



Integrated Fire Engineering and Response

COST action network number TU0904 in domain Transport and Urban Development

February 20-21, 2014, Cracow (Poland)

WP6 - Thought for Eurocodes Upgrade

Design fire scenarios for open car parks

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EN1991-1-2: Possible Annex on the selection of design fire scenarios for OPEN CAR PARKS

- A crucial aspect for the application of Structural Fire Engineering is the definition of design fire scenarios.
- In particular for open car parks, the fire scenarios are significantly affected, among other things, by the number of vehicles involved in the fire and the timing of fire ignition by a car to the adjacent one.

References (background information):

- These issues, in 2001, were object of investigation by an European research (**CEC AGREEMENT 7215-PP/025 “*Demonstration of Real Fire Tests in Car Parks and High Buildings*”**), which allowed the publication of a French guideline called **INERIS “*Parcs de stationnement en superstructure largement ventiles*”**.
- **NIGRO E., CEFARELLI G., FERRARO A., MANFREDI G., COSENZA E. (2011). “*Fire Safety Engineering for open and closed car parks: C.A.S.E Project for L’Aquila*”. Applied Mechanics and Materials, vol. 82 (2011), p. 746-751.**

Proposed changes:

- **Introduction of an additional Annex for the selection of the design fire scenarios for open car parks.**

EN1991-1-2: Possible Annex on the selection of design fire scenarios for OPEN CAR PARKS

Italian codes

➤ Italian Prescriptive Code

✓ D.M.Int 01-02-1986



R90 for Closed Car Parks

NOT WELL DEFINED for Open Car Parks

- ✓ **PROPOSAL of GUIDELINES FOR OPEN CAR PARKS** based on **REPORT PARCHEGGI (REPORT ON ITALIAN CAR PARKS)** “*Approccio ingegneristico per la sicurezza strutturale in caso di incendio di parcheggi aerati realizzati con struttura di acciaio*”, Final Report 2010. **Commissione per la Sicurezza delle Costruzioni di Acciaio in caso di Incendio.**



Submitted for Approval to Italian Department of Fire Brigades

European codes

- **CEC Agreement 7215 - PP/025:** “*Demonstration of Real Fire Tests in Car Parks and High Buildings*”, by CITCM (Francia), PROFIL-ARBED Recherches (Lussemburgo) e TNO (Paesi Bassi), closed 2001.



- ✓ In France 09-05-2006: “*Règlement de sécurité contre les risques d’incendie et de panique dans les parcs de stationnement couverts*” Ministère de l’Intérieur et de l’Aménagement du territoire.
- ✓ **Guide Lines** “Parcs de stationnement en superstructure largement ventilés. Avis d’expert sur les scénarios d’incendie”, Final Report 2001 by **INERIS** (Institut National de l’Environnement Industriel et des Risques) and by CTICM (Centre Technique Industriel de la Construction Metallique).

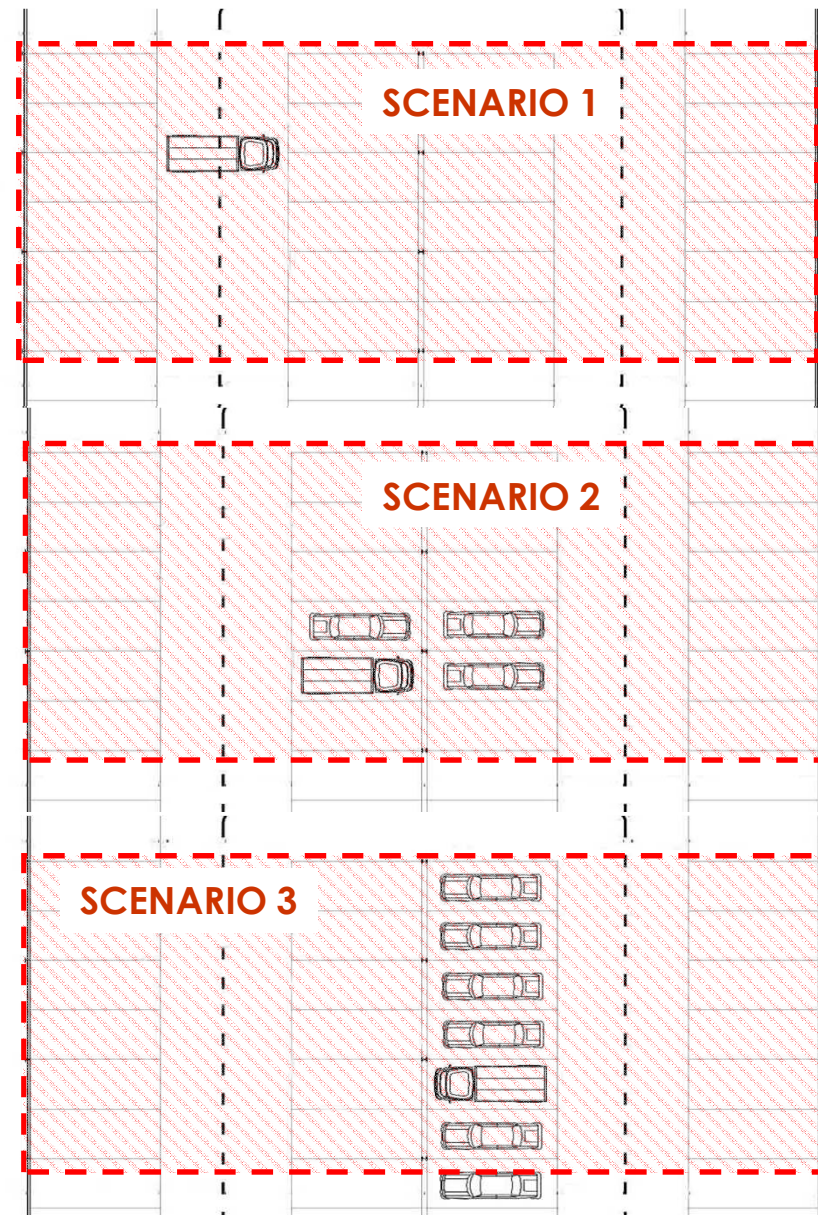


EN1991-1-2: Possible Annex on the selection of design fire scenarios for OPEN CAR PARKS

➤ **GUIDE LINES INERIS:** “Parcs de stationnement en superstructure largement ventilés. Avis d’expert sur les scénarios d’incendie”, Final Report 2001 by **INERIS** (Institut National de l’Environnement Industriel et des Risques) and by CTICM (Centre Technique Industriel de la Construction Metallique).

✓ Choice of Design Fire Scenarios

Propagation time between adjacent cars is **12 min**

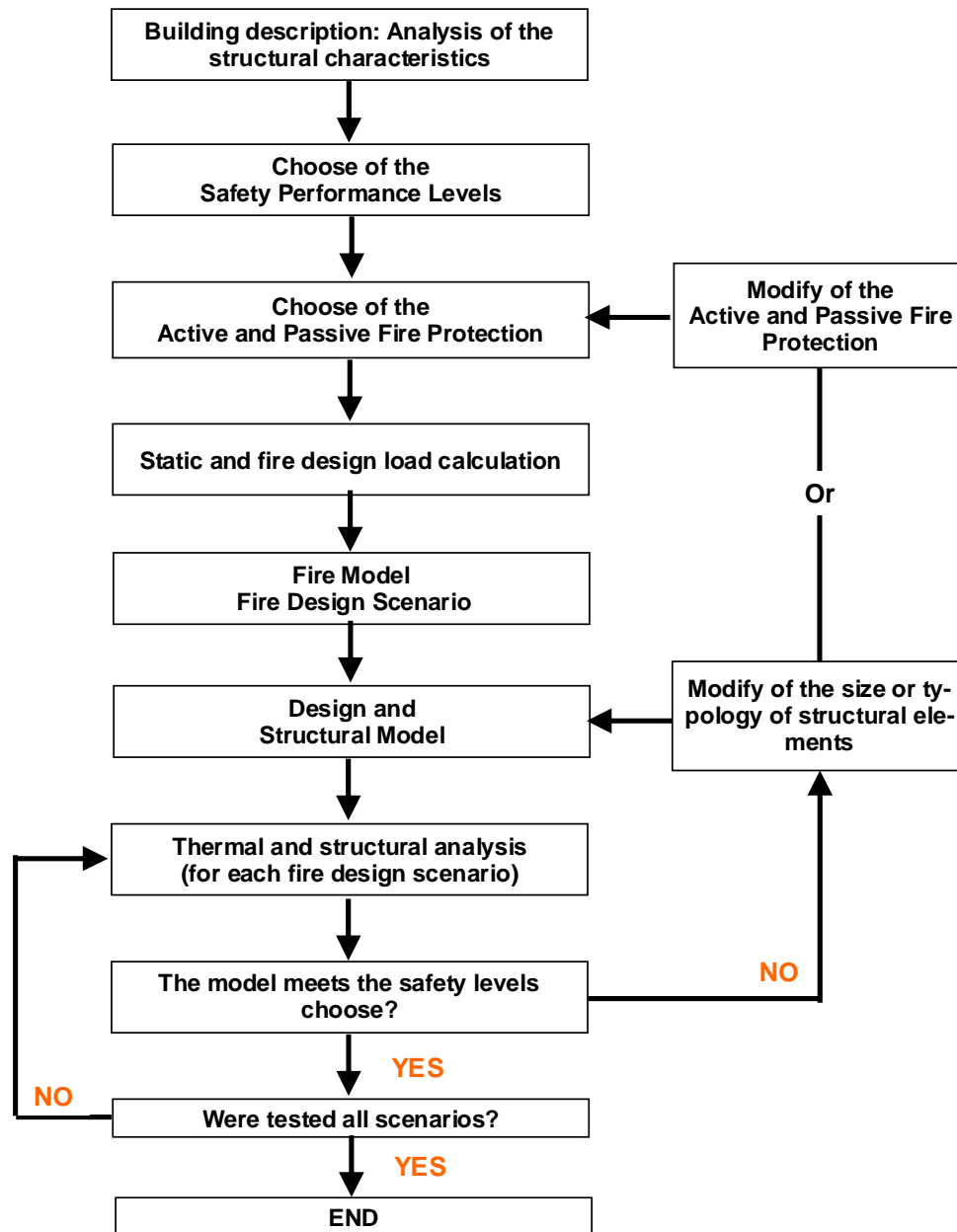
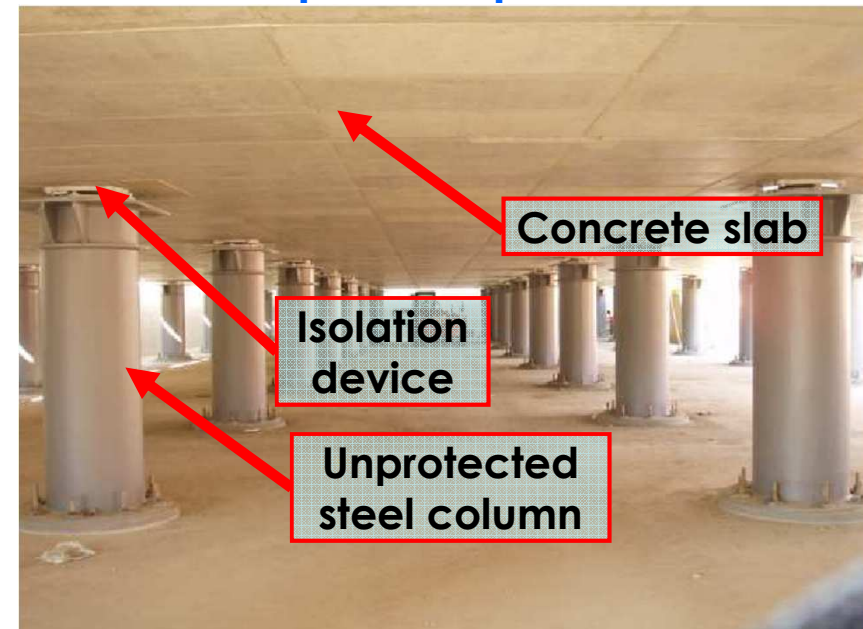


Application of Fire Safety Engineering to Open Car Parks

C.A.S.E. Project – L'Aquila (Italy)



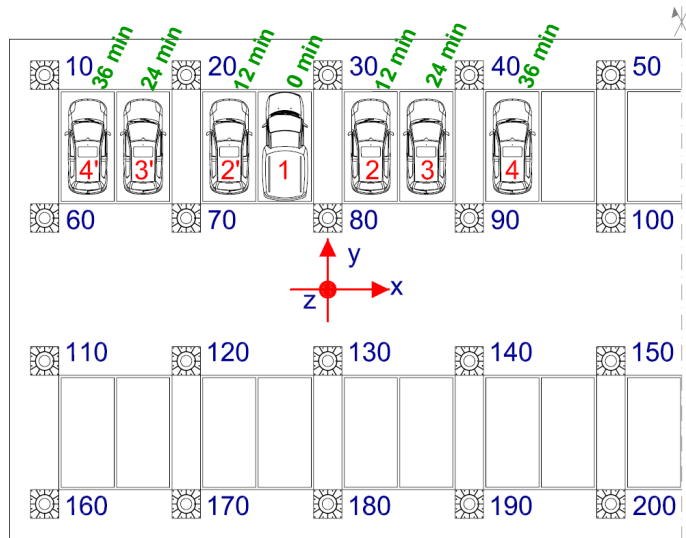
Open car park



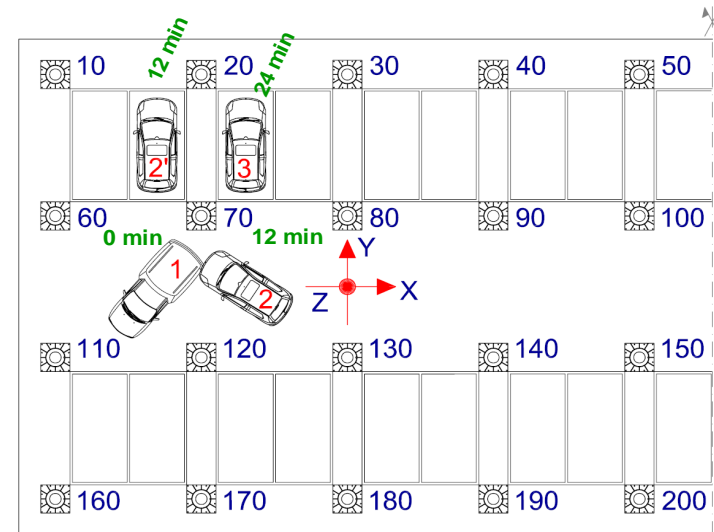
Design Fire Scenarios

Localised fire (Pre-flashover) from INERIS (2001) guideline

Fire scenario L1

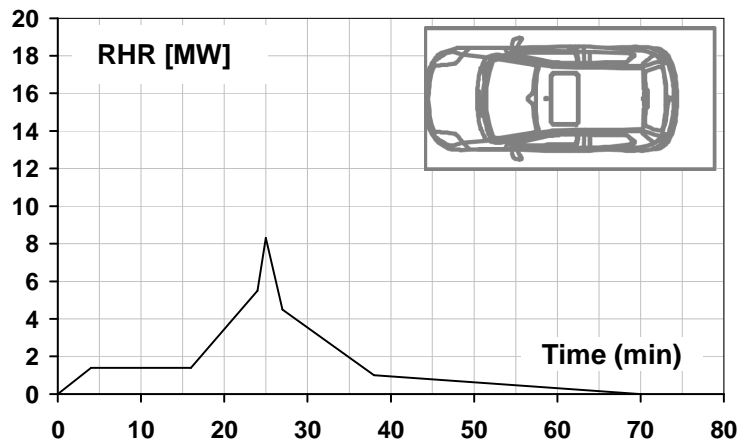


Fire scenario L2

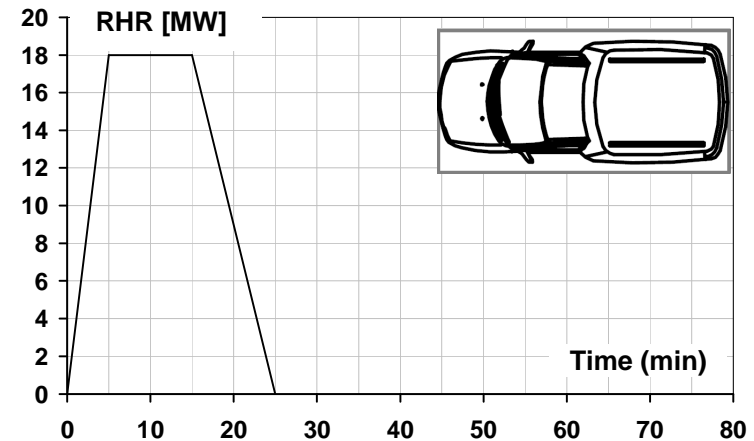


RHR curves from CEC agreement 7215-PP/025

Car (Category 3)

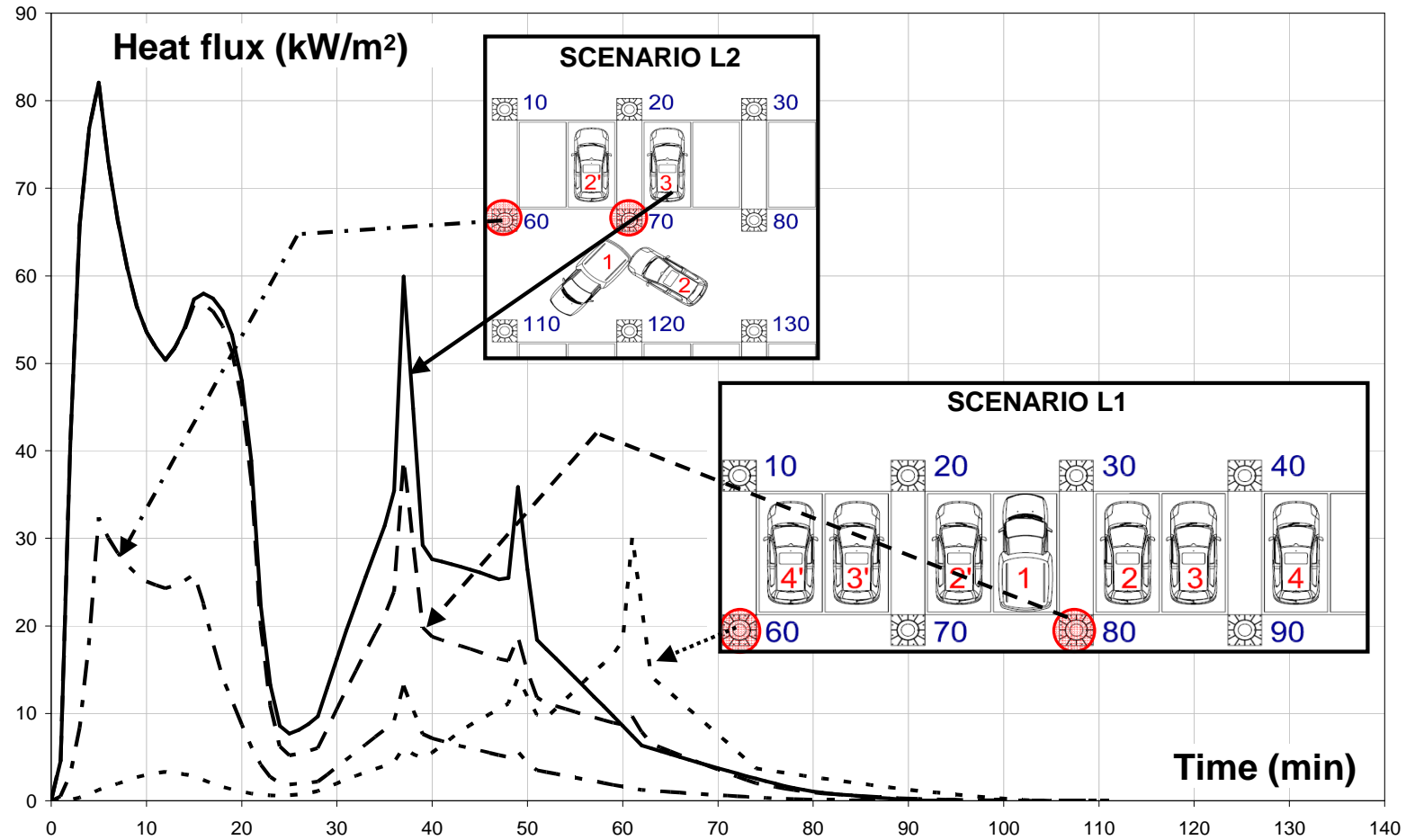


VAN



Fire model

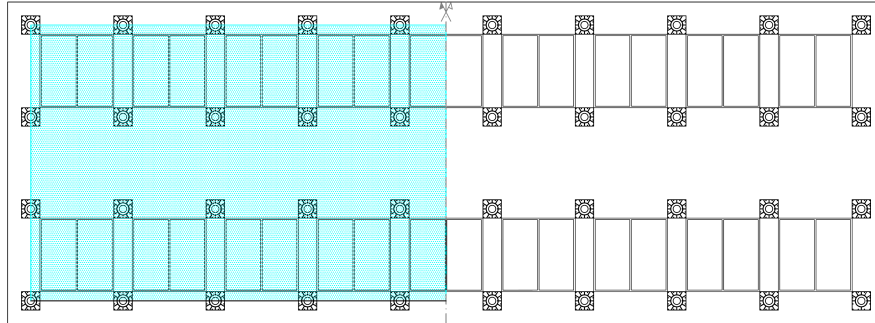
Hasemi Method From Annex C EN1991-1-2



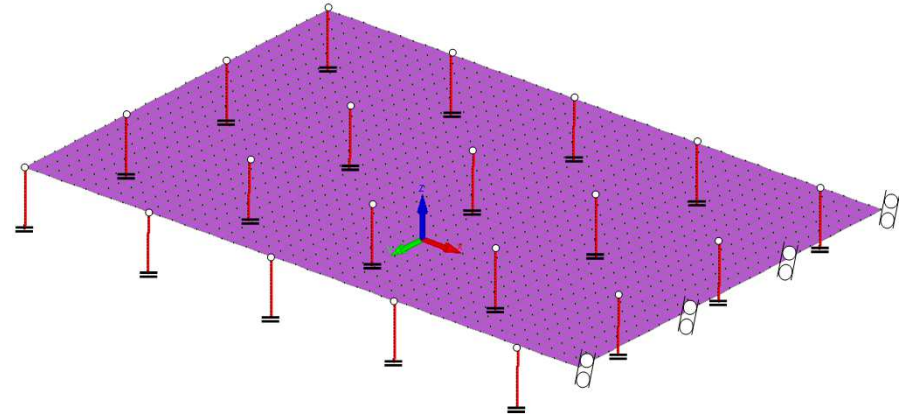
Structural models

Global analyses with non linear software SAFIR2007_

Substructure

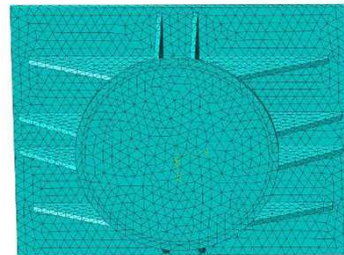
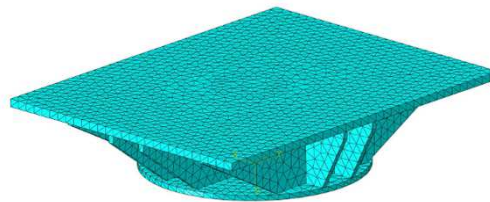


Static scheme



3D-Detailed analyses with software ABAQUS/standard_

Column



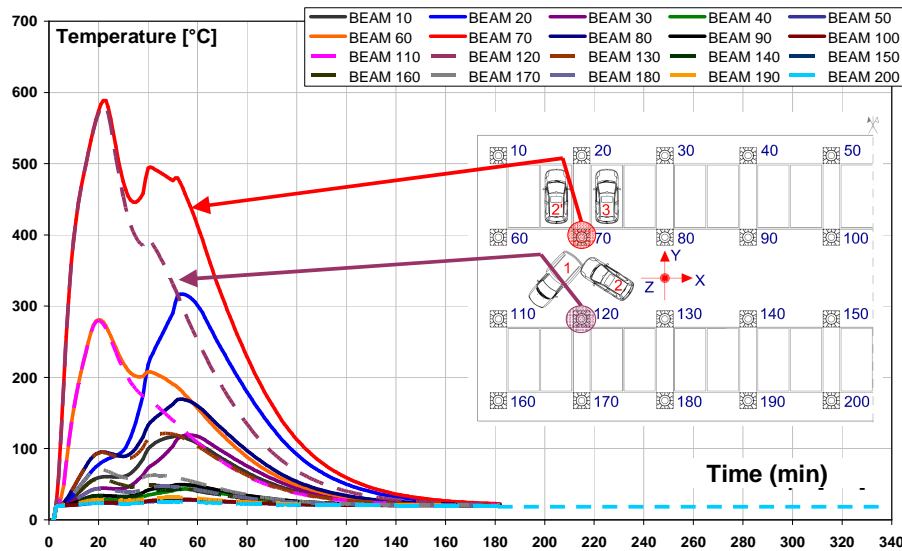
Loads on column corresponding to actions from global analysis

Performance Level 4:
Checks in terms of resistance and limitation of damage (differential vertical displacements in the columns)

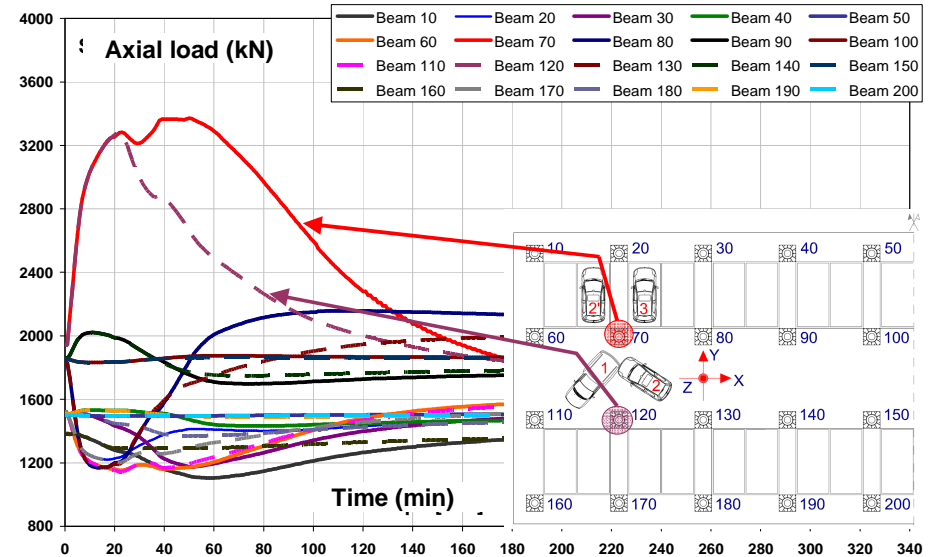
Global analyses results

Fire scenario L1

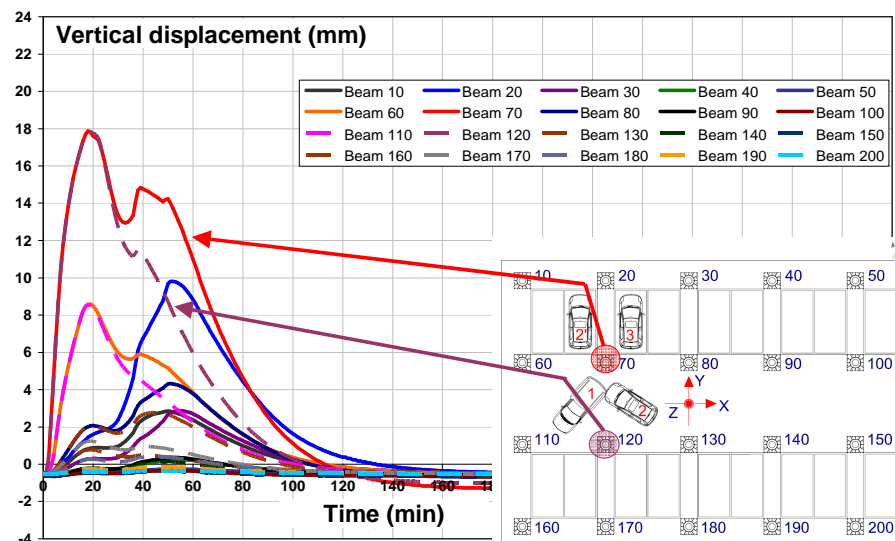
Temperatures vs time



Axial loads vs time



Displacements vs time



Axial load resistance vs time

