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Data and Model-based Metamodels for Prediction of Performance of Extended Hollo-Bolt Connections

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Abstract : Open section beam to concrete-filled tubular column structures has been increasingly utilized in construction over the past few decades due to their enhanced structural performance, as well as economic and architectural advantages. However, the use of this configuration in construction is limited due to the difficulties in connecting the structural members as there is no access to the inner part of the tube to install standard bolts. Blind-bolted systems are a relatively new approach to overcome this limitation as they only require access to one side of the tubular section to tighten the bolt. The performance of these connections in concrete-filled steel tubular sections remains uncharacterized due to the complex interactions between concrete, bolt, and steel section. Over the last years, research in structural performance has moved to a more sophisticated and efficient approach consisting of machine learning algorithms to generate metamodels. This method reduces the need for developing complex, and computationally expensive finite element models, optimizing the search for desirable design variables. Metamodels generated by a data fusion approach use numerical and experimental results by combining multiple models to capture the dependency between the simulation design variables and connection performance, learning the relations between different design parameters and predicting a given output. Fully characterizing this connection will transform high-rise and multistorey construction by means of the introduction of design guidance for moment-resisting blind-bolted connections, which is currently unavailable. This paper presents a review of the steps taken to develop metamodels generated by means of artificial neural network algorithms which predict the connection stress and stiffness based on the design parameters when using Extended Hollo-Bolt blind bolts. It also provides consideration of the failure modes and mechanisms that contribute to the deformability as well as the feasibility of achieving blind-bolted rigid connections when using the blind fastener.

Keywords : blind-bolted connections, concrete-filled tubular structures, finite element analysis, metamodeling
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