Integrated Fire Engineering and Response

COST action network number TU0904 in domain Transport and Urban Development

Application of Structural Fire Engineering – A.S.F.E.

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APPLICATION OF FIRE SAFETY ENGINEERING FOR OPEN CAR PARKS IN ITALY

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Fire Safety Engineering – 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

✓**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

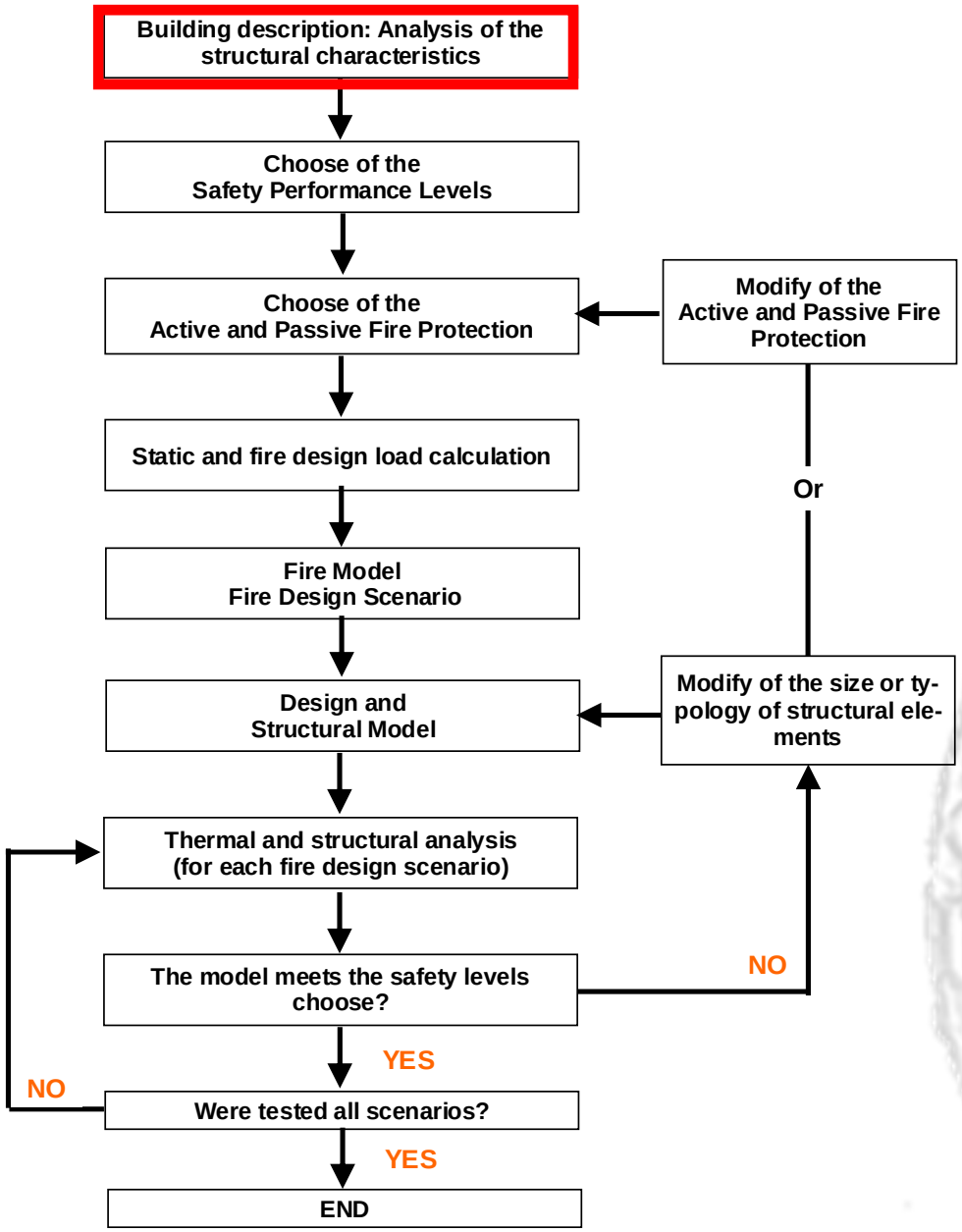
European codes

➢ **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 sècuritè contre les risques d'incendie et de panique dans les parcs de stazionnement couverts*" Ministère de l'Inteèrieur et de l'Amènagement du territoire.

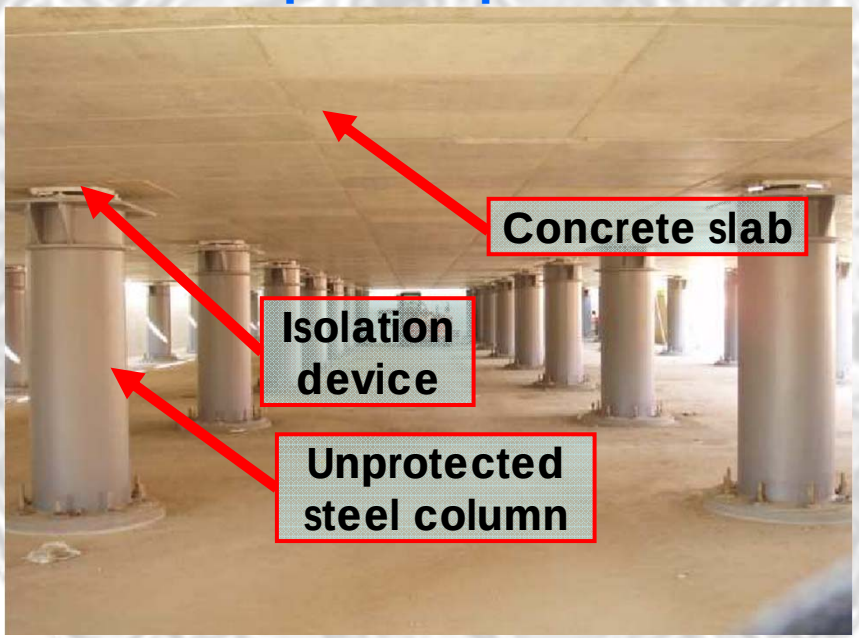
✓ **Guide Lines** "Parcs de stationnement en superstructure largement ventiles. Avis d'expert sur les scénarios d'incendie", Final Report 2001 by **INERIS** (Institut National de l'Environnement Industriel et des Risques) and by CTICM (Centre Technique Industriel de la Construction Metallique).

Fire Safety Engineering – Open Car Parks

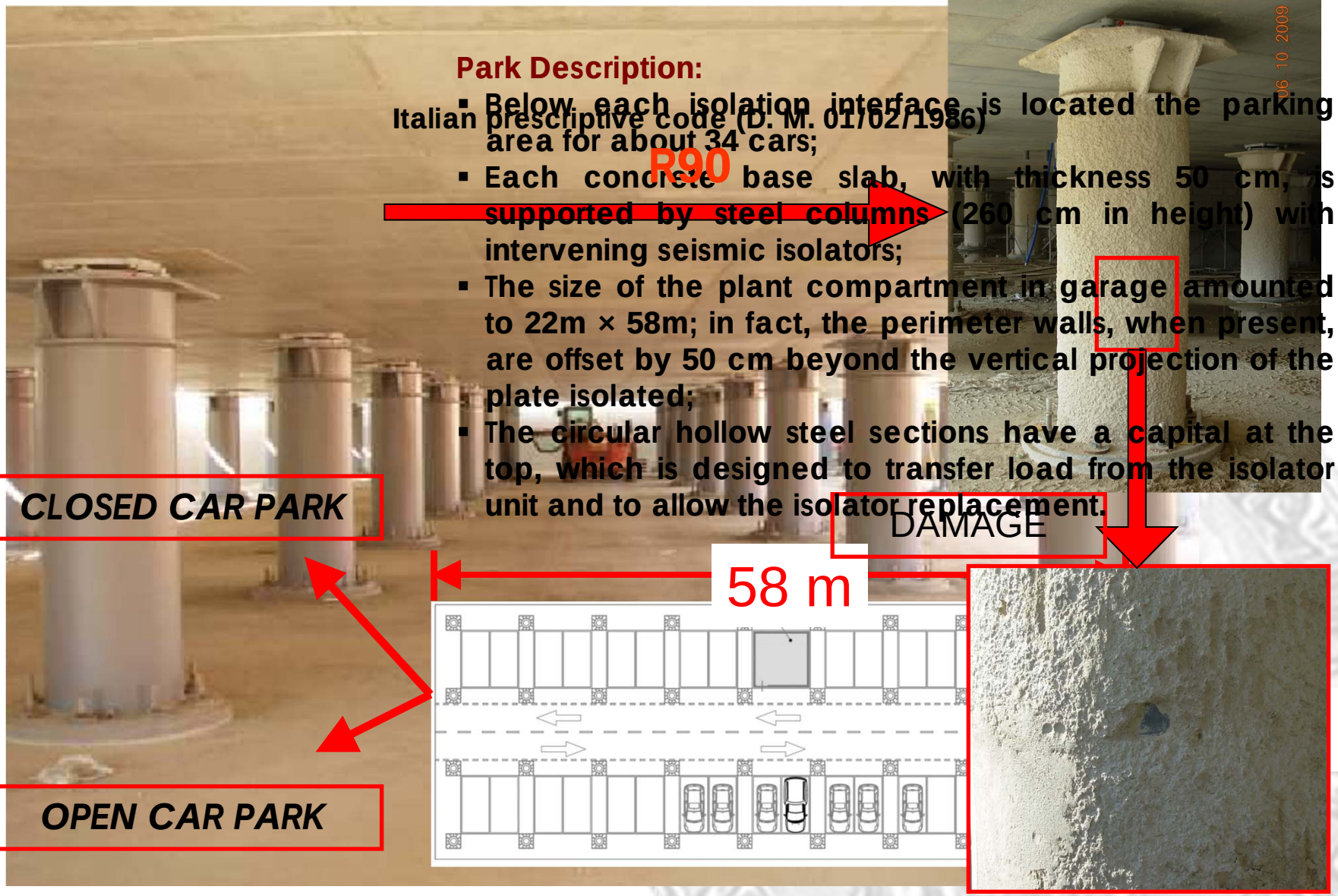


C.A.S.E. Project – L'Aquila (Italy)

Open car park



Fire Safety Engineering – Open Car Parks



Park Description:

- Below each isolation interface is located the parking area for about 34 cars;
- Each concrete base slab, with thickness 50 cm, is supported by steel columns (260 cm in height) with intervening seismic isolators;
- The size of the plant compartment in garage amounted to 22m × 58m; in fact, the perimeter walls, when present, are offset by 50 cm beyond the vertical projection of the plate isolated;
- The circular hollow steel sections have a capital at the top, which is designed to transfer load from the isolator unit and to allow the isolator replacement.

Italian prescriptive code (D. M. 01/02/1986)

R90

CLOSED CAR PARK

OPEN CAR PARK

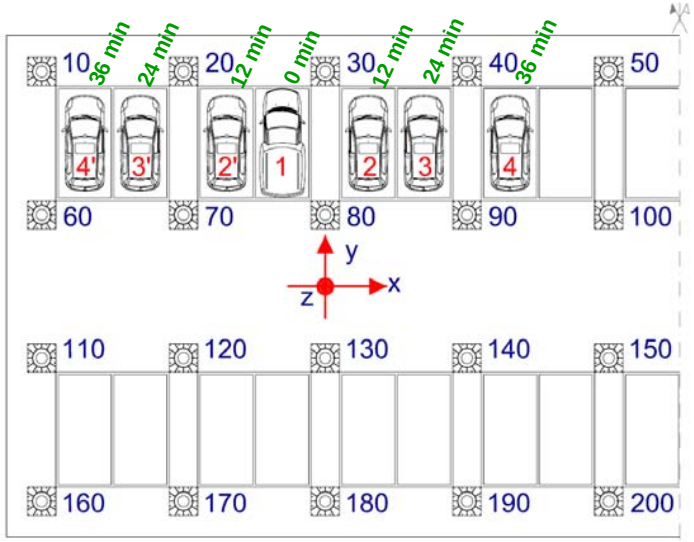
DAMAGE

58 m

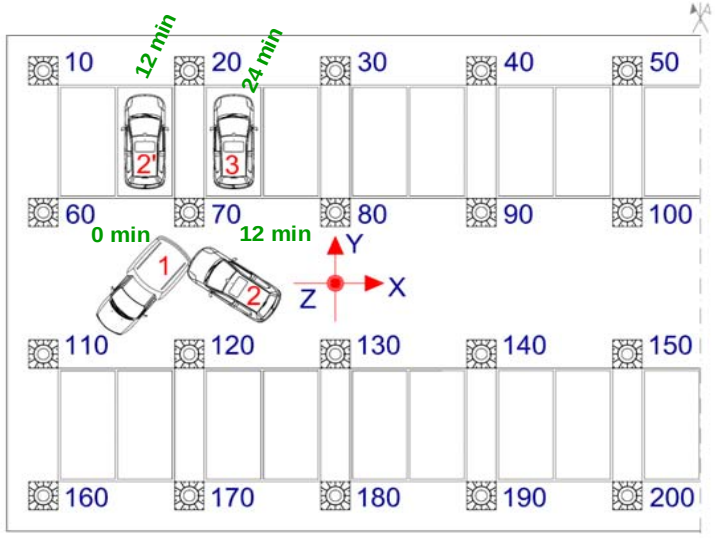
Design Fire Scenarios

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

Fire scenario L1

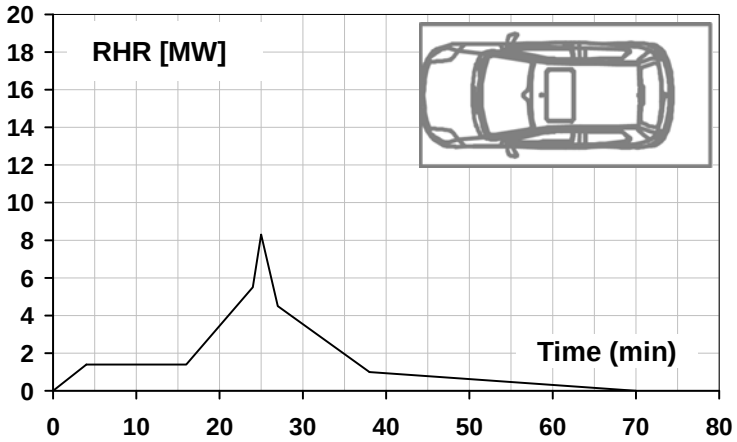


Fire scenario L2

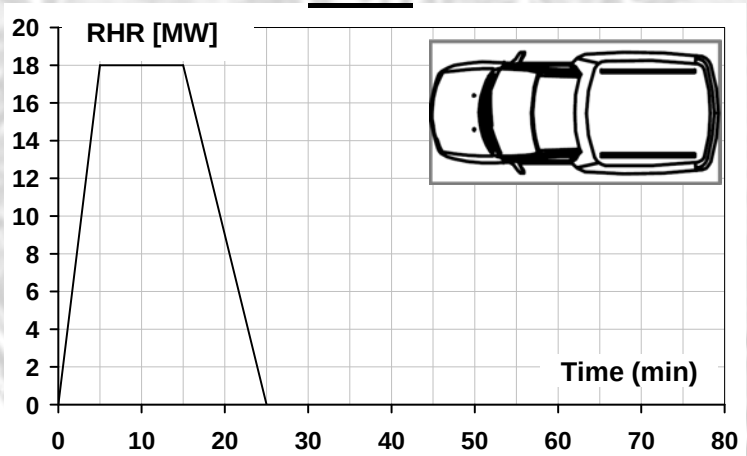


RHR curves From CEC agreement 7215-PP/025

Car (Category 3)

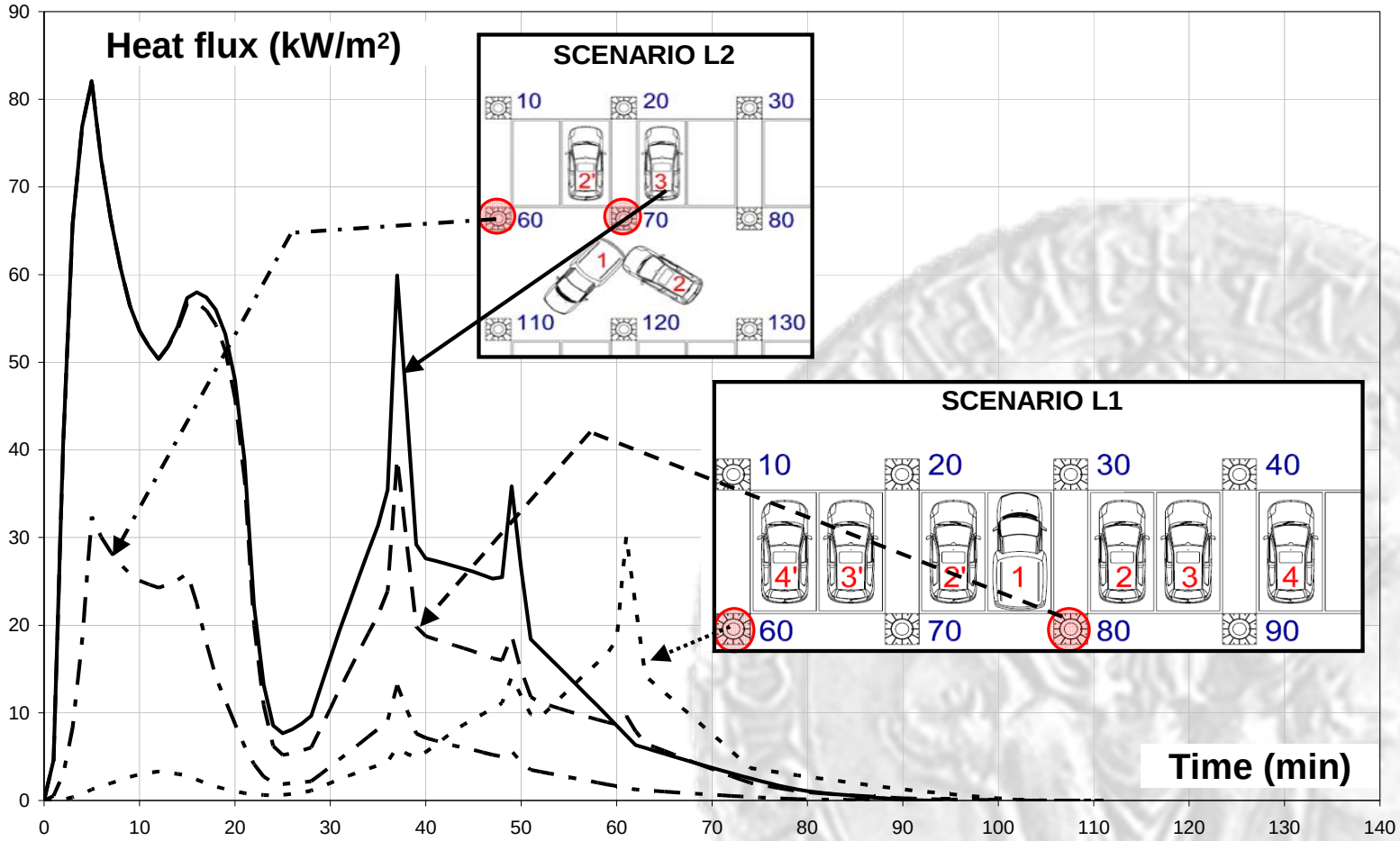


VAN



Fire model

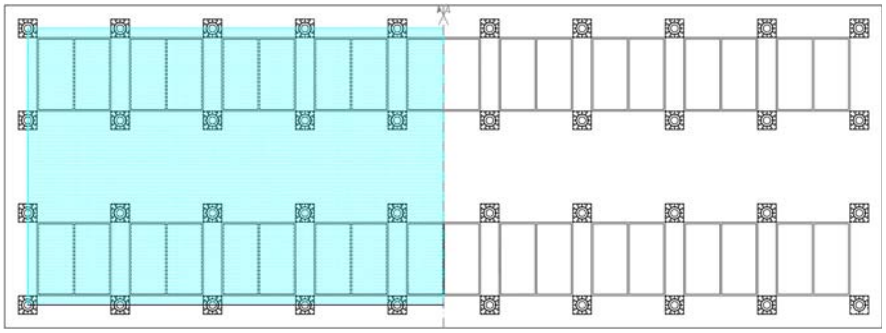
Hasemi Method From Annex C EN1991-1-2



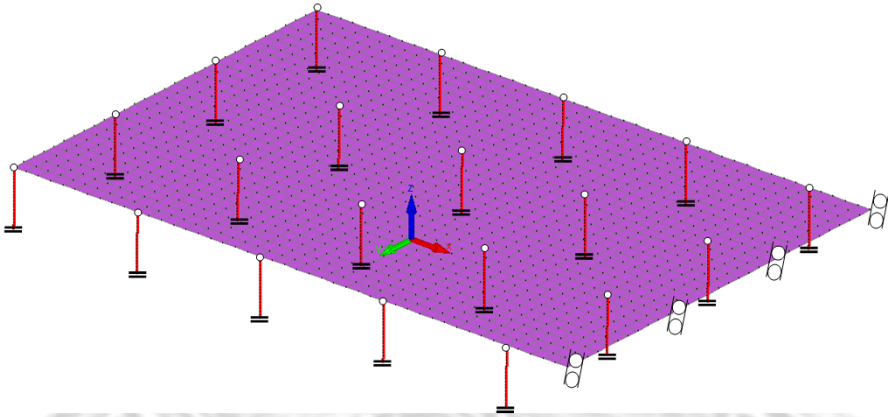
Structural models

Global analyses with non linear software SAFIR2007

Substructure

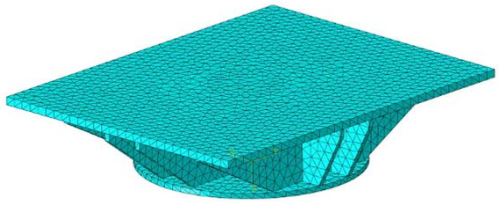


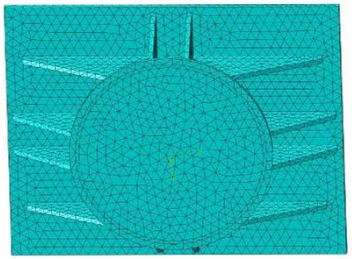
Static scheme



3D-Detailed analyses with software ABAQUS/standard

Column





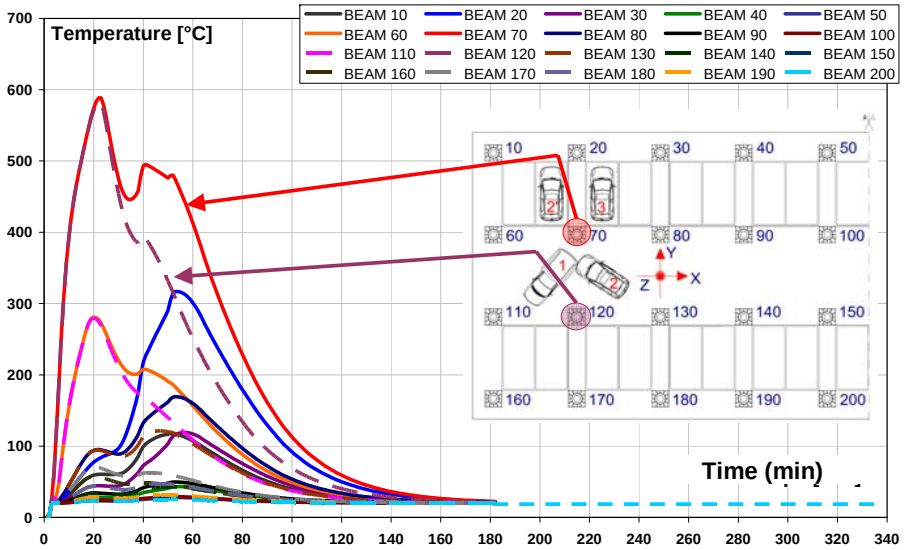
Loads on column corresponding to actions from global analysis

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

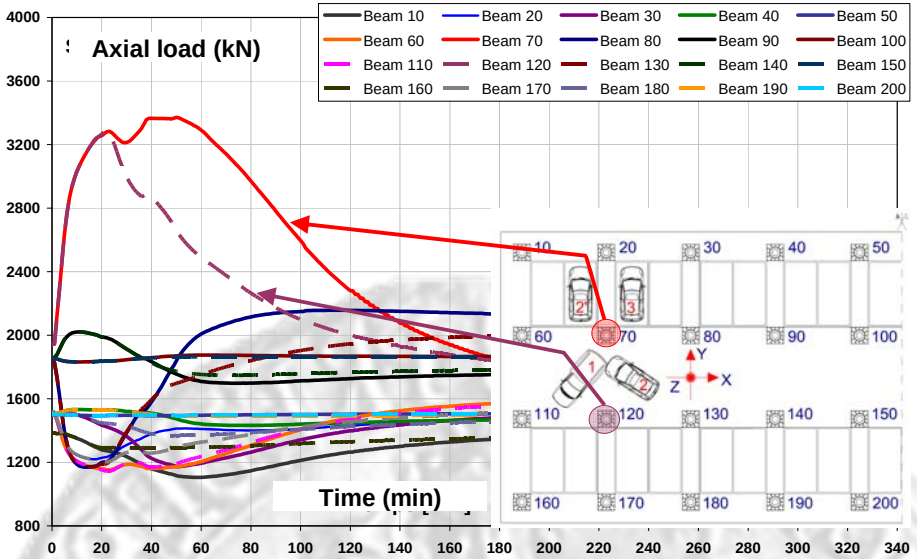
Global analyses results

Fire scenario L1

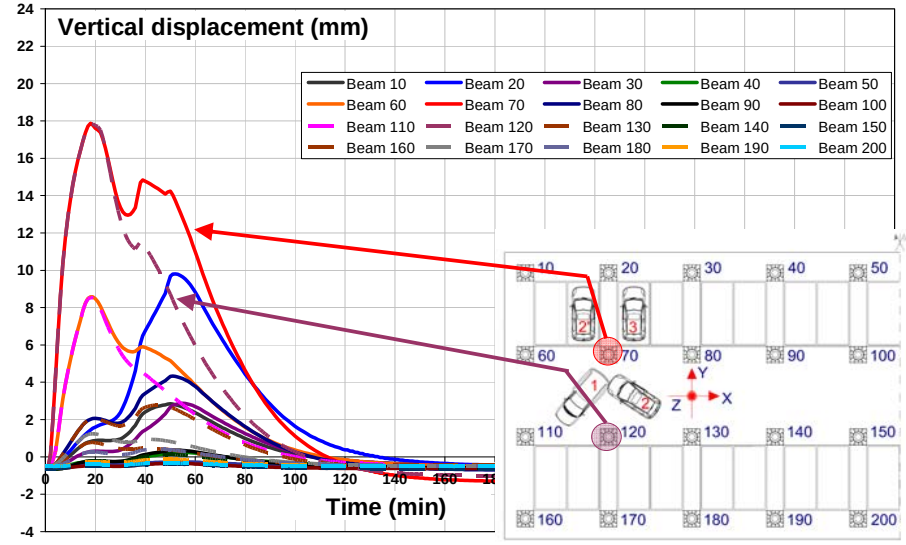
Temperatures vs time



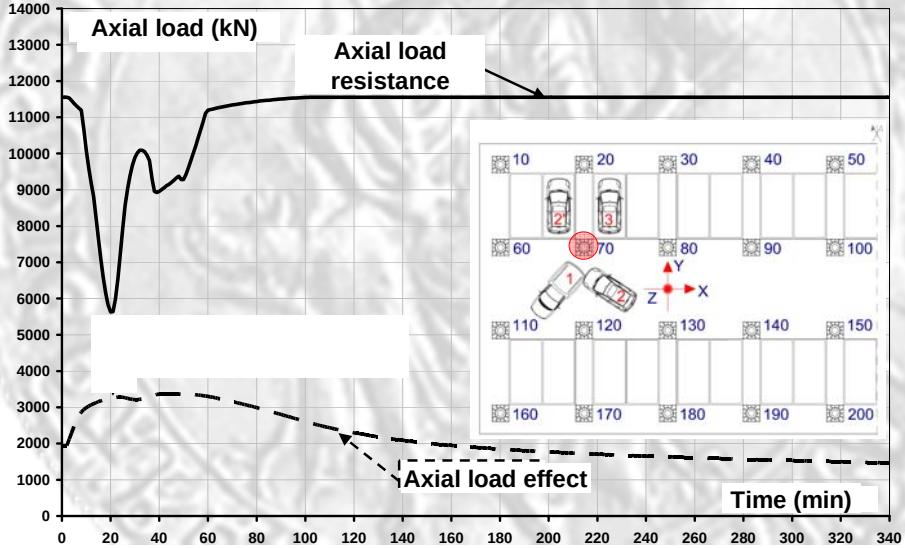
Axial loads vs time



Displacements vs time

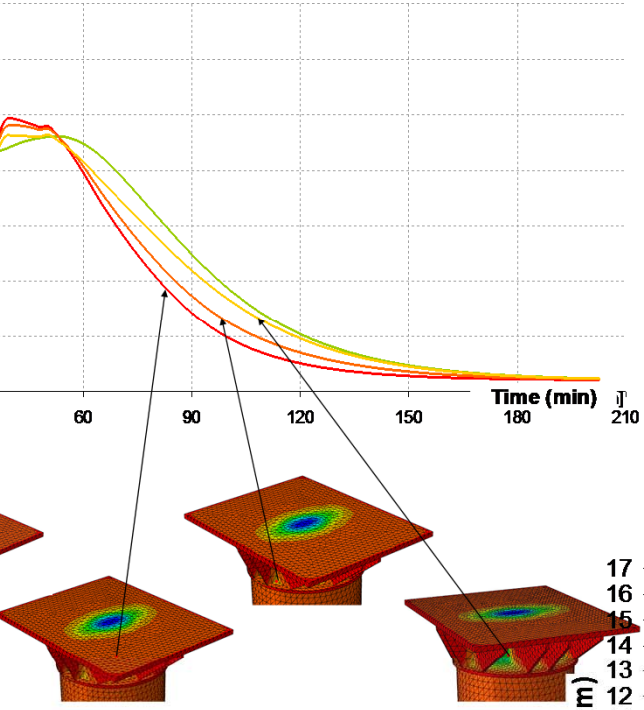


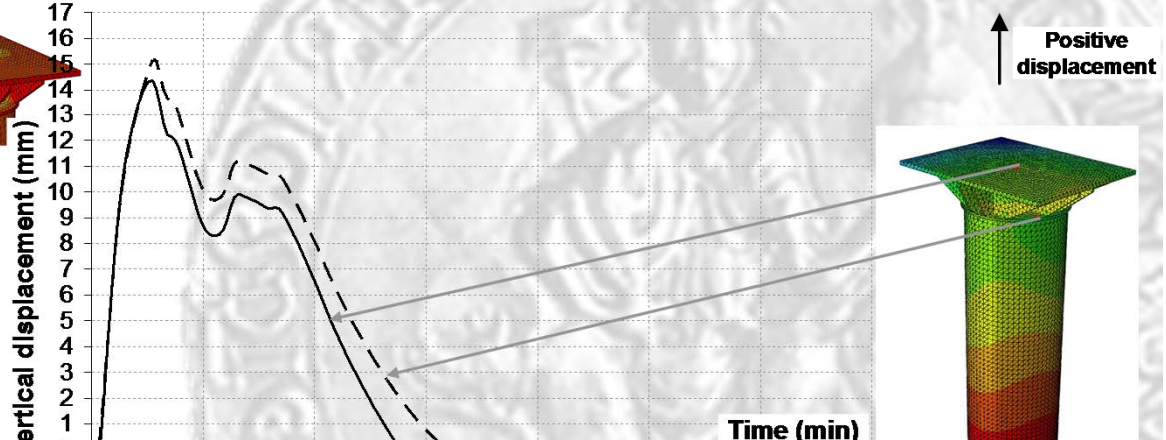
Axial load resistance vs time



Detailed analyses results

nario L1





Conclusions

SE application to car parks is facilitated by the informations about the ble fire scenarios provided by the European Research Project CEC ement 7215-PP/025 (2001) and from INERIS (2001) guideline.

ubstructure extension has allowed assessing in an appropriate way both hermal field and the hyperstatic effects induced by different thermal nsions of steel columns and bending of the concrete reinforced slab.

dition to the global analysis, for each fire scenario, in order to calculate accurately the thermal field and stresses distribution in the capitals e the columns and to assess the possible local buckling, a detailed 3D no-mechanical analyses has been conducted with reference to the more ed and heated column.

hermo-mechanical analyses in fire situations for the described case study ed that the structures, and in particular the steel columns, considered otected, satisfy the performance level set to the design fire scenarios, also ks to an overstrength in normal condition design.