

Application of Structural Fire Design  
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# BEHAVIOUR OF HEATED COMPOSITE JOINTS

## Preliminary numerical studies

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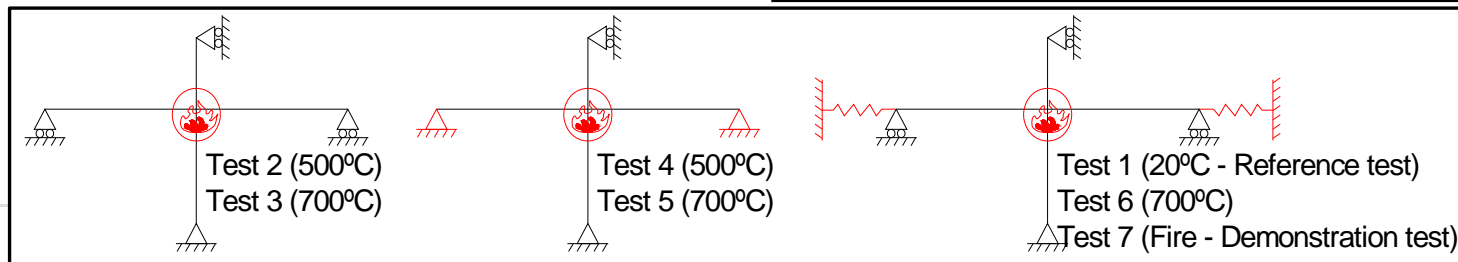
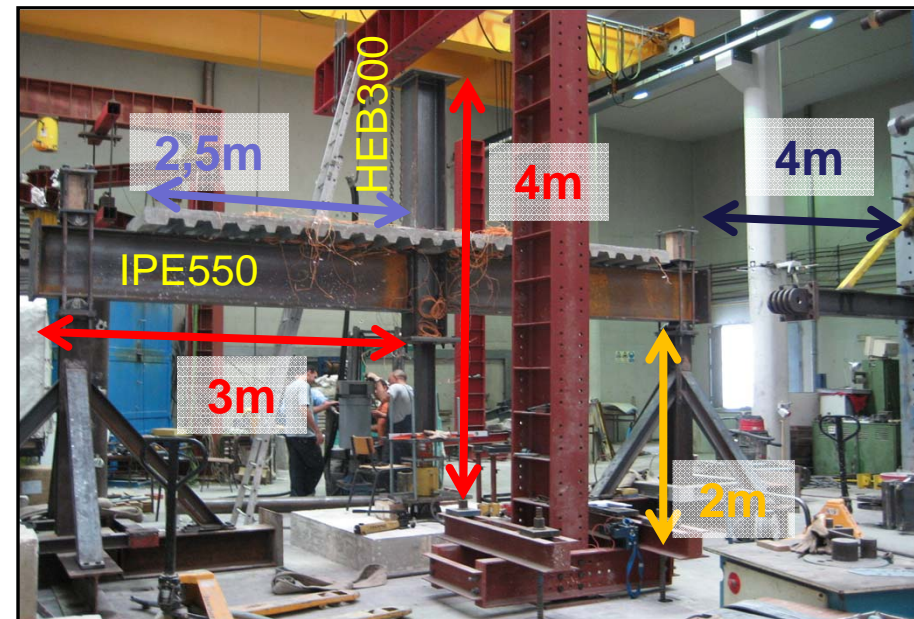
## INTRODUCTION

### ❑ EUROPEAN RFCS ROBUSTFIRE PROJECT

- **New design criteria** of car parks with sufficient **ROBUSTNESS** under localised fire
- **Practical design guidelines**

### ❑ EXPERIMENTAL TESTS

- **Behaviour study** of the frame elements directly affected by the localised fire
- Combined **BENDING MOMENT** and **AXIAL LOADS** in the heated joint when catenary action developed in the frame;
- **LOSS OF THE COLUMN;**
- Influence of the **lateral restraints**

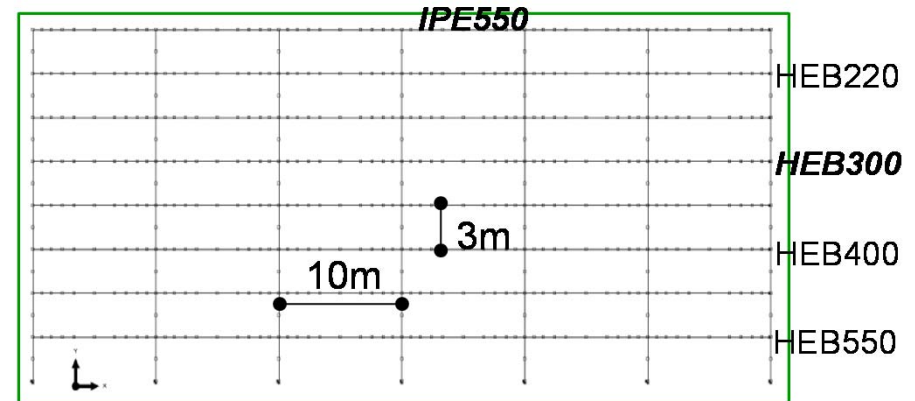


## NUMERICAL MODELS TO PREPARE THE EXPERIMENTAL TESTS

### ❑ ABAQUS

#### ❑ TO DEFINE THE INITIAL LOADING AS IN THE ACTUAL CAR PARK

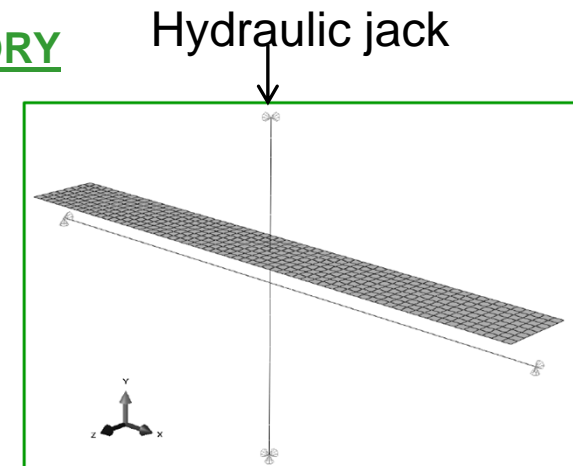
- Simplified 2D model (beam elements)
- **Initial hogging moment** in the joint:  
-236kNm (fire analysis)



Steel composite open car park modelled in ABAQUS

#### ❑ TO DEFINE THE REQUIRED CAPACITIES OF THE LABORATORY

- Static analysis including mechanical and thermal loadings;
- Beam B31 and shell S4R elements;
- Max. vertical load at the column top = 900kN (ambient temperature) → **Capacity of the hydraulic jack**
- **Load cell capacity, axial beam restraints**

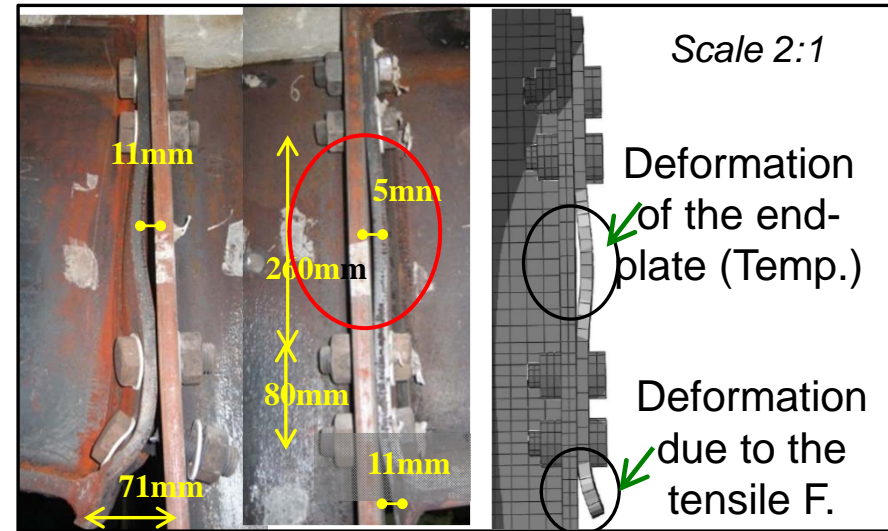


Sub-frame to be tested modelled in ABAQUS (test 2)

## NUMERICAL MODEL OF THE END-PLATE DEFORMATION

### □ SIMPLIFIED 2D MODEL

- **Localised deformation** observed at the steel end-plate centre in the exp. tests;
- C3D8R solid and contact elements;
- Initial deformation of the end-plate centre (0,6 mm);
- Temperatures measured directly applied;
- Deformation mode due to:
  - **Initial deformation of the plate**
  - **Different thicknesses column/plate**  
(19mm column > 15mm plate)



→ **Similar deformation**

### □ DETAILED 3D MODEL

