LATTICE DISCRETE PARTICLE MODELING OF REINFORCED CONCRETE

By

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ABSTRACT

Since the late 1800's, steel reinforcement has been used in concrete structural elements to resist tensile forces that develop as a result of flexural and shear forces induced by loading. Concrete is valued in construction for its high compressive strength, but its much lower tensile capacity prohibits the use of un-reinforced concrete members subjected to any significant tensile forces. Despite the age of the technology of reinforced concrete, its behavior is still not fully understood. This is mainly due to the heterogeneity of the concrete mixture, as well as complex interactions between the embedded reinforcement and the concrete. In the past, attempts to understand the behavior of reinforced concrete relied solely on physical testing.

With the increase of computational power and availability, several numerical models have been developed to capture the heterogeneity and associated phenomena of concrete, the most successful of which being the Lattice Discrete Particle Model (LDPM). LDPM simulations have proven to be accurate in predicting the behavior of plain concrete specimens subjected to a number of typical strength tests, including, but not limited to, unconfined compression, triaxial compression, and tensile fracturing behavior.

LDPM will be used in this thesis to model the flexural and shear failure of reinforced concrete beams. The adequacy of the model will determined from its ability to replicate results reported from physical studies of concrete failure. With respect to reinforced concrete, and plain concrete in general, the goal of numerical simulation is not only to predict the strength of the specimen, but the mode in which it fails. In addition to comparing strength and displacement values between LDPM tests and physical experimentation, the model will also be assessed based on its ability to replicate crack patterns.