ABSTRACT

Conceptual design stage is a phase where the initial decisions are made without actually performing the detailed design. Whereas today several advance softwares are being extensively used for detailed engineering designs, there is no tool available with the designer at the conceptual stage of design. In the presented research work, an attempt has been made for developing such a tool which could help in giving conceptual engineering solutions at preliminary stageof design. This stage of conceptual design holds high significance as the major design parameters for any project are decided and fixed, by far and large, in this stage only. Results obtained at conceptual design stage can then be used to determine the quantity and cost of major project constraints.Design in this stage governs the overall economy of the project.

For achieving the said goal, Artificial Neural Networks (ANNs) have been employed. ANNs can be explained as a network of small computational units (artificial neurons) that resemble biological nervous systems in living organisms. These artificial neurons have high computation power.Each computational unit is interconnected to every other unit in the adjacent layer and hence a network of neurons is formed. In such a system of network, information or data is absorbed from the input values. This information is then continuously processed by the neurons of one layer and then passed on to another layer of neurons to be processed. This is howthe output nearing to the target output is achieved.

In this study, effort has been made to model a neural network which would be capable of giving the conceptual design of PT slabs in terms of deflection and post tensioning steel requirement for various slab configurations. Design of three span post tensioned slabs has been performed using the standard software. As a part of research work, both single layered and double layered networks have been developed. The number of hidden layer neurons in case of single layered networks is taken as 5, 10, 15 and 20. On the other hand, the number of hidden layer neurons for the double layer networks is taken as 5, 7 and 9 in both the layers. Log-Sigmoid and Tan-Sigmoid are taken as the transfer functions with the linear function for the output layer. The training functions considered for training the networks are Levenberg-

Marquardttraining algorithm(trainLM) and Resilient Backpropagation algorithm (trainRP). A large number of neural networks have been developed with all possible network architectures. These developed neural network models are trained up to 1000 epochs starting from 100 and with an increment of 100 epochs every time after recording the mean square error.

In order to evaluate the efficiency of the network performance, four different types of validation techniques are employed. The first one is the “Resubstitution validation technique”, where the entire database undergoes training and testing. The second technique is the “Holdout validation technique”, in which a part of data is kept separate for testing and the remaining database undergoes training. The third technique is the “Three way data split technique” in which one part of the database is kept for training, second part for validation and third part for testing of database. Fourth validation technique is the “K-fold validation technique” (K taken as 10) in which the entire database is divided into 10 parts out of which 10% data is kept for testing and remaining 90% database undergoes training.Each network undergoes validation at 1000 epochs and hence the best network is chosen having minimum mean square error (MSE) as compared to the MSE given by all other developed neural networks.

This research demonstrates that the conceptual design aids can be successfully developed for PT slabs, using ANNs. The research also outlines detailed methodology for validation of ANNs based conceptual design tools for their acceptance by the engineering community.