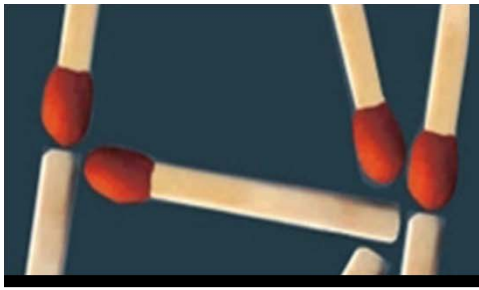

Prague 29 April 2011

International Conference

APPLICATIONS OF STRUCTURAL FIRE ENGINEERING

Modelling of multiple localised fires and steel structural members response using the software Elefir-EN

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Department of Civil Engineering

universidade de aveiro

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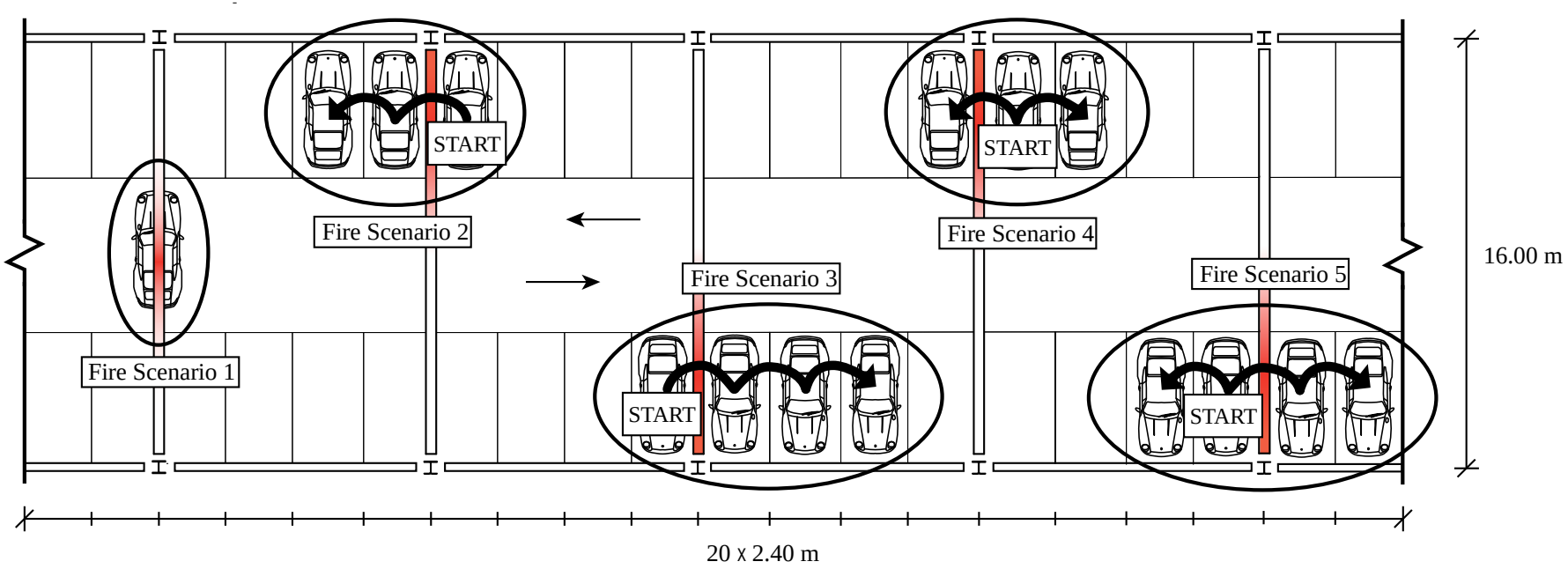
Analysed fire scenarios in a car park
Five fire scenarios



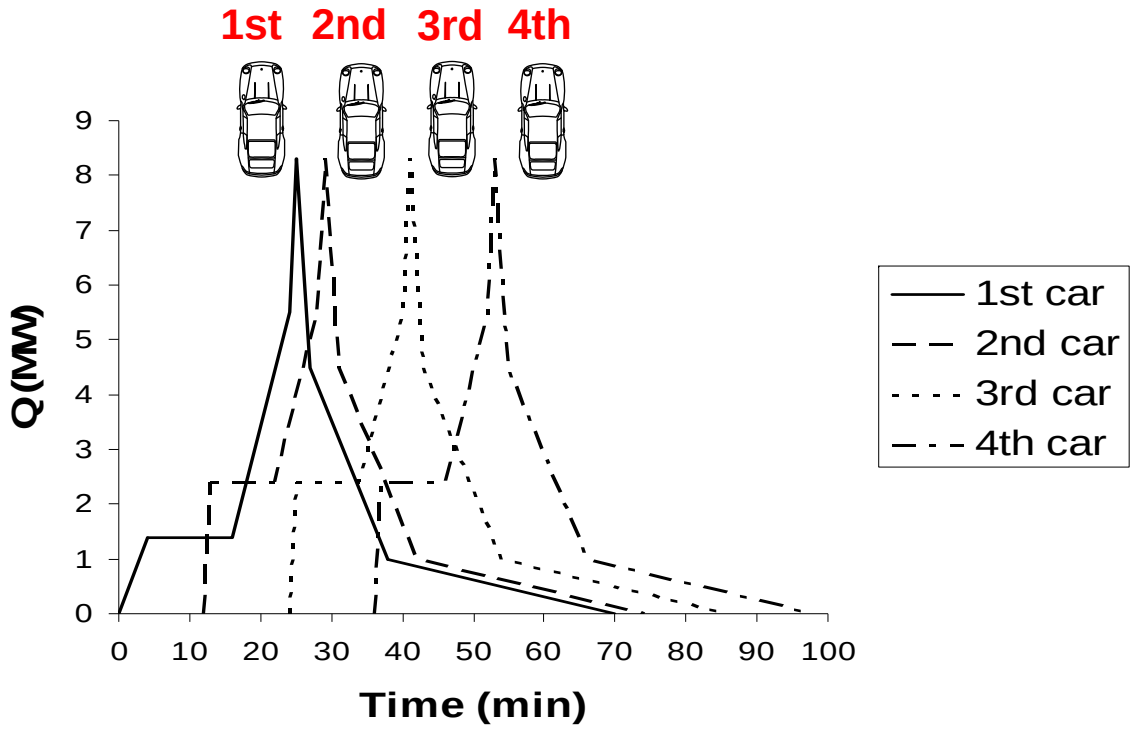
Height: H = 2.7 m
Diameter of flame: D = 3.9 m

Steel Beams: IPE 500

Localised fire

Rate of heat release of four burning cars

Curve of the rate of heat release of each car. A delay of 12 minutes has been considered.

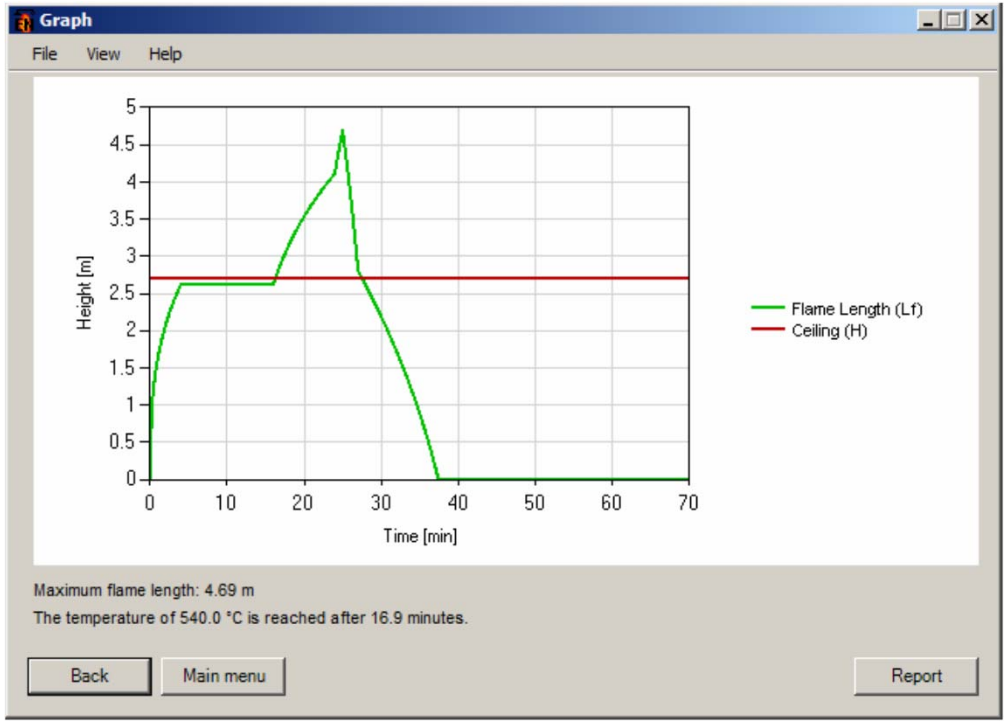


from ECSC Project: Demonstration of real fire tests in car parks and high buildings.

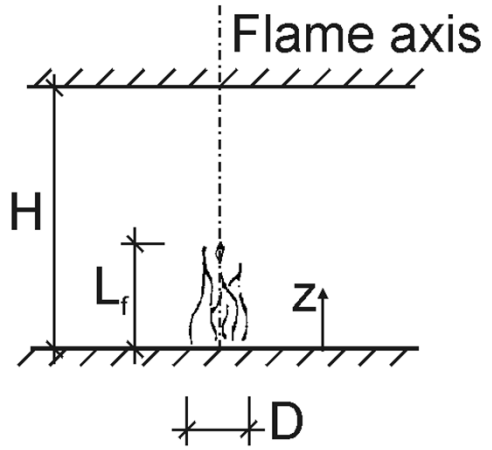
Two Localised fire models
Flame length

if $L_r \geq H$ $\Rightarrow$ Hasemi method has to be used

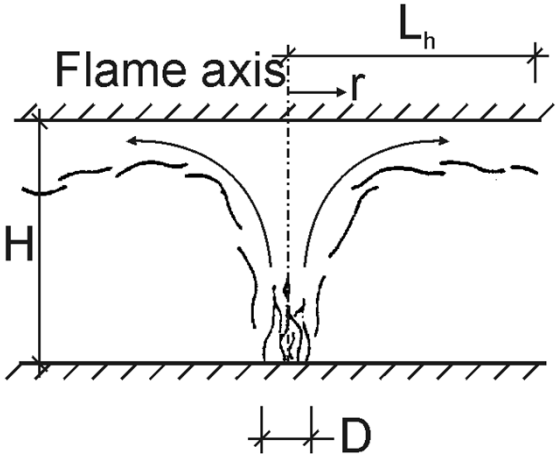
if $L_r < H$ $\Rightarrow$ Heskestad method has to be used



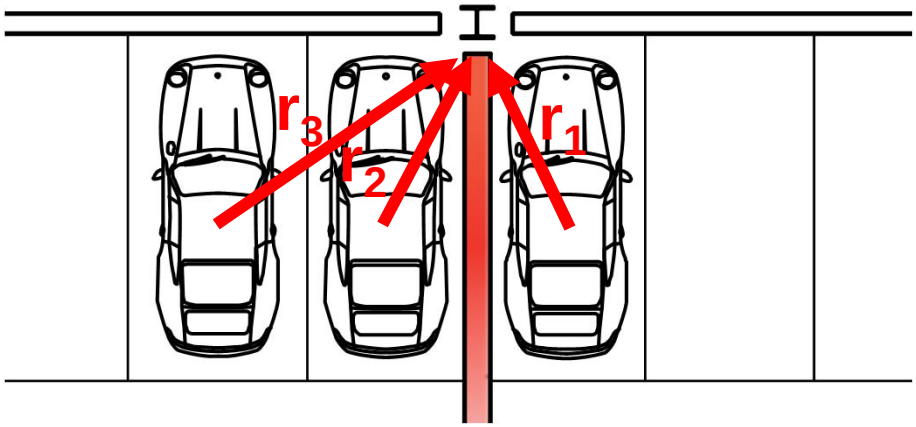
Heskestad Method

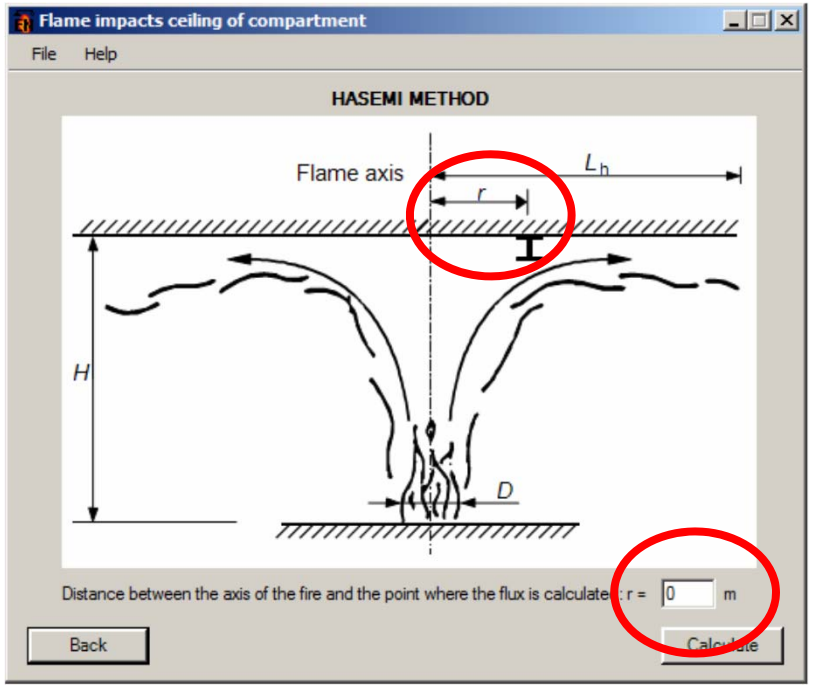


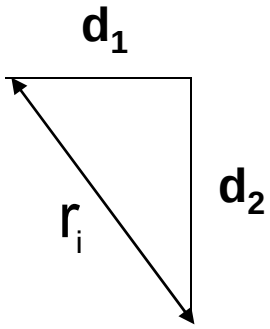
Hasemi Method



Hasemi method
Horizontal distances







$$r_i = \sqrt{d_1^{\,2} + d_2^{\,2}}$$

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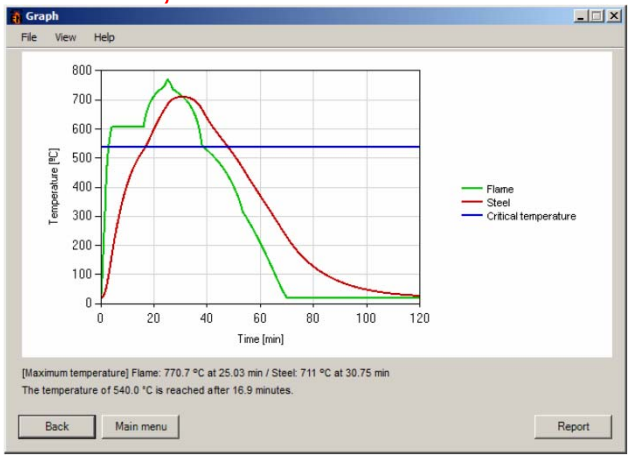
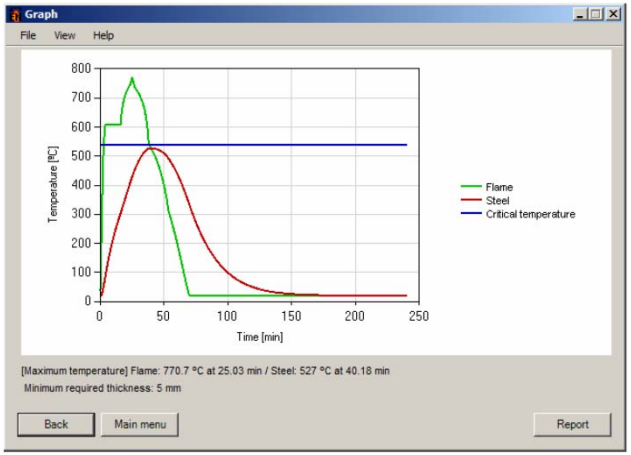
Temperature development
Gas and steel temperture

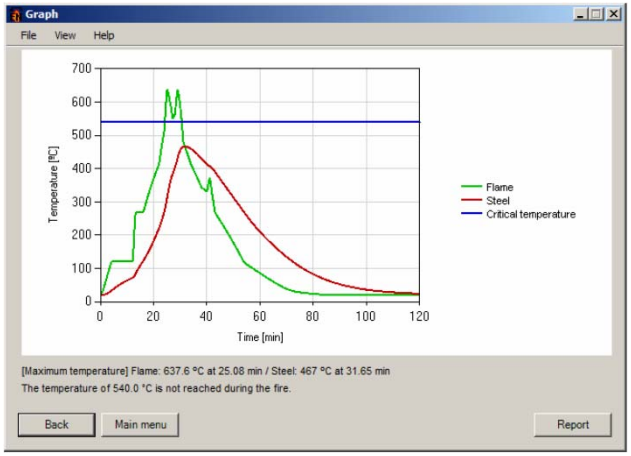
Scenario 1: unprotected steel ($\theta_{a,max}$ = 710.9 ºC)



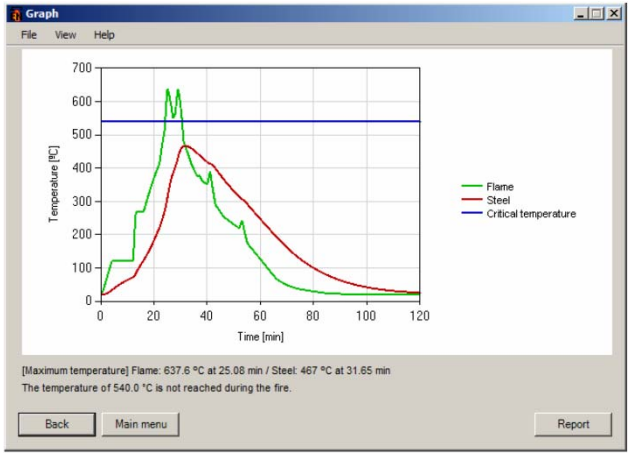
Scenario 1: protected steel ($\theta_{a,max}$ = 527 ºC)



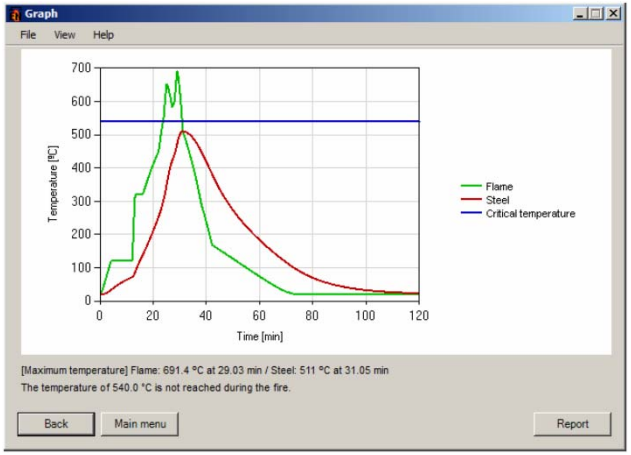
Scenario 2 ($\theta_{a,max}$ = 466.7 ºC)



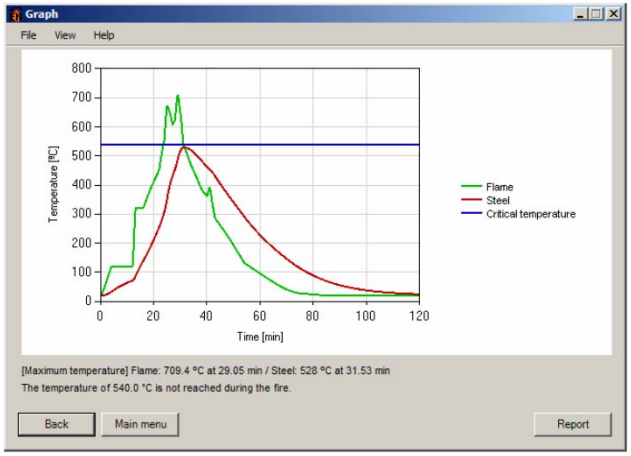
Scenario 3 ($\theta_{a,max}$ = 466.7 ºC)



Scenario 4 ($\theta_{a,max}$ = 510.9 ºC)



Scenario 3 ($\theta_{a,max}$ = 528.5 ºC)



Thank you for your attention