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Entitled

NUMERICAL SIMULATION OF CONCRETE BEAMS WITH DISCONTINUITY REGIONS REINFORCED WITH NONMETALLIC REINFORCING BARS

By

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Abstract

Nonmetallic glass fiber-reinforced polymer (GFRP) reinforcing bars are considered a viable alternative to the conventional steel reinforcement because of their high strength-to-weight ratio and noncorrosive nature. This research aimed to investigate the nonlinear structural behavior of GFRP-reinforced concrete beams with discontinuity regions (D-regions) through numerical analysis. Three-dimensional (3D) numerical models were developed to simulate the nonlinear structural behavior of GFRP-reinforced deep beams with and without web openings. The models adopted realistic constitutive laws that accounted for the nonlinear behavior of the materials used. Predictions of the numerical models were validated against published experimental data. A parametric study was conducted to examine the effect of key variables on the structural behavior of GFRP-reinforced deep beams with and without web openings. The interaction between the concrete compressive strength (f_c'), shear span-to-depth ratio (a/h), spacing between the web reinforcement (s), size and location of the web opening was elucidated. Simplified analytical formulas capable of predicting the shear capacity of GFRP-reinforced beams with D-regions were introduced based on regression analysis of results of the numerical simulation models. Predictions of the proposed analytical formulas were in good agreement with the results of the simulation models.

Keywords: Deep beams, GFRP, Numerical, Openings, Simulation, Shear.