SCHOTT Fire Resistant Glazing – Protecting Occupants

Helsinki High Rise Conference 2023

Agenda

01 SCHOTT Introduction

02 Fire rated glass – the basics

a) Integrity (E) – requirements, types, functionality

b) Integrity + Radiation (EW)

c) Integrity + insulation (EI)

03 Facade systems - solutions

a) Traditional curtain wall – requirements, test methods (acc. EN standard)

b) New solutions

- Internal – high level
- Canopies
- Balcony railings
- Internal – Low level

SCHOTT products for architecture

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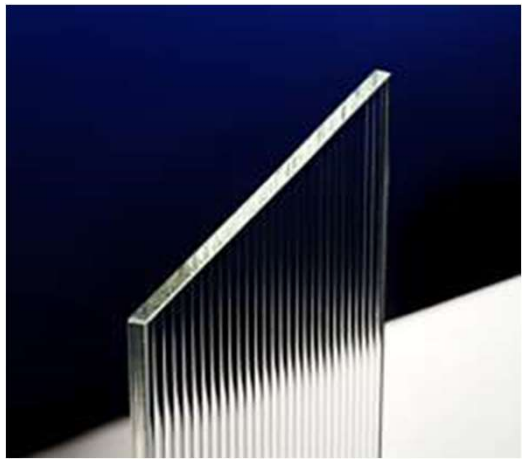
Fire Resistant Glass

Decorative Glass



Glass Tubing & Rods

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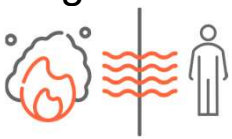
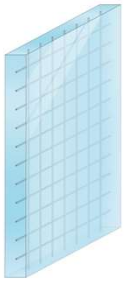
Fire rated glass – Integrity (E)

performance criteria		SCHOTT product
Regulation **E** 	Prevention of passage of flames	**PYRAN® S**
	Prevention of passage of smoke	

Soda-lime float glass with interlayers *

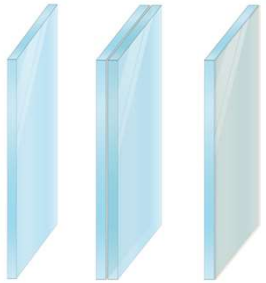
** No safety glass*



Wired glass*

Monolithic soda-lime float glass

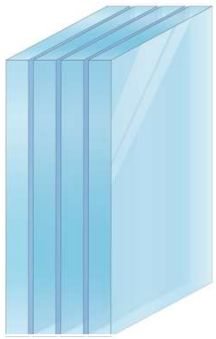
Monolithic borosilicate glass

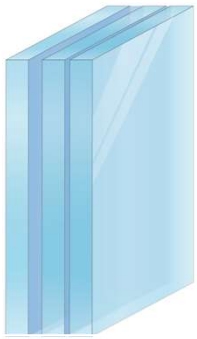


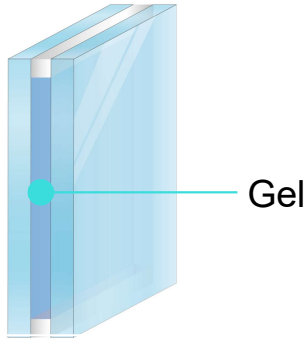
Transparent “green” floated glass-ceramic (monolithic*, laminated and filmed)

Fire rated glass – Integrity + Insulation (EI)

performance criteria		SCHOTT product
Regulation **EI** 	Prevention of passage of flames	**PYRANOVA®**
	Prevention of passage of smoke	
	Prevention of increase of temperature ≤ 140 K average, max. 180 K	
	Prevention of self ignition (cotton pad test)	







Construction: Soda-lime float glass + intumescent interlayers (foaming up)

SCHOTT glass made of ideas

Properties of fire rated glass – E glass vs. EI glass

Property	E glass (e.g.) PYRAN® S				EI glass (e.g.) PYRANOVA®			
Thickness (monolithic)	**E 30**	**E 60**	**E 90**	**E 120**	**EI 30**	**EI 60**	**EI 90**	**EI 120**
	≥ 6 mm	≥ 6 mm	≥ 6 mm	≥ 6 mm	15 mm	23 mm	37 mm	52 mm
Weight (monolithic)	14 kg	14 kg	14 kg	14 kg	36 kg	55 kg	86 kg	106 kg
Operable temperature range	No limitation				- 40 °C up to + 50 °C			
UV-stability	No limitation				Has to be protected			
Coating/printing	No limitation				Limited possibilities			
Safety	Tempered safety glass				Laminated glass			

Fire rated glazing is always a system solution

Frame

Glass

Fitting

Sealant

Blocks

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Skyscraper fires spread over the façade

Fire in London

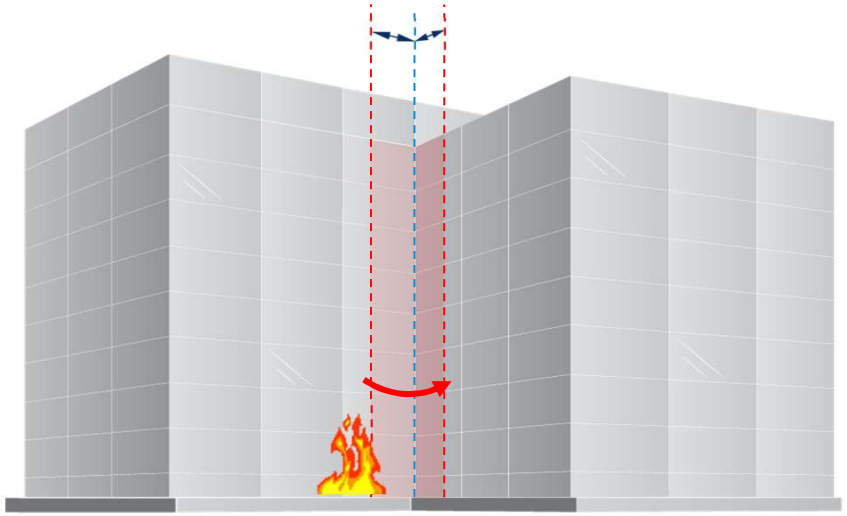
Source: https://www.spiegel.de/video/london-brand-in-hochhhaus-grenfell-tower-im-amateurvideo-video-1774795.html

Fire in Dubai

Fire rated façades – safety objectives

Objective: 1. Prevention against horizontal spreading of fire.

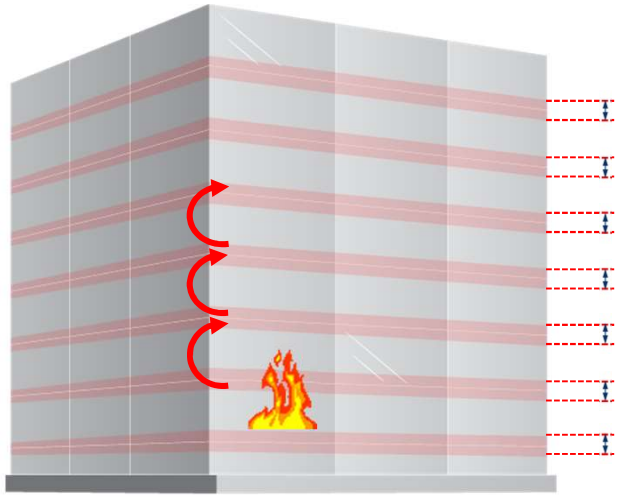
Reducing the risk of the fire spreading across the corner, the façade in this area must be fire rated. The area concerned depends on the distance to the building corner and must be defined by the local authority.



Fire rated façades – safety objectives

Objective: 2. Prevention against vertical spreading of fire.

Reducing the risk of the fire spreading from one floor to the next, the floors must be separated by a defined fire rated area.



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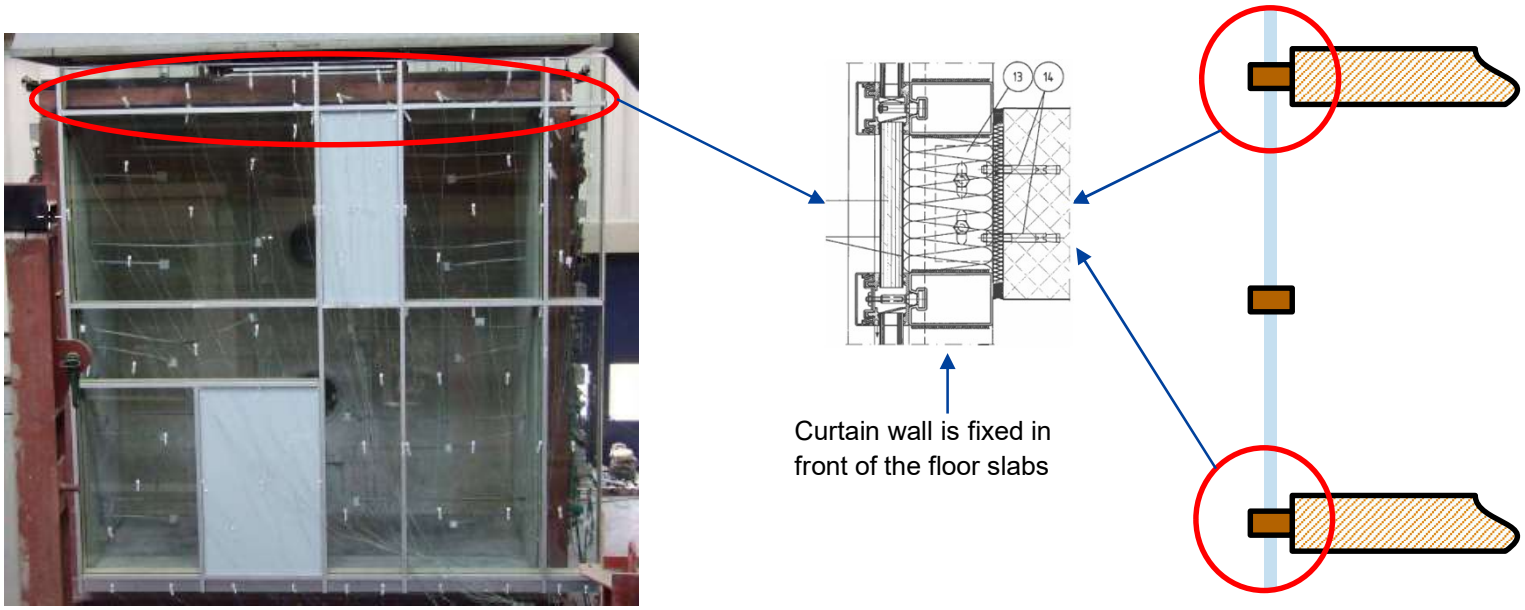
Façade systems – Curtain walls

In Europe, fire rated curtain walls are governed by the standard EN 1364.

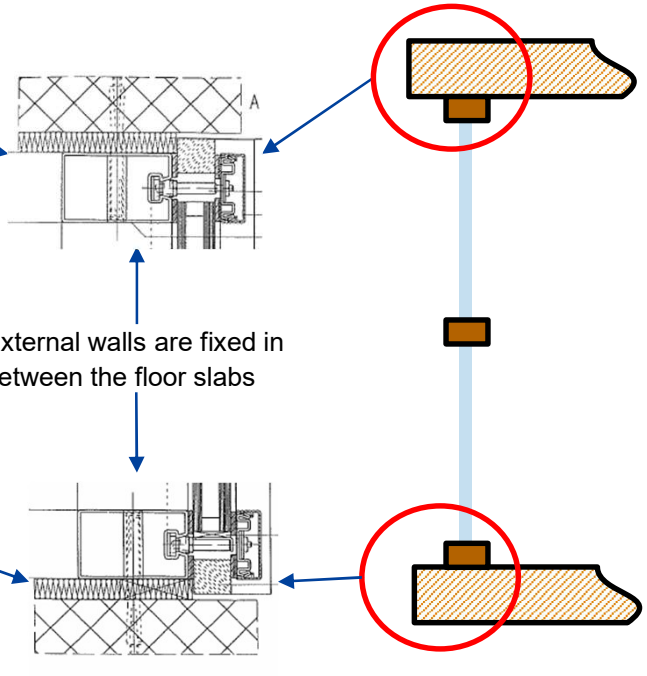


Example of a test set up at the test lab ift, Germany

Façade systems – External walls

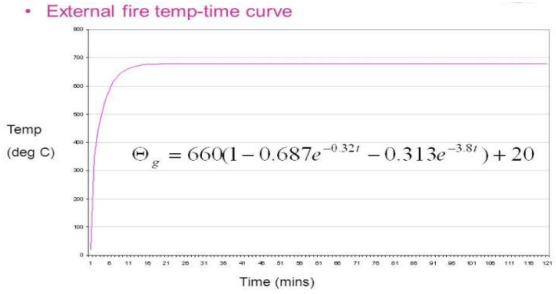
In Europe, fire rated external walls are governed by the standard EN 1364.

Example of a test set up at the test lab CTICM, France

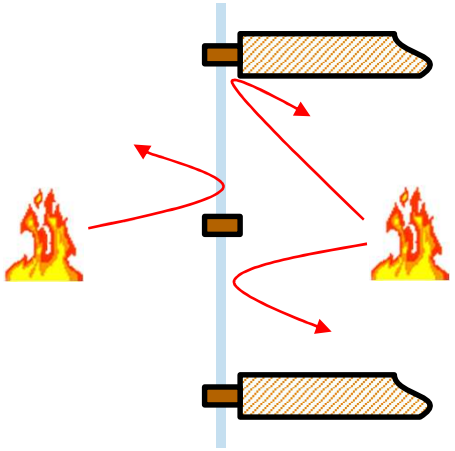


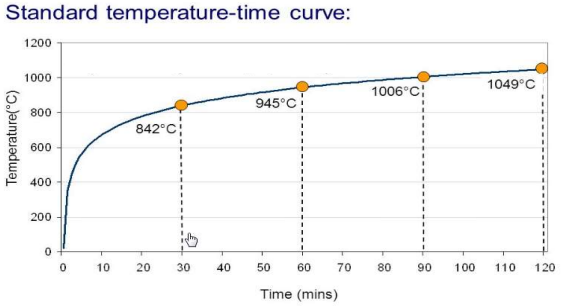
Façade systems – Curtain walls/external walls

According to EN 1364 it is possible to test curtain walls and external walls differently depending on the direction & Country



OUTSIDE





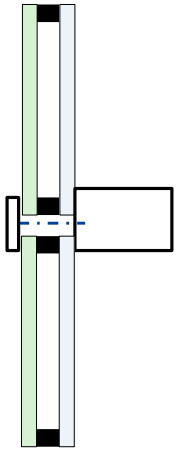
INSIDE

Because of the nature of external fire with the additional possibilities for heat dissipation,a lower level of heat exposure is given

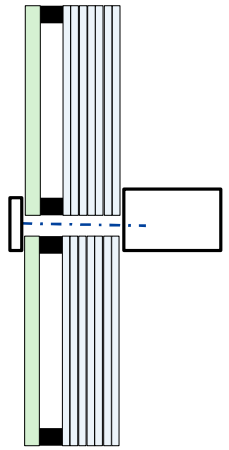
Fire rated façades – conventional solutions

Solution: Using a tested and qualified fire rated façade system.

Façade system with E glazing (e. g. PYRAN® S DGU)



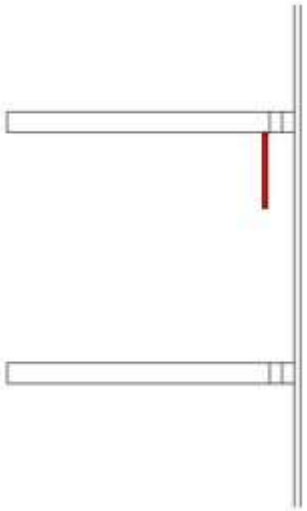
Façade system with EI glazing (e. g. PYRANOVA® DGU)



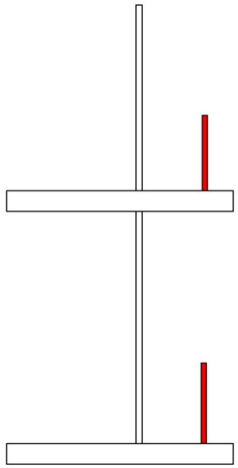
In most European countries the building code allows both classifications.
In some cases, E glazing is sufficient because there is normally no need to pass the glazing. Due to the absorption of the outside atmosphere, there is no threat by heat radiation.
When buildings are in close proximity then EI glazing may be necessary depending on distance.

SCHOTT solutions to prevent vertical spread of fire through façades – safety objectives

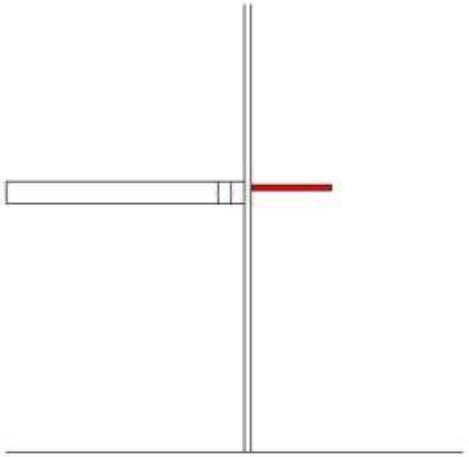
High level



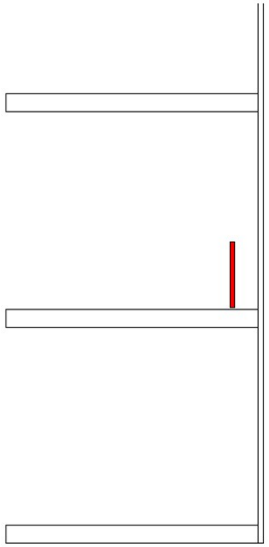
Balcony



Canopy



Low level



Research on external fire

- Carlsson (1999) states that "*time-temperature curve of the furnace tests is different from those resulting from a real fire"* . Growth rate are faster than the standards methods which do not consider the decay phase.
- Malhotra (1986) " *the main objective of provisions against external fire spread is to ensure that the possibility of a conflagration due to external fire exposure hazard is reduzed and fire spread from one building to another is prevented" &* " *There is no significant risk for radiation for temperatures at 350°C*."
- Law (1978) says that *" a major difficulty with the standard test has been encountered when building are designed with external structural steel elements. These elements are required by the codes to have the same minimum periods of fire resistance and hence the same cladding as internal elements, even though the external fire exposure conditions are known to be less severe*" Her studies define 12.6 kW/m² as critical point for pilot ignition.
- The rate of 12.6 kW/m² has been adopted for several building codes for building separation: England, United States, New Zealand, Sweden.

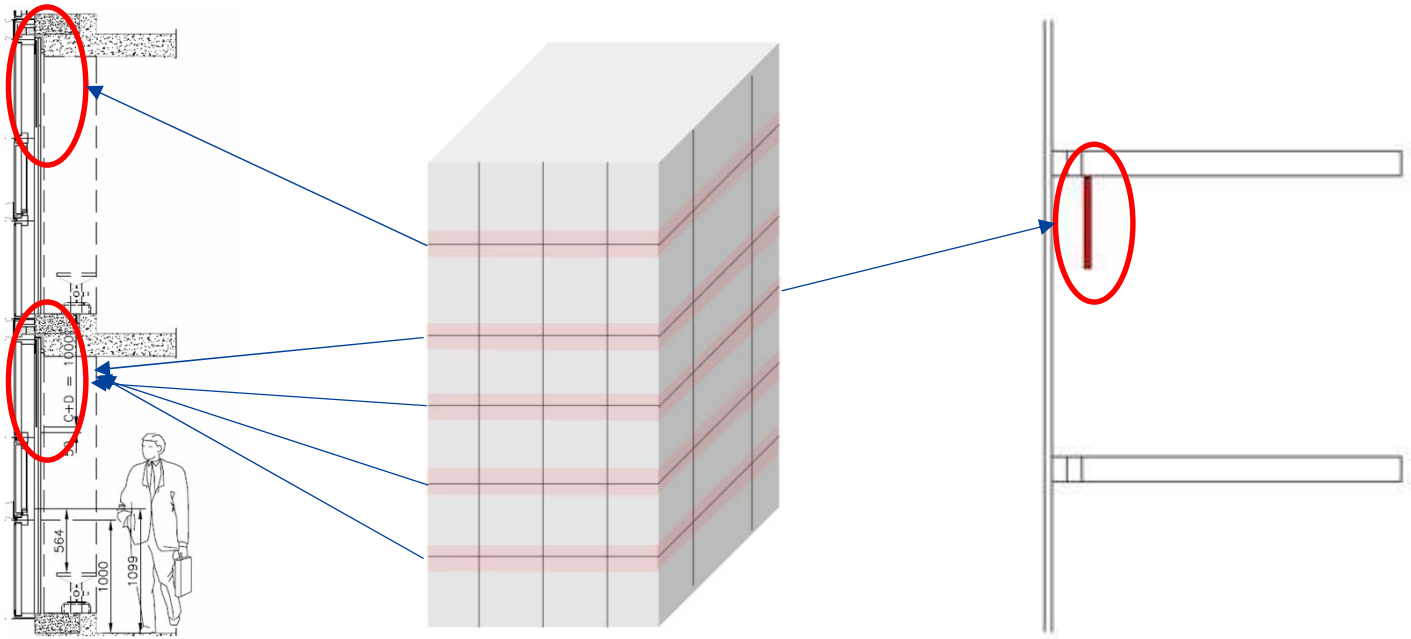
Criteria - DIN EN 1363-2:1999-10

DIN EN 1363-2:1999-10 Fire resistance tests Part 2: Alternative and additional procedures. Berlin, 1999.

- Defines “W” as the letter to define radiation
- Radiation is measured at 1.0 m at a distance from the unexposed face of the test
- There is no requirement to measure the radiation from a surface with a temperature below 300°C because the radiation emitted from such a surface is low (typically 6 kW/m² - even with an emissivity of 1,0)

Fire rated façades – New solutions

High level E60 FR glass screens



Fire rated façades – New solutions

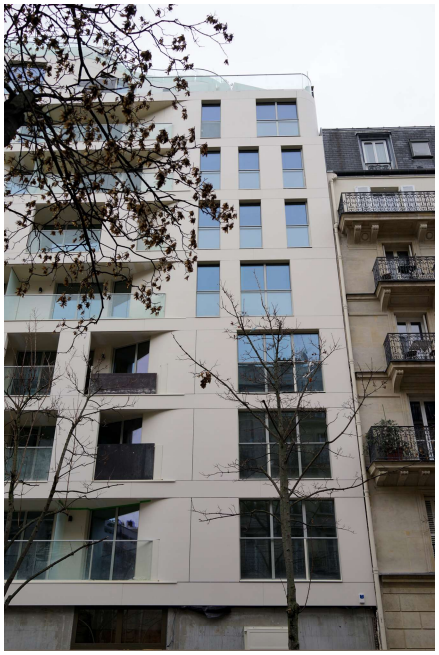
High level E60 FR glass screens

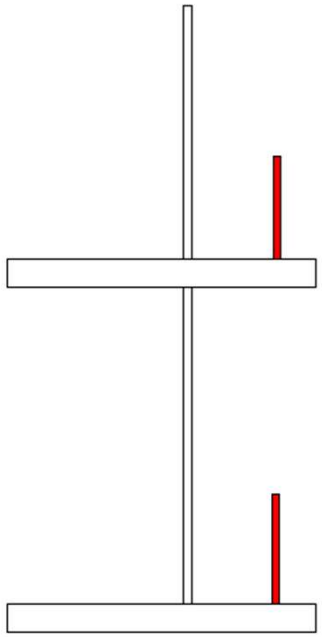
- Potential heat from two sides
- Maximum 200mm gap
- Fire safety upgrade without change to the existing windows
- High transparency due to the use of PYRAN® S

University of Paris in cooperation with Engineer, Bureau D' Etudes Colmar

Fire rated façades – New solutions

Balustrade/Balcony with E30





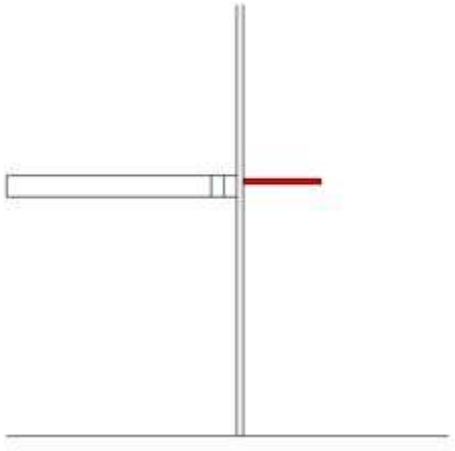
Fire rated façades – New solutions

Balustrade/Balcony with E30

- Fire risk from below
- Maximum distance 1m from facade
- Solution for apartment buildings thermal renovation
- Slim handrail
- Fire safety upgrade without change to the existing windows
- System looks like conventional balustrade
- Up to 1 m high
- High transparency due to the use of PYRAN® S

Fire rated façades – New solutions

External canopy E60



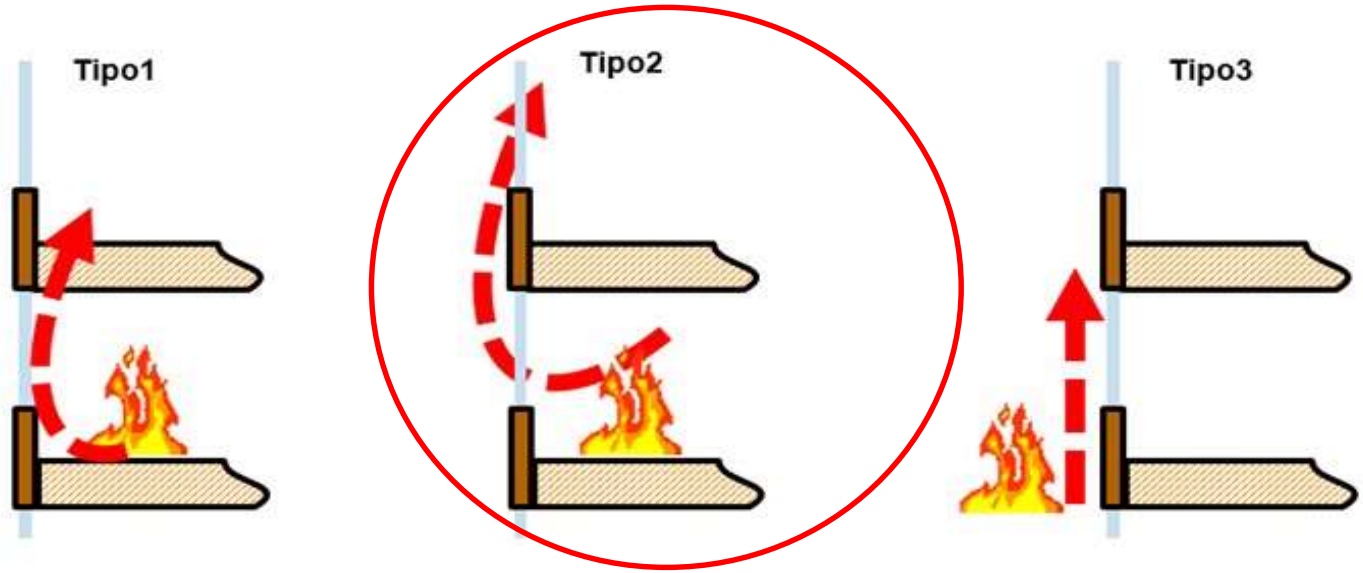
Fire rated façades – New solutions

External canopy E60

- Canopy solution with Laminated PYRAN® S
- Glazing supported on 3 sides
- Mounted to the slab edge
- Slim solution
- Achieved without changing the existing windows or façade

Fire rated façades – New solutions

Fire type 2, specified as “leap-frogging” by Oleszkiewicz (1988)



Main features: self ignition of combustible materials inside of the building as result of the high radiation flux projected by the external flames for the window below.

Fire rated façades – New solutions – ad hoc fire test

Internal floor level partition behind façade system

Goals

1) To have a better understanding about external fire;

2) Construct & simulate a “real” fire in two buildings with a fully glazed façade

3) Collect temperature and radiation values considering a 1,20m high internal separating wall for each solution:
   - Case A - Plasterboard wall according to Brazilian Standards
   - Case B - E120 glazing with PYRAN® S

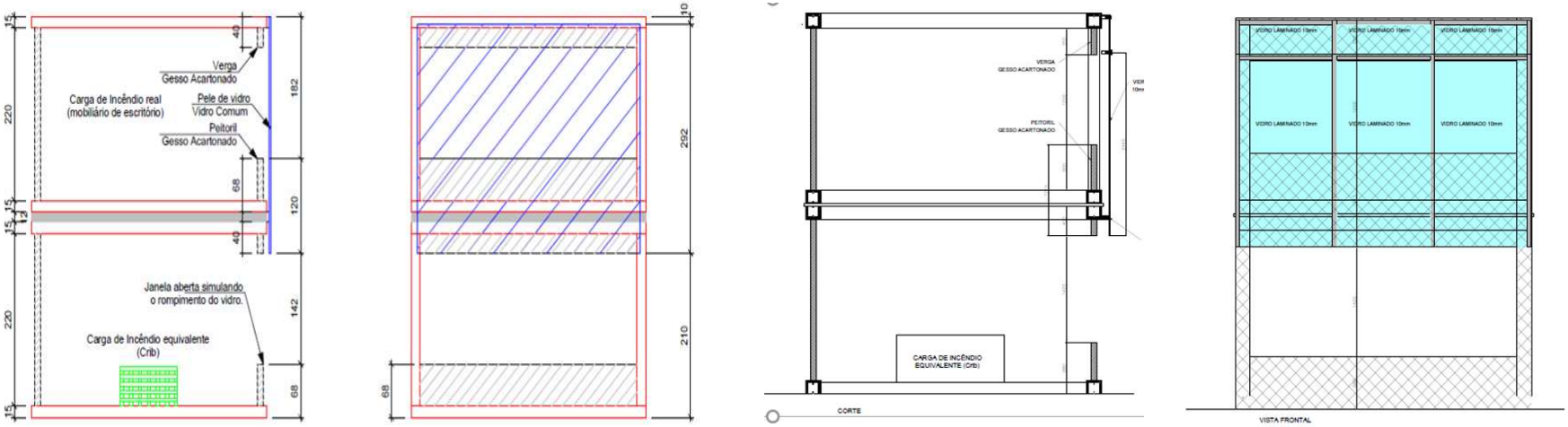
4) Check if the radiation that passes through the glazing can start a new fire due to non piloted ignition

Details

- Construction of twin buildings with different upper floor design to collect data;
- Modules constructed with steel frame structure and gypsum board
- Size: 3.70m length x 5.12m high

Case A – Design approach

- Vertical separation with Gypsum wall 1.20 m high sitting on floor slab
- Façade Construction: Stick façade glazed with 4mm soda lime glass + 2mm PVB + 4mm soda lime glass

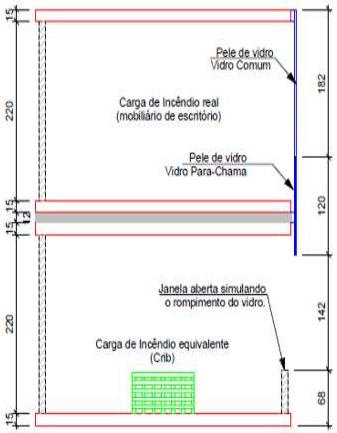


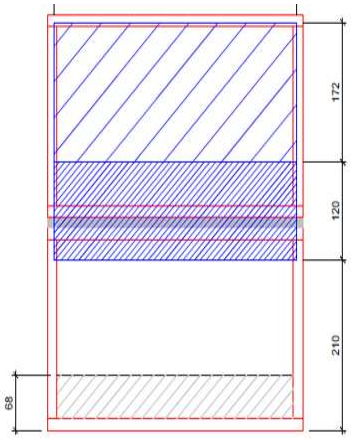
Case A – Design approach

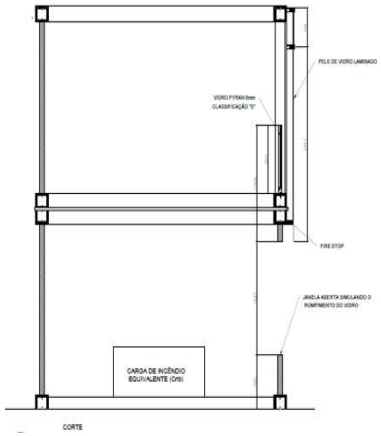
- Separation with 1.20 m high Gypsum wall sitting on floor slab
- Radiation measuring posistion

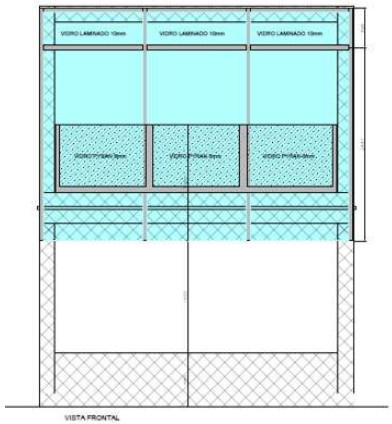
Case B – Design approach

- Vertical separation with PYRAN® S glass wall 1.20 m high sitting on floor slab
- Façade Construction: Stick façade glazed with 4mm soda lime glass + 2mm PVB + 4mm soda lime glass





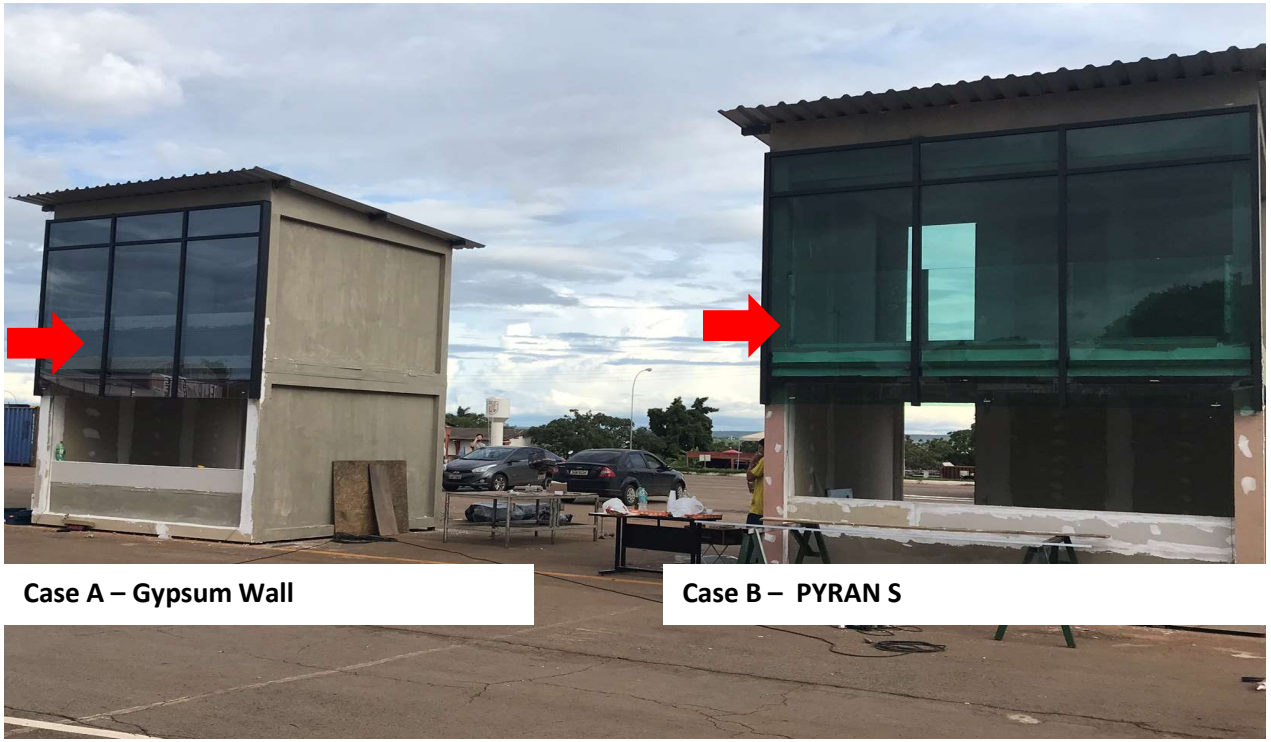




Case B – Design approach

- Vertical separation with PYRAN® S 6mm
- Radiation measuring position

Ready to test



Case A – Gypsum separation

Start

22 minutes

12 Minutes

32 minutes

Case B – Separation with PYRAN® S

Case B – Separation with PYRAN® S

13 Minutes

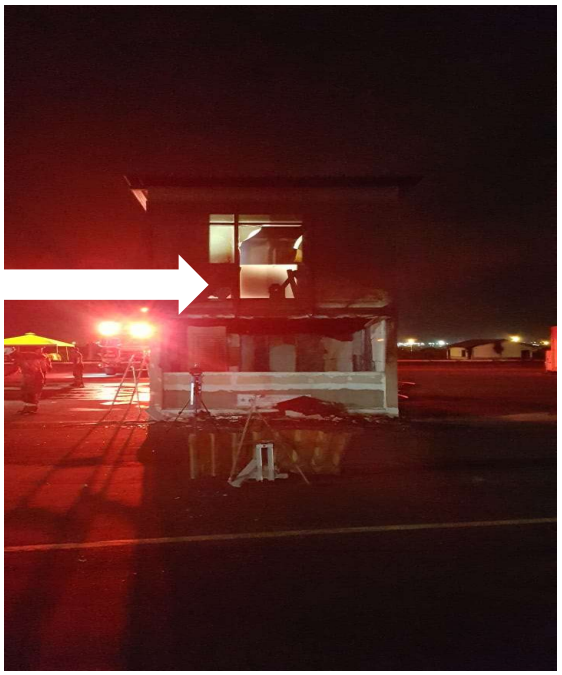
16 Minutes

15 Minutes

17 Minutes

Case B – Flame pattern with glass compartment

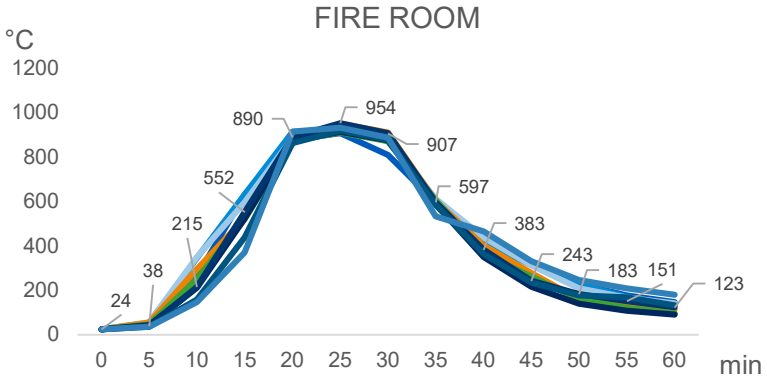
Case B – Separation with PYRAN® S

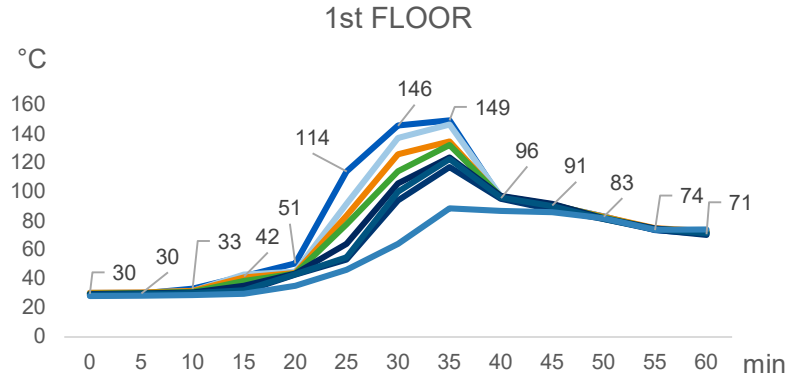


No deflection after 60 minutes

Results – Case A with Gypsum separation

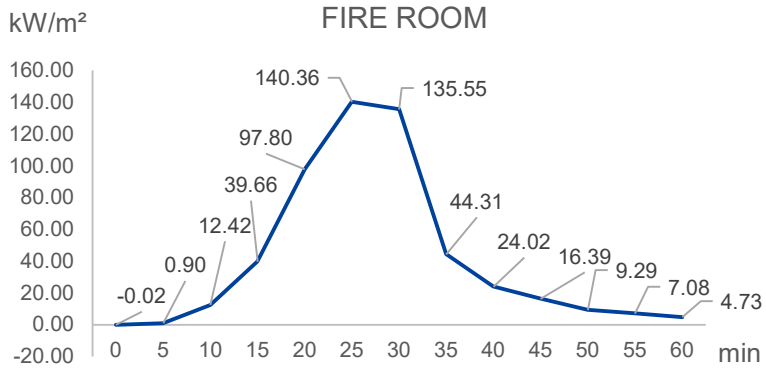
Temperature

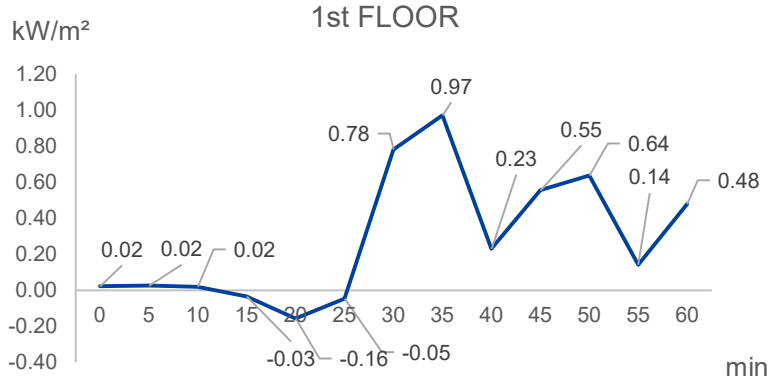




Results – Case A with Gypsum separation

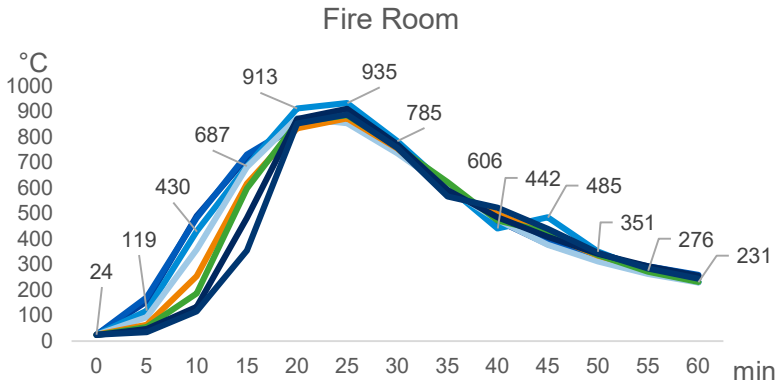
Heat Flux

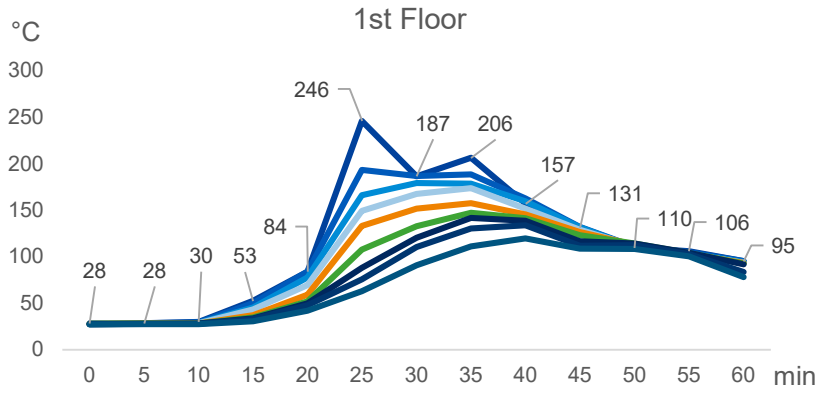




Results – Case B with PYRAN® separation

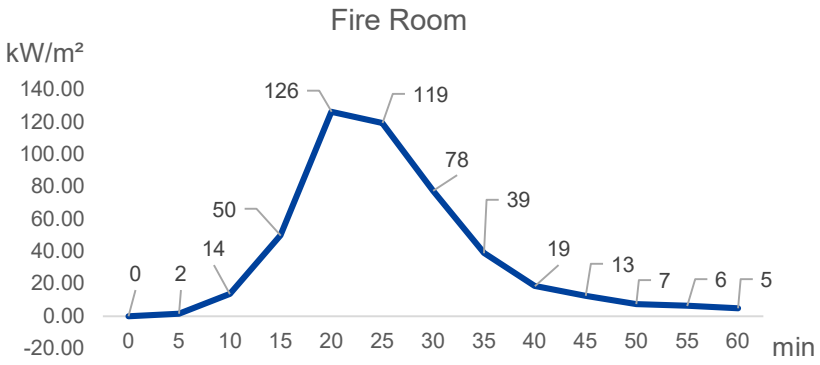
Temperature

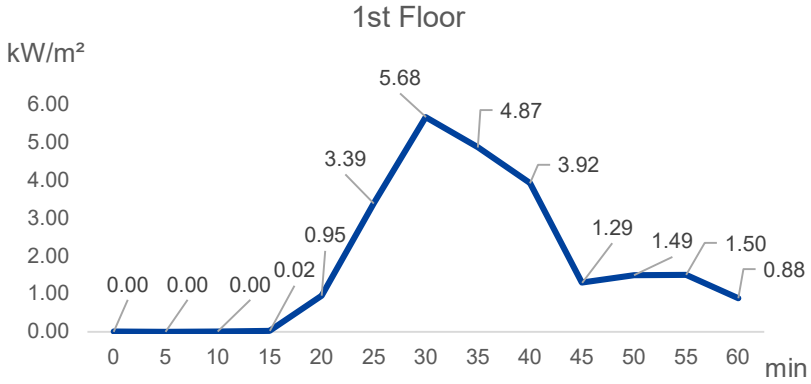




Results – Case B with PYRAN® separation

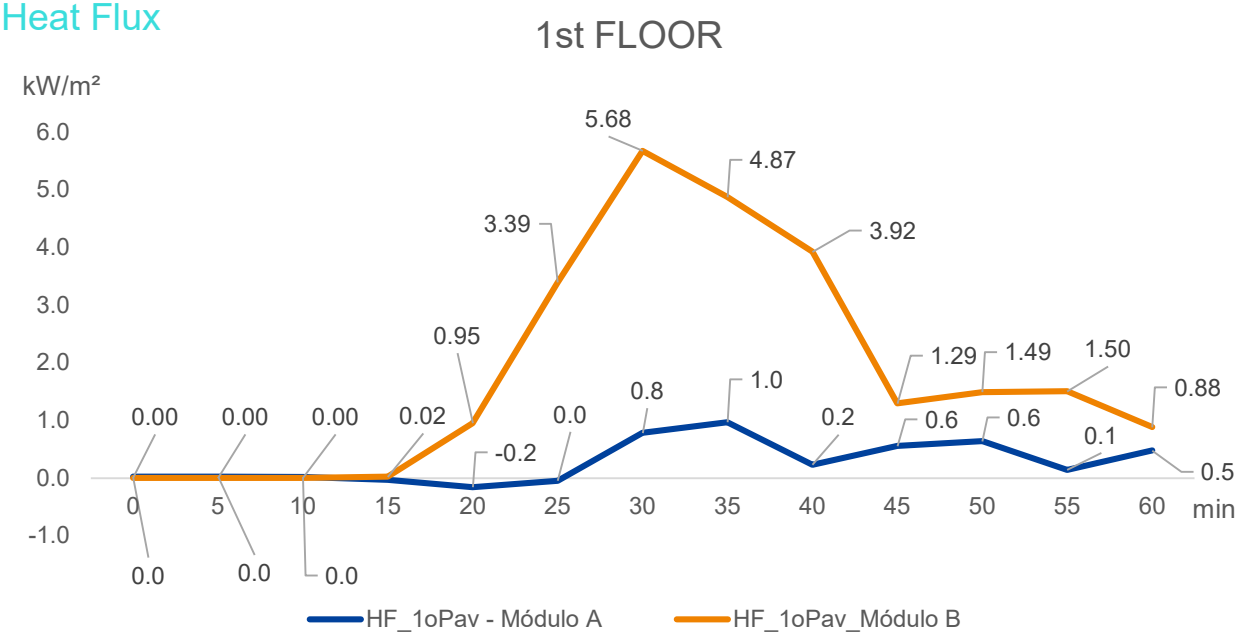
Heat Flux





Results comparison – Case A vs. B

Heat Flux



Case A – Gypsum Separation

Case B – PYRAN® S Separation

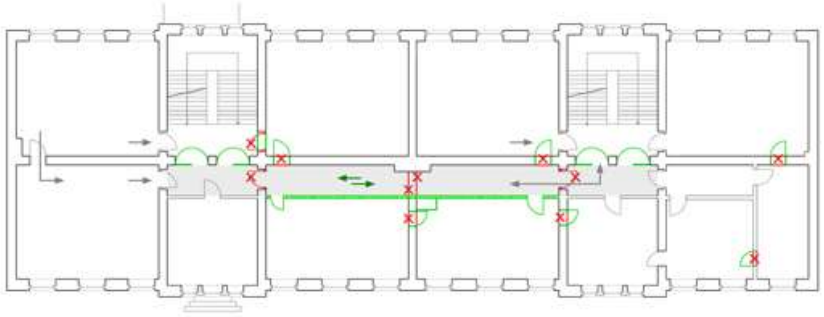
Conclusions

VERTICAL SEPARATION WITH PYRAN® S IS SAFE AND OFFERS LOW RISK

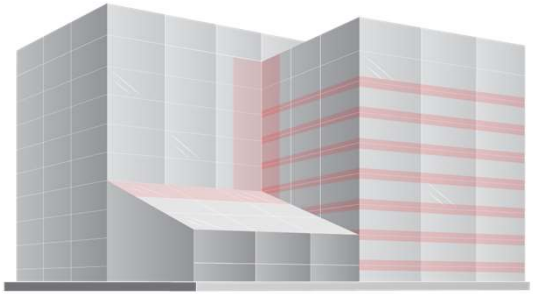
- Test results verify the articles written by Law, Malhotra, Oleszkiewicz that the external fire is less severe.
- Also the results prove what Carlson (1999) says about the difference of results in standard furnace tests versus a real fire situation.
- The peek of the internal radiation was with 30 minutes, 5,68 kW/m² and 246° C. No concerns regarding:
  - Building separation since the value given for calculation in the building codes is 12.6 kW/m².
  - External envelope material since DIN EN1363-2:1999 states no need to measure radiation from a surface with a temperature below 300°C. The radiation emitted from such a surface is low (typically 6 kW/m² - even with an emissivity of 1,0)

Conclusions: E glass or EI glass?

The target of EI glass is to protect people against heat radiation so that they can pass the glazing without being jeopardized. Therefore, the main application of EI glass are escape routes to ensure safety when leaving the building.



The target of E glass is to avoid fire spread to other parts of the building . Therefore, E glass is used to prevent extending fire over the whole building. The heat radiation is discharged to the atmosphere and is no threat for people. Especially for facades, E glass is more practical and economical.



Thank you.

Any questions?

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SCHOTT
glass made of ideas

Expert competence for your construction project

Our service:

- development of system solutions in cooperation with partners
- competent consultancy with the help of skilled sales engineers (national/international)
- full size fire test furnace for customized solutions
- customer trainings
- efficient logistic

Our competence is your safety!

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Rue de Châteaudun, Paris

- ISO PYRAN® S
- façade
- steel frame
- E 30
- curved

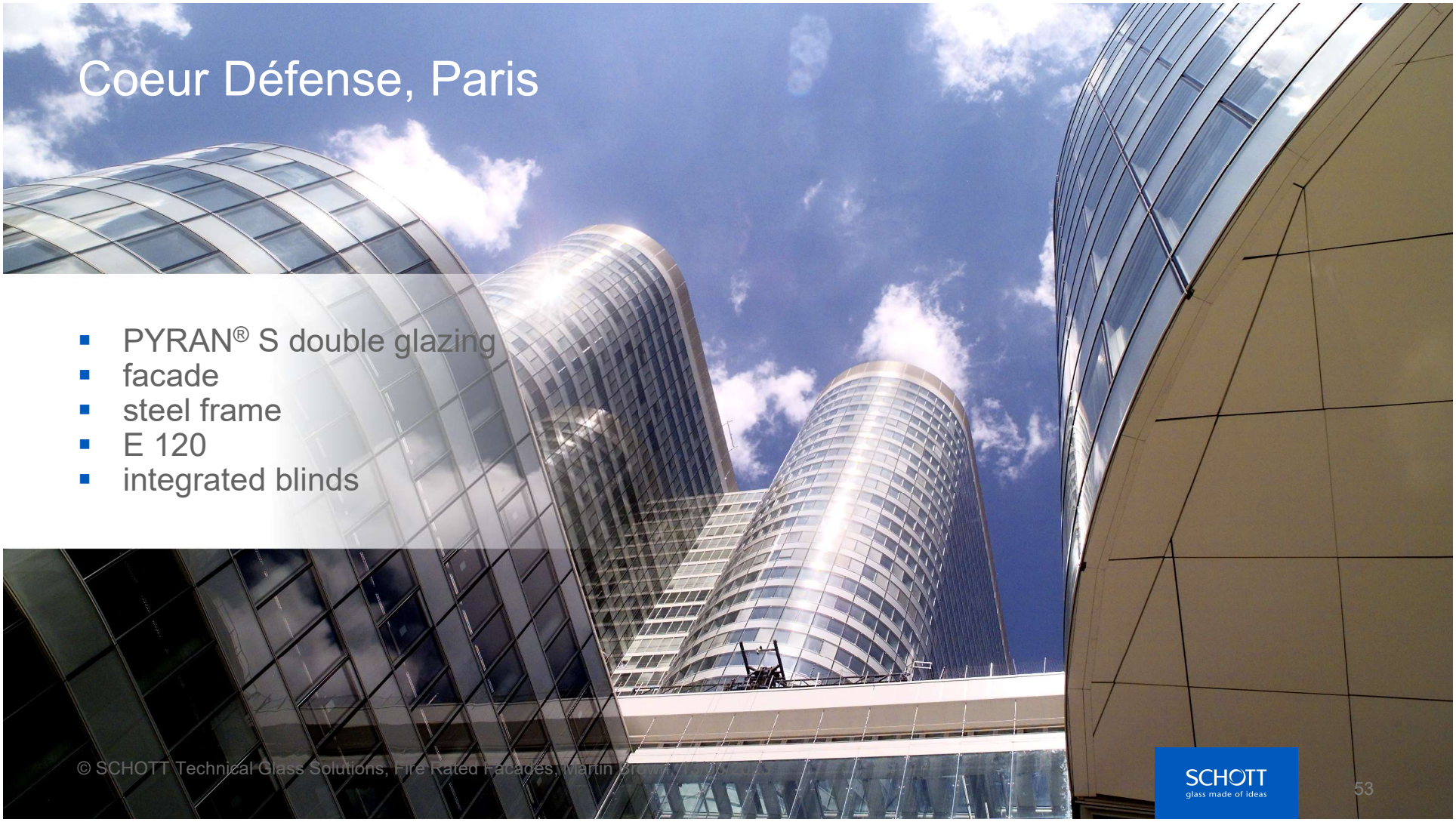
CET , Budapest

- ISO PYRAN® S
- façade
- steel frame
- E 30
- with melting valves

Baureferat , Munich

- DGU PYRAN® S
- Solar glass
- Façade
- Steel framing
- E 30

Coeur Défense, Paris



- PYRAN® S double glazing
- facade
- steel frame
- E 120
- integrated blinds

Seagate, Singapore

- Laminated PYRAN® S
- Fixed windows
- Steel framing
- E 120

Westdeutsche Immobilienbank, Mainz

- ISO PYRAN® S
- roof
- steel frame
- E 30
- screenprinting
- heat protection

BMW World, Munich

- ISO PYRAN® S
- roof
- steel frame
- E 30
- impact resistance