EDITORIAL

Photo: PCI.

Ya Don't Know What Ya Don't Know

William N. Nickas, *Editor-in-Chief*

There is a high likelihood that you are aware I have a bit of a concrete bias. I know what you're thinking: that's an understatement! It is not that I believe that concrete is the only material solution that can meet every construction requirement related to durability and sustainability, but I do believe, as Mary Poppins would say, that concrete is "practically perfect in every way."

So imagine my surprise when I was discussing the topic of structural (bridge) design with a fairly new engineer and he told me that we can't mix structural material types on a bridge superstructure. I wasn't sure I heard that correctly, so I asked him to clarify what he meant. He replied, "Well, if you build a bridge out of steel and it needs widening or a retrofit, you need to stick with steel. It just makes sense to stay with the materials previously used." Does it?

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Our discussion shifted to connections, how they relate to the structural member or components, and then we returned to the subject of basic overall bridge geometry and load demand. At this point, I decided to start from the beginning and raise some fundamental questions. What's the problem we're trying to solve? What are our environmental (load and deterioration) limitations and restrictions? How do the principles of any general structural design apply to the members and through the connections?

Refocusing the conversation on the load path and basic structural analysis helped the young engineer (and me) better understand possible solutions for superstructure design. We were both reminded that each step in the design process requires the engineer to understand and communicate an overall (holistic) solution that meets strength and stability criteria as well as the performance requirements for current and future needs.

Whenever we have a new project or are planning for the widening of an existing structure, a thorough understanding of all things related to connections, compatible deflections, and load path is the key to addressing misconceptions regarding the feasibility of mixing materials. In my conversation with my young colleague, I explained how ultra-high-performance concrete (UHPC) materials are being used to achieve innovative solutions for connection challenges. By the time we finished our conversation, the young engineer was considering a design in which lightweight precast, prestressed concrete components would be connected to that other material (structural steel) with cast-in-place normalweight concrete diaphragms, and UHPC would be used for the connections and deck closure pours.

In this conversation, exploring some "what if" scenarios was productive and enlightening for us both. My colleague's initial confusion about mixing materials being impractical was resolved by really understanding how to design the connection and defining expectations for the critical sections adjacent to the connection. The relationship between the component and the connection within the total bridge system is paramount. A solid grasp of these concepts should be the starting point for design and can open the aperture as it relates to "mixing materials." Changes in materials could involve several classes of concrete or connecting to structural elements made from carbon-fiber-reinforced polymers, carbon steel rolled shapes, or a lightweight concrete member.

So, the next time you find yourself in a conversation that seems limited by what you perceive or your unfamiliarity with your full range of options, go back to basics and make a connection. I bet that you'll choose a concrete one because concrete offers such a wide range of viable and cost-effective solutions!

Cover
The Christian to Crescent Bridge winds gracefully along the banks of the Schuylkill River with the Philadelphia, Pa., skyline in the background.

Reprints
lisa scacco • lscacco@pci.org

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Bob Risser, President

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