ABC-UTC 2022 In-Depth Web Training: Non-Proprietary Ultra-High-Performance Concrete (UHPC)		
#	**Questions**	**Responses**
	Module 4: Impact of Non-Proprietary UHPC Properties on Structural Design	
1	What is stopping precast girder producers from running two separate lines in parallel, one for conventional concrete and one for UHPC?	The difficulty for producers in running two production lines in parallel mostly concerns resources, including money. The precaster would probably need separate storage bins (e.g., for the silica fume), and separate mixers (high energy for the UHPC), and maybe separate crews, each with specialized training with one material or the other.
2	Would it be possible to make a girder with conventional (high strength) concrete in the flanges and UHPC in the web (for shear strength)?	In principle, it would be possible to use both UHPC and conventional concrete in the girder. In practice, it would be necessary to work out how to ensure a satisfactory interface between the two materials. Should you let the bottom flange undergo partial set before pouring the UHPC web? Since the UHPC is very flowable, it should be left to partially set before the top flange is poured. Delicate timing is needed.
3	What challenges would an engineer face in the design of long girders if a UHPC with f'c of 50 ksi (350 MPa) were to be developed?	The first challenge would be space for the strands. Ben Graybeal showed the use of 0.70-inch-diameter strands, but you would need to place them at closer centers, use even larger diameter strands, or develop some 500 ksi strand, to justify the f'c = 50 ksi UHPC. Deflections might also become problematic.
4	Is it better to use a shear key detail, or just to roughen the face of the concrete, at a joint between precast panels?	Personally, I believe a roughened surface is preferable. If a diagonal tension (shear) crack is to form in the adjacent conventional concrete, with a shear key it needs to crack only half the slab thickness. With a roughened interface, it needs to crack the full slab thickness.

5	Has anyone built a seismic column with the reduced diameter plastic hinge detail that you showed?	As far as I know, no one has built a seismic column with the reduced diameter plastic hinge detail as shown, but it would be a very interesting test to do so.
6	In terms of potential benefits that could be offered by UHPC, did you consider the fact that UHPC will have a lower carbon footprint than conventional concrete from the perspective of life-cycle analysis?	Since, with UHPC, the total quantity of concrete used is likely to be lower, it is likely to have a lower carbon footprint. But that is offset by the fact that UHPC typically has a high cement content. So the carbon footprint savings may not be as great as they appear at first sight.
7	FHWA is recommending UHPC for partial-depth overlays. How are they overcoming the boundary stress and electro-chemical reactions?	I defer to Ben Graybeal, of FHWA, on this question! (See Module 6, Question 11, for Ben's response.)
8	How can we place UHPC in a beam requiring 30 cubic yards without getting a cold joint?	A beam requiring 30 cubic yards sounds like a record length beam! You could make it in segments, then splice them together using post-tensioning. Or, to make a single piece beam, you would need a large number of mixers to ensure a continuous supply of material.
9	Are there any special requirements for UHPC closure pour design as compared to a conventional closure pour design?	For UHPC closure pour design, consider bar placement, erection, and tolerances when you choose the joint width. Preferably roughen the faces of the precast concrete units (with a retarder). Pre-wet the faces adequately. Make sure the joint forms are genuinely leak proof, and consider a top form if the deck is sloping.