Nonlinear Analysis of Reinforced Concrete Frames by a Combined Method

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ABSTRACT

A more realistic and hence nonlinear analysis of reinforced concrete structures is becoming increasingly important. A combination of the displacement method, the transfer matrix method, and a cross-section module is suggested which leads to an effective analysis method for reinforced and prestressed concrete frames. The combined method considers both material and geometrical nonlinearities including large displacements and rotations. The computation of the system is incrementally and iteratively carried out by the displacement method. At element level, an extended transfer matrix method is used. Thus neither displacement nor force shape functions are required. Instead, the axial strain and curvature distributions along the element are segmentally approximated by polynomials. The transfer matrix method provides both the element forces and the element stiffness matrix. It is recursively applied to the deformed element, which is discretised into individual segments whose number and lengths depend on the stiffness gradient. The cross section module is based on cross-sectional integration. It takes into account nonlinear material behaviour including cracking, softening and yielding of reinforcement. The combined method is presented for plane frames but can be extended to spatial systems.