Simulating Fiber-Reinforced High-Strength Concrete Using Microplane Models

by

Daniel Paul Horvath

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Gianluca Cusatis, Thesis Advisor

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ABSTRACT

Concrete is commonly used in the construction of Civil Engineering projects. Structures are designed and built based on a specified strength of concrete. Currently, compressive testing of concrete specimens is the predominant way of measuring the strength of a concrete mix. In controlled environments, these tests accurately measure compressive strength and other behaviors, but they also require significant amounts of time and money to cast and test the specimens.

New concrete mixes are under development that possess far higher strength than previously existing mixes, and the strength must be validated before the concrete can be used in construction. Though there is no substitute for tests on actual specimens, computer simulations can also be used to predict the strength of a given type of concrete quickly and at a lower cost.

Several computer programs exist to reproduce the behavior of concrete under loading. The microplane model, discussed here, simulates concrete behavior on internal planes, and then reassembles the results on the individual planes into the overall behavior of the concrete under a given loading.

Along with regular and high-strength concretes, the microplane model can be used to simulate the behavior of concrete containing steel fibers for reinforcement. Such concretes typically have a higher strength due to the reinforcing fibers.

In this thesis, the M4 microplane model is examined and its results are compared to a modified formulation of the M4 model. Two microplane models are also compared that simulate concrete with steel fiber reinforcement. Lastly, the modified M4 model and the modified fiber-reinforced model are used to reproduce the testing of a fiber-reinforced high-strength concrete by varying the input parameters.