Prediction of temperature variation in FRP-wrapped RC columns exposed to fire using artificial neural networks

ABSTRACT

This paper presents a novel application of artificial neural networks (ANNs) for predicting complete temperature profiles with varying time for circular reinforced concrete (RC) columns exposed to fire. The application is valid for un-strengthened columns or columns strengthened with fibre reinforced polymers (FRP) and isolated with different types and thicknesses of insulation materials under varying fire exposure condition. In addition, prediction of the temperature variation with time for constituent materials of the column such as concrete, reinforcement steel and FRP sheets is conducted. To reach this end, extensive nonlinear finite element analysis was conducted using ANSYS software to build database of 1200 training samples with different column diameters, concrete cover thicknesses, thermal conductivity curves, specific heat curves, insulation types and thicknesses. The prediction results of ANN model is validated against published full-scale experimental studies which reveal good agreement between experimental and predicted results. The novelty of this technique is the ability of ANN model to predict rapidly and efficiently the temperature–time for any part of continent materials of reinforced concrete column many in case scenarios of parameters; this is especially useful in avoiding the time-consuming and costly full-scale experimental fire tests. Moreover, this study encourages designers to use FRP in design applications in spite of the threat of fire conditions, by utilizing ANN as backend calculation provider for software design tool with graphical user interface presented in this paper.