November 2019 ABC-UTC Webinar Featured Presentation: Colorado DOT's Bronco Bridge over Platte River Replacement Project		
#	**Questions**	**Responses**
	Design	
1	Is this bridge listed on the National List of Historic Places?	The existing bridge was considered historical and eligible to be on the National List.
2	What was the coordination with the Preservation Agency?	After going through the selection process and determining that the costs and confidence level in rehabilitating and widening the existing bridge were unacceptable, the historical society documented the existing bridge history, drawings, etc., for preservation purposes. Plaques were added to the project to relate the history of the previous bridge.
3	What type of hydraulic modeling software was used for this project? Were there any issues with velocities around the piers?	The hydraulic modeling software used for the project was HEC-RAS. Scour was evaluated at the piers, and stability and strength were checked for a 500-year scour event. Riprap was included for lower scour events.
4	How did you assess subsurface conditions for foundation design? Was seismicity a significant hazard?	Normal geotechnical investigation was used. Normal groundwater / dewatering issues for caisson construction. Colorado is generally a low seismic state, i.e., Zones 1 and 2, so seismic was not a big issue.
5	Was lightweight concrete considered for any of the precast members?	No. Colorado has not had any luck with trying to get a lightweight concrete mix to pass the freeze-thaw tests, so it is not used in the state.
6	Is the bridge fixed or resting on expansion bearings atop the splayed columns?	The bridge is fixed atop the splayed columns. The original design had expansion bearings on top of solid piers.
7	Please discuss connection details between pier columns and footings, and piers and girders.	Reinforcing extended from the bottom of the pier shaft and the tops of each leg. The bottom reinforcing overlapped with the drilled shaft dowels, and the base was cast to connect the drilled shafts and piers. The reinforcing at the top of the pier legs extended into the precast U girders, and a cast-in-place diaphragm was poured to complete the connection. See slides 18, 26-29 & 31.

8	Were there any special requirements for the joint interface surfaces of the different elements of the bridge?	Surfaces should be surface saturated dry for placement of closure pour concrete. It is good to have roughened surfaces on precast elements using retarders or shotblasting, but this project only had normal precast surfaces at joints. No problems have been encountered with the joints yet.
9	Are there other projects in Colorado where a similar replacement has been used?	There are no NHS crossings of the Platte within Denver that are considered for replacement at this time. We have had several projects using prefabricated pier elements and full-depth precast decks.
	Construction	
10	How much vertical clearance was available under the existing bridge to drive the piles?	Approximately 23 ft of vertical clearance was available on the north abutment since the trolley line was originally a railroad. The south abutment had approximately 19.75 ft of vertical clearance.
11	Were there any erection problems with fit-up, for example, deck panels, beams or piers?	There were some normal issues with rebar in openings, fixed with a sledge hammer. All pieces were detailed well and consideration given for tolerances, so fit-up went well in the field. Some grinding was necessary on closure pours for roughness and placement of the waterproofing membrane. Crane lifting and placement were also evaluated during the design for the precast elements.
12	How many phases of construction were used to build the bridge, and what is the time frame?	Originally five phases were considered, but this number was shortened to four with value engineering. See slides 11 & 12.
13	Who provided the precast elements on the project? Were they pre-certified by the DOT regarding quality processes? What QA/QC processes were used for the precast elements?	Plum Creek Structures was the precaster for the girders and deck panels. The piers were precast in the Contractor's yard at the job site. The work plan and method were reviewed and accepted for site casting to meet quality requirements. The precaster plants are PCI certified.
14	Were any workforce changes required for the use of ABC on this bridge, and how did ABC assist in the workforce changes?	None to our knowledge. Some value engineering was done to take advantage of the Contractor's workforce and availability. No specialized expertise was necessary, and all work was performed by local forces.
15	Did anything not go as expected during the fabrication and construction?	Some minor reinforcing fit-up issues occurred, dealt with a sledge hammer. It's very important to detail well and account for tolerances in the plans.

16	Please discuss closeout procedures, claims and settlements... prevailing basis of claims?	Not aware of any claims or settlements necessary on this project.
	Cost	
17	Can you provide a cost comparison between ABC and conventional bridge construction for this project?	ABC was value engineered into the project as a no-cost change after bid. There were time savings that went into the Contractor's evaluation of ABC. As explained on slide 9, the original bid was 79% of the Engineer's estimate. The project was constructed on time and within budget.
	Questions during Webinar	
18	Please elaborate on the connection between U-beam ends. Was it post-tensioned? If not, how did you meet the tensile stress limits?	U-beams were designed as simple-span-made-continuous with splices and post tensioning over the piers in the top flanges. See slides 21 & 22. The girder lines were continuous for the deck slab, SDL and live load. The combination of straight and draped prestressing and post tensioning over the piers created fully-compressed girder lines for all DL. The deck slab was also stressed longitudinally. See slide 36. The girder lines were designed accordingly to meet tensile stress limits under all loading.
19	How were the prestressed strands addressed when cutting the cut-outs in the girder bottom flanges over the piers?	The strands that extended through the bottom slab blockouts were cut on either face of the blockout. Since the blockouts were near the ends, this prestressing was not needed for erection or permanent loads. The remaining straight and draped strands were not cut. See slide 29.
20	How do you re-deck this system if needed?	Very carefully. The girders are stable without the deck, so the deck can be removed and replaced. The deck will probably have to be demoed similar to a cast-in-place deck, i.e., individual precast segments won't be lifted off in complete segments.
21	Have you monitored the pockets for cracking?	The pockets are underneath the asphalt and waterproofing membrane and cannot be inspected. The first time we remove asphalt and waterproofing membrane (hopefully in 20 years +), we will be able to inspect.

22	Did you place concrete in the deck joint and in the pockets at the same time before post-tensioning?	Yes. The original design was to close up the transverse connections, post-tension, and then connect to girders. Value engineering revised the sequence.
23	How do the pier foundations address scour potential?	Pier caissons are embedded 22 ft into bedrock to deal with the scour potential.
24	What is the governing load case for the piers?	Strength I.
25	What structure software was used for design?	Original design: Conspan, RCPIER, hand calculations. VE design: Adapt ABI, Risa 2d & 3d, Lpile, RCPIER and hand calculations.
26	How wide are the longitudinal closure pours between the two decks? Was UHPC or normal concrete used for the closure pour?	Longitudinal closure pours were 2'-10". "Normal" concrete (8 ksi) was used. UHPC could have reduced the width.
27	Did Modjeski & Masters do the original design, or was it the contractor's VE design?	CDOT did the original design of the bridge. Summit Engineering (now Modjeski & Masters) did all VE designs.
28	Is it typical to use black reinforcement in bridge superstructures in Colorado, or was black rebar used because this bridge was composed of precast elements?	Black reinforcement is typically used only in substructure elements. Precast deck panels used epoxy-coated reinforcing. Typically we'll allow black steel in girders except for portions which extend into the deck, which is epoxy coated.
29	Could you comment on structural behavior with transverse diaphragms only at abutments?	The closed-cell box formed by the composite U Girders / deck slab is torsionally very stiff. Very little distortion from transverse flexure or incidental torsion is possible that would activate any significant resistance in a transverse diaprhagm. The bridge is also straight with skewed supports at the abutments where the girder ends are embedded in a continuous diapragm. Diaphragms were cast over the piers to transfer vertical loads to the pier shafts but diaphragms spanning between girder lines were not necessary.

30	Would you explain again how you handled the eccentric loading when one side of the arch pier was loaded and the other was not?	The pier shafts and drilled shaft foundations were analyzed for this load case. The 54-inch-diameter drilled shafts were able to resist the out-of-balance loading. A lateral analysis to evaluate the soil-structure interaction was performed, and the structure performed well during construction.
31	What were temperature ranges to which V-piers were designed?	30 degree rise, 40 degree fall. The bridge is not particularly long, so design movements were not significant when applied to the single drilled shaft foundations at the piers combined with the flexible abutmerts as shown on slides 15, 16 18 & 22. A lateral pile analysis was used to determine pier and abutment flexibilities.
32	Was there a space behind the back face of the new abutment and the front face of the existing, or was the front face of the existing used as a form? If so, what was used as fill in the space between?	The gap between the front face of the existing abutment and the back face of the new abutment was filled with select granular fill material and compacted. The existing abutment was actually a hidden span under the approach slab. Flowfill was used to fill the voids in the hidden span areas under the approach slab. All of the existing abutment was left in the fill under the new approach slab behind the new abutment.
33	What was the type of bearing upon continuity? Were there any seismic special consideration due to the pier shape?	Temporary 3/4-inch-thick neoprene levelling pads were used when the girders were erected. The ends of the girders at the abutments were encased in a solid concrete diaphragm which acts as the permanent bearing. A single row of dowels at the center of the abutment cap reinforces the diaphragm interface. See slides 17, 22 & 30.
34	Can you clarify how the piles were driven below the bridge?	All piling was driven with a vibratory hammer on the end of an excavator arm which could grip the sides of the piles.
35	How long did you wait before loading the drilled shafts?	28 days max. We allowed the contractor to proceed when concrete strength matched required dead loads.
36	How was the resistance verified if the piles were vibrated?	Every other pile was PDA tested to verify bearing capacity.
37	Was there any seismicity consideration in designing the bridge?	Yes, but Colorado is a low seismic state (Zone 1 primarily) so requirements were minimal.

38	How did you support and stabilize the arch columns above the drilled shafts?	Falsework built on a temporary pad built with the caissons. The piers were supported on framing at the top of the falsework towers using typical temporary pier jacks.
39	Is there sufficient development length for the struts into the piers?	Yes.
40	Did seismic govern any component? Assuming seismic loads were significant, did the torsion (given the skew) govern the flared/arch columns?	Seismic did not generally control the design since we're in Zone 1.
41	Where are the fix supports and expansion?	All supports are fixed. Expansion joints are provided at the outside ends of the approach slabs off of the bridge.
42	What was the strength of the pier concrete?	4.5 ksi, as is all the job site cast-in-place concrete.
43	You mentioned that savings for VE would not be shared by the DOT. Was there any savings on top of the tender offer?	Typically savings are split 50/50 between Contractor and CDOT for Value Engineering changes. This was a no-cost value engineering change so no money was involved. Time savings in construction was an added benefit.
44	Given that the majority of the bridge was precast, how difficult was it to figure out the temperature tolerances, i.e., expansion with changing weather conditions?	Was not too difficult. There were no significant weather changes during construction periods. There were 1/4-inch gaps between deck panels which allowed for expansion/contraction.
45	Were there any PT or rebar conflicts during production of U-girder and pier? How were they managed?	There were only minor conflcts that were easily resolved between the Engineer and Precaster.
46	Was concrete sealer applied to the girders?	No. Colorado generally does not apply sealer to girders unless they're in a splash zone.
47	Did you consider other ABC systems? Why did you select this particular configuration?	The project site is in a small river bed. The approach that was used worked well with conventional means and methods. No specialized equipment or expertise was necessary for construction.

48	Did the VE study include the Steel Bridge option? How did the steel cost compare with the concrete option?	The steel bridge option was considered during the original type selection phase. Steel rehab and widening were 2 to 4 million dollars more based on life cycle.
49	Were there any remedial surface repairs to the precast elements?	Minor if any.
50	What is the total deck width?	The total out-to-out width dimension of the bridge is 197 ft.
51	Was precasting much ahead of the Phase to avoid cold climate?	Precasting is done year round in the Denver area. Cold climate shutdowns are uncommon and don't last more than a few days. Temperatures in January routinely vary from 70 degrees to well below zero. Cold weather does not typically last more than week at a time. The area gets over 300 days of sunshine a year.
52	Are the struts under tension in some loading cases?	Yes, but the arch-shaped geometry of the struts and the rigid connection of the top of the columns resulted in lower forces than expected. All reinforcing in the struts was fully developed at the face of the pier shafts.