FIRE PERFORMANCE AND DESIGN OF COLD-FORMED STEEL WALL SYSTEMS

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Abstract

Cold-formed steel load-bearing wall systems are made of light gauge steel frames (LSF) lined with gypsum plasterboards, and are commonly used in many applications in buildings in many countries. However, they are being used without a full understanding of their fire performance. Hence a detailed fire research study into their performance was undertaken using full scale fire tests and numerical studies for standard fire conditions. It included both conventional walls and those based on a new composite wall panel in which the insulation was located between the plasterboards. Full scale fire tests showed the improvement to the fire resistance rating when the new composite panel was used. A detailed numerical study was then undertaken using finite element analyses of wall studs under both steady state and transient state conditions to investigate the axial compression strength behaviour of wall studs under non-uniform elevated non-uniform temperature conditions. The developed finite element models were not only able to simulate the wall studs’ behaviour accurately but also predicted the failure times of tested walls within 5 minutes. Using the test and numerical results, a new fire design method was proposed using Australian, North American and European steel design codes. A spreadsheet based design tool was also developed based on the new design rules to predict the failure load ratio versus time and temperature curves for varying LSF wall configurations. Recently this work has been extended to cover realistic design fire conditions and innovative wall stud sections. This paper presents the details and results of this research program at the Queensland University of Technology aimed at improving the fire safety of cold-formed steel buildings.