Institute for Sustainability and Innovation in Structural Engineering

Cécile Haremza, Aldina Santiago and Luís Simões da Silva

Department of Civil Engineering, University of Coimbra, Portugal

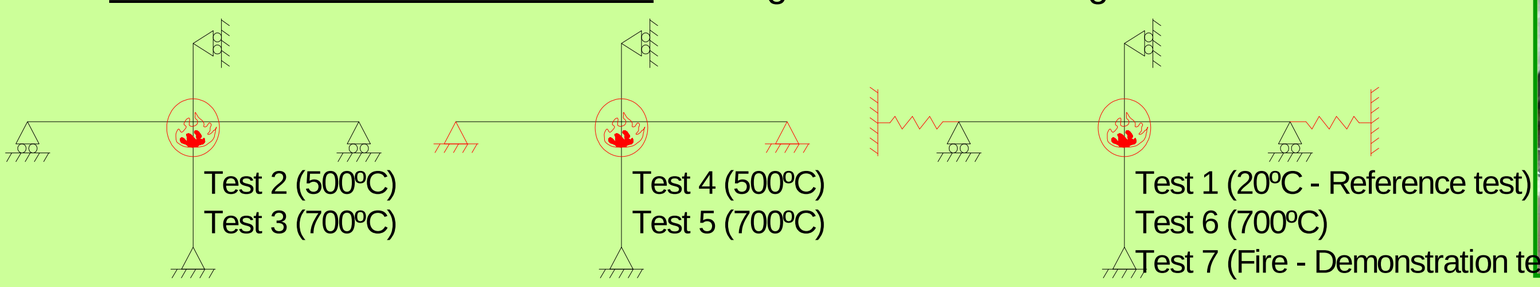
BEHAVIOUR OF HEATED COMPOSITE JOINTS
Preliminary numerical studies

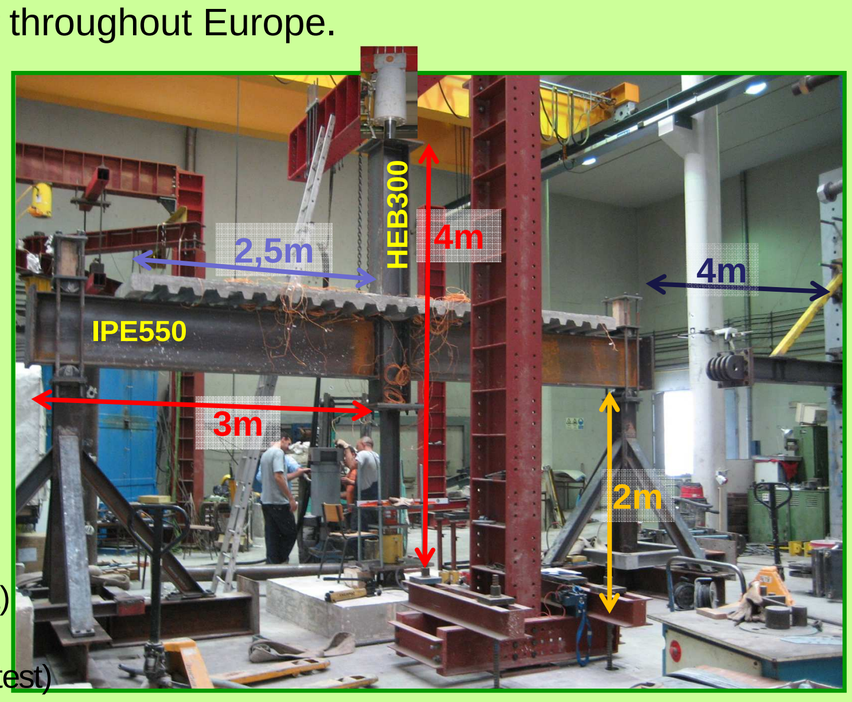
❑ RFCS EUROPEAN ROBUSTFIRE PROJECT

- Development of new design criteria for steel composite open car parks with sufficient ***ROBUSTNESS*** under localised fire;
- Derivation of practical design guidelines for the application of this design philosophy throughout Europe.

❑ SEVEN FIRE TESTS ON JOINTS

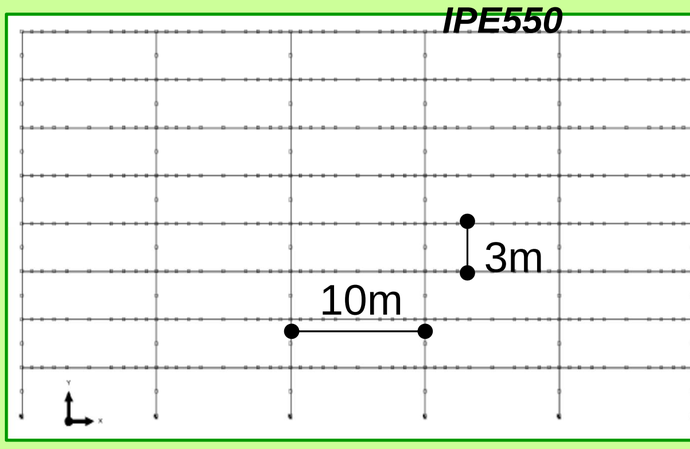
- Combined BENDING MOMENT and AXIAL LOADS in the heated joint when catenary action developed in the frame;
- LOSS OF THE COLUMN simulated in the composite frame;
- Influence of the lateral restraints coming from the undamaged structure:





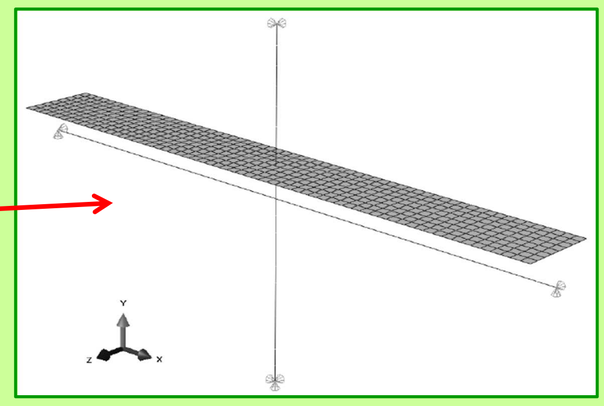
Outline of the experimental tests

❑ NUMERICAL MODELS TO PREPARE THE EXPERIMENTAL TESTS



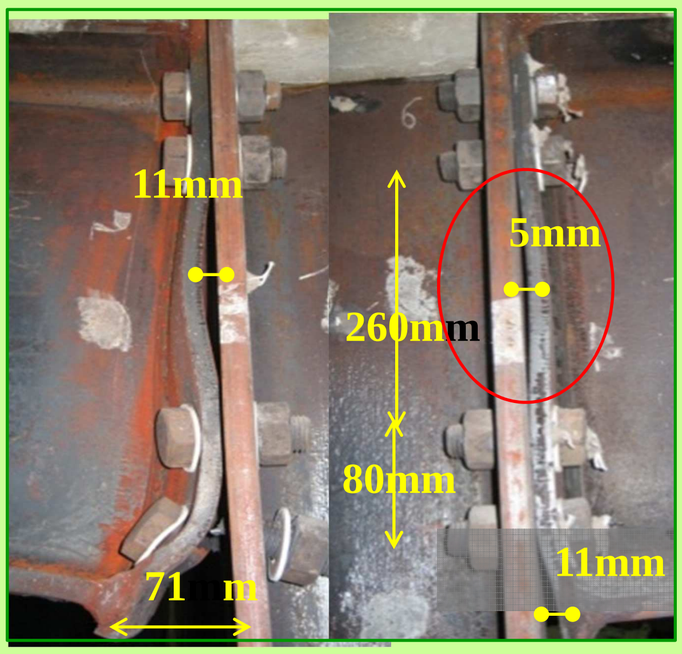
Steel composite open car park modelled in ABAQUS

- To define the initial loading as in the actual car park;
- To define the required capacities of the laboratory;
- Static analysis including mechanical and thermal loadings;
- Beam and shell elements.

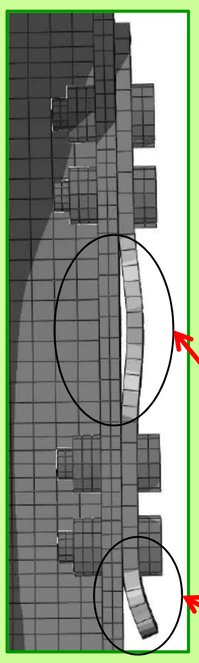


Sub-frame to be tested modelled in ABAQUS (test 2)

❑ NUMERICAL MODEL OF THE END-PLATE DEFORMATION OBSERVED IN THE EXPERIMENTAL TESTS



Joint asymmetric deformation in test 3



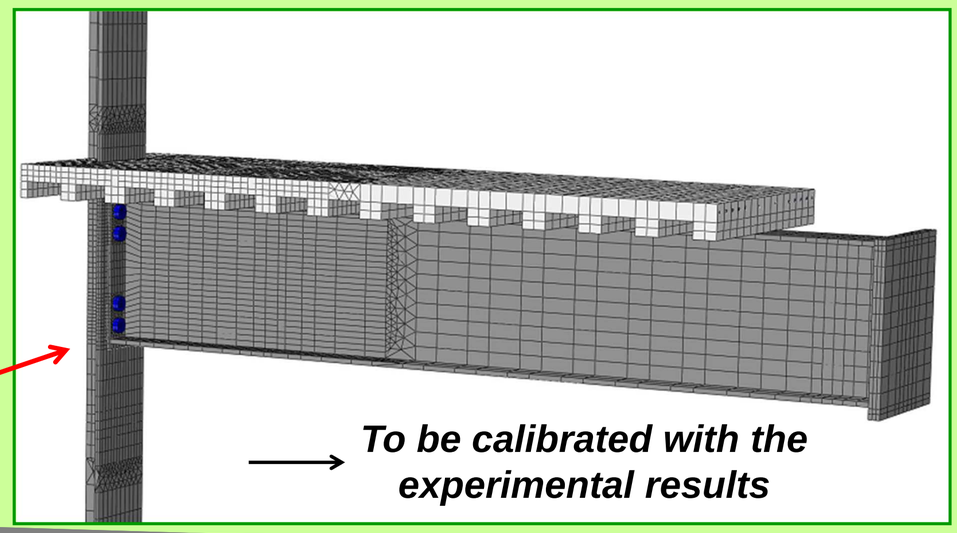
Deformation of the end-plate during the increase of temperature

Deformation due to the tensile force during cooling phase

End-plate deformation modelled in ABAQUS (Scale 2:1)

- **Localised deformation** observed at the steel end-plate centre in the exp. tests
- Static analysis, combining C3D8R solid and contact elements
- 3 load steps: 1 – pre-loading of bolts, 2 – increase of temperatures, and 3 – tensile force at the bottom of the end-plate (as under sagging bending moment)
- Initial deformation of the end-plate centre measured before the test (0,6 mm)
- Temperatures measured in test 3 directly applied

- Detailed 3D model of the entire steel composite sub-frame tested in the laboratory, combining 3D solid and contact elements



To be calibrated with the experimental results

Application of Structural Fire Design,
29 April 2011, Prague, Czech Republic

FCTUC FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE DE COIMBRA

SUSTAINABLE STEEL CONSTRUCTION