

May 2020 ABC-UTC Webinar Featured Presentation: Lateral Slide and UHPC Integral Abutment Connections on Iowa's 2019 Camp Creek Bridge Replacement

#	Webinar Questions	Responses
Design		
1	Would the connection details for UHPC piles be the same as for steel piles?	The project was let with both a CIP and precast pile cap. The connections could be the same for the CIP option. For the precast option, testing has not been done with UHPC piling but theoretically the connection could likely be the same. UHPC piling are an emerging technology at this time and not commonly used beyond research and pilot projects.
2	How were the piles mated to the abutment after the lateral slide?	The connection used on the project was a CIP pile cap.
3	What is the shear strength of the connection?	The shear strength of the connection is the same or greater than the conventional design.
4	What is the suitability of sliding bridges for skews between 25 and 35 degrees?	Iowa has not constructed a lateral bridge slide on a skew yet, but I think it is feasible with careful design and planning.
Construction		
5	Was there Pile Driving Analyzer (PDA) testing, and were the results of the testing as expected?	The wave equation with a driving graph was used.
6	Was the lateral slide operation specified in the contract documents in detail, or was the contractor allowed to submit a proposal?	One feasible method of slide with stainless steel sliding shoes and a teflon slide bearing was shown in the contract documents. The contractor was permitted to vary their means and methods by the special provisions. This contractor chose to use heavy duty rollers.

7	Did anyone evaluate expected friction resistance versus the actual friction resistance that occurred during the lateral slide?	For this project we did not closely monitor the contractor's slide operations. On the Massena project, our first lateral slide, we closely monitored this. Jacking operation gage pressure during the slide correlated to an effective coefficient of friction of about 12% of normal force. There are other factors beyond the slide resistance that contribute to higher forces required to move the bridge laterally, such as binding and racking. We recommend that the contractor design for a minimum of 10% of normal force.
8	What issues did the contractor encounter during the lateral slide? How did they address the issues, and was the equipment on site to fix the issues?	We are not aware of any issues on the project from the contractor's perspective.
9	What were the specifications for the UHPC for this application?	We issued a non-proprietary special provision for the UHPC.
10	Was a proprietary UHPC mix used? Were there any issues noted with achieving the desired material specifications? What quality control/quality assurance (QC/QA) was in place for the UHPC?	A proprietary mix was supplied to satisfy the performance requirements of the special provisions. The special provisions contain various QC/QA requirements.
11	What production variances, mix proportion, and aggregate grading can occur before rejecting a mix, and is this a barrier to market use?	Unknown.
12	Does UHPC need a wet cure? If yes, did you cure until the 28-day strength was achieved, or did you cure to an intermediate strength?	The UHPC was required to be cured per the manufacturer's recommendations. We did not specify an intermediate strength to open to traffic and opened at full strength, as there was time for cure on the critical path while other operations were being performed prior to opening to traffic.
13	Was there any mock-up test for the UHPC integral abutment before the construction?	Yes, mockups and constructability were tested by ISU at the research lab.
14	Was there a way to verify that the UHPC filled all the cavities at the abutment connection?	Both sides of the joint are visible after stripping the forms. Entrapped air is likely to be seen. We observed good consolidation.

15	How many of these joints have been cored?	None.
16	What lessons learned will you use moving forward on similar projects?	Front face UHPC pour pockets can be eliminated and replaced with smaller vent holes. Practice good survey with temporary works. Practice good finishing on the top of the CIP abutment pile cap.
Cost		
17	Does this project cause a large financial expense or improve the financing of the construction project?	There are no significant financing or cost implications of a bridge replacement project such as this one.
18	Can you provide a cost comparison (versus other options considered)? Also, what were the cost savings due to time saved during the critical closure period?	The alternative bridge replacement option was to construct a diversion and run traffic around the bridge site on a temporary bridge. The cost of both options are about the same, but the lateral slide reduces the impact to traffic from about 2.5 to 3 months down to fewer than 14 days.
19	What were the general costs for the lateral slide?	Contractors don't always balance their bids, but our bid tabulation items indicate the temporary works cost was \$191,000 and the lateral slide was \$168,000.
20	Can you provide a general discussion related to high probability claim settlement (time, weather)?	When an accelerated schedule is used for a construction activity, risk is increased. Contractors need to plan their work accordingly. No claims were made on this project.
Questions During Webinar		
21	Does the UHPC connection need grout and vent ports?	The UHPC joint used both placement ports and venting ports.
22	For the UHPC connection, should the short bars be headed?	The FHWA technote does not indicate the need for headed bars for the UHPC development and lap splice requirements.
23	On slide 23, the front face dowel in the lower portion extends above the bottom flange of the beam. How does this slide in a bridge with multiple beams?	The bars use a threaded coupler and are installed post-slide.

24	Why is the top of the bottom portion not roughened?	It was specified to be roughened.
25	How long was the lap length coming from above and below?	The actual lap was 6 inches. The lap required by the specifications was 5.25 inches.
26	Headed with taper threaded puck?	Unclear what is being asked with this question.
27	Are you concerned about UHPC connection uplift from beam rotation and any other upward superstructure loads?	The appropriate loads and movements need to be considered when designing and detailing the connection.
28	Do you have any concerns of voids in the closure pours?	Voids are a concern if there is not proper placement including venting and overpour to develop a head pressure on the joint. Upon stripping the forms, the joint appeared to be well consolidated with no voids.
29	What was the set time for the UHPC concrete in the lab tests?	The UHPC was allowed to cure 3 days.
30	Were repetitive loading tests performed on the UHPC joint given the presence of cracks in the material?	Several repetitive loadings were completed. However, the number of cycles was limited and would not represent a full 100 years of thermal cycles.
31	What are your views about the use of epoxy coated bars?	Both plain and epoxy-coated bars are commonly used with success when used appropriately.
32	Was the UHPC connection development length $8d$ sub b ?	Eight bar diameters.
33	Did the UHPC connection use external form vibration for the closure pour?	Typically you do not vibrate UHPC. You risk segregation of the fibers. The UHPC is self consolidating.
34	How long did the UHPC take to set? Can you slide the bridge and pour UHPC overnight to open the bridge to traffic in the morning?	No, UHPC has a longer cure time than overnight typically.
35	Were stay-in-place forms considered?	No, there was no need to use stay-in-place forms on this project as the forms were easily removed and not on the critical path.

36	Were vibration devices used on formwork during the placement of the UHPC?	Typically you do not vibrate UHPC. You risk segregation of the fibers. The UHPC is self consolidating.
37	Why not use precast abutment sections with voids that fit over the piles, to be grouted after placement of the abutment cap?	Both a precast option with pile pocket connections and a CIP option was included in the design for alternate bidding. The contractor chose to use the CIP option because it is a faster critical path choice. You get the benefit of a larger mass of concrete curing rather than the small pile pocket concrete.
38	What powered the slide to move the rollers?	Jacks were used to slide the bridge.
39	Was the contractor pre-certified for UHPC Work? Was the UHPC mixed on site? Was the UHPC subbed out to a concrete manufacturer?	No precertifications were required. There was a previous project experience requirement and significant QC requirements. Yes, the mix was done on-site, and they did sub the work out.
40	Would it be possible/cheaper to acquire some additional right of way and construct the new bridge adjacent to the existing bridge, then shift traffic onto the new bridge, to avoid the lateral slide and increased construction costs?	Some bridges are replaced this way. In this case, it would be a significant ROW take to realign the roadway plus the extended duration of closure for the road work. The only cheaper option would be conventional construction on detour. The extended detour would have been undesirable.
41	Did leaving the bird-mouth ports in place from the UHPC placement cause issues with installing the typical waterproof membrane?	No waterproof membrane was required.
42	Was high-early-strength concrete used for the pile cap and the approach slabs?	Yes, a mix with a favorable maturity curve was used.
43	How long before traffic can run over the abutment UHPC?	We would like to achieve at least 12 ksi prior to traffic.
44	Was waterproofing applied to the HPC connection area?	No waterproofing was applied. Note that the connection was UHPC.

45	Was a temporary roadway considered, using a lower posted speed limit, instead of the lateral slide? Was there a cost savings between using the lateral slide versus the temporary roadway?	The alternative bridge replacement option was to construct a diversion and run traffic around the bridge site on a temporary bridge. The cost of both options are about the same, but the lateral slide reduces the impact to traffic from about 2.5 to 3 months down to fewer than 14 days.
46	For the lab tests, was the frame action of an integral abutment structure modelled and compared for the three systems?	Frame action was not considered for any of the three systems. The goal of the testing was to evaluate the strength and serviceability of each relative to the control.
47	Did you check for voids in the UHPC with non-destructive testing (NDT) methods like ground-penetrating radar (GPR)?	No. We had good visibility of the joint after stripping the forms.