Discrete Element Analysis of Slender Reinforced Concrete Columns

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Many architectural solutions and creative structures tend to use column systems as main loadbearing structural system. In general, columns are structural members that transmit predominantly compressive loads. The column length and slenderness considerably influence the load capacity and trigger different failure mechanisms at different stress levels. Short columns mostly fail due to material failure when the imposed stresses exceed the material strength (i.e. concrete). Unlike short beams, long and slender columns can fail at lower stress levels due to buckling, as a result of sudden lateral deformation. This contribution focuses on the non-linear analysis of slender reinforced concrete (RC) columns. Several RC columns were cast for normal strength concrete and were axially loaded with various load eccentricities until failure. The analysis is carried out using the Lattice-Discrete Particle Model (LDPM). The model parameters are calibrated on material tests, as well as on data of column test of one size. The model validation is performed on column data of different configurations with a very good prediction quality. This validated model is used to investigate (a) the existence of a potential influence of casting direction and aggregate placement (initial imperfections, wall effect), (b) the time-dependent capacity of slender columns due to concrete aging, and (c) reductions in load capacity due to creep and shrinkage phenomena.