STRUCTURES IN FIRE FORUM

STRUCTURES IN FIRE FORUM – 10TH APRIL 2026

THE DIAMOND, 32 LEAVYGREAVE RD, BROOMHALL, SHEFFIELD S3 7RD

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Provisional Agenda (20 minute talks with 10 mins Q&A):

10:00 – 10:30 Registration and Coffee

"Fire Resistance Tests and Analysis of Plasterboard-Encased Steel Columns under Standard Conditions".

Octavian Lalu, Building Research Establishment BRE

The presentation discusses the fire resistance performance of plasterboard-encased steel columns exposed to standard fire conditions. Six experimental tests were conducted on 60- and 120-minute encasement systems using one or two layers of Type F plasterboard. Results demonstrate that 1×15 mm boards can achieve 60-minute resistance, while 2×15 mm boards provide up to 120 minutes, with load-bearing failure governed primarily by flexural and distortional buckling. Analysis of fall-off temperatures shows values around 800 ± 50 °C, typically occurring after column failure. The findings support improved understanding of plasterboard behaviour and inform future development of equivalent thermal properties for fire-protected steel columns.

"Fire testing method for passive fire protection exposed to natural fire curves".

Clifford Chinaya & Arnoud Breunese, Efectis France & Etex Group (respectively)

Currently, no standardised test method exists to characterise the performance of passive fire protection when exposed to natural fire curves. Within the presented research, a test method was developed based on the European standard EN 13381-4 for protection of steel structures. Extensive furnace and wood crib fire testing as well as finite element modelling was done to validate this new method for natural fire curves.

"Data centre prescriptive temperature approach".

Lee Kenneth Taylor, Akzo Nobel UK Ltd

Data centres are a growing area within the built environment, yet standard prescriptive temperatures risk unsafe outcomes given high residual loads. Over the last year, clients have applied YB6 temperatures that, when checked against loading, were unsuitable: a prescriptive 580°C often reduced to 525°C or less under performance-based design. Accepted applied actions are inconsistent: PD 6688-1-1:2011 suggests 3.5kPa, ACSE 7-22 suggests 4.79kPa, and practice varies up to 25kPa. Some designers put equipment as superimposed permanent with an added variable action for access and maintenance, rather than combined permanent actions; reductions should treat computer system actions as storage load in ALS if variable.

12.00 – 13.00 Lunch

"The wind effect on the disproportionate collapse of an open-sided steel-concrete composite floor car park in travelling fires"

Morvarid Koohkhezri, University of Liverpool

Open-sided car parks in the UK are commonly designed with reduced fire resistance based on assumptions of over-ventilated conditions and limited fire spread between vehicles. However, recent large-scale incidents have demonstrated extensive travelling fires and the possibility of disproportionate structural collapse. This paper investigates the impact of wind on the structural fire response of a large-scale steel–concrete composite floor subjected to travelling fires, using a case study. Fire Dynamics Simulator (FDS) is used to simulate travelling fires to analyse transient utilisation of critical steel columns. The findings highlight the role of wind in developing fire spread and increasing structural utilisation, raising concerns over current design assumptions.

"Heat transfer in concrete-filled steel tubes".

Rwayda Al Hamd, The University of Manchester

Rectangular CFSTs, with superior fire performance over hollow steel sections, have grown in popularity, yet their fire performance is less documented than circular sections. This work uses FEM with temperature data from experimental concrete-filled specimens to study heat transport in rectangular sections with exposed parts. Numerical modelling covered the furnace heat envelope and fill material validation curves. The FEM replicated observed temperature profiles, proving viability. The concrete core limited temperature rise and enhanced steel resilience. Results show rectangular CFST performance in fire and the importance of thermal conductivity at material interfaces.

“Concrete in Fire: Thermo-Hygro-Mechanical Coupling, Pore Pressure Build-Up, and Material Degradation.”

Giacomo Torelli, The University of Sheffield

Concrete in fire undergoes rapid heating that couples heat transfer, moisture migration, and mechanical deformation within its pore structure, leading to pore pressure build-up, cracking, and explosive spalling, threatening structural safety. This talk presents recent results on cementitious materials at high temperatures, introducing a physics-based modelling framework to capture coupled temperature–moisture effects. Complementary neutron tomography directly observes moisture redistribution during heating. Together, modelling and experiments provide new insights into vapour pressure development, fire-induced degradation mechanisms, and the multi-physics processes governing concrete’s response in fire.

14.30 – 15.00 Coffee

“An applied methodology for the inclusion of travelling fires in the fire safety design process of a building”.

Jorge Cisneros, Stantec UK

Travelling fires (TFs) in large compartments exhibit dynamic, non-uniform behaviour that is often overlooked in structural fire design. This presentation introduces a three-stage methodology to account for TF scenarios, with a design example of a steel column. Stage 1 assesses TF likelihood compared to fully developed fires; Stage 2 rapidly characterises the worst-case TF using analytical models; and Stage 3 assesses thermal boundary conditions through computational fluid dynamics (CFD). By combining simplified predictions with CFD, this method balances accuracy and practicality, offering a time-efficient and robust methodology for structural fire engineering.

“Travelling or Parametric fire curves? A data-driven model for building fire risk assessment in performance-based design”.

Qingfeng Xu, University of Manchester

Fire risk assessments typically use probabilistic methods to evaluate all possible building fire scenarios. However, compartments often differ in floor area, fuel-load density, and ventilation, making it difficult to choose between the Travelling Fire (TF) and the EN parametric fire curves. This study collected over 100 full-scale natural fire tests, compared each with the TF and EN models, and developed a logistic-regression model that automatically selects the model expected to give more accurate results for a given set of fire inputs. This procedure can be beneficial for the performance-based structural fire design.

“Why Eurocode parametric fire design framework cannot maintain target reliability through cooling- A first principles analysis”.

Ankit Agrawal, Jacobs

The Eurocode Parametric Fire Curves (EPFC) are a common methodology to approximate natural fire exposures on structural elements. While deficiencies of this methodology from a physics perspective have received some attention, a purely mathematical treatment from an uncertainty quantification perspective remains absent. After deriving the closed form first order (Taylor) variance of the EPFC during both heating and cooling phases, I will demonstrate that a design calibrated to a particular reliability level in the heating phase cannot maintain that level in the cooling phase, because variance grows faster than the mean temperature falls. Implications and possible mitigations will also be discussed.

16.30 – 16.45 END