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Research article

Hybrid nonlinear regression model versus MARS, MEP, and ANN to evaluate the effect of the size and content of waste tire rubber on the compressive strength of concrete

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ABSTRACT

Tire rubber waste is globally accumulated every year. Therefore, a solution to this problem should be found since, if landfilled, it is not biodegradable and causes environmental issues. One of the most effective ways is recycling those wastes or using them as a replacement for normal aggregate in the concrete mixture, which has high impact resistance and toughness; thus, it will be a good choice. In this study, 135 data were collected from previous literature to develop a model for the prediction of rubberized concrete compressive strength; the database comprised different mixture proportions, the maximum size of the rubber (1–40 mm), and the rubber percentage (0–100%) replacing natural fine and coarse aggregates were among the input parameters in addition to cement content (380–500 kg/m^3) water content (129–228 kg/m^3), fine aggregate content (0–925 kg/m^3), coarse aggregate content (0–1303 kg/m^3), and curing time of the samples (1–96 Days); then the collected data were used in developing Multi Expression Programming (MEP), Artificial Neural Network (ANN), Multi Adaptive Regression Spline (MARS), and Nonlinear Regression (NLR) Models for predicting compressive strength (CS) of rubberized concrete. The parametric analysis reveals that as the maximum rubber size increases, the reduction in compressive strength becomes more pronounced. Notably, this strength decline is more significant when rubber replaces coarse aggregate than its replacement of fine aggregate. Among the input parameters considered, it is evident that the fine aggregate content exerts the most substantial influence on the compressive strength of rubberized concrete. Its impact on predicting compressive strength surpasses other factors, with the concrete samples' curing time ranking second in importance. According to the assessment tools, the ANN model performed better than other developed models, with high R^2 and lower RMSE, MAE, SI, and MAPE. Additionally, ANN and MARS models

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