

September 2019 ABC-UTC Webinar Featured Presentation: Precast Segmental Bridges for the LaDOTD I-49/I-220 Interchange

#	Questions	Responses
	Design	
1	How do we know if segmental construction is a better and cheaper option compared to other options in the bridge planning stage?	This project was bid with two alternatives - segmental vs. steel box girders. There were 4 bids received - 3 segmental and 1 steel. At the planning stage, the DOTD used some costing data from similar projects to evaluate the cost competitiveness between the alternates and felt comfortable with preparing designs for both alternatives.
2	In what kind of projects can you apply this?	The ABC principles covered can be applied to most bridge projects.
3	What were some of the structural design issues?	The interchange geometry and varying span lengths present the biggest challenge in developing a complete segmental alternate.
4	What advantages do prefabricated segmental bridges have?	There are several advantages - on site fabrication reduces the schedule for on site activities, high quality and long service life performance history, aesthetics and cost competitiveness.
5	What was your biggest design challenge?	How to accommodate the large variance in the span lengths, superstructure horizontal curvature and roadway cross slope. With 730 segments, the solutions had to be simple and cost effective.
6	What were the major hurdles during the programming, design, and construction phases? What were the benefits of using ABC?	There were a number of site constraints that made the project challenging, including the geometrical requirements of the interchange and how to construct the ramps while maintaining traffic through the existing transportation corridor. The addition of the precast segmental design alternative during the final plans phase of the project was challenging given the required timeline.
7	Can you discuss the structural design of the bridge with regard to Load and Resistance Factor Design (LRFD) methodology versus Allowable Stress Design (ASD) methodology, and its differences in terms of feasibility and budget?	The DOTD requires LRFD for all new bridge designs; a comparison with ASD was not made. The segmental bridges were designed per the LRFD and the DOTD design requirements for permitted loads. There were no significant differences between the results or budget for LRFD and ASD requirements.

8	Can you discuss the analysis method used (e.g., 3D finite element, etc.)?	The 3 segmental ramps were designed with the Bentley RM software and checked with the LARSA software. Both programs are FEA, 3D, time dependent, and staged construction. The superstructure design was done in 3D with full time dependent effects and construction staging modeled.
9	Can you discuss the use of an alternative software for checking purposes of the analytical results?	Please refer to Question 8 for the response.
10	Can you discuss the choice of the erection method and some of the other options?	From our experiences, we thought that balanced cantilever segment erection with ground positioned cranes was the simplest and most cost effective method. During the design, we did not evaluate any other possibilities.
Construction		
11	Was the construction of the bridges very difficult?	Substructure was more challenging than segment erection.
12	What do you want to do differently for your next project of a similar nature?	Require concrete batch plant to be on site. Require steam curing of segments.
13	Did LaDOTD have sufficient qualified bidders for this project since the superstructure type was a "first"?	Yes, the DOTD received four total bids, three of which were for the precast segmental alternative.
14	Can you comment on the geometry control of the segments for assembly?	Contractor used MC3D program for controlling geometry of segments. Segments were match-cast.
15	What special considerations were given to post-tensioning the curved segments of the bridges?	The superstructure was designed in 3D, and the tendon geometry was considered for the local affects in the deviation points and for the losses during the stressing for friction and wobble.
16	What type of post-tensioning has been installed internally - bonded or unbonded? If unbonded, what type of filler has been used?	The top slab / cantilever tendons are internal and grouted. The continuity and positive moment tendons are external, grouted and unbonded.
17	What is the purpose of a casting machine core?	It provides the forming for the top slab and webs.

18	Have you considered the use of polymer concrete materials for closure pours between the precast segments?	Contractor considered using polymer concrete but found it to be too cost prohibitive.
19	Were precast concrete barriers used on this project?	The permanent barriers on the segmental structures were slip-formed.
Maintenance		
20	What is the design life of the bridge based on the concrete mix that was used?	The structure was designed in accordance with the AASHTO LFRD Specifications; the empirical design life is in accordance with those provisions. A separate design life analysis was not made for the structure.
Cost		
21	What was the Engineer's estimate and the construction contract?	The engineer's estimate for the project was \$129.4M. The low bid for the project was \$137.8M.
22	What was the cost per sq ft for constructing the segmental bridges?	The segmental bridges cost approximately \$275 per square foot.
23	What is the breakeven deck square footage to go segmental considering the cost of the casting beds?	Many factors go into determining the feasibility of a segmental project, and the cost of casting machines are only a small part of the considerations. Other items are erection requirements, MOT, transportation, etc.
Questions during Webinar		
24	Did the bid documents include a site for casting segments or did the contractor find his own?	No. The contractor choose their own site.

25	Why did you decide to go with linear to constant haunches versus a parabolic haunch?	The linear haunches gave us the required structure depth at the piers for an efficient longitudinal PT layout and simplified casting by having more standard segments. For a haunches, parabolic deck, the visual continuity would not have been as good, and the segment depths would have required continuing form adjustments. Our experience with the linear haunch has been very good, and we felt it would give a simpler and cost effective solution.
26	Slide 10: Was the falsework tower on its own foundation? Was the tower relatively easy to remove from under the completed structure?	The only falsework that had its own foundation was that used for building the cast-in-place span for ramp EN. The falsework towers had jacks that could be lowered to allow for removal of the towers.
27	What type of changes/adjustments (if any) had to be made during the installation of the precast bridge segments?	Some of the closure sections did not quite match up, so a skew had to be built into the closure pours.
28	Were non-symmetric tendon layouts considered to counteract the torsion induced by the tight radii, i.e., more tendon on outside of curve compared to inside?	We did not consider using an unsymmetrical tendon layout. We were able to accommodate the design requirements with a symmetrical layout and felt that doing something different would be an unnecessary complication.
29	Is the top slab of the segments the riding surface, or is there an overlay?	The top of the segments was milled after an entire ramp was complete and serves as the riding surface.
30	It doesn't look like epoxy-coated rebar was used. Comment?	No epoxy rebar was used. DOTD Bridge Design policy is to use low-permeability concrete mixes with black reinforcing steel in lieu of using corrosion resistant (or epoxy coated) reinforcing steel.
31	Do the external ducts sag with the weight of the grout?	No, strands were stressed very taut.
32	How were the bottom temp. PT bars connected in the variable depth portion?	The PT bars are coupled near the faces of the temporary anchor blocks, and the segment geometry requirements were accommodated in the deck sizing and position for the haunched segments.
33	When were bearings installed and grouted?	Bearings were installed before erection began and grouted after the 3rd segment was installed on either side of the pier.

34	If the designers or contractors had known there would be no traffic below, would cantilever construction be used? If not, what type segmental, or would steel have been more competitive?	The only time we had traffic below was when we crossed I-220. The steel alternative was not competitive.
35	How was the stability of the bridge handled using the balance cantilever method while the bridge is on a curve? I imagine the stability in the radial direction was challenging.	We had no problem as long as the geometry of the segments were correct. Contractor was allowed to use shims between the segments to adjust alignment.
36	With such good ground access, was cast-in-place (CIP) on falsework considered as an alternative structure type?	No. In the southeast part of the USA, the CIP method has not proven to be cost competitive. There is one span of CIP on false work that had been used due to the varying cross-section width that was greater than what could be accommodated with the typical segment detail. By using CIP on falsework for that span, we could maintain a constant overhang detail and only vary the distance between the webs. This provided better aesthetics and eliminated a complicated detail for the precasting and erection operations.
37	Was a hybrid design considered so that cast-in-place could be used where it is possible and segmental at other locations?	Since a casting yard was already set up to produce precast units, it would have been cost prohibitive to also use cast-in-place units.
38	Were there any segments rejected during construction? From whom did rejections come - the contractor, EOR, DOTD? Was there any criteria for what constituted a rejectable deficiency?	Yes, about 20 segments were rejected by the DOTD due to strength requirements and geometry tolerances.
39	Is the DOTD considering use of segmental in the future?	Yes. DOTD will consider the use of segmental concrete construction in the future.
40	Can this bridge really be called ABC construction, or am I missing something?	Precast segmental is considered one of the ABC tools; for example, the segments are constructed offsite and quickly erected onsite.

41	How many insitu stitch bars were provided in any typical span?	The segments were epoxied together, and there was one smaller cast-in-place closure element at the ends of the cantilever / mid span.
42	What treatment is between the segments - grout, epoxy, ...?	An epoxy was used to "glue" the segments together.
43	Did you grind transverse tines into the deck after erection?	Yes, transverse tines were ground into the decks after they were first ground smooth.
44	Any particular seismic consideration?	Most of Louisiana, including Shreveport, falls into Seismic Zone 1. The structures were designed accordingly. The seismic criteria used was standard AASHTO and at the lowest level to be considered. It was not a controlling load case.