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COST Action TU0904, Integrated Fire Engineering and Research - Christchurch, 14 to 19 October 2011

Fire Performance of an Office Building with Long-span Cellular Floor Beams - Britomart East, Auckland

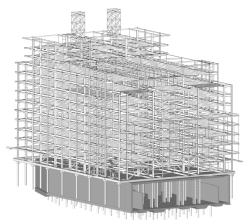
Dr Stephen Hicks (WG2), HERA Manager Structural Systems
 Martin Feeney, Principal, Holmes Fire
 A. Prof. G. Charles Clifton (WG2), University of Auckland

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General Building Description

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- 12-storey steel-framed building
- 36,000 m² of office space over Britomart underground train station in Auckland CBD
- Building protected with automatic sprinkler system, as well as automatic smoke detection and voice messaging system for staged evacuation.
- R60 floors and columns

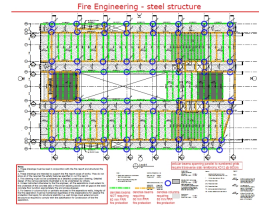


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General Building Description

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- 130 mm deep concrete slab cast on ComFlor 60 trapezoidal decking
- 12 m span secondary beams consisting of 496 mm dp Asymmetric Cellular Beams spaced at 2.75 m centres
- Secondary beams supported by 11 m span primary beams consisting of 800 mm dp Welded Beams




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Cellular beams

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- Westok UK product licensed in NZ to Grayson Engineering
- Ambient temperature design now formalised in SCIP355 by Lawson and Hicks from ECSC LWO and RFCS LWO+ projects
 - RWTH Aachen,
 - CTICM,
 - Luleå University of Technology
 - SCI
- Under development prEN 13381-9 'Test methods for determining the contribution to the fire resistance of structural members – Part 9: Applied fire protection systems to steel beams with web openings'



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Regulatory requirements

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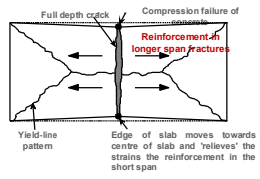
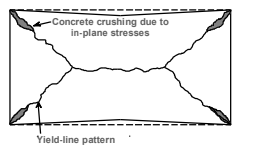
- New Zealand Building Code (NZBC) is performance-based:**
 - Deemed to comply prescriptive compliance documents known as *Acceptable Solutions* and *Approved Verification Methods* (e.g. Codes of Practice)
 - Structural fire safety solution outside the scope of compliance documents categorised as an *Alternative Solution*.
- Common strategy is to establish that the **Alternative Solution** provides an equivalent level of performance as **Acceptable Solution**.

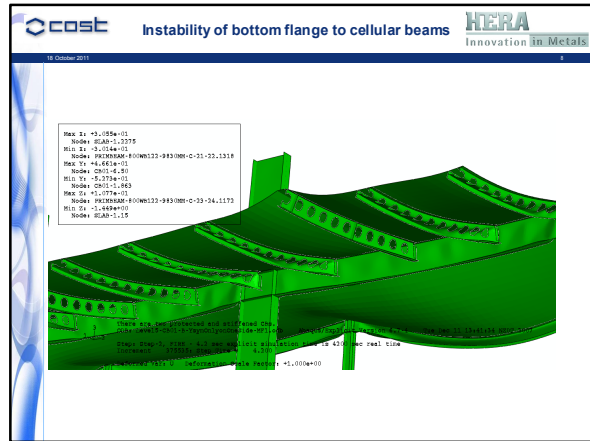
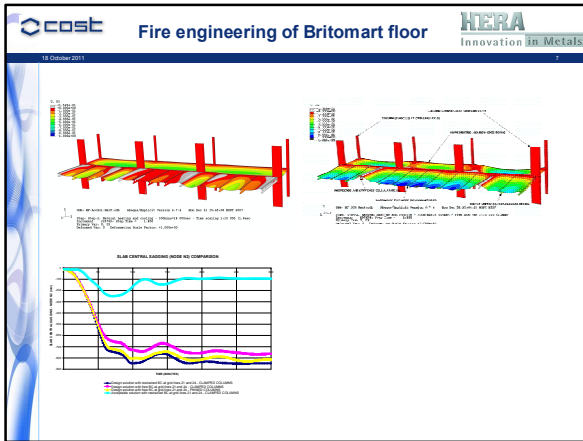
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Application of HERA SPM to Britomart floor

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- HERA Slab Panel Method (SPM) possesses a number of enhancements over existing software such as TSLAB and FRACOF
- FEA also used to assess validity of the SPM approach to the floor system; particularly to cellular beams which had little reserve in strength
- Design case fire scenario low probability event of a fire not being controlled by the sprinkler system, which reaches full development
- Acceptable Solution model subjected to 45 minutes heating up and 255 minutes cooling down period



- cost** Conclusions **HERA**
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- Simulations for a range of design fire severities indicated tendency for the bottom flange to the cellular beams to displace laterally (remedied by transverse web stiffeners linking the top and bottom flanges at quarter points to the secondary beams forming the slab panel supports)
 - Although larger deflections predicted by FEA for partial protection solution (800 mm), post-fire residual deflections for fully protected Acceptable Solution (100 mm) would still require replacement of affected structure.
 - Final design solution demonstrated that approximately 80% of the secondary beams did not require passive fire protection, resulting in a saving of more than NZ\$300,000,- (= €170,000,-) to the project.
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