

Development, Characterization and Applications of Non-Proprietary Ultra High Performance Concretes for Highway Bridges

Description

Meta Fields

Project Completion Year : 2017

Project Starting Year : 2013

Other Documents 0 Other Documents File : 2540

Primary Sponsor Contact Info : Michigan Department of Transportation Murray Van Wagoner Building 425 West Ottawa, P.O. Box 30050 Lansing, MI 48909 USA Steve Kahl kahls@michigan.gov (517) 322-5707

Project Length : 48

Budget : 311125.00

Key Words :

Bridge construction; Bridge members; Compressive strength; Concrete bridges; Cracking; Energy absorption; High performance concrete; Mechanical properties; Tensile strength; Ultra high performance concrete

Abstract :

Ultra High Performance Concrete (UHPC) is a specially formulated concrete that is capable of achieving extremely high performance. When properly reinforced with steel fibers, the material is capable of achieving the following properties: (1) High compressive strength, approaching that of mild steel. (2) High tensile strength, several times that of regular concrete. (3) Pseudo-ductility, with tensile softening strains of up to an order of magnitude greater than that of regular concrete. (4) Exceptional energy absorption prior to fracture. (5) Extremely small crack widths, small enough to practically eliminate ingress of chlorides. (6) Exceptional durability, primarily enabled by the very small crack widths and the extremely high packing density of the material at the microstructure level. (7) Self-consolidating properties, which simplify construction. (8) Autogenous self-healing properties, enabled by small crack widths under service loads. High material cost coupled with complicated and costly construction procedures have seriously delayed widespread adoption of UHPC in the United States (US). An alternative UHPC developed at the University of Michigan, here termed np-UHPC for non-proprietary-UHPC, has the potential for removing all obstacles preventing widespread use of UHPC in the State of Michigan and in the US. In addition to the basic 8 properties listed above, this new material has 3 new critical advantages: (1) Substantially greater pseudo-ductility, up to an order of magnitude greater than available materials, when fibers are used. (2) It is nonproprietary and made up of components that are available on the US market. (3) Does not require expensive heat or pressure treatment as Ductal and other material do. In fact, it can be made using conventional mixers, which reduces adoption costs dramatically and allows the material to be made and delivered the same way as regular concrete. The material has currently broken world records in terms of energy absorption, but could be optimized for lower cost, albeit with lower strength performance. The objective of this research is to optimize the cost of various np-UHPC's using materials available in the State of Michigan, characterize their mechanical properties, and explore applications, focusing on Accelerated Bridge Construction (ABC) and Precast Bridge Element Systems (PBES).

Subject : Alternative to UHPC
Group : Ultra-High Performance Concrete (UHPC)
Category : Ongoing Projects