UQ Fire Project #2019.03

THE RESPONSE OF TALL BUILDING DIAGRID STRUCTURES TO FIRE

Advisory Team

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Keywords

Tall buildings, finite element analysis, mechanical performance, fire behaviour

Background and motivation

The steel diagrid, popularised by Norman Foster in the 30 St Mary Axe "Swiss re. Gherkin" and the Hearst tower in New York, has enabled a change in approach to tall building design. Formerly restricted by a reliance on a stiff internal core to carry lateral loads and internal columns to carry vertical loads, tall buildings utilising diagrids take advantage of a laterally stiff and vertically strong external structure to reduce the interruption to the interior space of internal columns and minimise the required stiffness of the core. This solution is more structurally efficient, resulting in taller, lighter, leaner buildings.
The importance of designing tall buildings for fire on multiple floors was reinforced by the events of September the 11th 2001, as well as other tall building collapses since then (e.g. the Windsor Tower, the Plasco building). However there has been very little research to study the response of diagrids to fire. This project aims to address this and to carry out a preliminary study of a regular diagrid type structure exposed to fire using finite element analysis.

Research objectives

1) Develop a finite element model of a regular diagrid type structure for further analysis of the response of the building to fire
2) To study the mechanical response of the diagrid structure when exposed to fire on one of the mega-floors and on one of the intermediate floors.
3) To summarise the impact of fire on a diagrid type structure exposed to fire on multiple floors.

Methodology

This project is numerical and will take advantage of the finite element method to address the objectives listed above.

Recommended literature

[1] Moon, K.S., Connor, J.J., Fenrandez, J.E.. (2007). Diagrid structural systems for tall buildings: Characteristics and methodology for preliminary design Struct. Design Tall Spec. Build. 16, 205–230 (2007)

[2] Lange, D., Röben, C., Usmani, A. (2012). Tall Building collapse mechanisms initiated by fire: Mechanisms and Design Method; Engineering Structures 36, 90-103; doi: 10.10167j.engstruct.2011.10.003

[3] Volner, I. (2011). Dissecting Diagrid; Architect Magazine.