Experimental Investigation of the Mechanical Behavior of Concrete under Uniaxial and Multiaxial Stress States

by

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ABSTRACT

Concrete has been utilized as a construction material for centuries, however its behavior is not completely understood. In practice, structural engineers use empirical formulas and large safety factors to account for uncertainties in the material behavior of concrete. Even computer models cannot fully capture concrete behavior. Many existing models are valid for one type of loading condition and cannot accurately predict all types of concrete behavior.

The Lattice Discreet Particle Model (LDPM) is one model that can accurately predict concrete behavior under numerous loading conditions. A comprehensive set of experimental data is integral to calibrate this comprehensive model. This data set has not yet been developed.

A series of experiments were designed and performed to fully capture concrete behavior and provide data to calibrate the LDPM. All specimens were cast using the same mix design under laboratory conditions. Concrete was tested in uniaxial compression, tension, and confined compression. The tests performed include the uniaxial compression test, three point bending test, Brazilian splitting test, and confined compression test.

Two rounds of data analysis were performed on the results. The initial round explored problems with the data and attempted to correct them. Individual results that were uncharacteristic of concrete behavior were excluded. A second, more in depth round of analysis was performed on the corrected data. Computed properties as well as the consistency of the results were examined. The adherence to certain trends in behavior, such as size effect and experimental error were also examined.

The results of these experiments will be utilized to calibrate the LDPM and improve future concrete testing at RPI. Another series of experiments will be designed and simulated using the LDPM. A second round of testing must be performed to validate the results of the computer model.