly superstructure replacements but one lift span replacement with barges.
 - One project where patented precast precompressed (by jacking) slab units were used.
 - In the process of developing standards for precast slab units utilizing 1' closure pours, precast bents with closure pours, and precast approach slabs. These standards are typically for smaller span projects and do not use UHPC.

Appendix D – State Requests

The following requests were shared by the state host, prior to the training, as particular interests to emphasize during the training. The questions and points the state's raised gave insight into their understanding and comfort level with accelerated bridge design and the SHRP2 program.

Pennsylvania

In discussing the upcoming training with PennDOT's Tom Macioce, he asked the trainer to provide lessons learned on design and detailing so that we do not make "bad" designs. For example, if there is a detail that didn't work to provide examples - such as issues using integral abutment (u wings). While it is not a huge piece, the fabricator needed to use 3-D modeling software so that the wing would be slid in and grouted – cantilevered. This needed a crane till the bar came up so a threaded rod was used to hold it in place.

Tom requested more guidance on determining realistic timeframes for construction. Including guidance on minimum timeframes. It seems like 7 days is the absolute minimum unless using SPMT so is confirmation available that you can go less than 7 days. He wanted his staff to hear about New York demonstration with new sub/super structure. (Site specific when you go under the bridge.) Tom's final request was to make sure to present a tool to evaluate cost benefit of using ABC methods

Wisconsin

Bill Dreher of WisDOT requested to show real world examples of time savings and how it incorporates in incentives/disincentives. It was important to Bill to provide general awareness of benefits associated with the various concepts including benefits for implementers and benefits from agency perspective on why it is needed. (He emphasized to tell people why this is a benefit.) Bill wanted to encourage a level of comfort using these technologies. He has informed the technical people but wants to provide them the talking points to go back to their agencies as to why we need to make these changes.

Other topics of interest mention were a discussion on balancing contractors and risk and specific data on Precast deck panels: long term performance (even in the first 5 years). Provide data and experiences with performance. Have concerns on long term results leakage with UHPC. He wanted to know any issues with this technology. Wisconsin wanted to emphasize discussion of joints. Not just a successful joint but one that is performing well.

South Dakota

Steve Johnson of SDDOT requested that the training explain what ABC is; present toolkit and resources available and discuss costs including the economy of ABC and how would it work for South Dakota.

Nebraska

Fouad Jaber needed a broad approach to introducing the R04 training. He simply asked to present when, what and how ABC works and specifically how ABC works for rural areas; and prove ABC isn't a crazy new thing, but pretty common and something they can adapt to their needs.

Illinois

Carl Puzey wanted to encourage openness to new methods among his participants. He requested to present greater understanding of techniques that have been successful along with knowledge of available resources to

implement ABC. Lessons learned were really important for Nebraska to foster greater understanding of techniques that have been successful. He stressed a focus on design, construction, and maintenance. Nebraska has a strong interest in level of effort and what is required for a decision matrix and policy of when to determine what to use and why, particularly in relation to their tollway work.

Iowa

Ahmad Abu-Hawash intended to use this to promote to his districts and asked that the presentations not be too technical. He wanted to enable participants to propose candidates for ABC as well as others in the process. Exploring common interest between participants could help to decide and how to spot a good candidate – and when will it work best. He expected the training to help participants to understand overall costs and considerations. He suggested to inform participants that R19A is also being used in Iowa.

The trainer was also asked to relate training to Iowa methods of onsite detour with temporary bridges but costs of a lateral slide are competitive and saving 5 months of detour with less safety and access. This could include discussion of the many costs associated with temporary bridges.

New Jersey

Nat Kasbekar of NJDOT, asked that the training discuss decisions that result in good joints, different types of grout, decision on materials for closure pours, detailing and getting a good fabricators and tolerances as well. He wanted to provide examples of deck projects – using post tensioning rods and grouts, issues, and lessons learned (like Utah). He also wanted to discuss approach slabs and time needed for curing issues. The audience in New Jersey was not familiar with the concept of ATC's and there is more opportunity to educate the state more on the usage of these.

Arkansas

Talking with Rick Ellis of AHDT, he desired to bring staff to same level of understanding and knowledge as the director has – the same comfort level; understanding why, where, how; and perspective on costs. He wanted to show common techniques other states are using – what is useful and resources available.

Michigan

Matt Chynoweth of MDOT wanted to create confidence in ABC because when snags come up, confidence waivers with contractors and construction staff in the field. Some go well but some are nightmares. He asked to discuss risk since confidence will reduce risk, and reduced risk reduces cost. He hoped to help contractors gain confidence by understanding some of the design influences.

Michigan also requested the following:

- Focus on Contractors – want Contractor feedback – want to get feedback on their ideas.
- Discuss cost efficiencies – lessons learned. Always a deciding factor. If we can get it on par with conventional builds it would help.
- Analyze when it is the right decision to use ABC. We have tried it on a lot of projects but received push back from industry. Help us pick the killer application for when we deploy ABC elements. Some projects go as planned others are completely process engineered.
- Focus on advancements and innovations on ABC instead of introduction.
- Discuss I-84 because the state has had multiple previous presentations on Keg Creek (if you do mention Keg Creek focus on the maintenance side and how it's holding up over the past 4 years).
- Describe pre-fabricated elements – deck beam structures, bulb tees, how other states have done this will help.

- Don't keep it too basic, you can discuss actual designs. Steel on Steel with grease and 20% friction since we've done 4 slide-ins, one with rollers.
- Talk about coordinating availability with heavy equipment people.
- Show how other states are managing pre stress elements and specifications.
 - In a two pour sequence describe similar work others are doing and 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 fab yard, others doing a mock erection. Talk about mixes for the decks.

New Mexico

Ray Trujillo of NMDOT wanted the training to provide a better understanding of the benefits of ABC as well as to equip participants to sell ABC internally and externally. Having only done 10 projects over the past 15 years many of his staff have no experience in this but he wanted them to be well versed to sell this on their projects. He asked to provide a flowchart on decision making process – how to decide ABC is a good fit.

New Mexico's bridge designer use the EDC process so for every rehab or replacement they need to talk about ABC in the scoping report with explanation of why ABC is chosen or not. He wants better explanation in these scoping reports as to why or why not they are choosing ABC. In New Mexico, risk management is huge as construction people would rather have a longer schedule than risk losing funding. An issue in the division office is that if something is built out of specifications they get hit on non-participation.

Florida

Participants need to be knowledgeable and comfortable with ABC, according to Florida host, Robert Robertson. He asked that the training show that when precast is used for almost all parts of bridges the secret is connections. He requested the training touch on research on connections so district people are assured connections are going to be a durable product. Substructure use is primary for Florida as the issues for accelerating are regarding substructure parts.

Louisiana

Paul Fossier of LADOT had specific requests of the training including: to explain what is appropriate per site; to show how to cost out during design; and to present methods from cost standpoint. He wanted the training to describe how to get contractors involved and discuss constructability issues including local understanding of contracting issues and other aspects.

South Carolina

Terry Koon simply asked the trainer to present how best to implement ABC technologies, where they can access technical resources and clear understanding of the benefits of using ABC.

Montana

Kent Barnes was interested in applicable alternate contract methods like CMGC. In Montana the state law allows any agency to do CMGC but one line says for the purpose of this law the DOT is not considered a state agency. They are working to get that changed but influenced by contracting industry and have had some education to highway contractors (now about 70% on board). It's important topic to Montana.

He requested to create a positive feeling about decision making process. ABC almost always costs more but you have to look at it from a global perspective of the project with other savings that can be factored in. He offered the example of Deep Creek Canyon – replaced over weekends that cost more, but had no detours or

environmental issues and saved buckets of money. He also expected the training to provide a clear understanding of the SHRP2 tool and how it's used for decision making process.

Puerto Rico

In Puerto Rico, Christian Berrios Soto was hoping to give participants confidence on how to apply the toolkit as well as lessons learned and experiences to help them to think ABC and begin to apply it regularly and not just for special project.

He expected the training to present an understanding of ABC, what it means and why important; to show how to apply and understand the toolkit and to provide examples of using the toolkit and how to actually use it. The main areas of interest to his participants are bridge design/construction and lessons learned from other states. This is their first year with a design build project and they are looking into starting this process officially.

Delaware

Jason Hastings of DelDOT requested to explain the design tools available and how they can be utilized considering issues that may not be consider under traditional design. He asked to show benefits of ABC from all standpoints including construction, speed, safety, shorter durations, and e-costs. Specifically he asked to discuss prefab vs. bridge movements. We have modular steel units in design and working with precast deck panels. Movements are less likely to occur.