Advanced Structural Fire Engineering at intersections among disciplines

Villa del Grumello (Como, Italy) - May 26-30, 2025

FINAL PROGRAM

Monday May 26, Morning
Luke Bisby - University of Edinburgh (UK)
The Foundations of Structural Fire Safety - Regulation, Testing, Competence

Luke will discuss foundational aspects of structural fire engineering, by providing historical context to the evolution and development of current practices within this discipline. He will discuss the roles and motivations of regulation and testing, presenting the underlying logic that underpins contemporary “fire resistance” design; and leading to questions of what this means for practitioners seeking to perform more advanced, so-called performance-based structural fire engineering.

Monday May 26, Afternoon
Ruben van Coile - Gent University (Belgium)
Risk acceptance and the Value of Information

Why do structural fire engineering? Why do another fire test or calculation?
Structural fire testing and structural fire engineering calculations provide us with information. What do we do with this information? Do we even need it? Or do we need more of it?
In the first part of the presentation, the risk acceptance foundations of fire engineering are briefly discussed. In the second part we discuss what we can learn from a fire test or fire engineering calculation, and the decision-making framework of the Value of Information is introduced.

Tuesday May 27, Morning
Bart Merci - Gent University (Belgium)
Convective and radiative heat transfer modelling in CFD simulations of fires

An overview will be provided of common practice modelling of radiative and convective heat transfer in state-of-the-art CFD simulations of fires. Some demonstration of the impact thereof will be given in the context of flame spread and compartment fires. The link will also be made to gas temperatures, thermocouple measurements and adiabatic surface temperatures for academic cases.

Tuesday May 27, Afternoon
Andrea Frangi - ETH Zurich (CH)
Timber structures in the era of tall timber buildings

Due to the combustibility of timber, the fire safety of timber buildings has always been a major safety concern for authorities, the building owners, the fire brigades and the designers. Based on fundamental experimental and numerical analysis, new design models have been developed for the fire design of timber structures, which will be included e.g. in the revision of the Eurocode 5. Due to the increasing use of timber as building material in complex large and/or tall buildings, several fundamental questions remain open. The presentation will review the past and recent achievements and will look into the future development of timber fire engineering.

Wednesday May 28, Morning
Ian Burgess - University of Sheffield (UK)
Advances and Open Issues in Steel Structures Exposed to Fire

The mechanical and thermal properties of low-Carbon steels are probably the most reliable of those for all structural materials, and the design procedures defined in Eurocode 3 Part 1-2 for isolated steel members in fire are generally well validated. However, nonlinear interactions and very high deflections are caused in connected steel framed structures, due to combinations of thermal strains and the degradation of mechanical properties. These make simplified

approaches incapable of accurately representing the behaviour of a building in fire, including local member failure or its susceptibility to disproportionate collapse. Where steel members interact with less advantageous materials such as concrete or timber the problem is exacerbated. In order to be able to base fire resistant design on an accurate representation of the structure and its fire scenarios, efficient whole-structure computational approaches need to be developed. This presentation will concentrate on the development of such approaches and the preliminary work which needs to be done to make them a reality.

Wednesday May 28, Afternoon

Thomas Gernay - Johns Hopkins University - Baltimore (US)

Performance-Based Structural Fire Design: Methods and Applications

This presentation will discuss the performance-based design approach applied to structures in fire. We will describe the differences between prescriptive and performance-based approaches and illustrate the benefits of the latter through practical examples. We will present a systematic procedure to conduct a performance-based structural fire design, with a particular focus on the role of advanced numerical modeling. We will also discuss performance objectives, damage states, and functional recovery to support resilience. Recent related research on burnout resistance under natural fires will support these considerations. Finally, a cost-benefit study for composite steel-concrete buildings will be presented.

Thursday May 29, Morning

Olivier Vassart - Arcelor Mittal, University of Leuven (Belgium)

Natural fires: available models and implementation strategies

Modern fire engineering allows engineers and architects to significantly optimise their design by defining the most adapted fire protection strategy. The new generation of Eurocodes has been improved in order to tackle more advanced phenomenon and calculation concepts.

Thursday May 29, Afternoon

Jean-Marc Franssen - Liege University (Belgium)

Finite element analysis: structural models tickled by fire scenarios

The first part of this course is dedicated to the different models which can be considered to represent the action of the fire in a structural analysis made with the finite element method: time-temperature curves, zone models and various localised fire models such as LOCAFI, HASEMI or CFD-FE interaction. The highlight is put on the coherence which must exist between the chosen fire model and the type of structural model.
In the second part, the author will present some particular models or amazing results which were presented to him for debugging by various users of the finite element software SAFIR.

Friday May 30, Morning

Stefano Dal Pont - Université Grenoble Alpes (France)

Coupled thermo-hygral transients: new perspectives on explosive spalling

The talk will focus on the synergy between advanced modelling of transport phenomena and ad-hoc experiments for cement-based materials at high temperature. The close relationship between theoretical-numerical developments and top-notch experiments, ie. full-field techniques such as neutron imaging, allow an in-depth understanding of the thermo-hydric phenomena in concrete subjected to a fire.

Friday May 30, Afternoon

Giuseppe Abbiati - Aarhus University (Denmark)

Hybrid testing: fire tests tickled by structural models

The failure mode of a structural component subjected to fire loading is sensitive to its mechanical boundary conditions. For example, thermally induced buckling of a restrained column exposed to fire might occur or not, depending on the stiffness of beam-column joints. Simulating the correct boundary conditions is crucial for obtaining meaningful experimental results. Hybrid fire testing has been developed for this purpose. Specifically, a structural component under test is loaded using servo-controlled actuators while exposed to thermal loading (e.g., using gas burners or electric heaters). Actuator setpoints are adjusted in real time to simulate the interaction between the tested structural component and a numerically simulated subassembly. This seminar introduces the hybrid fire testing concept and presents some recent developments related to control algorithms and simulation tools.