

# Executive Summary, Research Readiness Level Assessment and Technology Transfer

## Precast Concrete Deck-to-Girder Connection using UHPC

### Research Objectives

The main project objective was to develop and test a new UHPC connection between precast concrete deck panels and NU precast/prestressed concrete girders that eliminates any changes to girder design/production and any possible conflict between deck and girder reinforcement.

Typical girder shear reinforcement were used and positioned below the bottom mat of deck reinforcement, then, UHPC was placed through grouting holes to fill the trough and haunch areas (i.e., a hidden composite connection).

The constructability and structural performance of the new connection was evaluated analytically and experimentally using commercial and local UHPC mixtures (currently being developed under another NDOT project).

### Research Benefits

The outcome of this study was an economical deck-to-concrete girder connection that simplifies girder design and production as well as panel erection. The new connection provided full composite action while maintaining deck durability and speed of construction.

### Principal Investigators

**George Morcous (P.I.)**  
University of Nebraska

### Lead TAC Member

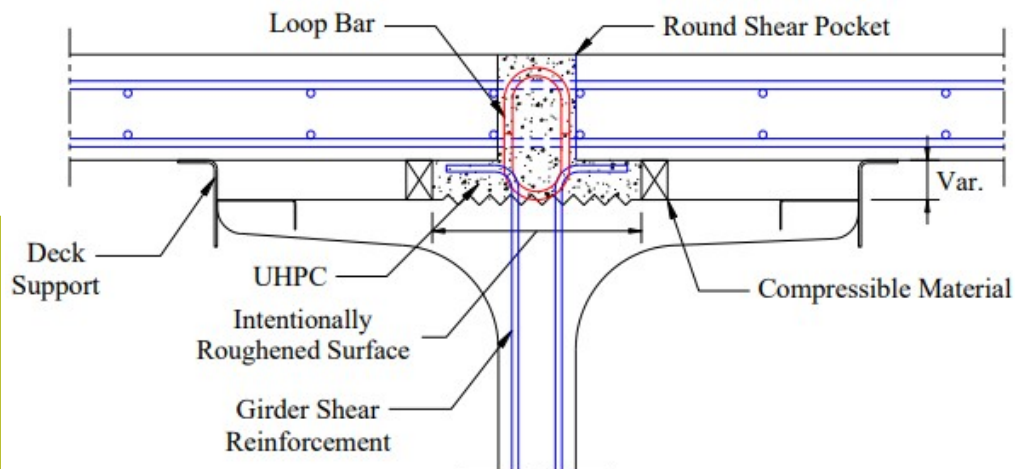
**Fouad Jaber, PE, Assistant  
State Bridge Engineer**

### Background

The implementation of ultra-high-performance concrete (UHPC) in bridge construction has been growing rapidly in the last two decades due to its excellent mechanical properties, workability, and durability. This report presented a new UHPC connection between precast concrete deck panels and bridge girders that eliminates changes to the design and production of girder shear connectors commonly used in conventional cast-in-place concrete deck construction. In conventional construction, girder shear reinforcement or studs are extended into the cast-in-place concrete deck to transfer interface shear and create composite section. In the new connection, girder shear reinforcement or studs are kept underneath the deck panels, while UHPC is used instead to fill the haunch and shear pockets and transfer interface shear between deck panels and girders. Using UHPC and eliminating changes to standard shear connectors make precast concrete deck systems more economical and enhance their constructability.

### Conclusion

The report presented the experimental investigation conducted to evaluate the interface shear resistance of UHPC using direct shear, slant shear, L-shape push-off, and double shear tests. Also, three full-scale specimens of the new connection were constructed and tested to evaluate its structural performance and constructability. Based on the experimental investigation results, empirical equations were developed to predict the interface shear resistance of the new connection and develop design aids for different bridge types and configurations. Design procedures and construction recommendations were also developed based on the outcomes of the experimental investigation.



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### NDOT Recommendations Based Off of Research Project

Bridge Division is looking for the next deck to use and when the Division identified the right bridge and traffic volume, Bridge Division will then use the UHPC mix designed developed by the University of Nebraska under the project M072- [Feasibility Study of Development of Ultra-High Performance Concrete \(UHPC\) for Highway Bridge Applications in Nebraska](#) by Dr. Jiong Hu and Dr. George Morcoux (Dec 2019).

- *As provided by Fouad Jaber, Lead TAC Member*

### Technology Transfer

#### Conference Publications

- AboElkhier, M., Morcoux, G., and Hu, J. (2019) "Interface Shear Resistance of Ultra High-Performance Concrete (UHPC)", 2nd International Interactive Symposium on UHPC, Albany, NY, June 2-5.
- AboElkhier, M., Morcoux, G., and Kodosy, A. (2018) "Precast Concrete Deck-to-Girder Connection Using UHPC", 10th International Conference on Short and Medium Span Bridges", CSCE, Quebec City, QC, July 31- August 3.

### Research Readiness Level (RRL) Assessment

**RRL 3**

#### Level 3: Development – Field Level

Research/Technology developed in an operational environment (real-world situation).

Interested in finding out more?

Final report is available at:  
[NDOT Research Website](#)

**This brief summarizes Project SPR-P1 (19) M085  
"Precast Concrete Deck-to-Girder Connection using UHPC"  
Nebraska Department of Transportation Research Program**