IBT/ABC-UTC January 2024 Building Bridges at the Speed of Segmental		
#	**Questions**	**Responses**

Please note that these responses are those of the Presenter and are not endorsed by the IBT/ABC-UTC.

General

1	Can you provide pro and cons for variable width segmental construction (Precast or Cast-In-Place) with some examples.	Variable width decks for segmental construction are easily accommodated during casting by varying the wing length for Precast and Cast-in-Place. Larger width variations require core form modifications which are more complicated but still economical for larger projects requiring multiple precasting forms.
2	Please describe the major differences in construction methods between Cast-In-Place Segmental and Precast Segmental bridges.	In Cast-in-Place Segmental Construction, the segments are fabricated in their final location within the bridge using moveable forms. In Precast Segmental Construction, the segments are fabricated in forms away from the bridge and then brought to the bridge and erected.
3	How are post tension tendons repaired or replaced if they become damaged or loss strength over time?	Traditionally, internal cementitious grouted tendons are abandoned and replaced with supplemental tendons to restore the reduction in capacity while external tendons are removed and replaced. Recently, the use of flexible fillers and other details are being implemented to allow simpler tendon removal and replacement if needed.
4	Who are the main/most-common segmental bridge builders and designers in the industry?	Many of the most prominent owners, constructors, designers and suppliers within the segmental industry can be found at the American Segmental Bridge Institute's website at https://asbi-assoc.org/about/membership/.

Design

5	What are typical software packages used to design segmental bridges?	Segmental bridge design requires software that can account for time-dependent staged construction analysis, for which several commercially available products have versions that include this capability. Other more proprietary or specialized software is often utilized for unique aspects such as segment geometry control during casting.
6	What are the Codes and Standards that are used for segmental bridge design?	Segmental bridge design conforms to jurisdictional codes. In the U.S., segmental bridge designs conform to AASHTO Design Specification requirements, including specific requirements as defined in Section 5.14.2.
7	Can you comment on the procedures, equipment options, and design details based on Canadian CSA standards and CHBDC codes?	While I have not had the opportunity to work on a Canadian segmental bridge, the procedures, equipment and details are universally applicable as much of the industry originated internationally.
8	What are the related codes, standards, and textbooks for launching design. (Loading: wind speed, deadload, etc.)	Codes and standards are dependent on jurisdiction, however, launching design is subject to typical erection loading criteria and capacity requirements. This method is discussed in more detail in the ASBI Construction Practices Handbook, Chapter 6.
9	What method do you use for calculating the modulus of elasticity (E) of the concrete?	The modulus of elasticity for the 28-day design concrete strength is typically determined using AASHTO Design Specifications, while time-dependent material properties are typically based on CEB-FIP Code.
10	What is the typical thickness of each segment?	Segment depths vary based on project requirements. Precast segments are often 9 ft to 10 ft deep to accommodate transport limitations, but may increase if transport/handling limitations are not applicable. Cast-in-Place segments have been fabricated nearing 40ft deep.
11	What is the maximum segmental length without deck joints?	Maximum segment lengths are dependent on project specific conditions and bridge geometry. Precast segments transported on roadways are typically ~10 ft in length to fit within a travel lane but may be increased based on special travel permits or wide load conditions. Segments may increase in length up to full span length dependent on transport and handling restrictions. Longer segments may require more specialized equipment.
12	For segmental bridge with continuous multiple spans, what kind of bearings are used?	Segmental bridges can be either simple or continuous, and use either bearings or be constructed integral with the piers. Bearings are typically reinforced neoprene pads for shorter span-by-span constructed bridges, whereas longer balanced cantilever bridges often utilize high-load multi-rotational bearings like pot or disk bearings.
13	For the footings, are they precast or cast in place? Please discuss the connections between footings, pier columns and precast segments.	Footings may be either precast or cast-in-place, although in the examples shown they are cast-in-place. Connections may be either grouted reinforcing couplers or continuous post-tensioning bars or tendons. Additional references are provided at the end of the presentation.

Cost & Economics

14	What is the minimum deck square footage area that is economical for segmental bridge construction?	Many factors may influence the economics of a particular project, including site access or environmental concerns that are independent of project size. Cast-in-place segmental bridges constructed using form travelers may be 3-span structures with 20,000 sf deck area when project conditions warrant their use, whereas precast segmental may be economical at 50,000 sf and above.
15	What is the typical cost of formwork for a segmental bridge?	Formwork costs vary substantially based on the complexity and variability of the segments as well as project size and schedule. Segment precasting considerations should include the number of forms required to meet the project schedule, size and location of the casting yard and transport duration and restrictions. These considerations are similar to those of any prefabricated element.

Construction

16	Regarding the segment on the pier (solid section), do you fix it to the pier during erection in the case of the balanced cantilever method?	The pier segment is horizontally restrained during erection. This is most often accomplished using a fixed bearing assembly or temporarily retraining a sliding bearing, which is released following span continuity. Rotations are typically restrained using temporary jacks/shims until falsework towers are engaged.
17	In the case of the balanced cantilever method of construction, do you stress the post tension (PT) bars that assemble segments after or before erection?	PT bars are typically part of the erection process and are stressed after the segment is lifted into position and epoxy has been applied to both segment faces. The PT bars are stressed to draw the segments together and support the installed segment which can then be released from the crane or lifter.
18	Did you use shallow foundations in the project presented? If so, how did you ensure the stability of the shallow foundation during the erection of the segments (balanced cantilever method)?	The projects presented all used deep foundations using either driven piles, drilled shafts, micropiles or auger cast piles. Falsework towers are either supported by the permanent foundations, or the cantilever is stabilized using props on shallow foundations that resist vertical loads only.
19	When match casting precast segments - how are the segments cured when in the match-casting position?	Initial curing occurs while the segment is in the casting bed prior to being moved into the match-cast position. Curing practices vary by geographical region but include steam curing, insulating forms, applied curing compounds, misting and covering. Once moved to the match-cast position, curing is typically controlled by the use of applied compounds to the top deck surface.
20	Can you talk about post-tensioning stressing and grouting procedures and equipment in ABC/overhead construction and how those influence the overall construction and design.	Post-tensioning stressing operations are typically part of the bridge erection procedures that are required to support the segments or spans and must consider overhead construction restrictions. Tendon grouting is not typically an erection requirement, but must be performed in a timely manner to protect the tendon from corrosion. Restrictions for overhead grouting may include provisions for preventing overspill or containment. Additional information is available through PTI/ASBI as well as from the FHWA PT Tendon Installation and Grouting Manual. (https://www.fhwa.dot.gov/bridge/construction/pubs/hif13026.pdf)
21	For the mobile segment lifter, is there a maximum height/bridge clearance where this technology can be used?	Segment lifters have been used on four level interchanges and main water channel crossing over 100ft in elevation. When erecting a bridge beneath an overhead structure or utility conflict, erection equipment clearance needs to be considered and accounted for in the design and use of the equipment, however, lifter operations are relatively compact when compared to cranes.
22	When two cantilevers are constructed from opposite abutments/piers and for some reason the last segment does not align/fit perfectly what are the measures that can be adopted to resolve that? Has there been any experience like this before?	Misalignments have and do occur, although there are several methods of limiting their occurrence. Segment geometry is routinely monitored during casting and erection and adjustments can be made to limit closure misalignment. Cantilevers may also be rotated to provide a best-fit alignment, and in extreme cases may be displaced to improve alignment. Misalignments may also be mitigated using overlays or surface grinding to improve rideability.