CLEMSON
GLENN DEPARTMENT
OF CIVIL ENGINEERING

Brandon E. Ross, PhD, PE
Cottingham Associate Professor of Civil Engineering
Associate Professor School of Architecture (courtesy appointment)

Civil Engineering: Servicing the Present and Creating for the Future

This is an exciting time to be a civil engineer. Advanced materials, automation, and data science are growing the civil engineering "toolbox," and civil engineering problems are being reframed by sustainability, resilience, and adaptability. However, as the profession adds new tools and solves new problems, many aspects of civil engineering remain constant. Concrete and steel structures remain ubiquitous and Hooke's Law remains critical to structural analysis and design. This presentation will describe research that utilizes tried-and-true approaches for servicing society's present needs, as well as research that creates novel tools and frameworks for engineering the future.

The first topic presented will be end region design of precast, pretensioned concrete I-girders. These girders are workhorses for the US highway system and proper end region design is critical to their performance. The end region serves two critical functions: First, it receives forces from the prestressed strands and delivers these forces to the remainder of the girder. Second, the end region receives shear forces generated from applied loads and delivers them to the support. Partial debonding of strands is commonly used to prevent end region cracking due to receiving and delivering the prestress, yet debonding also has a negative effect on the end region shear capacity. A method will be presented for designing debonding schemes that balance the serviceability benefits of debonding with its drawbacks on shear strength. Derivation and validation of the method will be discussed.

The second topic will be Design for Adaptability (DfA). DfA is an emerging philosophy that can be used to design obsolescence-resistant buildings. Such buildings can be easily modified to suit changing functional, economic, and social needs. As the obsolescence "hazard" grows – in many cities obsolescence results in more building demolitions than structural failures – the need for a quantitative framework for DfA will also increase. This part of the presentation will introduce ideas and strategies associated with obsolescence mitigation and DfA. A quantitative framework will be discussed along with ongoing data collection and validation efforts. It is intended that this framework will become a standard tool for designing next-generation buildings.