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Journal of Building Engineering
Volume 43, November 2021, 103195

Artificial neural network and regressed beam-column connection explicit mathematical moment-rotation expressions

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Received 3 May 2021, Revised 11 August 2021, Accepted 26 August 2021, Available online 30 August 2021.

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https://doi.org/10.1016/j.jobe.2021.103195

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Abstract

Steel flush endplate beam-column connections behavior is commonly described by the moment-rotation, M-φ, relationship, which is characterized by two essential terms; resistant moment, $M_{j, Rd}$, and initial rotational stiffness, $S_{j, init}$. A great amount of concerted effort has been invested worldwide to either experimentally or analytically describe these properties due to geometrical and material variations. However, these methods are either costly, laborious, or time-consuming. Therefore, acknowledging the wealth of literature information, this paper formulates a set of practically convenient mathematical M-φ expressions by means of artificial neural network (ANN) and multi-linear regression (MLR) approaches utilizing the MATLAB software. Differing from most existing machine learning variants, the paper offers explicit expressions for maximum moment, M_{max}, and $S_{j, init}$, which can be characterized through a simplistic insertion of input parameters in terms of beam depth, beam width, thickness of beam flange, thickness of beam web, column depth, column width, endplate depth, endplate thickness, and bolt capacity. The computed M_{max} and $S_{j, init}$ can then be adopted to express the currently defined continuous M-φ relationship. By statistical evaluation, it is witnessed that the mean-absolute-percentage error (MAPE) and correlation coefficient (R^2) of both ANN and MLR methods are of remarkable prediction vitality. Also, ANN outperforms slightly MLR model in the prediction of both M_{max} and $S_{j, init}$ although both approaches agree closely with the source data. Therefore, both approaches are