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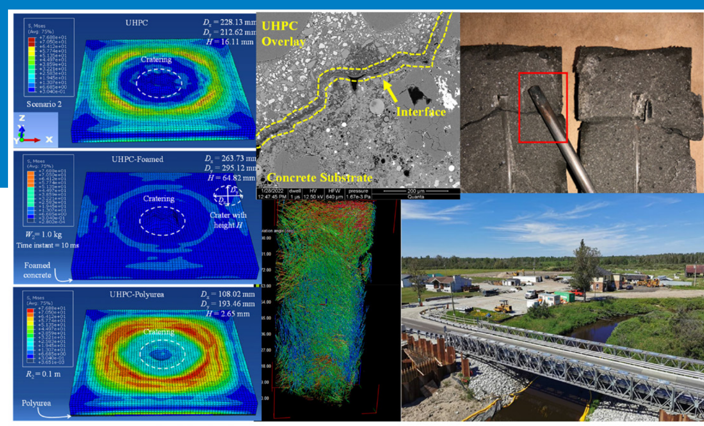

Developments, Applications, and Case Studies in UHPC for Bridges and Structures

SP-363

Editors:
Yail J. Kim, Steven Nolan, and Antonio Nanni

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Developments, Applications, and Case Studies in UHPC for Bridges and Structures

Ultra-high performance concrete (UHPC) is a state-of-the-art cementitious composite. Since the concept of this novel concrete mixture emerged in the 1990s, significant advancements have been made with numerous benefits such as high strength, flowability, high post-cracking tensile resistance, improved durability, reduced maintenance, and extended longevity. Currently, UHPC is employed around the globe alongside recently published practice guidelines. Although numerous research projects were undertaken to examine the behavior of UHPC-incorporated structures, there still are many gaps to be explored. Of interest are the development of robust and reliable mixtures and their application to primary load-bearing members for bridges and buildings, including various site demonstration projects that would promote the use of this leading-edge construction material. This Special Publication (SP) contains nine papers selected from three technical sessions held in the ACI Spring Convention in March 2022. All manuscripts were reviewed by at least two experts in accordance with the ACI publication policy. The Editors wish to thank all contributing authors and anonymous reviewers for their rigorous efforts. The Editors also gratefully acknowledge Ms. Barbara Coleman at ACI for her knowledgeable guidance.

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UHPC Fresh Chloride Limit Testing

Raid S. Alrashidi, Rami Zamzami, Megan S. Voss, Daniel J. Alabi,
Christopher C. Ferraro, H. R. Hamilton, Joel B. Harley, and Kyle A. Riding

Synopsis: The presence of chloride ions is one of the most widespread causes of corrosion initiation in reinforcing steel in concrete. Trace chlorides present in cementitious materials or admixtures typically result in very low fresh chloride contents in normal-strength concrete that do not present a danger of corrosion. UHPC mixture designs, however, use much higher dosages of cementitious materials and admixtures that can result in non-negligible total fresh chloride contents. These high chloride values are likely to occur more frequently in the future as more UHPC mixtures are made with locally available materials and alternative cementitious materials and may result in concrete mixtures failing to meet specifications for fresh chloride content limits that are based on mixture proportions used in normal-strength concrete mixtures. UHPC and normal concrete samples were made without fibers and with increasing levels of internally admixed chlorides for four different levels of strength to determine chloride thresholds for internally added chlorides. The chloride threshold for fresh concrete was measured using a slightly modified version of the accelerated test EN 480-14. The water-soluble and acid-soluble chloride ion content of UHPC mixtures tested were measured according to ASTM C1218 and Florida Method FM 5-516 to determine the bound chlorides and fresh chloride limits for corrosion. The results demonstrate that the UHPC had ~ 25% higher chloride threshold than the control mixture when measured as an absolute content per unit volume of concrete. When the UHPC chloride content is normalized by mass of cementitious material, it was found that the amount needed to initiate corrosion may be lower than fresh chloride limits given in ACI-318 and ACI 222. Therefore, the ACI-318 water-soluble chloride limits as a % by mass of cementitious materials were found to be non-conservative for the two of the UHPC mixtures tested and should be re-examined for UHPC.

Keywords: acid-soluble; chlorides; corrosion; critical chloride threshold; EN 480-14; UHPC; water-soluble