



ACCELERATED BRIDGE CONSTRUCTION
UNIVERSITY TRANSPORTATION CENTER

UTC Project Information	
Project Title	Development of Non-Proprietary UHPC Mix
University	OU
Principal Investigator	Floyd, Royce
PI Contact Information	rfloyd@ou.edu
Funding Source(s) and Amounts Provided (by each agency or organization)	ABC-UTC funds: \$100,000 Match funds: \$50,000 from ODOT
Total Project Cost	\$150,000
Agency ID or Contract Number	Accelerated Bridge Construction University Transportation Center (ABC-UTC) 69A3551747121
Start and End Dates	2019/01/01- Active
Brief Description of Research Project	<p>Deterioration of bridges can often be related to poor performance of longitudinal connections or transverse deck joints, which can be more frequent when precast panels are used for accelerated bridge construction. Ultra-high performance concrete (UHPC) is a relatively recent advancement in cementitious composite materials with mechanical and durability properties far exceeding those of conventional concrete. It combines a high percentage of steel fibers with an optimized gradation of granular constituents, resulting in a compressive strength in excess of 22 ksi, a high post-cracking tensile strength, and exceptional durability. The short reinforcing bar development lengths and exceptional durability provided by UHPC lead to great potential for use in bridge deck joints, other applications for accelerated bridge construction, and as a repair material. The long-term benefits of using UHPC in a number of applications are evident, but commercially available proprietary mixture formulations are very expensive and mix design using local materials is much more complicated than for conventional concrete. The material characteristics, complicated mix design, and need for specialized mixing procedures require detailed specifications and quality control testing currently not included in most states' standard specifications. Guidance for UHPC produced with local materials that can achieve the necessary mechanical properties and durability for use in bridge component connections is needed to provide additional options for DOTs. All ABC-UTC partner institutions are considering the use of UHPC for bridge deck joints and a number of other applications, but coordinated efforts are</p>

	<p>needed to understand the repeatability and impact of locally available materials on performance of non-proprietary UHPC mixture formulations. A mix design developed in one part of the country may not directly translate to another region of the country if the constituent materials used for the mix are not exactly the same. Examination of material properties for UHPC made with constituent materials from different regions is needed to provide guidance applicable for the entire United States. Furthermore, steel fibers are typically the most expensive component of the UHPC mix and also have a significant impact on structural behavior of UHPC. A more thorough understanding of the impact of different fiber contents on non-proprietary UHPC performance could allow for different mix designs with an optimum fiber content tailored to properties required for specific applications. The primary objective of the project is to develop guidance for an “ABC-UTC Non-Proprietary UHPC Mix” design produced with local materials that can achieve the necessary mechanical properties and durability for use in bridge component connections. The five ABC-UTC partner institutions will coordinate efforts to examine material properties, reinforcing bar development length, shear behavior, full-scale joint behavior, and durability of the “ABC-UTC Non-Proprietary UHPC Mix.”</p>
<p>Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here</p>	<ul style="list-style-type: none"> • Matching funds from Oklahoma DOT • As reported under 2016-C2-FIU01, collaboration between FIU, UNR, and OU invited to present a full-day non-proprietary UHPC mix workshop, held in Miami on 12-11-2019 • On 03/20/2020 Royce Floyd responded to phone request from Alabama DOT Miscellaneous Structures & Bridge Design engineer for input on similar non-proprietary UHPC efforts in Alabama • As requested by Oklahoma DOT, Royce Floyd gave a presentation ("Non-Proprietary UHPC for Transportation Structures") during Oklahoma Transportation Research Day (OTRD) on October 20, 2020 • Follow-on research implementation (field) project from the Oklahoma DOT (see also C4-OU01) • Related follow-on research project awarded to Jeffery S. Volz (PI) and Royce Floyd (Co-PI), “Innovative Multi-Hazard Resistant Bridge Columns for Accelerated Bridge Construction”, \$198,000. Project award date is October 1, 2021 to September 30, 2023. • Two-day workshop at December 2021 ABC Conference was held in partnership with others; hybrid to allow audience to experience mixing UHPC • An implementation proposal submitted to Oklahoma DOT for FY 2021/2022 on non-proprietary UHPC joint design was funded for Feb 2021-Sept 2022 (\$133,000) [initially reported Apr 21] • Based on interest by others, a half-day workshop on non-proprietary UHPC will be held on December 7, 2022 in conjunction with International ABC Conference in Miami (placeholder)
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<ul style="list-style-type: none"> • Non-proprietary UHPC mix was included as an option in bid documents for traditional UHPC projects, which says they now have that option for subsequent projects • Currently writing a standard specification for Oklahoma for UHPC and Non-Proprietary UHPC • Oklahoma DOT will be incorporating change to allow this output (non-proprietary UHPC) as a standard option (see also C4-OU01)

Web Links <ul style="list-style-type: none">• Reports• Project website	https://abc-utc.fiu.edu/research-projects/ou-research-projects/development-of-non-proprietary-uhpc-mix/