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Modeling reinforced concrete structures under fire conditions

In recent years, a robust finite-element software Vulcan has been developed for three-dimensional modeling of reinforced concrete structures under fire conditions. In this non-linear procedure, a reinforced concrete building is modeled as an assembly of finite plain beam-column and slab elements, reinforcing steel bar elements and bond-link elements. Both material and geometric nonlinearities are considered in the model. To consider the effects of concrete spalling on the thermal and structural behaviors of concrete structures in fire, a 'void layer' and 'void segment' are introduced to represent the spalled concrete part within concrete slabs, beams, and columns. A critical temperature is used as the concrete spalling criterion. These developments enable the model to simulate quantitatively the effects of concrete spalling on both the thermal and structural behaviors of reinforced concrete structures in fire. Under fire conditions, the formation of large cracks within reinforced concrete floor slabs may significantly reduce the fire resistance of buildings. For modeling integrity failure of reinforced concrete slabs in the fire, a nonlinear hybrid FE model has been developed to predict the large cracks formed in RC floor slabs. The developed model was validated using the previously tested results. The nonlinear model developed can be used for assessing the integrity failure of the floor slabs in fire. Also, a robust finite element procedure for modeling the localized fracture of reinforced concrete beams at elevated temperatures has been developed. An extended finite element method (XFEM) has been incorporated into the concrete elements in order to capture the localized cracks within the reinforced concrete beams.

Biography

Zhaohui Huang is a reader in Civil Engineering at Brunel University London. He was involved in the teaching and research in structural engineering for more than 20 years. He is an internationally leading researcher in Structural Fire Engineering. He has published more than 100 refereed papers including 51 journal research papers. He has been awarded ASCE 2005 Raymond C Reese Research Prize. He is one of the main developers of designer's version of Vulcan: a software which won two of the 2005 British Computer Society's Annual Awards.

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