PREDICTION OF LOAD CARRYING CAPACITY OF REINFORCED CONCRETE DEEP BEAMS WITH AND WITHOUT WEB OPENINGUSING ARTIFICIAL NEURAL NETWORK

Artificial neural networks (ANNs) are proposed to estimate the ultimate shear capacity of simply and continuous deep beams and various types of web reinforcement are investigated.

The study presents the fundamentals of using a multi layered feedforward neural network with gradient descent with momentum (GDM) and resilient backpropagation (RPROP) training algorithms. The neural network toolbox that is available in MATLAB version 7.0.0is used to conduct the study. The input layer describes the geometry of beam and material properties of concrete and reinforcement, and the output is always the ultimate load capacity. The effects of the various parameters, such as preprocess of patterns, weights initialization method, number of nodes in hidden layer(s), and selecting of learning rate and momentum coefficient, on the behaviour of neural network have been investigated.

GDM training algorithm exhibits slow convergence, therefore, RPROP has been used in this study. The results show that the Maximum and Minimum normalization method and Widro-Hoff initialization method give good performance.

The proposed networks are used to investigate the behaviour of deep beams as a result of varying the different parameters (inputs), and the results are discussed in relation with strut and tie method (ACI 318-08) and modified strut and tie method.

For reinforced concrete deep beams with vertical and horizontal web reinforcement, increasing vertical web reinforcement parameter from 0.05 to 0.35 enhances the shear strength by 9%, 24%, 44%, and 67% for shear span to effective depth ratio (a/d) equal to 1.25, 1.5, 1.75, and 2, respectively. Increasing force in tension reinforcement (Ast×fyt) from 200 kN to 320 kN enhances the shear strength by 13%, 34%, and 70% for shear span to effective depth ratio (a/d) equal to 1, 1.5, and 2, respectively.