



LOCAFI+

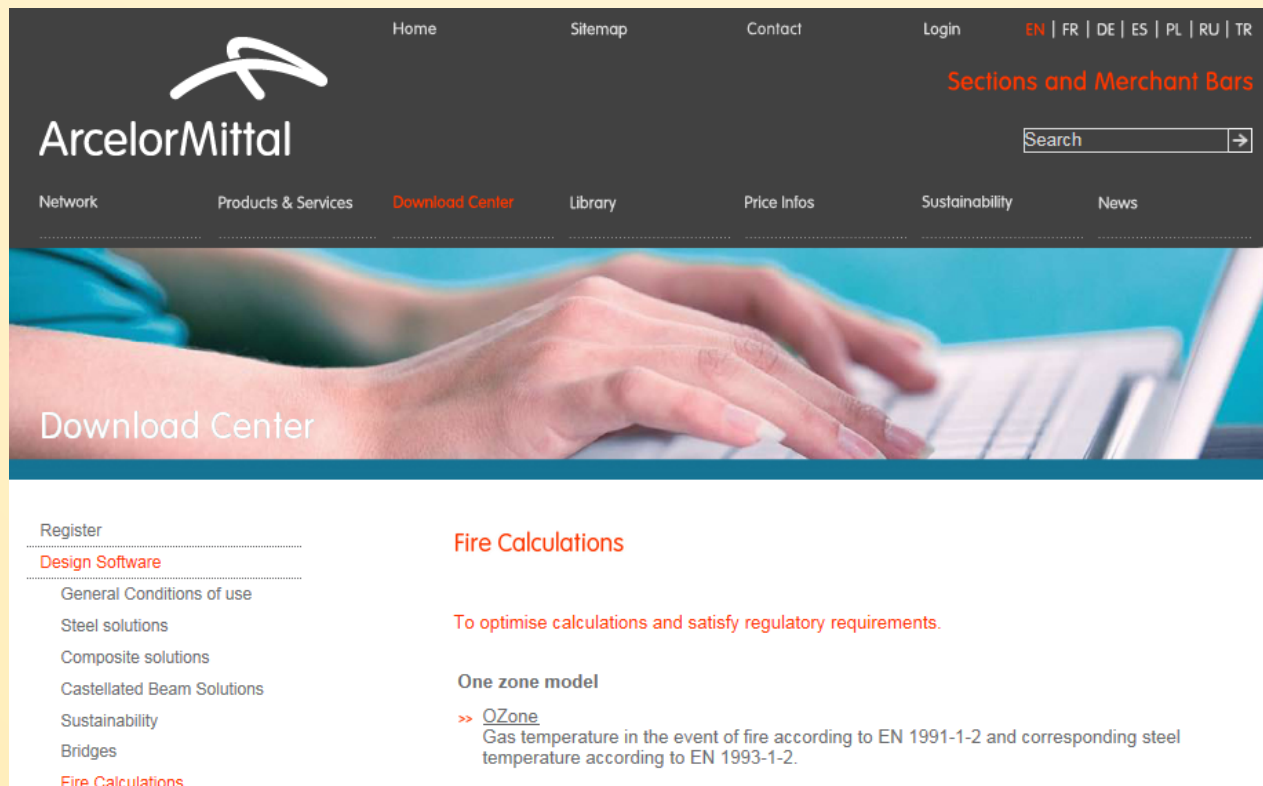
Temperature assessment of a vertical member subjected to LOCAIised Fire Dissemination

Grant Agreement n° 754072

5. Software

5. Software

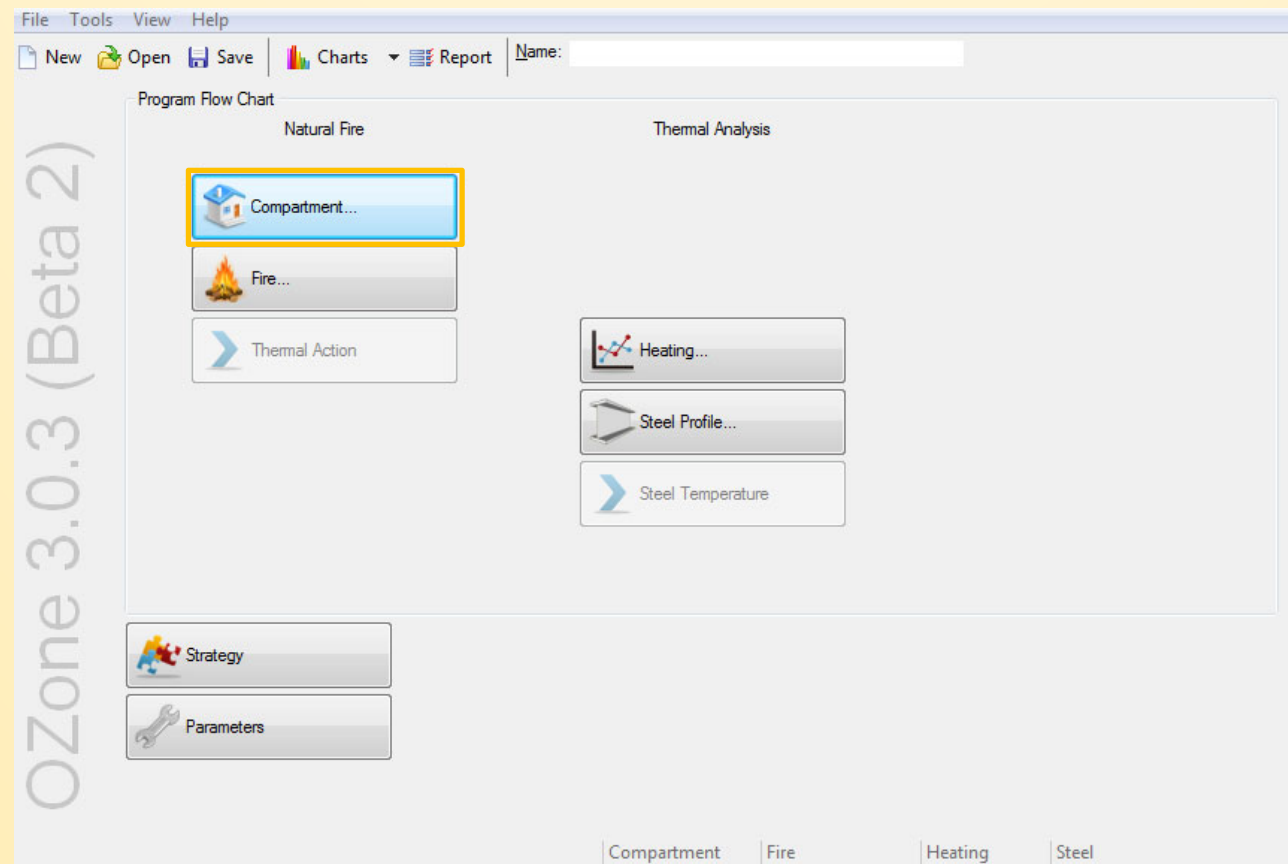
5.1. OZone Compartment



<http://sections.arcelormittal.com/download-center/design-software/fire-calculations.html>

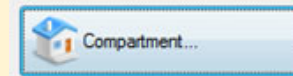
5. Software

5.1. OZone Compartment



5. Software

5.1. OZone Compartment



File Tools View Help

Form of Compartment

☒ Rectangular Floor
☒ Flat Roof
☐ Single Pitch Roof
☐ Double Pitch Roof
☐ Any Compartment

Height: m
Depth: m
Length: m

Define Layers and Openings

Select Wall:

Select Walls to Copy to:

☐ Copy Openings

Defined Walls:

Wall	Type	Openings	Length
Floor			
Ceiling			
Wall 1			
Wall 2			
Wall 3			
Wall 4			

Forced Ventilation

Smoke Extractors:

	Height	Diameter	Volume	In/Out
	m	m	m³/sec	
Extractor 1				
Extractor 2				
Extractor 3				

OK Cancel

Geometry of the compartment

Properties of floor, walls and ceiling

Forced Ventilation (if any)

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5.1. OZone Compartment

File Tools View Help

Wall Length: 13 m


	Material	Thickness	Unit mass	Conductivity	Specific Heat	Rel Emissivity	Rel Emissivity
		cm	kg/m ³	W/mK	J/kgK	Hot Surface	Cold Surface
Layer 1	Steel [EN1994-1-2]	0.1	7850	45	600	0.8	0.8
Layer 2	Glass wool _Rock wool	6	60	0.037	1030	0.8	0.8
Layer 3	Steel [EN1994-1-2]	0.1	7850	45	600	0.8	0.8
Layer 4							

Enter each layer on a single row in the table above (up to four layers). Just click in a cell and edit its value. If not found in the list of materials you can define your own material, by filling in the appropriate cells. Define your layers starting from Layer 1 (Inside).

Define your openings if any (up to three openings in a single wall). Click in the desired cell and input your values. Start from Opening 1.

To delete or insert a row, right click on a row header and select the appropriate command from the popup menu.

Inside

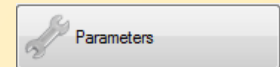


Outside

	Sill Height H _i	Soffit Height H _s	Width	Variation	Adiabatic
	m	m	m		
Opening 1	0	4	4.2	Stepwise	no
Opening 2	0	2	1	Stepwise	no
Opening 3					

OK Cancel

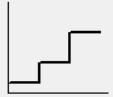
Properties of
layers for each
wall



Temperature Dependent Openings

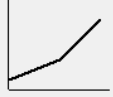
Temperature Dependent: 400 °C

Stepwise Variation



Temperature °C	% of Total Openings
20	10
400	50
500	100

Linear Variation



Temperature °C	% of Total Openings
20	10
400	50
500	100

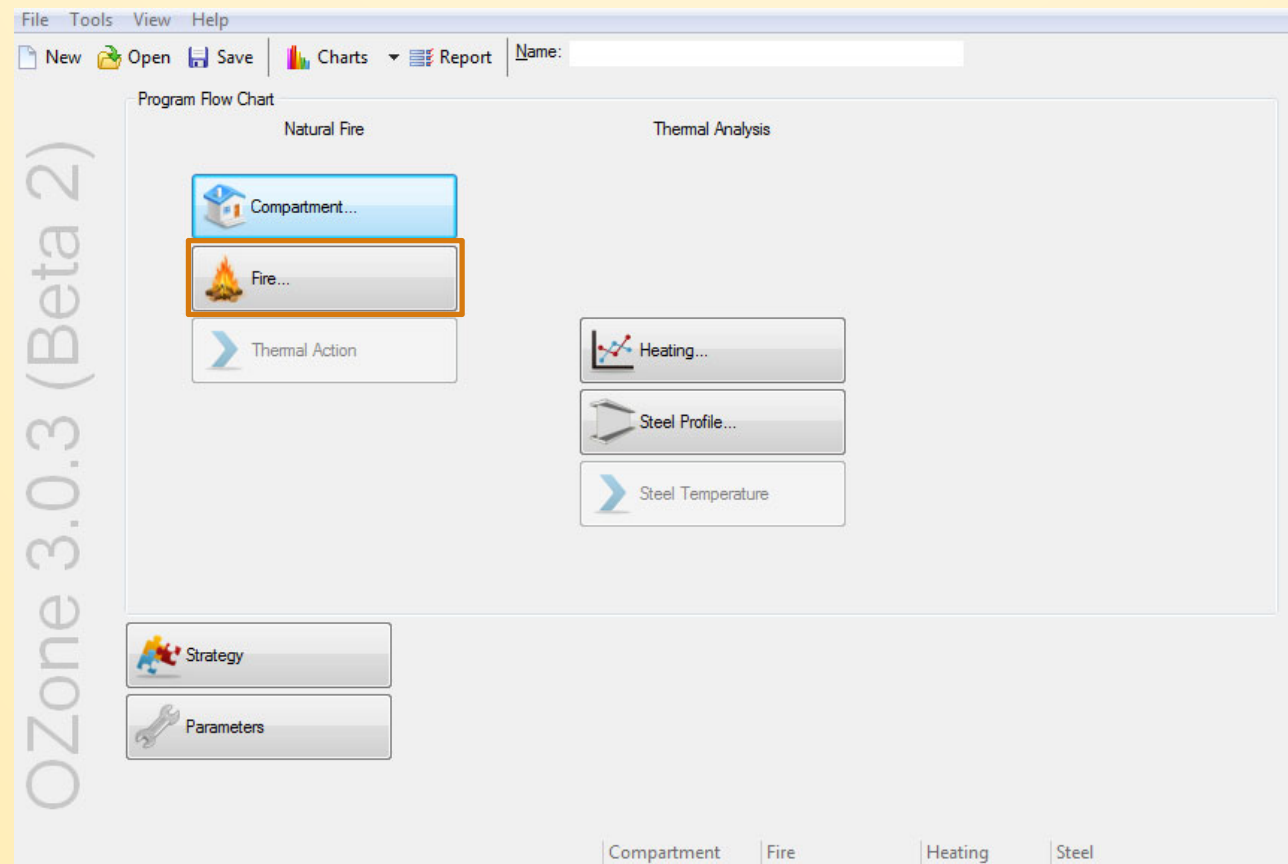
Time Dependent Openings

Time sec	% of Total Openings
0	5
1200	100

Openings

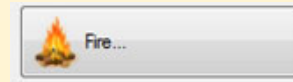
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5.1. OZone Compartment



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5.1. OZone Compartment



Fire

File Tools View Help

Compartment Fire: ☒ Annex E (EN 1991-1-2) ☐ User Defined Fire

Localised Fire: ☐ Localised Fire

National Annex:

Occupancy	Fire Growth Rate	RHRf [kW/m²]	Fire Load q _{f,k} 80% Fractile MJ/m²	Danger of Fire Activation
School	Medium	250	347	1

Active Fire Fighting Measures

- ☐ Automatic Water Extinguishing System $\delta_{n,1}=1$
- ☐ Independent Water Supplies ☒ 1 ☐ 2 $\delta_{n,2}=1$
- ☐ Automatic Fire Detection by Heat $\delta_{n,3}=1$
- ☐ Automatic Fire Detection by Smoke $\delta_{n,5}=1$
- ☐ Automatic Alarm Transmission to Fire Brigade $\delta_{n,6}=1$
- ☐ Work Fire Brigade $\delta_{n,8}=1$
- ☐ Off Site Fire Brigade $\delta_{n,9}=1$
- ☒ Safe Access Routes $\delta_{n,10}=1$
- ☐ Staircases Under Overpressure in Fire Alarm $\delta_{n,10}=1$
- ☒ Fire Fighting Devices $\delta_{n,10}=1$
- ☒ Smoke Exhaust System $\delta_{n,10}=1$

Fire Info

Max Fire Area: m²

Fire Elevation: m

Fuel Height: m

Design Fire Load

Fire Risk Area: m² $\delta_{q,1}=1$

Danger of Fire Activation: $\delta_{q,2}=1$

Active Measures: $\prod \delta_{n,i}=1$

$q_{f,d} = \delta_{q,1} \delta_{q,2} \prod \delta_{n,i} m q_{f,k} = 277.6 \text{ MJ/m}^2$

Combustion

Combustion Efficiency Factor:

Combustion Model:

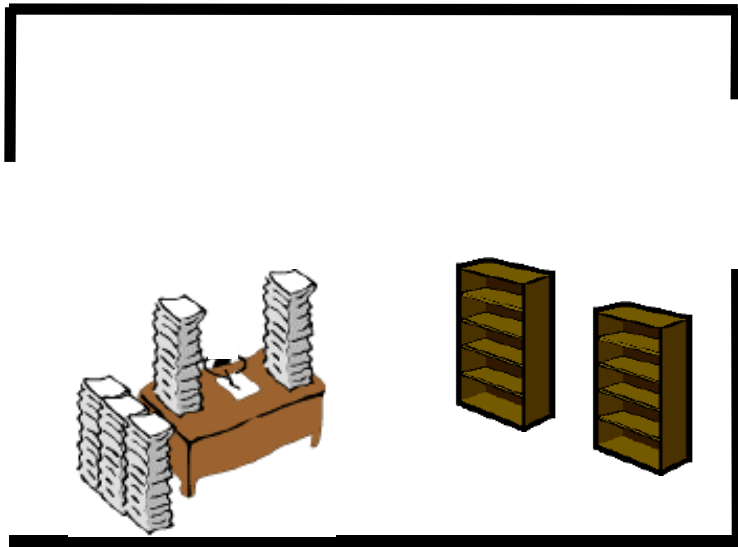
Stoichiometric Coefficient:

OK Cancel

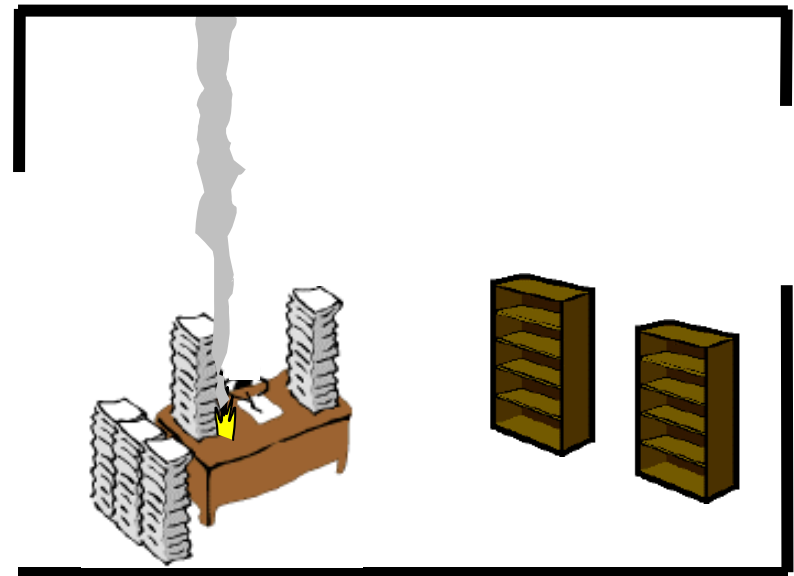
5. Software

5.1. OZone Compartment

Before the fire



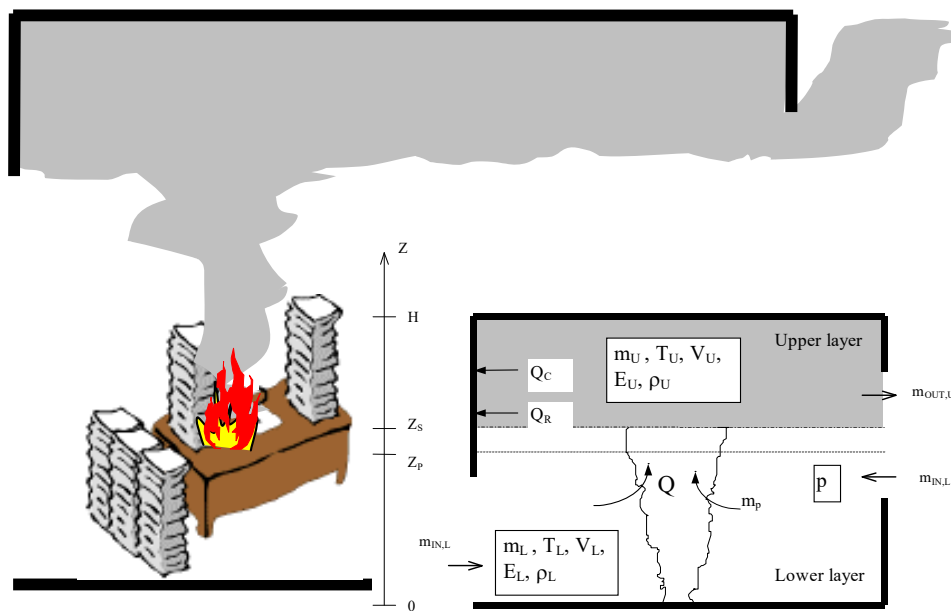
Ignition



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5.1. OZone Compartment

Localised fire

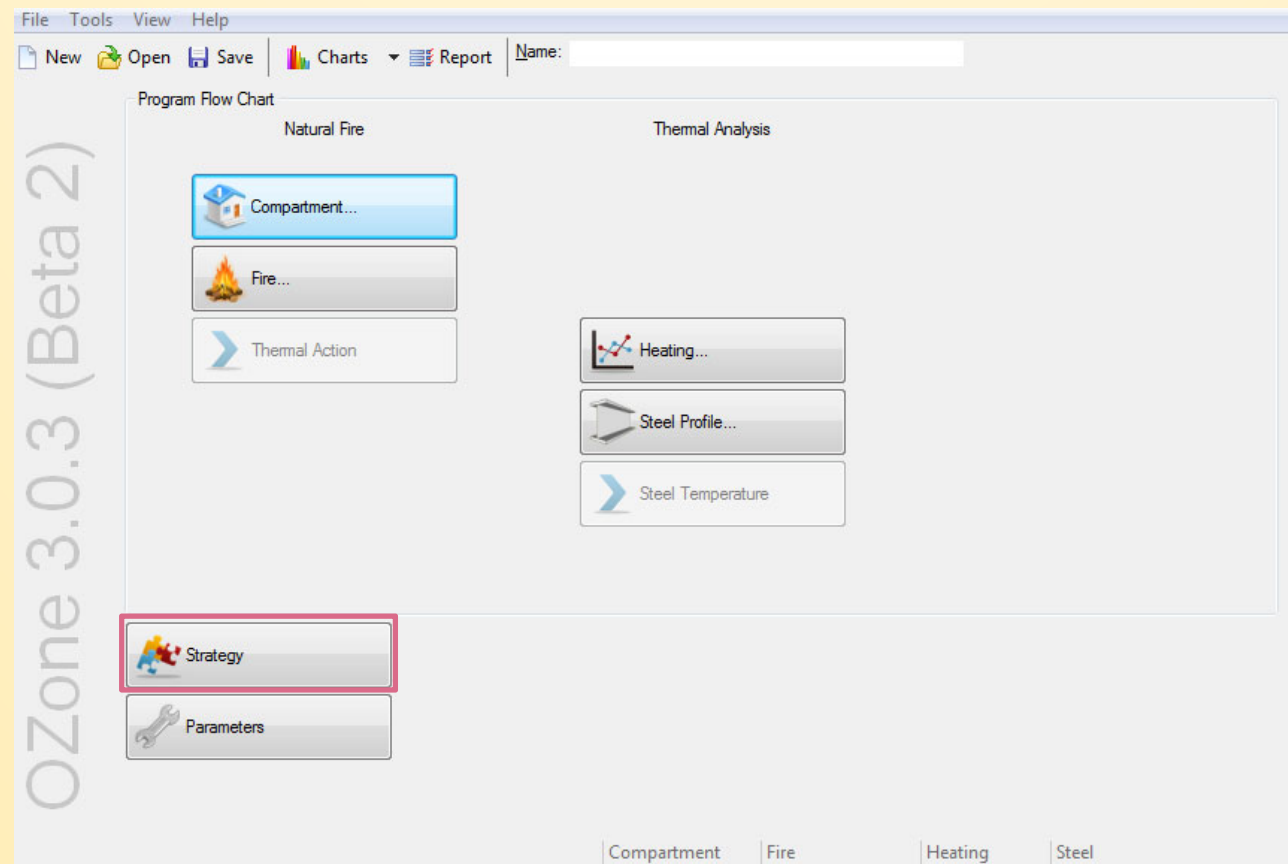


Fully-developed fire



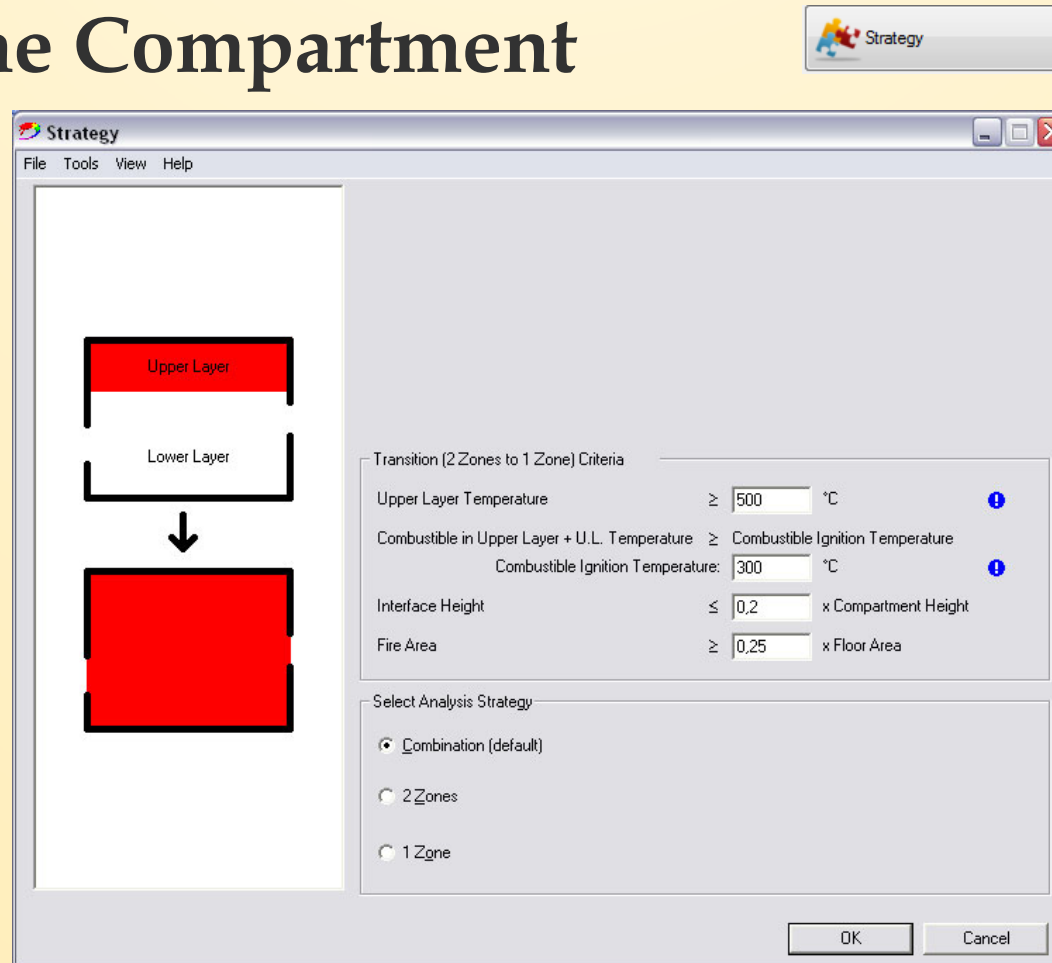
5. Software

5.1. OZone Compartment



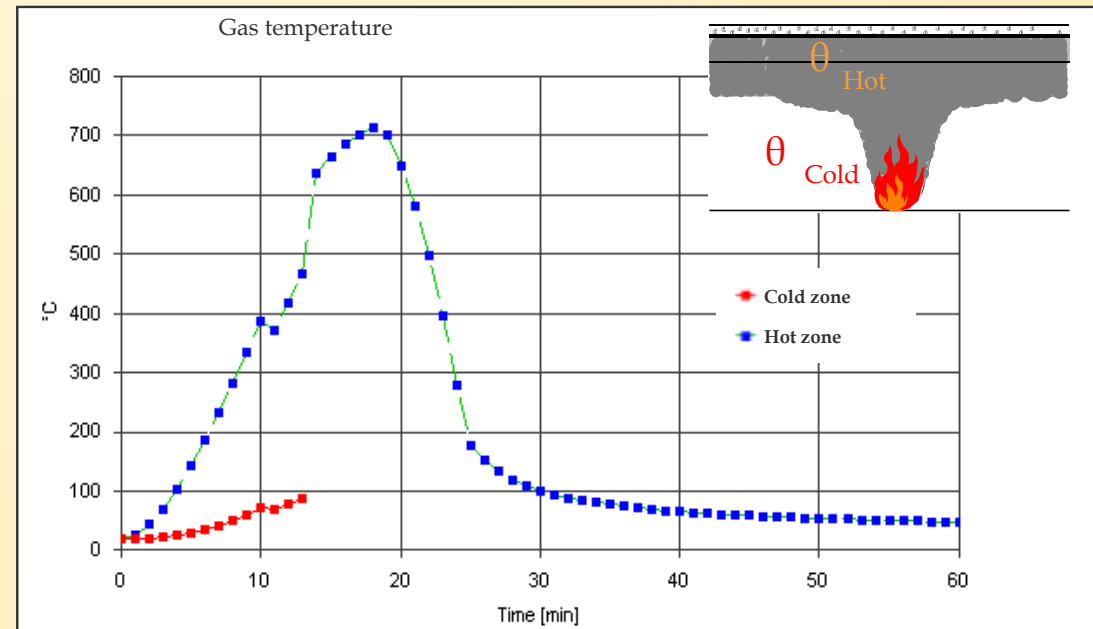
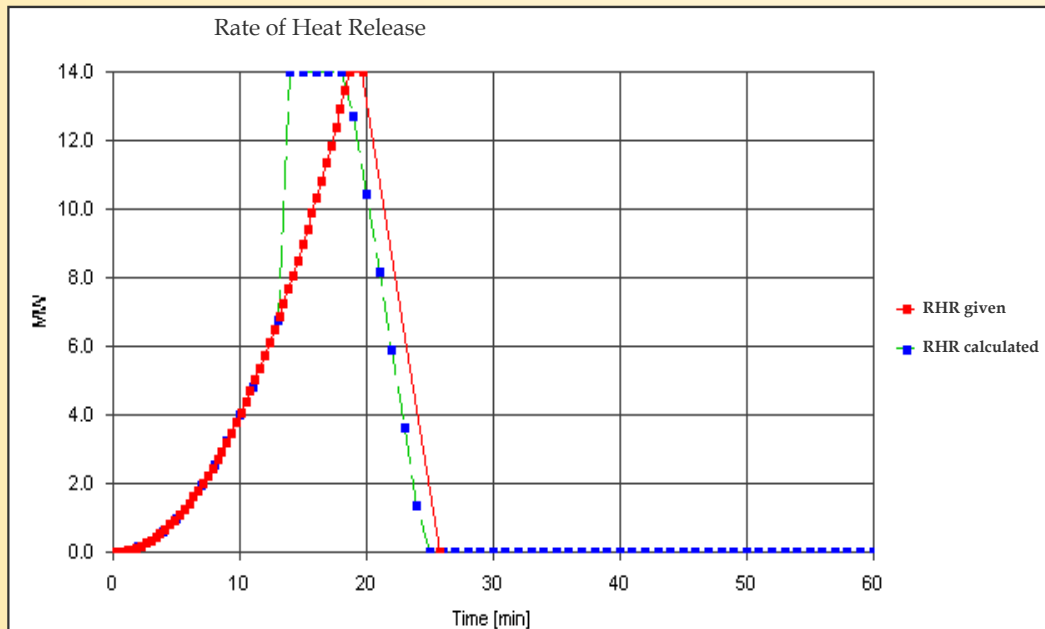
5. Software

5.1. OZone Compartment



5. Software

5.1. OZone Compartment



After 13 minutes, the hot zone temperature reaches 500°C → Switch from 2 zones to 1 zone

5. Software

5.1. OZone Compartment

The screenshot shows the 'Fire' software window with the following components:

- Menu Bar:** File, Tools, View, Help
- Compartment Fire:** ☐ Annex E (EN 1991-1-2) ☒ **User Defined Fire** (highlighted with an orange box)
- Localised Fire:** ☐ Localised Fire
- Table:** A table with 5 columns: Point, Time (sec), RHR (MW), mf (kg/s), and Fire Area (m²). It contains 23 rows, with rows 1-10 visible.
- Data Points:** Buttons for 'Save...' and 'Load...'.
- Fire Info:** Fields for 'Max Fire Area' (m²), 'Fire Elevation' (m), and 'Fuel Height' (m).
- User Defined Fire Columns:** Radio buttons for 'Only RHR' (selected), 'Only mf', 'RHR and mf', and a checkbox for 'Fire Area'.
- Combustion:** Fields for 'Combustion Efficiency Factor' (0.8), 'Combustion Model' (No combustion mode), and 'Stoichiometric Coefficient' (1.27).
- Buttons:** 'OK' and 'Cancel' at the bottom right.

5. Software

5.2. OZone Localised fire

File Tools View Help

Compartment Fire: ☐ Annex E (EN 1991-1-2) ☐ User Defined Fire

Localised Fire: ☒ Localised Fire

Number of fires: 1

Select fire: 1

Fire	Diametre [m]	Pos X [m]	Pos Y [m]
Fire 1	3	2.5	1.25
Fire 2			
Fire 3			
Fire 4			
Fire 5			

Diameter and position of the localised fire(s)

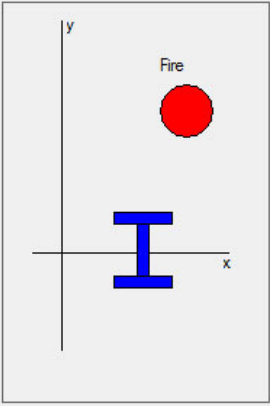
Geometrical Data

Ceiling Height: 3.5 m

Distance on Axis (x): 0 m

Height on Axis (z): 3.4 m

The target (column,...) is always on the axis $y = 0$. It is recommended to set it on $x = 0$



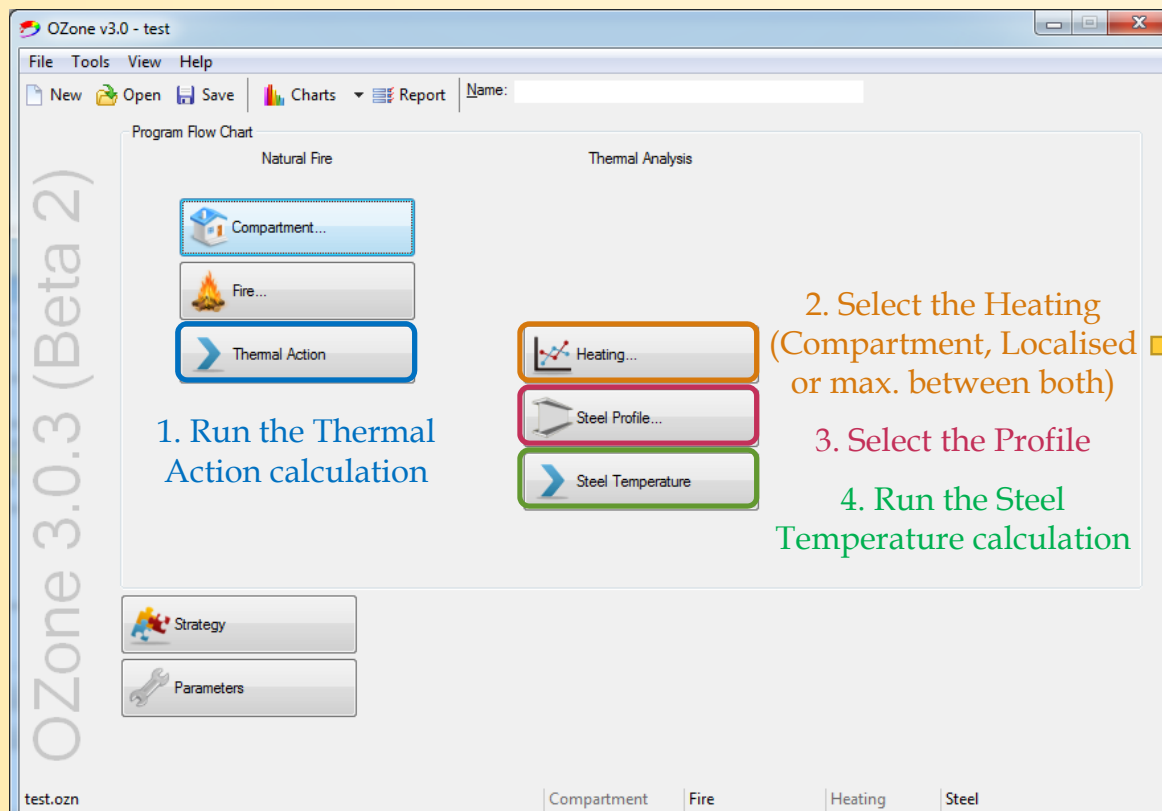
	Time [min]	RHR [MW]
Point 1	0	0
Point 2	5	1
Point 3	10	2
Point 4	15	2.5
Point 5	20	1.5
Point 6	25	0
Point 7		
Point 8		
Point 9		
Point 10		
Point 11		
Point 12		
Point 13		
Point 14		
Point 15		
Point 16		
Point 17		
Point 18		
Point 19		
Point 20		

Evolution of RHR

OK Cancel

5. Software

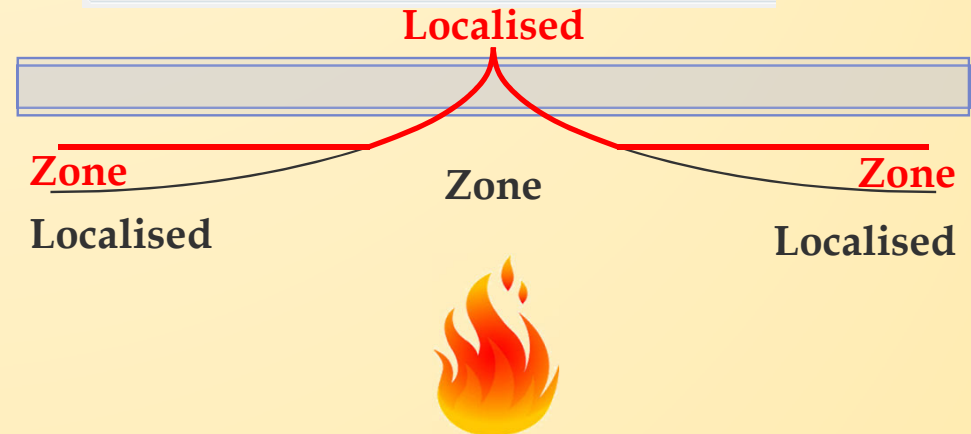
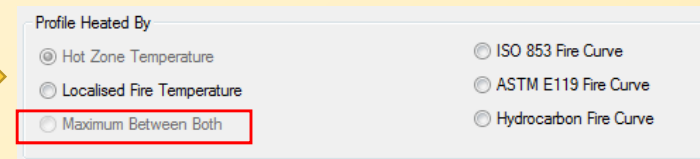
5.2. OZone Localised fire



EN 1991-1-2 § 3.3.2 (4)

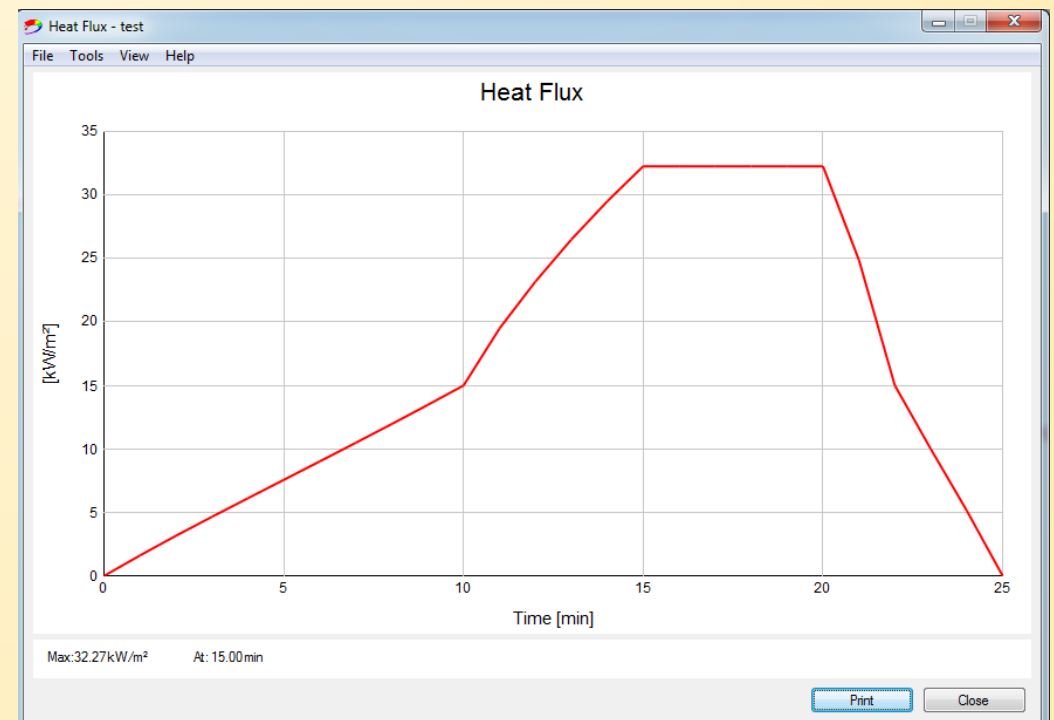
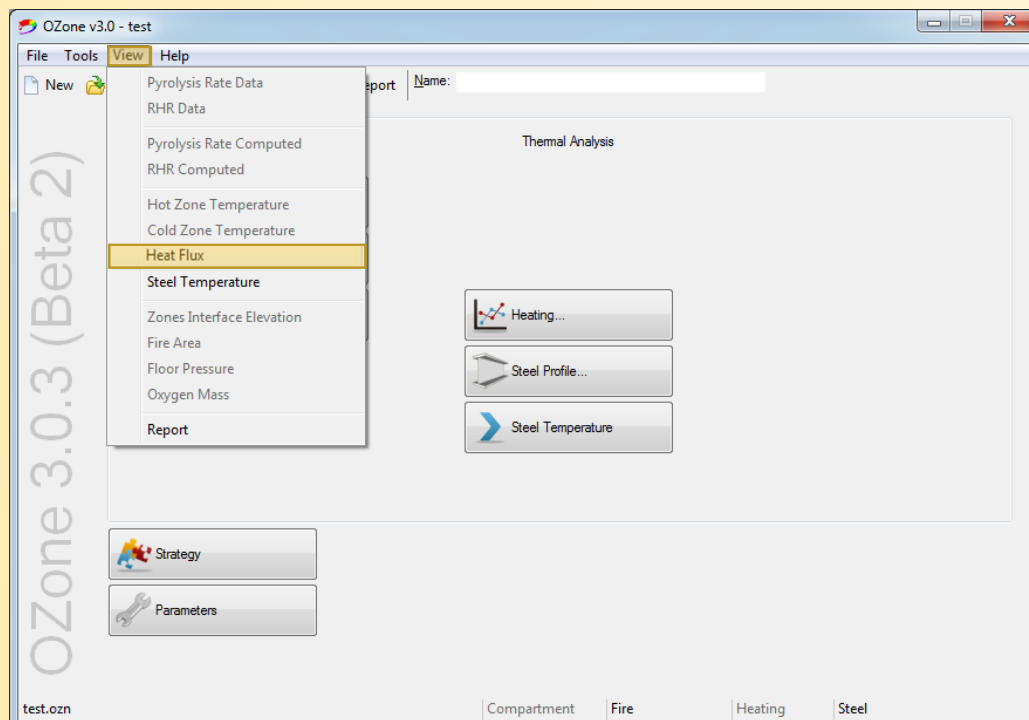
In order to calculate more accurately the temperature distribution along a member, in case of a localised fire, a combination of results obtained with a two-zone model and a localised fire approach may be considered.

NOTE The temperature field in the member may be obtained by considering the maximum effect at each location given by the two fire models.



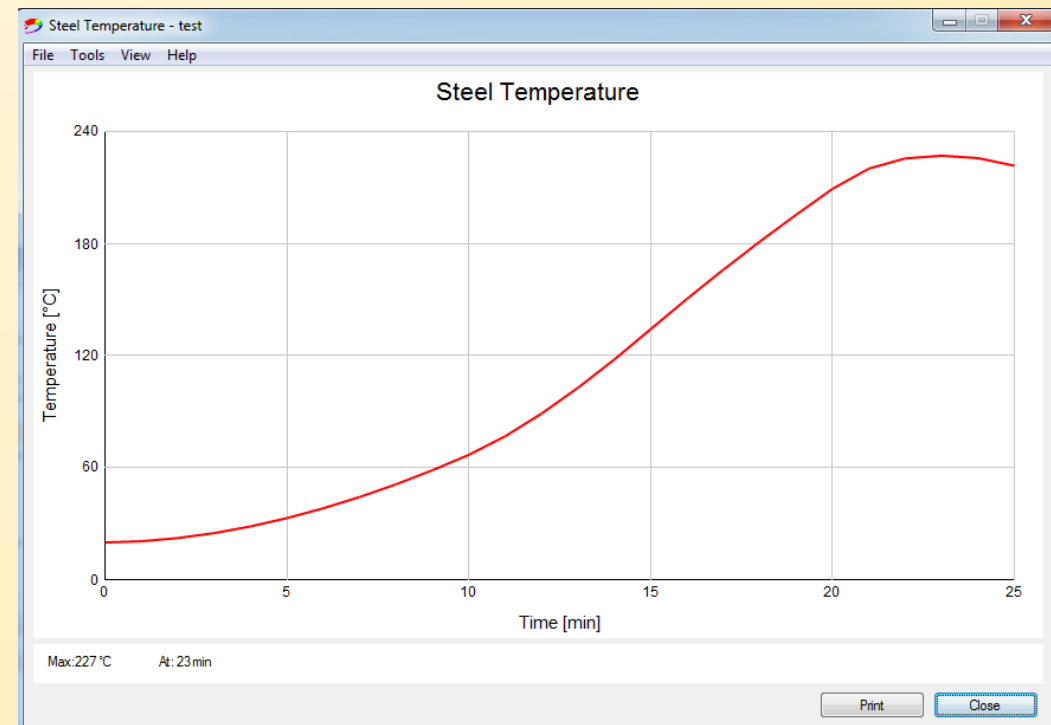
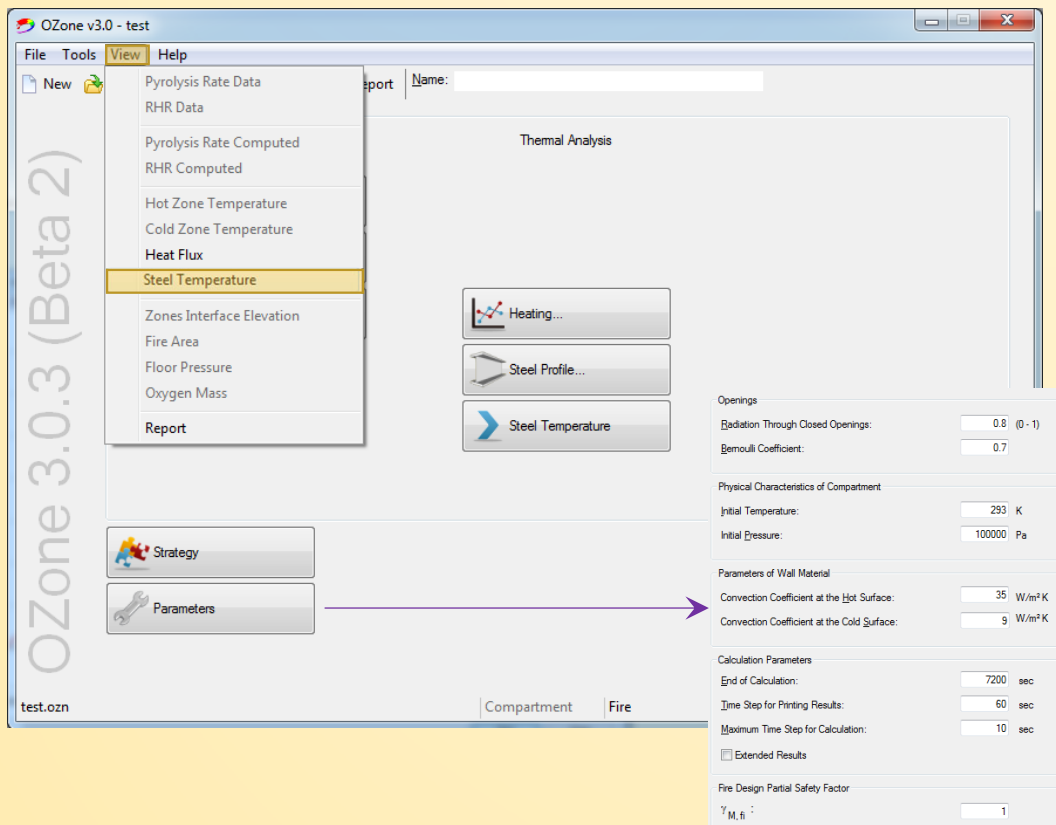
5. Software

5.2. OZone Localised fire



5. Software

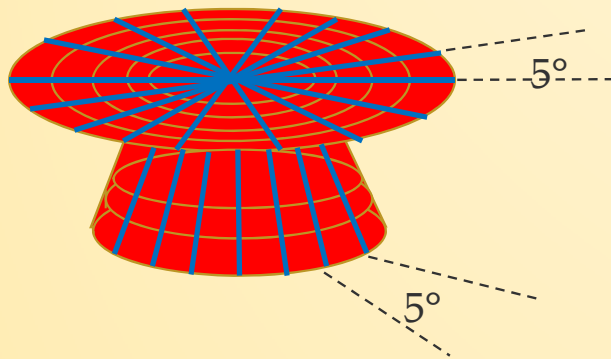
5.2. OZone Localised fire



5. Software

5.3. SAFIR Localised fire

Cylinder flame
(touching the ceiling)



- Geometrical method has been implemented into SAFIR (direct heat exchange between finite surfaces).
- This generates **non-uniform distributions of temperature** in the analysed sections.
- Each fire source is described by position (x, y, z), shape (cylinder or cone), vertical position of the ceiling, evolution of diameter according to time, evolution of RHR according to time.
- In case of several fires, contributions are summed up and limited to 100 kW/m^2

Franssen, J.-M., & Gernay, T. (2017). Modeling structures in fire with SAFIR®: Theoretical background and capabilities. Journal of Structural Fire Engineering, 8(3), 300-323.

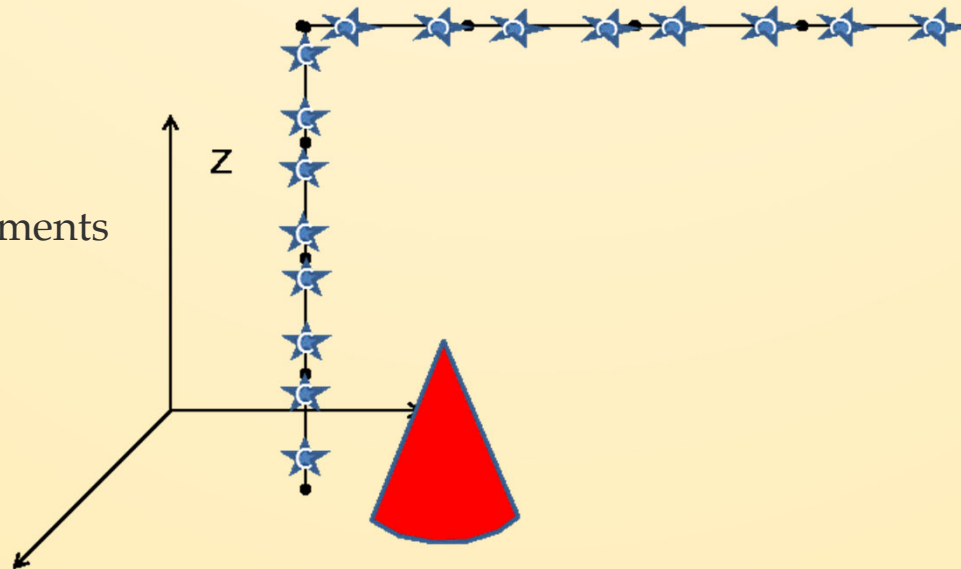
5. Software

5.3. SAFIR Localised fire

- One 2D thermal analysis is performed in each Gauss point of each beam (or shell) finite element.

This beam has 4 finite elements => 8 points of Gauss

This column has 4 finite elements
=> 8 points of Gauss



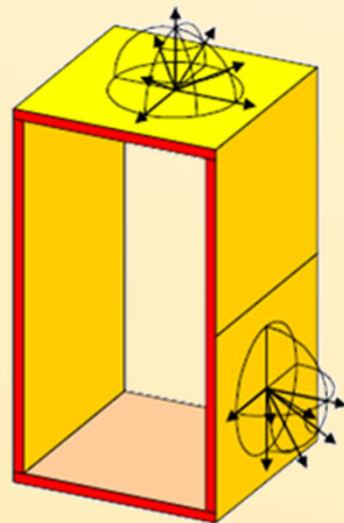
This column is not heated

5. Software

5.3. SAFIR Localised fire

- In a concave section, shadow effect is automatically considered if the section is outside the fire.

Convex shape



Concave shape

