Prestressed Ultra High Performance Concrete Beams From Local Materials

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Summary

Large-scale prestressed ultra high performance concrete (UHPC) girders were cast and tested under four-point bending. All materials, excluding the steel fibres, were obtained from local suppliers in the state of New Mexico, USA in order to provide a more economically feasible UHPC compared to commercially available products. Two beams were tested to investigate their structural behaviour, the contribution of steel fibres, and the elimination of all mild steel reinforcement (including shear reinforcement). The results of these tests will aid the development of design procedures and further the implementation of UHPC into infrastructure.

Keywords: ultra high performance concrete; innovative material; prestressing; bridges; experimental testing

1 Introduction

As new structural materials become available, it is important to develop guidelines that provide safe and reliable methods for engineers to fully utilize the material's potential. Ultra High Performance Concrete (UHPC) is a relatively new, innovative material that does not currently have any adopted design guidelines in the U.S. Before UHPC can be implemented into design, a better understanding of the behaviour of UHPC under various load conditions is required. This research focuses on the casting and laboratory testing of rectangular large-scale prestressed UHPC beams subjected to four-point bending. Additionally, there has been limited use of this material due to the high cost associated with commercially available products. Thus, this project takes advantage of recent research that developed economical mixture proportions using materials readily available in New Mexico, USA [1].

Integrating UHPC into bridge superstructure design can provide several advantages to the currently degraded state of the bridges in the U.S. Due to its improved durability properties, UHPC has been shown to have a vastly increased design life, up to twice that of normal or high strength concrete [2]. Also, increased compressive and tensile strengths allow for the design of smaller, more aesthetic members. Providing locally developed, sustainable UHPC has the potential to dramatically improve infrastructure in the U.S.

The UHPC studied in this research uses mixture proportions previously developed at New Mexico State University (NMSU), which take advantage of local aggregates, cement, and admixtures. Furthermore, all mixing, casting, and curing was performed at a local New Mexico precaster, Coreslab Structures (Albuquerque) Inc. Unlike commercially available UHPC's, which typically come in pre-weighed, ready to mix packaging, implementation of the local materials allowed for the use of normal batch plant operations and ingredients for this particular UHPC. The mixing, casting,

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