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Simulation of Nonlinear Behavior of Reinforced Concrete Slabs Using Rigid Body-Spring Discrete Element Method

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Abstract : Most analysis procedures of reinforced concrete (RC) slabs are based on elastic theory. When subjected to large forces, however, slabs deform beyond elastic range and the study of their behavior and performance require nonlinear analysis. This paper presents a numerical model to simulate nonlinear behavior of RC slabs using rigid body-spring discrete element method. The proposed slab model composed of rigid plate elements and nonlinear springs is based on the yield line theory which assumes that the nonlinear behavior of the RC slab subjected to transverse loads is contained in plastic or yield-lines. In this model, the displacement of the slab is completely described by the rigid elements and the deformation energy is concentrated in the flexural springs uniformly distributed at the potential yield lines. The spring parameters are determined from comparison of transverse displacements and stresses developed in the slab obtained using FEM and the proposed model with assumed homogeneous material. Numerical models of typical RC slabs with varying geometry, reinforcement, support conditions, and loading conditions, show reasonable agreement with available experimental data. The model was also shown to be useful in investigating dynamic behavior of slabs.

Keywords : RC slab, nonlinear behavior, yield line theory, rigid body-spring discrete element method
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