# DISCRETE MODELING OF ULTRA HIGH-STRENGTH, FIBER-REINFORCED CONCRETE

By

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# ABSTRACT

High-strength and high-performance concrete (HPC) is a relatively new type of cementitious material. It is often characterized by very brittle behavior in compression and is known for its use in columns of high-rise structures. This material is often preferred to conventional concrete because it provides the most economical method of transferring vertical loads to the foundation.

A new type of HPC, termed Cortuf, has been recently developed at the United States Army Corps of Engineers, Engineer Research and Development Center (ERDC) and is under testing. Fiber reinforcement has been added to aid its response to bending since the material can be quite brittle. It would be very beneficial to obtain a method for testing these materials that would not be as costly and time consuming as previous experimentation. Also, the model must be versatile since the components of concrete mixtures are changed fairly easily.

The Lattice Discrete Particle Model (LDPM), a recently developed numerical model for concrete may provide a solution to this challenge. Thus far, the model has been successful at simulating and validating the behavior of regular-strength concretes. In addition, LDPM was favored in this investigation because it has been able to capture the splitting crack failure in compression, localized and crack bridge failure in tension, and other behaviors associated with HPCs.

The objective of this research project is to simulate the behavior of Cortuf both with and without fiber reinforcement and predict its response through the use of LDPM and LDPM-F which includes fiber reinforcement. This purpose was accomplished through a calibration and validation process using numerous experimental results from tests already performed on Cortuf. Additionally, by predicting the response of Cortuf using LDPM, it will be revealed how the model can be used as an alternative to or along with previous experimental testing methods.