May 2017 ABC-UTC Webinar Featured Presentation: Virginia's Rehabilitation of I-64 Dunlap Creek Bridges Using High-Performance Link Slabs and Overlay Materials: ABC Component		
#	**Questions**	**Response**
	Design	
1	Link slab design method and detail calculation.	See Section 9 of Chapter 32 of VDOT's Manual of the Structure and Bridge Division [http://www.virginiadot.org/business/resources/bridge/Manuals/Part2/Chapter32.pdf]
2	What length of slab do you replace each side of the joint, and how was that determined?	2 feet in either direction. See details in Section 9 of Chapter 32 of VDOT's Manual of the Structure and Bridge Division [http://www.virginiadot.org/business/resources/bridge/Manuals/Part2/Chapter32.pdf]
3	Describe the design/analysis process for the link slabs. What guidelines were available for design of the link slabs?	See Section 9 of Chapter 32 of VDOT's Manual of the Structure and Bridge Division [http://www.virginiadot.org/business/resources/bridge/Manuals/Part2/Chapter32.pdf]
4	Modelling induced moments in the deck and determining length of negative moment regions.	The moments applied to the link slab are assumed to be imparted by the live load rotation applied to the adjacent spans.
5	Literature suggests an optimum link slab width of 5% to 7.5% of the span length. Please address the rationale of your 4-ft width.	We have had good historical success (over 30 years) with 4-ft spans, and have not seen the need to increase the length of the link slabs.
6	Do beams supporting the link slabs need to be made continuous or to be continuous?	No.
7	Do you use link slabs at a fixed-fixed joint?	No. If an existing pier has two bearings fixed against longitudinal translation, one of them should be released for translation.
8	How to handle the provision for expansion on the bridge deck when the link slab take one expansion joint out?	Thermal expansion is moved to the end of the bridge. Piers will see increased loads due to thermal movement and braking forces. Piers must be analyzed to verify capacity before installing link slabs.

9	Demolition details. Bridge size/type restrictions for link slab.	Demolition is usually with chipping hammers, although sawcutting can be employed. VDOT currently permits 4-ft link slabs on bridges with up to 100-ft spans, based on histrorical performance. Longer spans may use links slabs, but they must be individually analyzed.
10	Any detailed information on how traffic was maintained would be greatly appreciated.	For this project, extended closures behind barriers were permitted. This is usually not the case on interstate highways.
	Materials	
11	Are fibers added to the link slab concrete mix, and is the material preference steel or plastic? Do you have slabs without fibers to compare?	We have not historically used fibers on link slabs, and we do not require them currently. However, this project successfully used fibers. Steel and polymer fibers are both very helpful.
12	How did you control the cracking in the link slab? Which products did you use?	Mixes had a low water/cement ratio, which helped with drying shrinkage. The link slabs were cured in the field to minimize plastic shrinking cracks.
	Construction	
13	Can link slabs be poured monolithically with the slab itself, with a sawed joint over the bent centerline?	This is a good idea. I see no reason why we couldn't do this, although I'm not familiar with any instances in which we've done it. I presume you're referring to an existing superstructure receiving a new deck (new bridges tend to be structurally continuous or continuous for live load).
14	How do you attach closure pour forms to the new panels?	Connect to bottom of adjacent decks.
	QA/QC	
15	What quality control approaches are implemented during construction with HPC or UHPC materials?	Customary QA/QC procedures for concrete, but with more expert oversight during and prior to placement.
	Performance/Durability	
16	What are the time, cost and longevity differences of this method versus a regularly placed concrete deck?	Overlay with link slabs cost about 15% of the cost of an new concrete deck while providing 40 years versus 80 years for a new concrete deck.

17	Discuss about the proposed lifespan of the repair.	We anticipate a 30+ year life span for the link slabs and deck extensions.
	Cost	
18	What is the additional cost to the project to use this material?	Varies by fiber type, but up to 100% premium. But this is about a 50% increase for installation, since labor is roughly the same.
19	What kind of overlay is used, and what is the cost?	The project used 4 different types of overlay materials: 1) Latex modified concrete overlay; 2) Silica fume concrete; 3) Low cracking concrete with shrinkage reducing admixture; 4) Low cracking concrete with coarse aggregate; 5) Low cracking concrete with lightweight fine aggregate.
	General	
20	What are the link slab and overlay materials?	Link slabs used 4 different materials: 1) Latex modified concrete; 2) Concrete with 2% ECC fibers [0.4" long]; 3) Concrete with 1.2% HyFRC Synthetic fibers [2" long]; 4) Concrete with 0.6% HyFRC Synthetic fibers [2.4" long]. The project used 4 different types of overlay materials: 1) Latex modified concrete overlay; 2) Silica fume concrete; 3) Low cracking concrete with shrinkage reducing admixture; 4) Low cracking concrete with coarse aggregate; 5) Low cracking concrete with lightweight fine aggregate.
21	How were claims handled under accelerated completion?	No claims.
22	Please provide details for the overlay materials.	See VDOT's Road and Bridge Specification, Section 200: [http://www.virginiadot.org/business/resources/const/VDOT_2016_RB_Specs.pdf]
	Questions during Webinar	
23	Do you have any thoughts/experience with using link slabs on highly skewed bridges?	We have used them on skews up to 40°. Our guidance permits them up to 30° without analysis.
24	Slide 7: Are your details on standard drawings or developed specifically for each bridge?	Standard drawings.

25	Due to the thermal expansion/contraction of steel girders, is there a max span limit for replacing expansion joints with link slabs?	No limit, but thermal movement must be calculated and accommodated at the ends of the span units.
26	What is the effect of snow removal such as salt and sand on this type of slab?	Good performance. Because link slabs provide a smooth ride with the rest of the deck, they don't tend to catch snow plow blades. Of course, the primary benefit is to keep salt and water from the superstructure and substructure.
27	What was the purpose and advantage of using steel fiber reinforced concrete? Were they small or big fibers? Was a mix of steel and polypropylene fibers used for shrinkage control?	Fibers help with crack control and provide a type of ductility through strain hardening. Fibers varied in size depending on type. {Concrete with 2% ECC fibers [0.4" long]; concrete with 1.2% HyFRC Synthetic fibers [2" long]; concrete with 0.6% HyFRC Synthetic fibers [2.4" long].} Different fibers were used to get a side-by-side comparison to determine which were more expensive, easier to install, and more durable.
28	Slide 29: The removal process of the top of an existing deck is a standard process/specification unique to VDOT?	Standard process. We rotomill to remove the first 1" or so (depending on the deck) and hydromill the remainder.
29	Did you applied a bonding agent between the old concrete and the new overlay?	No. The surface provided by the hydromilling provides an excellent bond.
30	Were all deck joints eliminated, so it is essentially jointless end-to-end?	Yes. All deck joints were eliminated.
31	Was the bearing configuration changed or left as-is, resulting in the piers functioning as fixed piers?	Bearings were changed.
32	Was a guardrail on the trailing end of the rehabilitated bridge?	There is guardrail on all leading approaches.
33	Have you considered having longer link slabs, say 4 ft each side instead of 2 ft each side? Longer link slabs may be more flexible and crack less.	We have considered this, but have found that the 4-ft link slabs have performed well. We may need longer link slabs for larger spans, but we hope to alleviate the cracking by use of fibers.

34	Instead of the fiber concrete for the link slab, some 25 years ago in Pretoria, South Africa, I have used the same concept but with an elastomer made up of a mix of epoxy, chlorinated rubber and small aggregates. As far as I know, it only needed replacement after more than 20 years, with this replacememnt being quite easily done with traffic flowing, also one lane at a time.	We have tried a similar detail that we call the "elastomeric concrete plug joint." After some initial trials we are having success with this detail. However, it is still a joint, and we don't think it will provide the same value as eliminating the joints.
35	Is the crack associated with high stresses, or environmental issues such as temperature, concrete mix, and shrinkage?	Combinations of reasons, including flexure, temperature and shrinkage.
36	What type of instrument was used to measure the cracks as small as 0.1 mm?	Standard inspector's plastic card with crack widths.
37	Were crossovers considered? Was a polyester polymer overlay considered? Was UHPC considered for the link slabs?	Considered but not needed, since extended lane closures were permitted. Polyester not considered, since Virginia has better success with concrete overlays. UHPC not considered since ultra-high strength was not needed for this application.
38	What was the NBI condition code before and after rehab?	Before and after for both bridges was the same: Deck: 6, Superstructure: 7; Substructure: 6.
39	Why aren't you extending the slab (approach slab) at least 15 ft beyond the backwall as PennDOT is currently doing? It seems to work very well and definitely keeps salt away from the abutments.	We found that the "micro-abutment" details were more economical.