The Summer Undergraduate Research Fellowship (SURF) Symposium
7 August 2014
Purdue University, West Lafayette, Indiana, USA

Finite Element Analysis of Bolted Connections under Fire

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ABSTRACT

Over the course of human history, fire disasters are one of the major catastrophes that causes loss of lives and properties. In order to ensure building safety against fire, civil engineers seek to understand the behavior of structures at high temperatures. Moreover, they need to study the behavior of bolted connections, given the important role it plays in steel structures. Sarraj (2007) proposed a plate-bearing computational model used to describe this behavior; however, it has never been experimentally verified. Prior to this specific project, a series of single-bolted connection tests at 400°C and 600°C were conducted in the Bowen Laboratory at Purdue University. In this project, the experimental data from these tests was used to benchmark a finite element (FE) model. Additional finite element analysis was conducted based on 16 double-splice joint specimens tested at Chiba University, Japan. The purpose of the analysis was to further verify the accuracy of the previous FE model. Once the FE model was well benchmarked, a parametric study was conducted afterwards to identify other parameters that could affect the plate-bearing behavior of bolted connections. Comparison of load-deformation plots between experimental and numerical results showed that the model is capable of predicting the behavior of bolted connections with good precision. The results of the parametric study indicated that bolt size and loading angle could also affect the plate-bearing behavior in fire. Further work is necessary to verify the accuracy of Sarraj's model, and to conduct experimental tests on bolted connections at other temperature levels.

KEYWORDS

Fire safety, Finite Element analysis, Connections, Load vs. deformation behavior, Plate bearing

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