THE LATTICE DISCRETE PARTICLE MODEL (LDPM) FOR CONCRETE: CALIBRATION AND VALIDATION UNDER QUASI-STATIC LOADING CONDITIONS

By

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ABSTRACT

Concrete is a material widely used in Civil Engineering due to its good resistance capacity and its durability. Even thought engineers have designed reinforced concrete structures for centuries, concrete material behavior is still not well understood. That is particularly true outside the elastic range when fracture and other inelastic phenomena occur. The main reason for this lack of knowledge is due to the extreme complexity of concrete internal structure which is highly heterogeneous.

In the past several models that try to describe concrete heterogeneity have been formulated. One these being the Lattice Discrete Particle Model (LDPM) which is used in this thesis to investigate quasi-static and dynamic problems in tension and compression. The goal is to better understand the potentiality of the model and how it can be improved.

In Chapter 1 a brief review of the models used to simulate concrete behavior is reported.

In Chapter 2 the formulation of model is presented and explained.

In Chapter 3 the parameters of the model are presented together with their effect on particular concrete tests, which are explained. Next, a procedure to calibrate the parameters is proposed.

In Chapter 4 an experimental campaign of uniaxial unconfined compression tests [40] is presented and simulated.

In Chapter 5 an experimental campaign of three point bending tests from [19] is presented and simulated.

In Chapter 6 the extension of the model for the simulation of the so-called the rate effect is explained. Next, an experimental campaign of uniaxial unconfined compression tests with different strain rates [18] and two dynamic experimental tests with a Hopkinson Bar are presented and simulated.