April 2022 ABC-UTC Monthly Webinar: North Carolina's Rodanthe "Jug Handle" Bridge: Precast Bridge Elements and Innovative Construction Approach		
#	**Questions**	**Responses**
1	Was seismic design a serious consideration for this project, or was the lateral load design entirely wind and wave driven?	Seismic design was not required for this project. Wind and wave/water forces were part of the controlling load case for the design.
2	What material was used to connect the precast deck panels?	A 5.5-inch-thick cast-in-place (CIP) concrete deck was poured on top of the precast deck panels and girders. This provided connectivity to the deck panels.
3	What type of beams are used in the superstructure?	45-inch-deep Florida I-Beams (FIBs) were used in the south curve, and 72-inch-deep FIBs were used in the tangent section and north curves. 24-inch-deep cored slab units were used in the transition spans at both ends of the structure.
4	Which AISC / NSBA, AASHTO and/or ACI codes are used for this applications?	The AASHTO LRFD Bridge Design Code, 8th edition, was used for this project.
5	Can you address design steps for corrosion-resistant precast concrete element connections?	Stainless steel rebar, increased concrete cover, and calcium nitrite corrosion inhibitor were used to provide increased corrosion resistance for the structure.
6	Can you address any corrosion problems and what was done to mitigate those problems for the project?	To address corrosion problems during construction, more frequent maintenance was required for all equipment. Fresh water supply tanks were incorporated to help wet/wash forms prior to concrete placement.
7	Can you describe what was learned during construction that would have changed the approach to the project, and/or the design?	Some of the lessons learned include: (1) The girders and piles were designed very close to within 1 % of their design capacity. In retrospect, we would recommend leaving more reserve capacity for construction challenges and tolerances. (2) More care and consideration could have been given to the effects of the eccentric load introduced by having the overhang precast into the girder. (3) Revised storage plans at the precast yard and revised erection plans were developed during construction.

8	Did the design-build contract method facilitate the use of precast to shorten the construction duration? If so, by how much?	The design-build construction method allowed the project to be completed on an accelerated schedule. Utilizing two headings (north & south) allowed the construction to be completed in half the time.
	Questions during Webinar	
9	What is the radius of the south curve, and what are the span lengths and the beam spacing?	The radius of the south curve is 1,330 feet and meets a design speed of 60 mph. The span lengths and beam spacings are shown below: - South Curve: 45-inch-deep Florida I-Beam @ 97.25-ft span length / 12.5-ft beam spacing - North Curves: 72-inch-deep Florida I-Beam @ 137-ft span length / 12.5-ft beam spacing - Tangent Section: 72-inch-deep Florida I-Beam w/ Precast Curb @ 137-ft span length / 12.83-ft beam spacing
10	Were there any issues with the edge girder camber or sweep due to the non-symmetric shape?	There were issues with girder sweep, but most were mitigated by careful storage at the precast yard. The curbed section of the girder did not have any prestressing; relief cuts at 3 ft on-center were incorporated into the curbed section of the girder.
11	Considering the repetition, were precast bent caps considered instead of cast-in-place concrete caps?	Precast bent caps were considered, but due to the driving tolerances of the 54-inch-diameter cylinder piles, cast-in-place concrete bent caps were chosen as the more appropriate choice.
12	How thick was the cast-in-place deck over the precast deck panels?	The 5.5-inch-thick cast-in-place concrete deck was poured over the 5-inch-thick precast deck panels.
13	The haunches seemed unusually deep; how deep were they?	The haunches are deeper than normal. The FIBs (Florida I-Beams) have a 4-ft-wide top flange and the superelevation in the south curve spans was 0.06. In addition, we anticipated an extra amount of camber growth due to the expected age of the girders at the time of the slab pour. Build-up in the south curve spans was 6 inches.

14	Can you discuss the exterior beams with the deck lip? Were there any challenges or unique design considerations for these girders?	The sweep of the exterior girders had to be monitored, and the eccentricity had to be accounted for during shipping and erection. The curbed section of the girder did not have any prestressing; relief cuts at 3 ft on-center were incorporated into the curbed section of the girders.
15	Do you required a concrete plug in the concrete cylinder piles for scour, vessel collision, and for the connection to the bent cap? What were the concrete plug lengths for the concrete cylinder piles?	The concrete cylinder piles have a plug extended down to elevation -2.50, which was related to the vessel collision zone. The cap pile connection was designed as a moment connection to distribute loads to all four spans within the unit.
16	How long did it take to perform the design for all the temporary piles, tracks, crane set-ups, and rolling gantry?	It took about 12 months to design the temporary works for the project.
17	Was it mentioned that the bridge may be extended? If so, what is the future plan for the bridge?	The bridge may be extended in the future. Future extension has been accommodated at the north end of the tangent section to continue north over the Pamlico Sound all the way to the Marc Basnight Bridge (Bonner Bridge Replacement) over the Oregon Inlet.
18	Did the U.S. Fish and Wildlife Service (USF&WS) have staff at the site on a regular basis, and were citizen advocacy groups keeping a watchful eye on the project?	There were quarterly meetings with USF&WS held on site to review the construction project. The NCDOT had direct privity for coordination and communication with these permitting agencies. The community was very interested in the project, and NCDOT held routine virtual open forums for the public.
19	Did you have any issues with the precast deck panel bedding strips settling over time?	The precast panels were supported on high density polystyrene foam. We went through a few iterations upfront on how best to attach the foam to the girder/panel; a spray adhesive intended for specific use with polystyrene was found to be the best option. There were no issues with the precast deck panel bedding strips settling over time.
20	Do you anticipate hurricanes of Category 4 and above causing waves to go over the roadway?	INTERA did a hurricane study for NCDOT and predicted a maximum wave height of 17 feet at this project location. The bridge is above this elevation.
21	Was a cast-in-place or precast concrete segmental bridge solution considered for the design?	A concrete segmental bridge was not considered by the design-build team for this project.

22	How did you ensure the durability of the precast piles knowing that these piles are immersed in tidal waters (very aggressive environment for the reinforced concrete)?	The team specified 10 ksi concrete and extra concrete cover for the rebar cage in all the piles. Additionally, all concrete contained calcium nitrite corrosion inhibitor.
23	Were Stay-In-Place-Fascia-Forms (SIPFF) considered in lieu of custom precast fascia girders?	Stay-in-place forms were not allowed by the Request for Proposal.
24	How was the bridge elevation set? Also, were the superstructure connections to the substructure designed for wave forces?	The bridge elevation was set just above elevation (EL) 25 ft. The maximum wave EL of 17 ft plus a structure depth of 8 ft determined this elevation. The superstructure of the bridge is below EL 17 for a couple hundred feet at both the north and south ends of the bridge. There is a positive connection of the superstructure and the substructure in these regions.
25	What are the advantages of using an edge girder with a curb? Would you recommend casting the curb monolithically or pouring it after the girder was cast?	The edge girder curb provides a nice side form for the edge of the cast-in-place concrete deck. These girders did have the curb monolithically cast with the top flange, including open joints in the curb spaced along the beam to control cracking. Other projects have connected the curb to the top flange in the field.
26	What width of voided slabs was used in the project? Was any consideration given to the use of CFRP (carbon-fiber reinforced polymer) in reinforcing any of the bridge elements? Narrow right-of-way (ROW) constrictions drove some of the constructability decisions; who owns the ROW outside of what was acquired?	The voided slabs were 3 ft wide. The Design-Build Team did submit an ATC (Alternative Technical Concept) to use MMFX rebar for the project. That ATC was not accepted by NCDOT. The federal government owns the ROW within 150 feet of the shore line adjacent to the Pea Island National Wildlife Refuge.
27	For what loads was the temporary falsework on either side of the bridge designed?	The critical loading scenario was the M16000 Crane/Platform with a 175-kip load on the lifting hook using a 60-ft radius.The entire system was designed to withstand a Category 3 Hurricane event. The hurricane preparation plan was mandated at wind speeds greater than 70 mph.

28	With the Rodanthe Town limits being one of the NC12 hotspots, did coastal modeling predict opening a new inlet, and was it a shallow or deep inlet?	An inlet is predicted at the Rodanthe S-Curve location. However, it is predicted to be a shallow inlet that will probably fill itself with sand from time to time.
29	Were the FIB (Florida I-Beam) girders all simply supported?	The FIB (Florida I-Beam) girders were simply supported.
30	Why was this construction method with all the temporary works chosen instead of the top-down span-by-span construction method Flatiron used on the Washington Bypass in North Carolina?	The system used on the Washington Bypass was considered, but the alignment of the Washington Bypass project was a relatively straight bridge in comparison to the Rodanthe Bridge. The gantry system used on the Washington Bypass was best suited to construct long, straight spans. The Rodanthe alignment had tight radius curves, and using the Washington Byass Gantry system would have limited span lengths to about 60 ft. The gantry equipment was designed to adjust speeds of independent sides (inside leg versus outside leg) as determined by positioning targets at 8-ft increments.
31	What prevents reflective cracking through the cast-in-place concrete deck without a positive connection between the precast deck panels?	There is some minor reflective cracking experienced by all the cast-in-place concrete decks that utilize precast deck panels.
32	How were the girders and piles transported to the jobsite, i.e., by highway or by water?	All precast elements were transported via highways. Travel distance from the precast yard to the project site was just over 100 miles.
33	What is the maximum length of the span, and what is the maximum thickness of the bearing pad?	The maximum span length is 137 feet. The maximum thickness of the elastomeric bearing pads was 4 5/16 inches.
34	Was FRP (fiber-reinforced polymer) reinforcement considered for use in the cast-in-place and precast elements?	FRP (fiber-reinforced polymer) reinforcement was not considered for this project.
35	Why wouldn't the RFP (Request for Proposal) allow precast Stay-In-Place-Fascia-Forms (SIPFFs) but allowed SIP (stay-in-place) precast planks, or did the RFP refer to SIPFFs as steel?	SIP (stay-in-place) forms are Metal SIP forms in North Carolina and are not permitted along the coast.
36	I don't remember if continuity was discussed. Was simple span design used, or if not, how many expansion joints were used and where were they located?	The bridge consists mainly of four-span continuous units. There are thirty-two expansion joints installed along the length of the bridge.