October 2018 ABC-UTC Webinar Featured Presentation: ABC Methods for Delaware's All-Precast Bridge 1-438		
#	**Questions**	**Responses**
	Design	
1	Was this the only ABC proposal considered, or did DelDOT evaluate other ABC projects?	This design was an iterative, in-house design process. We used the project to try different ABC techniques we felt had potential to expedite construction on this project as well as future projects.
2	Why the additional deck (overlay)?	The UHPC overlay was applied as a trial almost. We saw potential applications from a rehabilitation standpoint. We also thought that on future projects, the structural strength of the overlay could be counted on to help minimize the height of the member below it. The UHPC also basically makes the deck impermeable and adds to the durability of the structure.
3	What was the transverse P/T stress across the abutment joints?	The abutments were not post-tensioned together. They are doweled together, and held in place with the closure pour of the piles to make them composite.
4	How do you connect to the precast, i.e., the parapet, without drilling into the precast?	The parapet was actually entirely precast into the exterior beams. The bolt connections for the metal rail were precast into the curbs. The barriers had precast sleeves to accommodate the guardrail-to-barrier connections.
5	What steps were used to prevent longitudinal cracking at box joints (short & long term) that are typical for adjacent box beams?	The UHPC joint mix helps to prevent these longitudinal cracks. The FHWA shear key and UHPC joint mix makes the joint the strong point of the bridge superstructure.
	Construction	
6	What challenges did you have regarding the curing time due to temperature?	With us constructing in the middle of the summer, cracking was our major concern. As such we had the contractor apply a curing compound and plastic sheeting immediately after laying the overlay. This proved essential in preventing shrinkage cracks in the UHPC overlay.

7	Explain your acceptance criteria and results for UHPC?	A copy of the specifications for the UHPC can be found at http://utcdb.fiu.edu/bridgeitem?id=532 under "Downloadable Resources."
8	What foundation prep would be used for a spread footing?	We did not use a spread footing for this project. I would imagine that it would require significant quality control to ensure proper grades were established for the precast elements.
9	How thick was the UHPC overlay, and was the surface textured?	The UHPC overlay ranged from 1" to 3 1/4". The surface was blanket ground once it properly cured.
10	What were the construction challenges for the UHPC overlay?	Workability and the unknown were our two biggest challenges. This was a new material for Delaware and the contractor. It did not behave like normal UHPC or normal concrete. We had an issue initially with workability but were able to adjust the mix in the field to fix the issues.
11	How did the DOT handle the abrasive surface of the UHPC overlay? Was it a concern?	This was an initial concern. We had several conversations with Iowa DOT and Lafarge about the rough texture of the roadway. We became convinced that the exposed fibers would rust off given time. Today, the exposed fibers have broken away and the bridge is much less rough to the touch. It is worth noting that this never affected the rideability of the bridge. The bridge has always performed very well from a rideability standpoint.
12	How long does it take for the average construction of a bridge using precast under good conditions?	I would consider our conditions for this project to be good. As such, for a bridge of this size and nature, I would say 20-30 days seems reasonable. Keep in mind that our contractor only worked one night. Most of his days were from ~7 am to ~6 pm. I believe this project could have been constructed much faster if held to tighter time constraints.
13	I'd like to see some of the closure pour details for the caps.	A copy of the plans can be found at http://utcdb.fiu.edu/bridgeitem?id=532 under "Downloadable Resources."
	Maintenance	

14	Could you discuss the idealized maintenance plan, and expected length of service?	We feel that this bridge is a 100-year solution that will hopefully require minimal maintenance. Utilizing the precast elements helps to ensure a higher level of quality control. Using the UHPC between the beam joints turns a once weak point in the superstructure to the strongest part of the bridge. The UHPC overlay acts as an impervious barrier between water and deicing chemicals and the various bridge elements.
15	What is the durability of the connections?	The UHPC joint connections are now seen as the strength of the superstructure. Longitudinal cracking was an issue with structures of this type before, but now they are no longer a concern. Because the material is relatively new, I am not certain we have data on the lifespan of these connections. However, given the strength and crack arresting properties of UHPC, I would believe they are significantly durable.
	Cost	
16	What was the construction cost and how would it compare over traditional construction methods?	Construction costs for these ABC techniques were $1,025,801. For conventional methods of similar bridges we have seen prices between $700,000 to $750,000.
17	What was the cost savings by using all precast elements?	Using all of these ABC techniques resulted in more expensive construction from a monetary standpoint. However, it did result in a time savings of ~60 days. Implementing this on higher volume roadways could result in significant road user cost savings.
18	What was the cost and schedule of the project versus cast-in-place construction?	This project took 31 days to complete and cost $1,025,801. Conventional construction takes approximately 90 days and costs between $700,000 to $750,000.
	Questions during the Webinar	
19	Worker inside a trench deeper than 6'. Was that OSHA compliant?	For a Type A soil, the trench can have a 3.5 ft vertical face and then may be cut back at 0.75:1. The maximum height of an unsupported trench of this nature is 8'.

20	Slide 8 - What techniques were used to adjust the precast to meet bearing seat elevations?	The contractor spent a good deal of time making sure that the graded aggregate base coarse was level and set to the proper elevation. By doing this, he was able to avoid having to adjust the precast in any way.
21	What material was used to connect the precast abutments to the piles, and to connect the precast abutment sections?	The precast abutments were not mounted to the abutments in any way except via the closure pour.
22	Slide 11/12: Were the precast bridge beam cross-sections rectangular or parallelograms to accommodate the horizontal curve and superelevation?	The beams were rectangular but the precast abutments were cast at a slope that matched the superelevation. The beams were then placed on a slope.
23	After one year construction, was any reflective cracking found along the shear key?	To-date, there has been no reflective cracking found in any of our bridges that utilize the FHWA shear key and UHPC joint mix.
24	How thick was the overlay?	The UHPC overlay ranged from 1" to 3 1/4".
25	Will the different properties of the UHPC cause delamination of the UHPC from the concrete deck?	The tops of the precast beams were intentionally roughened to create a good bonding surface for the UHPC overlay. Our spec also calls for SSD condition on the tops of the beams before the overlay can be placed. These factors should ensure that the UHPC does not delaminate.
26	How is the rideability of the UHPC overlay? Too smooth or too rough?	The rideability of the bridge is actually great. It rides very smooth. The only issue we had with the UHPC overlay was that grinding exposed the steel fibers. The steel fibers made the bridge rough to the touch but had no effect on the rideability.
27	I have seen contractors interpret SSD as meaning "throw water on the concrete, wait 5 minutes, then cast concrete." How did you enforce proper understanding of SSD?	Honestly, we have had the same issues and have a very hard time enforcing this aspect of our spec. The issue is that there is not a field test that is able to confirm SSD condition. We have been looking into a research project that studies the different methods contractors use to "achieve SSD" and their effects on the performance of the UHPC.
28	Did the designer use a 3D model to test the tolerances on the connections?	I used Google Sketchup to ensure proper fit-up.
29	Were the costs mentioned for UHPC in cubic meters?	Both UHPC items were measured in CF. The UHPC overlay cost $350/CF for this project. The UHPC Joint Mix cost $400/CF for this project.

30	Is a copy of the UHPC overlay specification available?	A copy of the specifications for the UHPC can be found at http://utcdb.fiu.edu/bridgeitem?id=532 under "Downloadable Resources."
31	Are you worried that the exposed steel fibers in the overlay will present a pathway to deterioration, rusting, or cracking due to salt intrusion?	This was a question we asked of Lafarge, Iowa DOT, and Iowa State University and they did not feel that this was a concern. The UHPC has crack-arresting properties that prevent cracks from propagating. The rusting of the fibers seems to stop at the surface and does not penetrate into the concrete. The Department will be monitoring this question of the life of the bridge and studying the performance of the overlay every 6 months for two years.
32	What is the selection criteria for the successful bidder? Cost? Schedule?	The low bidder was the successful bidder. This project took 31 calendar days to complete and cost $1,025,801.
33	In pedestrian areas, could the exposed overlay fibers be rolled flat using a light steel roller?	This may be a possible solution. It is not one that we looked into. In the future, we plan to utilize the UHPC overlay in areas where pedestrian traffic is not a concern.
34	How is the load transferred from abutment to piles?	The closure pour between the abutments and piles helps to transfer the load from the abutments to the piles.
35	Why were spread box beams not considered?	DelDOT's common practice for bridges of this size is to use adjacent box beams. Adjacent box beams lend themselves well to using the FHWA shear key, which has been adopted as a standard for the Department.
36	How fast was the strength gain in the overlay? How quickly could traffic be placed on the overlay?	We placed traffic on the bridge after about three days. This was somewhat of a conservative approach given that this was a new material for us. It could probably have been loaded a day sooner. For more information on our requirements, a copy of the specifications for the UHPC can be found at http://utcdb.fiu.edu/bridgeitem?id=532 under "Downloadable Resources."

37	I'm surprised to hear that the PPC cost was an issue when compared to UHPC since UHPC is significantly more expensive than PPC.	Cost of the PPC was not so much of an issue. We have found PPC costs to be higher than typical overlays (not as high as UHPC), and the placement process to be rather intensive. Our Construction Section has had issues in the past with proper placement of this material. However, the main driving factor behind using the UHPC overlay over PPC was from a testing standpoint. We were interested to see this material applied.
38	What repair plan did you have in place to deal with low spots in the joint casting?	Initially we didn't have one in place. Once the contractor saw how the material was bonding and working, he suggested the idea of patching the low spots with additional UHPC overlay. The differential camber of the beams was made up for in the UHPC overlay.
39	What surface roughness was required in the joint, and how did the precaster achieve the roughness?	The joint had a retarder applied to the formwork during the casting. This exposed the aggregate of the concrete and created a rough bonding surface for the UHPC.
40	How many bidders?	There were 5 bidders.
41	What was the soil capacity?	The blow counts of the soil at the depth of our piles was between 44 & 50.
42	What type of deck prep was done (bead blast?) for the deck overlay and for the deck patch?	The tops of the precast beams were intentionally roughened to create a good bonding surface for the UHPC overlay. The UHPC joints were also ground once they had cured and the overlay was ready to be placed. The patch was not prepared much in any way. The only preparation we did was to remove the curing compound that had been applied. The patch held through the grinding process and is not visible today.
43	Work hours? Any night work?	Our contractor only worked one night. Most of his days were from ~7 am to ~6 pm. I believe this project could have been constructed much faster if held to tighter time constraints.
44	What slump should be used for UHPC overlay concrete?	The UHPC is not measured using a slump test. The tests outlined in our spec can be found at http://utcdb.fiu.edu/bridgeitem?id=532 under "Downloadable Resources."
45	What is the ASTM designation of the overlay UHPC used?	A copy of the specifications for the UHPC can be found at http://utcdb.fiu.edu/bridgeitem?id=532 under "Downloadable Resources."

46	Could you talk about the type of joint used between the backwall and the beam ends?	There is not a joint between the backwall and the beam ends. We chose to use a sort of "pour-over" detail with the UHPC joint mix. When we poured the joints, we also poured a small "pour-over" backwall that is bonded directly to the ends of the beams. Details of this can be found in the plans at http://utcdb.fiu.edu/bridgeitem?id=532 under "Downloadable Resources."
47	Given the high stiffness (brittle nature) of the UHPC overlay, is performance expected to be good on very high traffic volume bridges like Interstate freeway bridges?	The steel fibers in the UHPC overlay give tensile strength hardening which helps prevent cracking. This helps the material hold up to the heavy stress from road traffic and deicing chemicals. As such, yes, we believe the UHPC overlay will perform well on high traffic volume bridges.