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Competitive Steel Building in Luxembourg Including Dwelling, Office and Shops through Fire Safety Engineering.

February 2009



Background

The “Fonds du Logement”, official organisation for social dwellings in GD Luxembourg, had a project of a building near the railways station of Luxembourg. It is composed of 5 areas : **car parks, shops, offices and dwellings:**

- The car park is located at the 2 underground levels
- Shops and offices are at the ground and first floor
- Dwellings at the second to fourth storey.

Thanks to **lobbying action from AM BCS**, the owner decided to choose a steel solution for the structure and the partitions of the building. The R&D was contacted to perform a fire safety engineering analyse in order to optimise the steel structure regarding the fire protection.

Engineering Office: BEST

Architect: D. Heirend

Owner: Fonds du Logement”,



Objectives

The objective was to develop a competitive steel structure suitable for the 3 types of occupation: dwelling, shops and offices while meeting the wish of the architects and the economical constraints of the owner.

One of the key factor of the optimisation is the fire protection which had to be dealt with by using the advanced fire engineering techniques developed by R&D in the past and included now in the Eurocodes.

Fire engineering studies have been performed by R&D and TECOM.



Fire safety analysis of the steel structure

- Definition of the different fire scenarii
- Definition of the fire curves
- Calculation of the temperature field in the section
- Structural behavior
 - **Beams**
 - **Columns**
 - **Wind bracing systems**

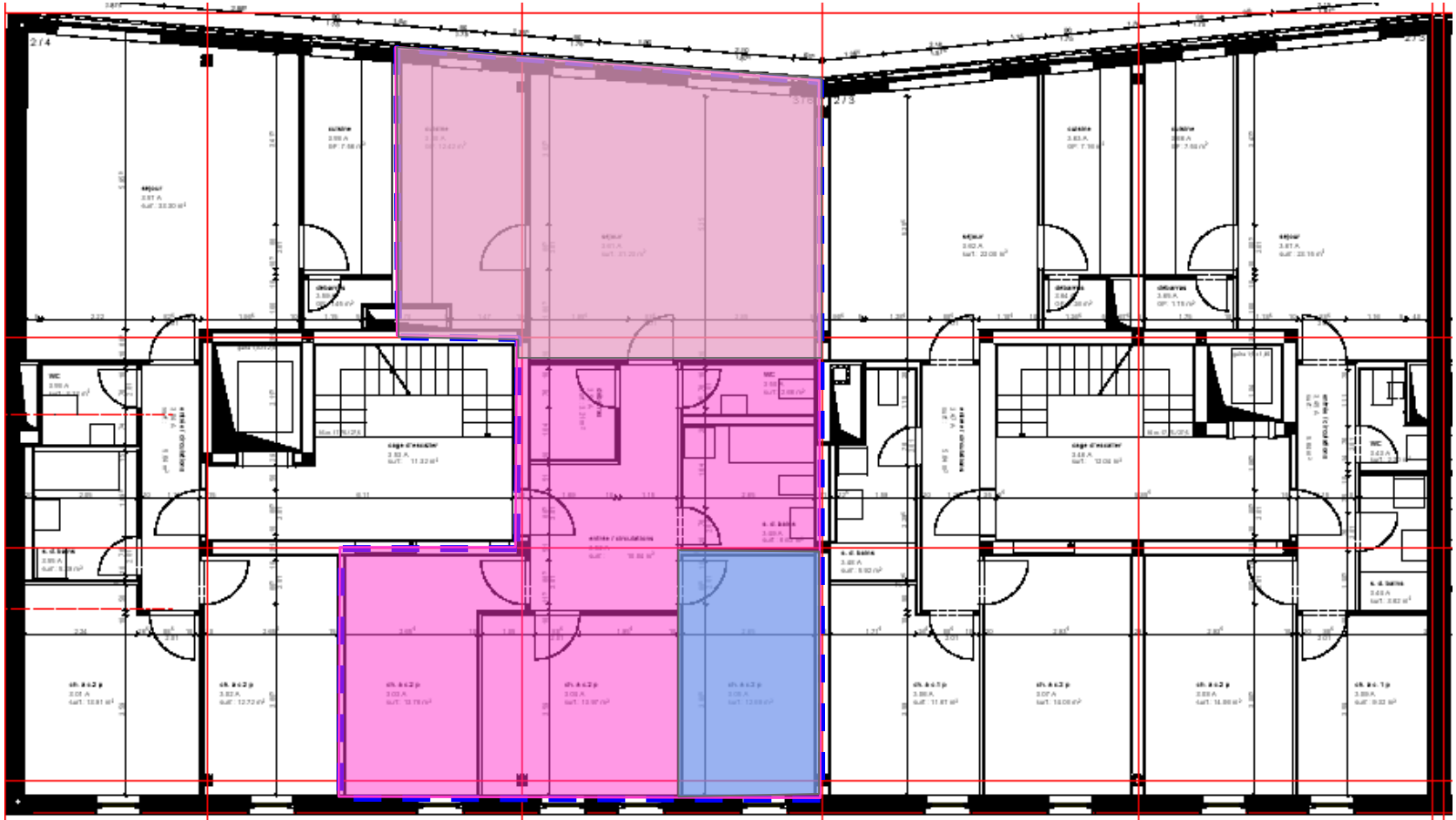
Definition of the different fire scenarii for Beams

- Dwelling storey's
 - 7 Natural Fire scenarii
- Ground and first floor (shops and offices)
 - less severe Natural Fire



Definition of the different fire scenarii

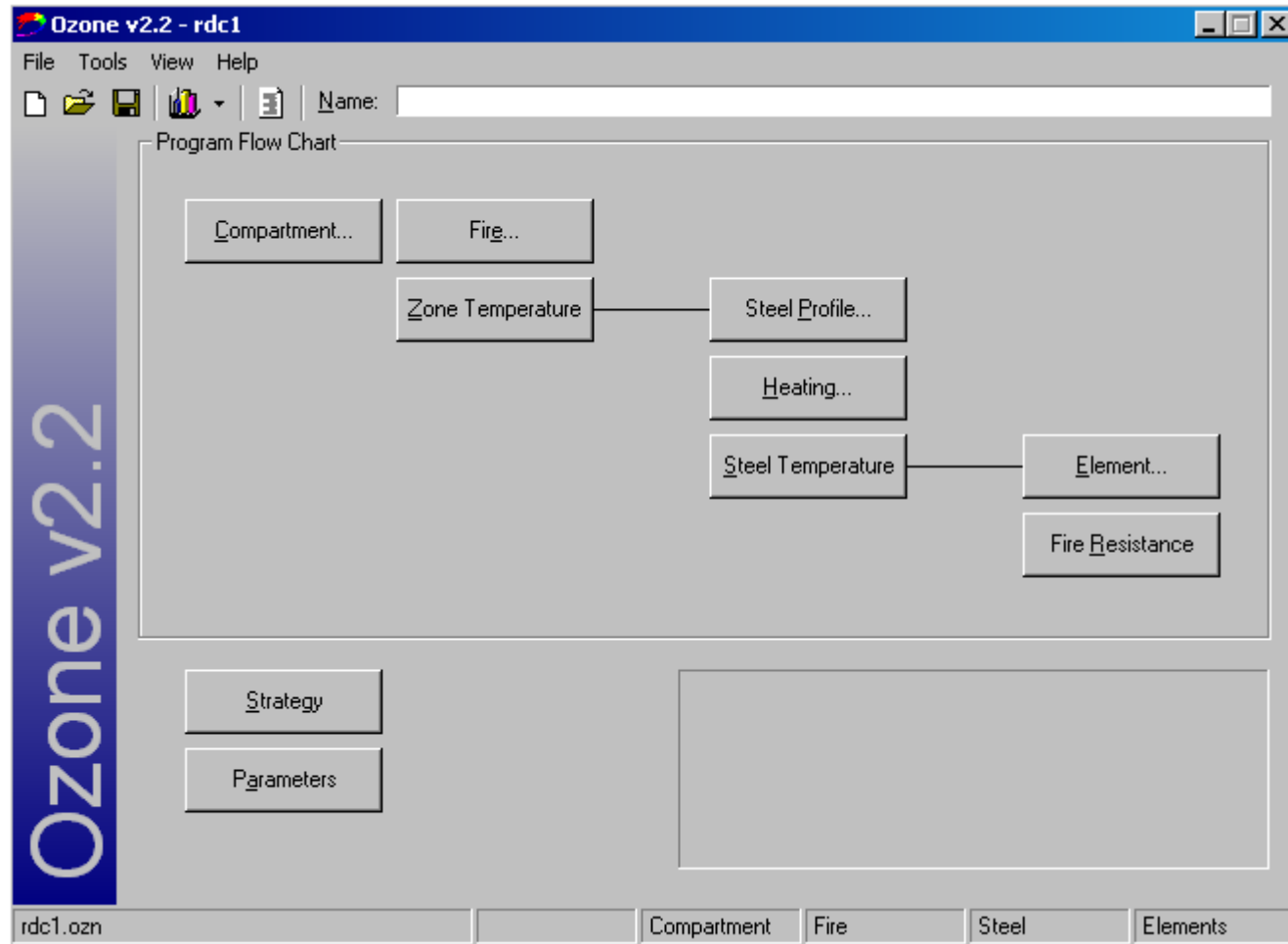
Dwelling example



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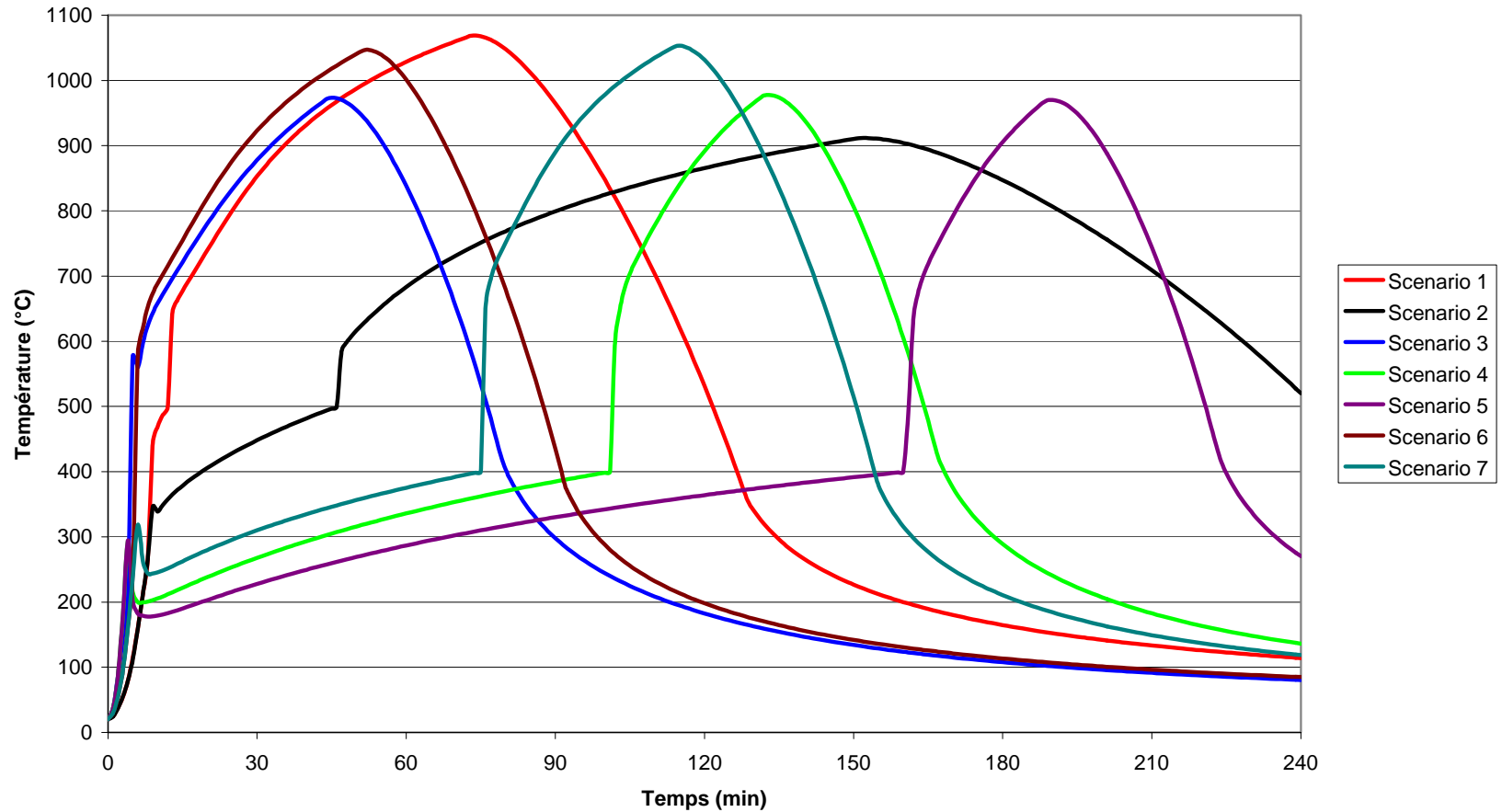
Determination of the fire curves

Calculation software according to the Eurocodes



Fire curves in the dwellings

Dwelling example - Calculated temperatures for 7 different scénarii

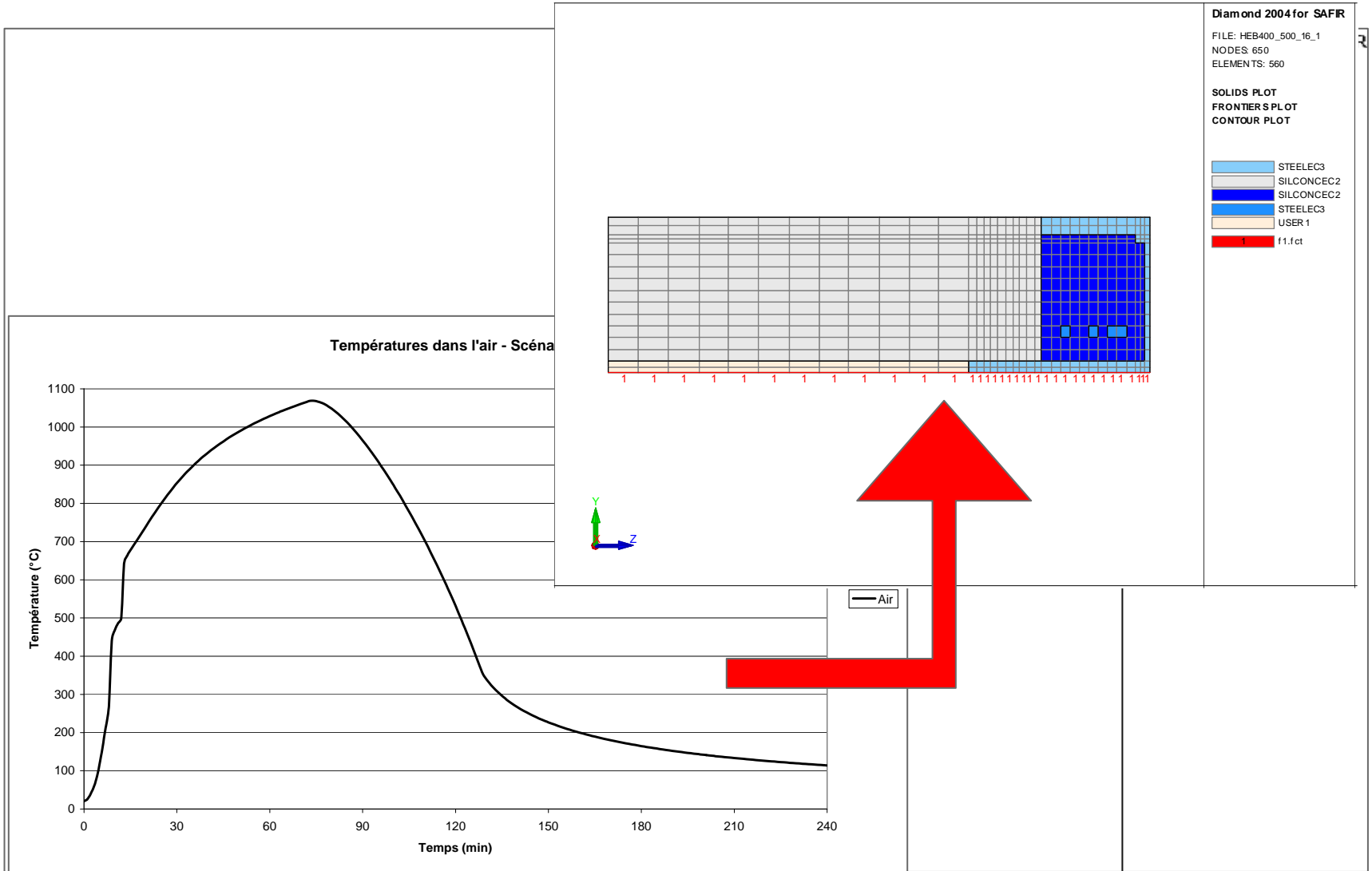


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Temperature field calculation in the sections

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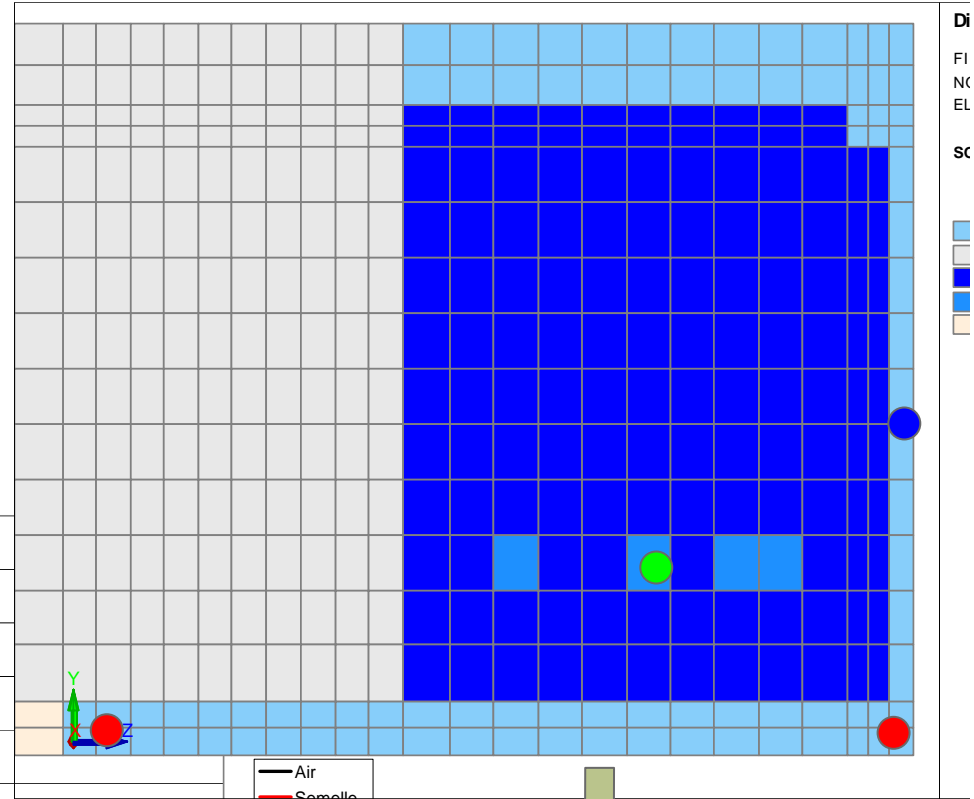
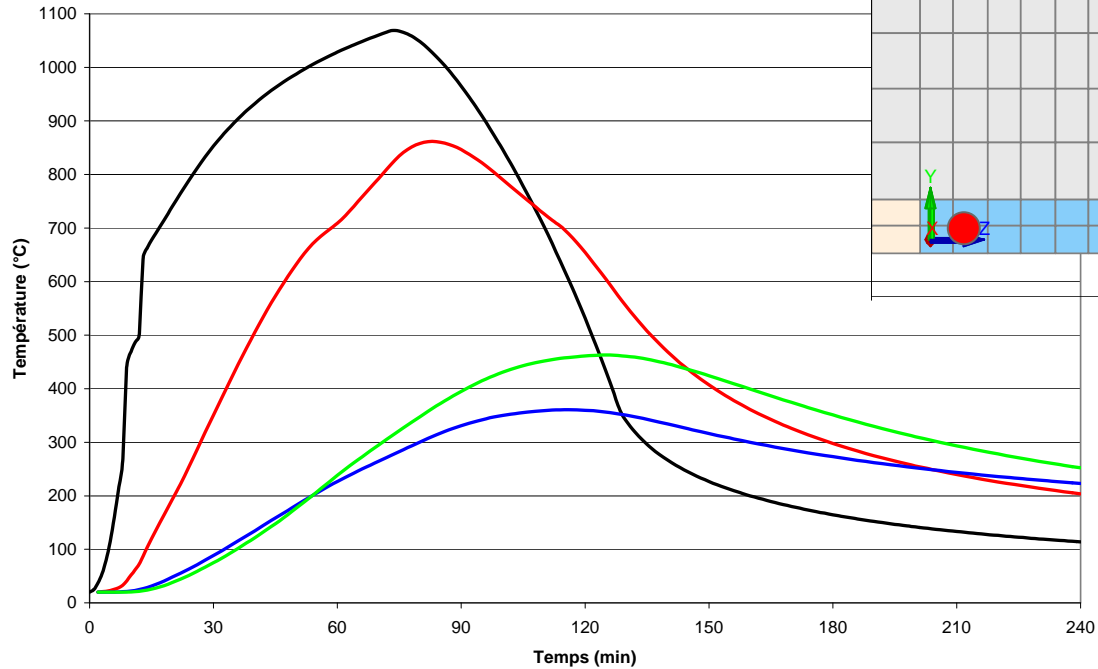




Temperature field calculation in the sections

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Températures dans la section - Scénario 1





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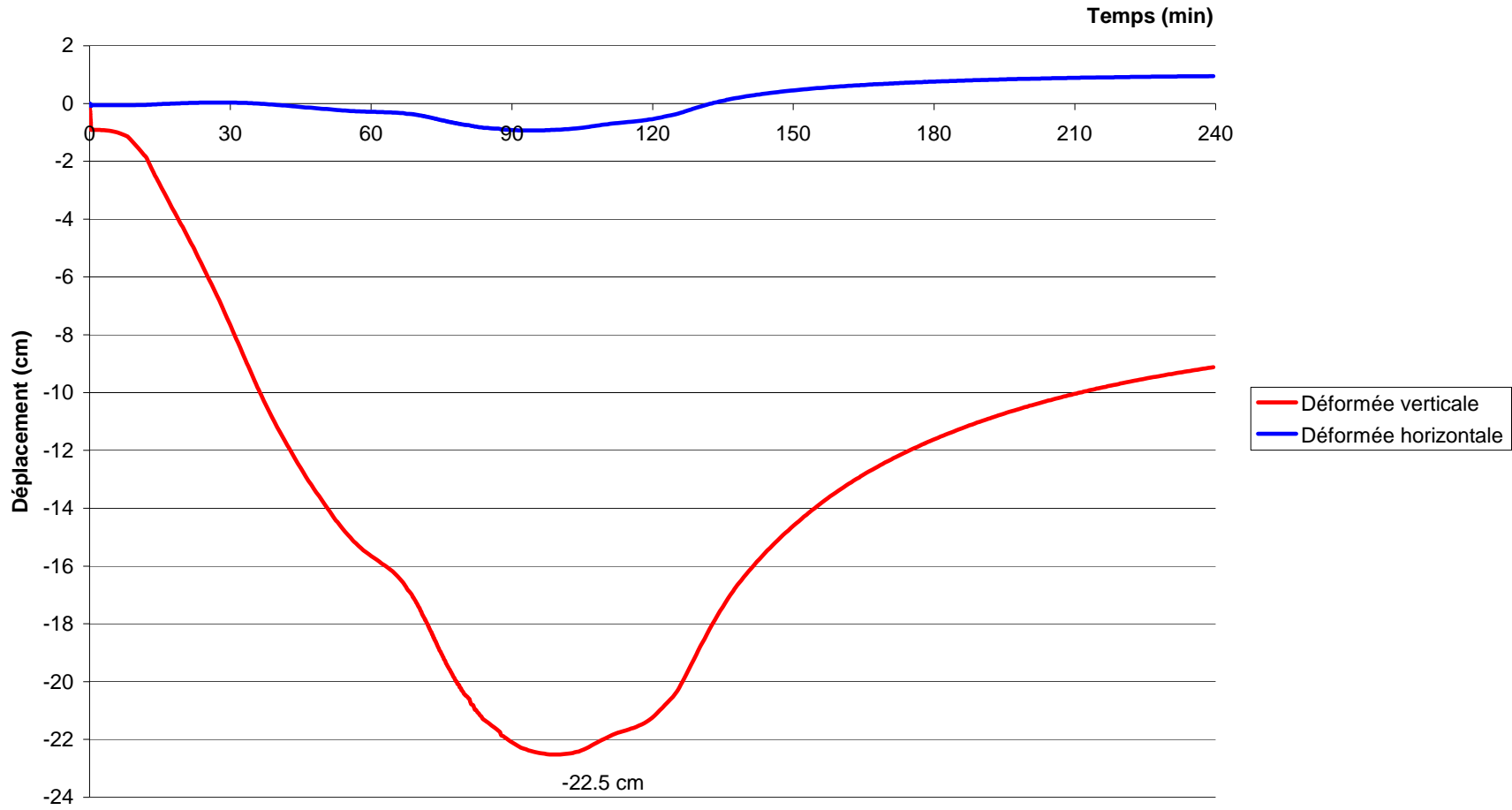
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10-02-2009

TECOM meeting

Vertical and Horizontal deformations Scenario 1

Déplacements de la poutre - Scénario 1



Definition of the different fire scenarii for Columns

- Dwelling storeys and Underground levels
 - ISO fire
- Ground and first floor
 - Shopping area (Natural Fire + Localised effect)
 - Office area (Natural Fire + Localised effect)
 - External area, range D in ground level (External Fire)



The columns of ground level situated in shops and offices close to both façades (Row A and D) will be visible. It enables to avoid the protection and really to show the steel, which delights the architect.



Row D, naked steel column

Bureau

Row B et C, composite column

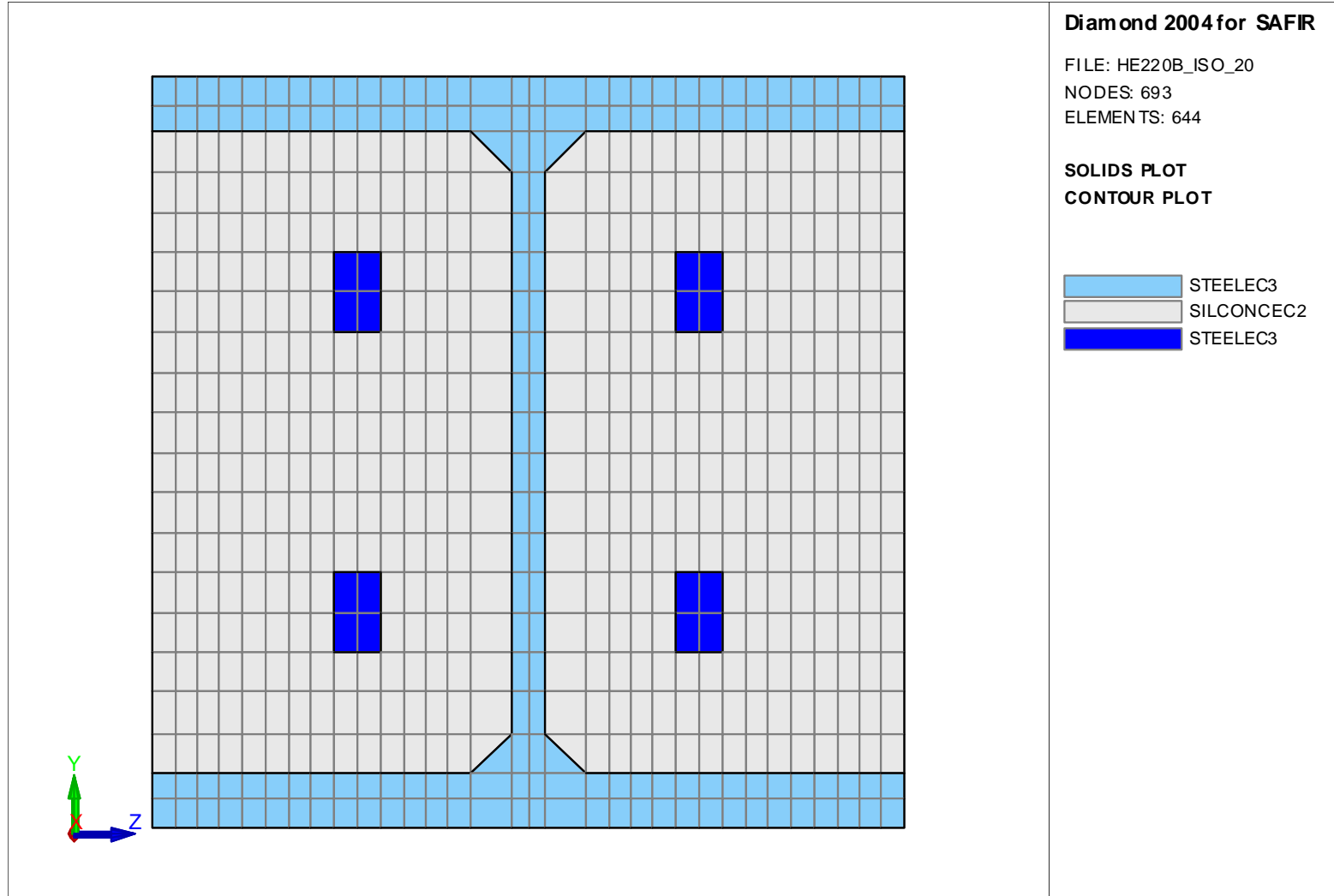
Commerce

Row A, naked steel column



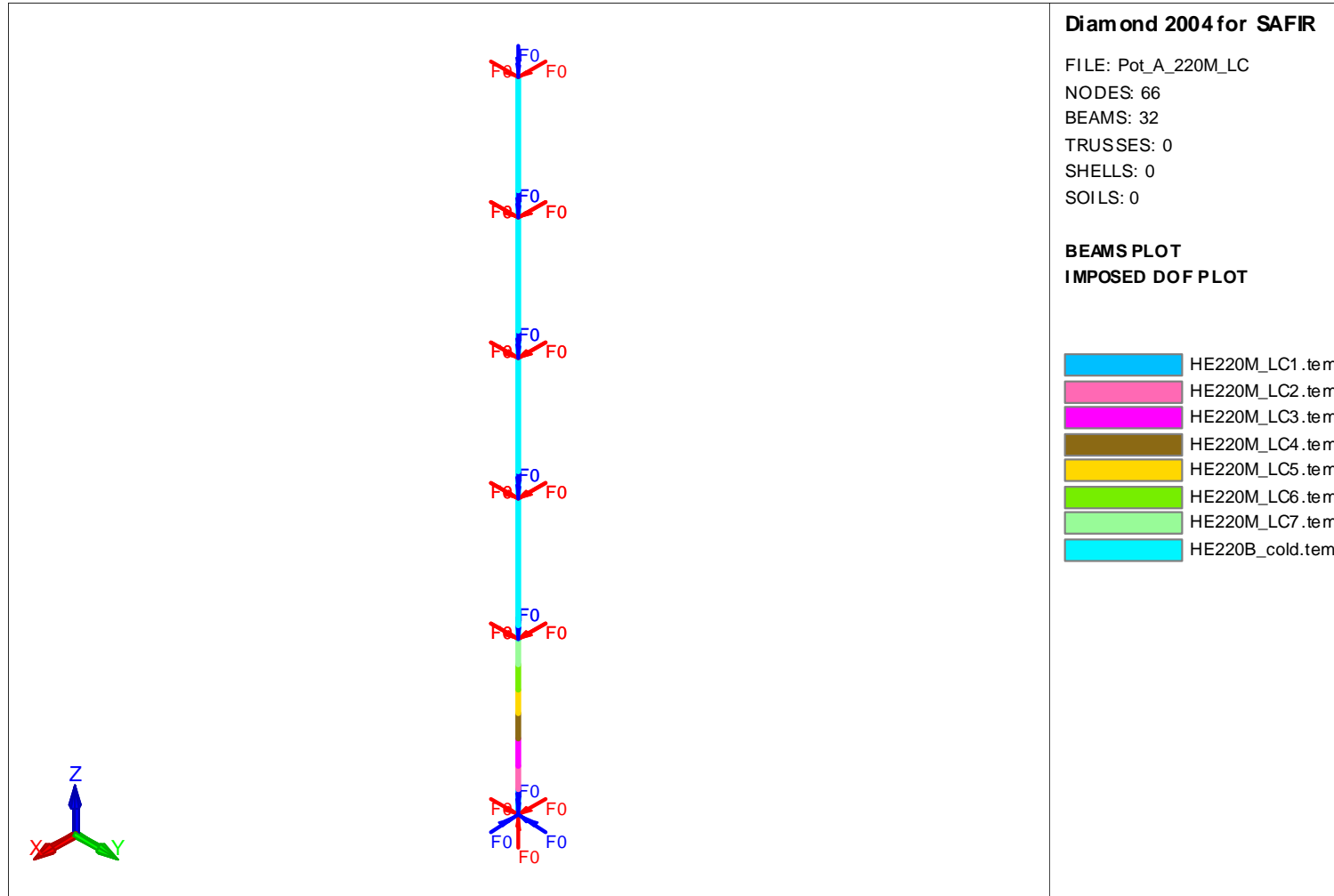
Steel-concrete composite column

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Localised fire of 0.5 m² around the column

Calculation according to EC3-1-2 Annex C

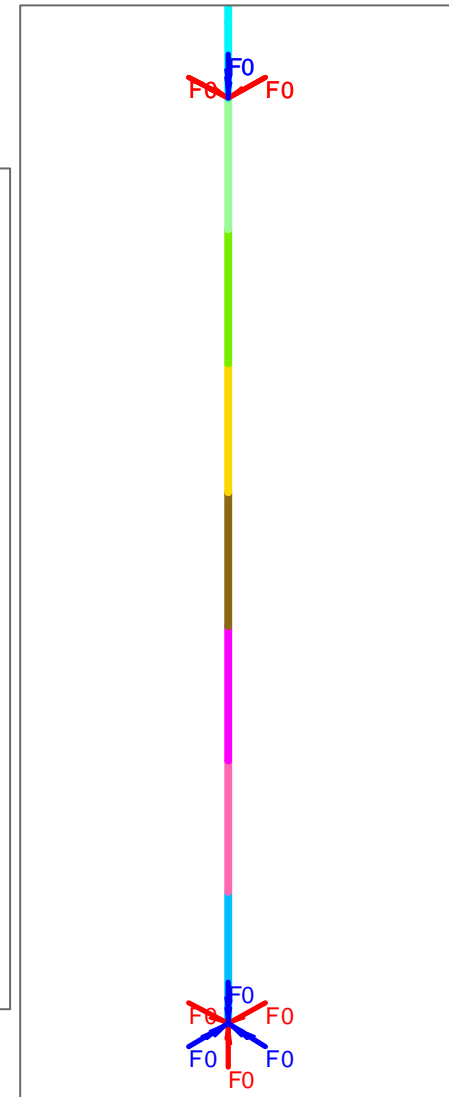
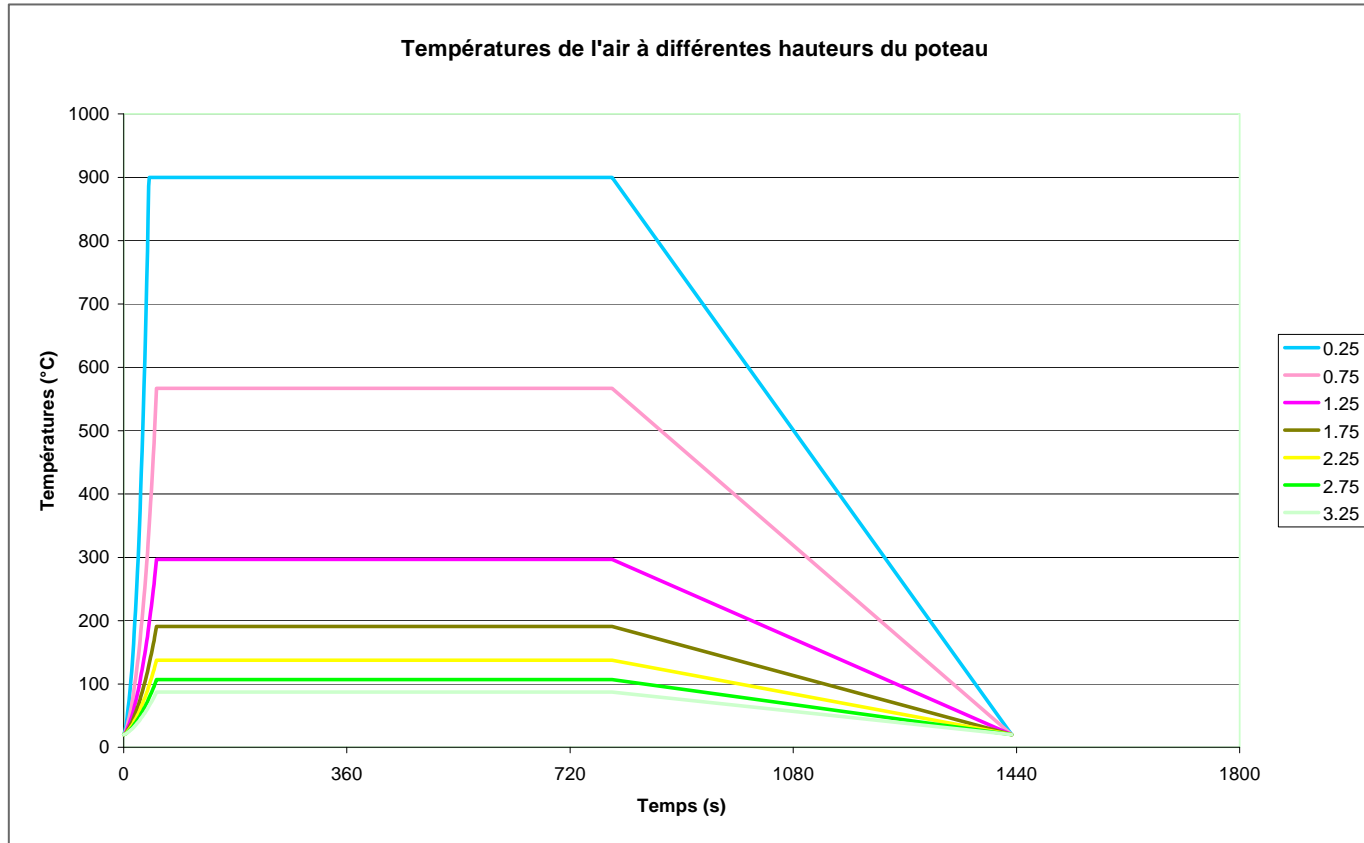


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Summary Table

Ranges		A	B	C	D
Storeys		A	B	C	D
Underground		HEB 260 + 4 ϕ 20 <i>FISO</i>	HEB 300 + 8 ϕ 20 <i>FISO</i>	HEB 300 + 8 ϕ 20 <i>FISO</i>	HEB 260 + 4 ϕ 20 <i>FISO</i>
Ground		HEM 220 <i>rdc_loc</i>	HEB 220 + 4 ϕ 20 under localised fire <i>rdc1</i> (<i>rdc2</i>)		HEB 220 ($\theta_{crit}= 638^{\circ}\text{C}$) under external fire EC1-1- 2 Annex B <i>Fires_50%</i> ($\theta_{max}= 622^{\circ}\text{C}$) <i>Fires_100%</i> ($\theta_{max}= 469^{\circ}\text{C}$)
1 st floor	Others	HEB 200 + 4 ϕ 20 <i>pr_1</i>	HEB 220 + 4 ϕ 20 <i>pr_1</i>	HEB 220 + 4 ϕ 20 <i>FISO</i> (>120') with partitions (61') without partitions	HEB 220 + 4 ϕ 20 <i>FISO</i> (86')
	Axis 7	HEB 200+ 4 ϕ 20 <i>pr_21 et pr_22</i>	HEB 220 + 4 ϕ 20 <i>pr_21 et pr_22</i>		
2 nd floor		corridor HEB 200	HEB 220 + 4 ϕ 20 <i>FISO</i> (xxx') with partitions (71') without partitions		HEB 220 + 4 ϕ 20 <i>FISO</i> (96')
3 rd floor		HEB 200+ 4 ϕ 20 <i>FISO</i> (94')	HEB 220 + 4 ϕ 20 <i>FISO</i> (xxx') with partitions (83') without partitions		HEB 200 + 4 ϕ 20 <i>FISO</i> (94')
4 th floor		HEB 200 + 4 ϕ 20 <i>FISO</i>	HEB 220 + 4 ϕ 20 <i>FISO</i> (xxx') with partitions (93') without partitions		HEB 200 + 4 ϕ 20 <i>FISO</i>



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Wind bracing systems





Project outcome

Competitive steel building reference for dwelling

- Hollerich Building is the first steel building sponsored by the “Fonds du Logement”.
- Fire safety engineering studies have managed to develop safe and competitive solutions.
- These developments have been made with the engineering office Best who will join our « secure with steel » network. It consists on another example of transfer of knowledge from R&D to engineering offices.

'Fire Safety Engineering' application to buildings in G-D of Luxembourg



SECURE with STEEL in Europe

25 European engineering offices specialized in Fire Engineering assisted by 9 universities and/or research centers



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- Austria** - Bernard Ingenieure
- Belgium** - Greisch, Technum, Steel Information Centre, Delta, University of Liège
- Czech Republic** - CTU Prague
- France** - Arches-Etudes, E2C Atlantique, Terrell International
- Germany** - Lenz Weber Ingenieure, Schmitt Schtumpf Fruhauf & Partner, BFT Cognos GmbH, Universität of Hannover
- Italy** - Studio di Ingegneria delle Strutture
- Luxembourg** - Schroeder & Associés
- Poland** - Keonn
- Portugal** - Tal Projecto, GIPAC, University of Aveiro
- Spain** - NB35, Idom, LABEIN
- Sweden** - Swedish National Testing & Research Institute
- Switzerland** - MP Ingénieurs, Borgogno Eggenberger + Partner, ETH Zürich
- The Netherlands** - DGMR, Hamerlinck Advies bureau, Cauberg-Huygens, DHV BV
- United Kingdom** - ARUP Fire, University of Edinburgh

Ebitda :
last trimester
2008: 1993 K€

