Numerical Technique of Designing Concrete Columns with any Arbitrary Shape Subjected to Axial Load with Biaxial Bending

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Abstract:

Due to geometric complexity of the arbitrary shape sections and material nonlinearity of reinforced concrete, analytical solutions of designing this section under the effect of axial load and biaxial bending are still difficult to obtain from the equilibrium equations. Therefore, many researchers have tried to solve the reinforced concrete columns problems using numerical methods. A new computerized iterative method, namely, the Quasi Newton method is utilized in this paper to design the reinforced concrete columns under uniaxial or biaxial loads. In this iterative method, the sectional dimensions, material properties and steel bars position are assumed before ahead, while, the unknowns are the neutral axis parameters and steel bar diameters, steel ratio in the section. The section capacity is evaluated based on a known neutral axis parameters and steel ratio. Variation of the assumed neutral axis parameters and steel ratio, using Central Difference method, made it possible for the calculation of the partial derivatives required in the multivariable nonlinear Newton method. Two different examples are presented in this paper to show the validity of the proposed technique in designing concrete columns under the effect of axial load biaxial bending. The results of these two examples are verified with the available commercial programs such as PC-COLUMN. In all the studied cases, convergence in Newton method is attained in only seven iterations starting from any arbitrary given neutral axis position and steel ratio.