



University of Zabol

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Faculty of Engineering

Department of Civil Engineering

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**Prediction of ultimate strength of steel fiber reinforced concrete beams using hybrid artificial intelligence**

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## ABSTRACT

Currently, The use of modern composite materials in the construction industry has increased due to their greater capacity. Reinforced concrete beams with fibers are one of these materials. These fibers are available in different materials, including steel. Since adding more than steel fibers to concrete reduces the ultimate capacity, investigation of failure of these beams is an important issue. In this study, the ultimate capacity of reinforced concrete beams reinforced with steel fibers (SFRCB) was investigated. For these materials, two modes of bending and shear have been investigated using artificial intelligence methods, such as the genetic algorithm (GA), the particle swarm algorithm (PSO), the harmony search algorithm (HSA) and gray wolf optimization (GWO). In order to train these algorithms 385 experimental data for shear and 210 experimental data were used for bending. The results indicate superiority of artificial intelligence methods than empirical methods. The best neural network structure was achieved by gray wolf algorithm with 8 neuron. The results of training and testing of gray wolf algorithm by using error statistics are compared with several empirical models and other artificial intelligence models. Deductive statistics such as mean-square error (MSE) and compliance coefficient ( $R^2$ ) have been used. The estimation of the gray wolf algorithm in both the training and the test section provides the best response to other models. Training of this algorithm with a coefficient of 0.8024 and testing it with a coefficient of 0.7728 for shear data, as well as training with a coefficient of 0.9755 and testing it with a coefficient of 0.9443 for bending data have the best compatibility compared to other models. Therefore, ANN-GWO model is a suitable tool for predicting the final strength of SFRC beams. Finally, data were modeled using ANN-GWO algorithm for shear and bending and the effect of input parameters on the final shear and flexural capacity is presented in the form of a diagram.

### Key word

ultimate strengths, reinforced concrete beams, steel fibers, artificial intelligence