

Performance of an office building in fire

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Abstract: *The fire resistance of steel framed multi story buildings and their ability to withstand exposure to fully developed fire conditions without the need for all structural members to be protected with insulating material (passive fire protection) has received significant attention in recent years. This has been based around determining patterns of partial passive fire protection in accordance with sound fire engineering procedures that will ensure satisfactory performance in severe fires. A suitable procedure is the Slab Panel Method (SPM), which has been developed from a programme of small and large scale experimental testing under both Standard Fire (ISO 834) and natural fire conditions, in conjunction with implicit and quasi-static explicit simulations. The Abaqus experience gained from this applied research is utilized to full extent in the current design study. In this paper the application of the SPM design approach is briefly outlined for a new 12 level office building under construction in Auckland's central business district, followed by details of the FEA undertaken to validate the SPM results. The outcome of the performance based design process is a steel structure with partial fire proofing. Structural elements which are critical for structural stability are protected with conventional fire proofing materials, and the floor beams for which fire proofing provides no improvement in structure performance are designed without this passive fire protection. Abaqus simulations are presented and benchmarked against the design.*

Keywords: *Buckling & Collapse, Design, Fire, Concrete*

1. Introduction

The design of composite steel-reinforced concrete slabs in multistorey steel buildings for fire is either based on a prescriptive approach based on Standard Fire Test conditions and element performance or based on the application of performance based fire engineering design. The former is easy to apply, however does not accurately reflect the behavior of the overall steel structure in fire and does not allow the reserve of strength available from such systems to be utilized. The SPM (Clifton, 2006) is one of the emerging performance based methods developed over the last few years. It calculates the inelastic reserve strength available from a floor system responding in two way action. The method is based on the Cardington full-scale office building fire tests (Kirby, 1998), Colin Bailey's postulated tensile membrane action model (Bailey, 2000), and six slab panel floor systems that were experimentally tested in New Zealand (Lim, 2002). This was followed by extensive implicit and explicit quasi-static simulations (Mago, 2005).