Artificial Neural Network Prediction of Size Effect on Shear Strength of RC Beams without Stirrups

O. Iruansi[1], M. Guadagnini[2], K. Pilakoutas[3], and K. Neocleous[4]

[1] Centre for Cement and Concrete, Department of Civil and Structural Engineering, The University of Sheffield, Sheffield S1 3JD, UK, O.Iruansi@sheffield.ac.uk

[2] Centre for Cement and Concrete, Department of Civil and Structural Engineering, The University of Sheffield, Sheffield S1 3JD, UK, M.guadagnini@sheffield.ac.uk

[3] Centre for Cement and Concrete, Department of Civil and Structural Engineering, The University of Sheffield, Sheffield S1 3JD, UK, K.Pilakoutas@sheffield.ac.uk

[4] Centre for Cement and Concrete, Department of Civil and Structural Engineering, The University of Sheffield, Sheffield S1 3JD, UK, K.Neocleous@sheffield.ac.uk

Keywords: *Reinforced concrete, shear; uncertainty modelling, artificial neural network.*

Abstract

Current design models for shear of Reinforced Concrete (RC) members were formulated by fitting laboratory test data. However, the modelling uncertainty (V_{test}/V_{pred}) of these design expressions has been shown to produce very large scatter. Several reasons have been proposed for this large scatter including, availability of only a limited selection of large RC beam specimens and the variability arising from the different ways the laboratory tests were conducted.

Experimental evidence clearly suggests that the shear capacity of RC members without stirrups is a function of their depth, a phenomenon known as size effect. Thus, it is debatable if the empirical expressions, included in these design models, can be safely be extrapolated to members which are currently deficient in the database, used to develop these expressions.

In recent years, Artificial Neural Network (ANN) models have been used successfully to predict the shear strength of RC beams. A distinct characteristic of the ANN is its ability to deal with incomplete and noisy data and, therefore, ANM can be used to populate existing shear test database and further used to calibrate existing design models.

This study investigates the feasibility of using "shear data" generated from ANN to study various size effect expressions included in current design provisions. A feed forward Neural Network model trained using a resilient back propagation algorithm and early stopping is constructed to predict the shear strength of RC beams. A parametric study was carried out along with comparisons with existing codes. On the basis of the above analysis, a new size effect expression is proposed and its implementation in some of the existing code design provisions is examined.