

# BRE: Behaviour of thermal rehabilitated façades in case of fire

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## **Presentation structure**

Types of façade systems

Examples of fires involving combustible insulation materials

Design recommendations

Experimental research – medium scale, large scale and modelling

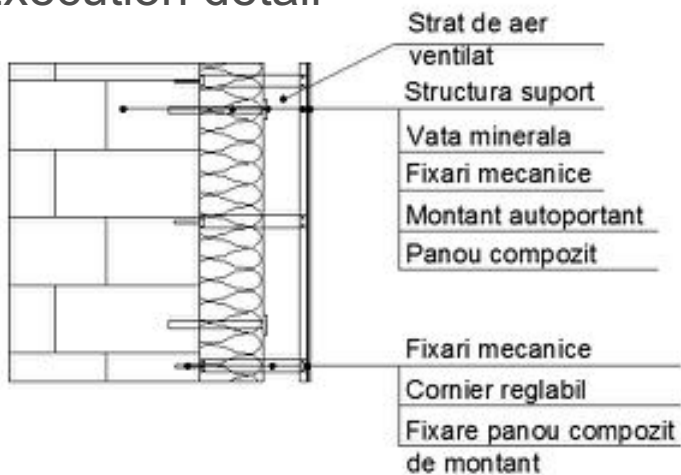
Conclusions



## Types of façade systems

- Ventilated façade composite systems

### Execution detail



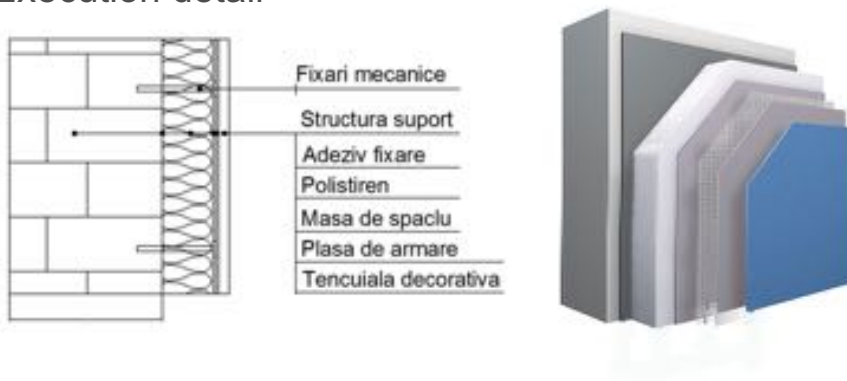
- Reduced time of execution
- Aesthetic system, which does not bring considerable load to on the structure

## Types of façade systems

- External Thermal Insulation Composite System (ETICS)



Execution detail



- Over 5000 building rehabilitated in Bucharest
- No studies on fire behaviour

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**Examples of fire involving  
combustible insulation  
materials**



## Examples of fires involving combustible façades

- Office Building, Bucharest 2009



- Millennium Business Centre – 72 m height



## Examples of fires involving combustible façades

– Block of flats, Romania 2012

Vertical fire spread



Burning droplets



Façade system after fire

## Examples of fires involving combustible façades

- Block of flats, Hungary 2009





## Fire examples

- Block of flats, South Korea 2015



## Fire examples

- High rise buildings



Tamweel Tower 2012



Al Tayer Tower 2012



Address Downtown Hotel  
2016

## Fire examples

- Residential building, Russia 2014

Experimental work



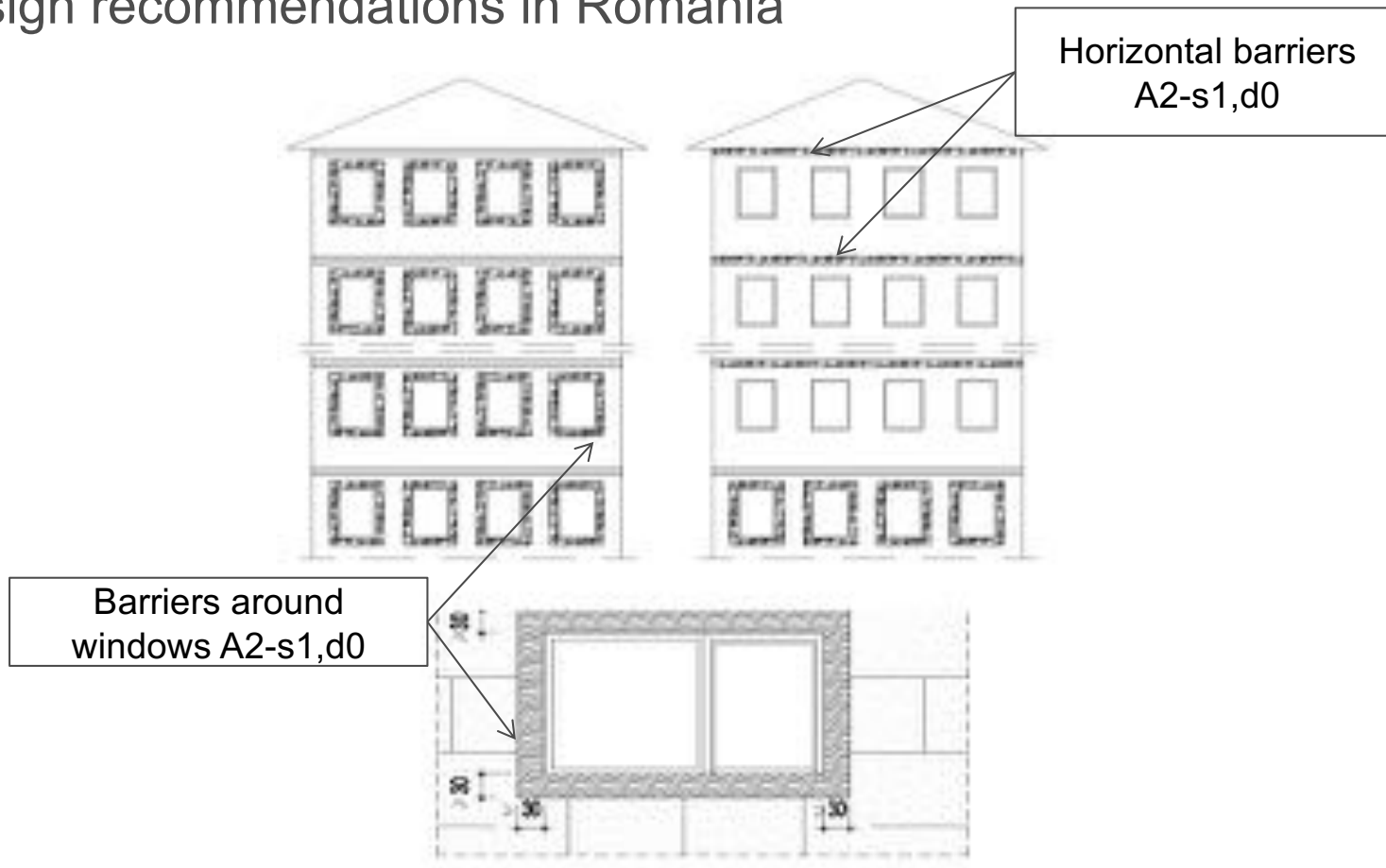
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## Design recommendations



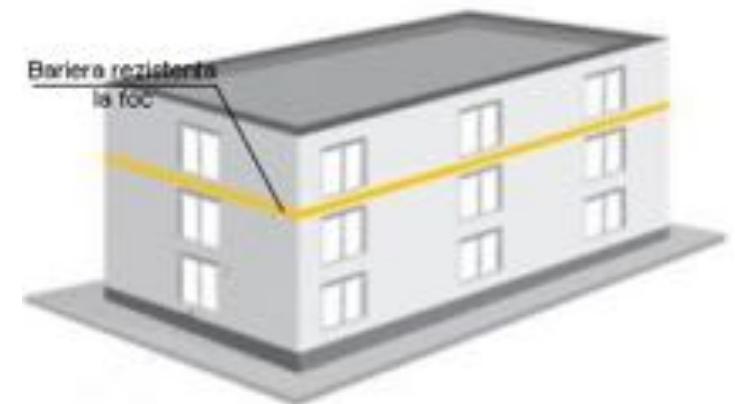
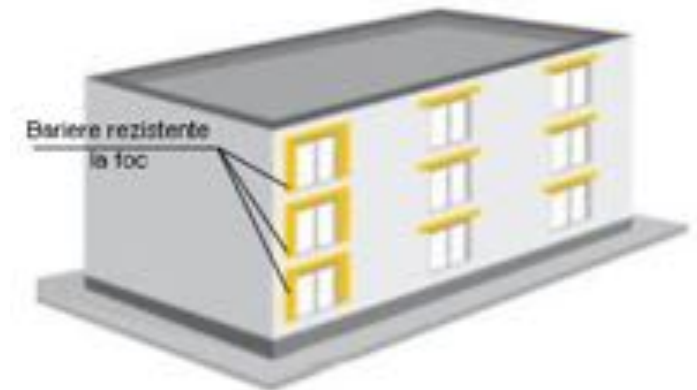
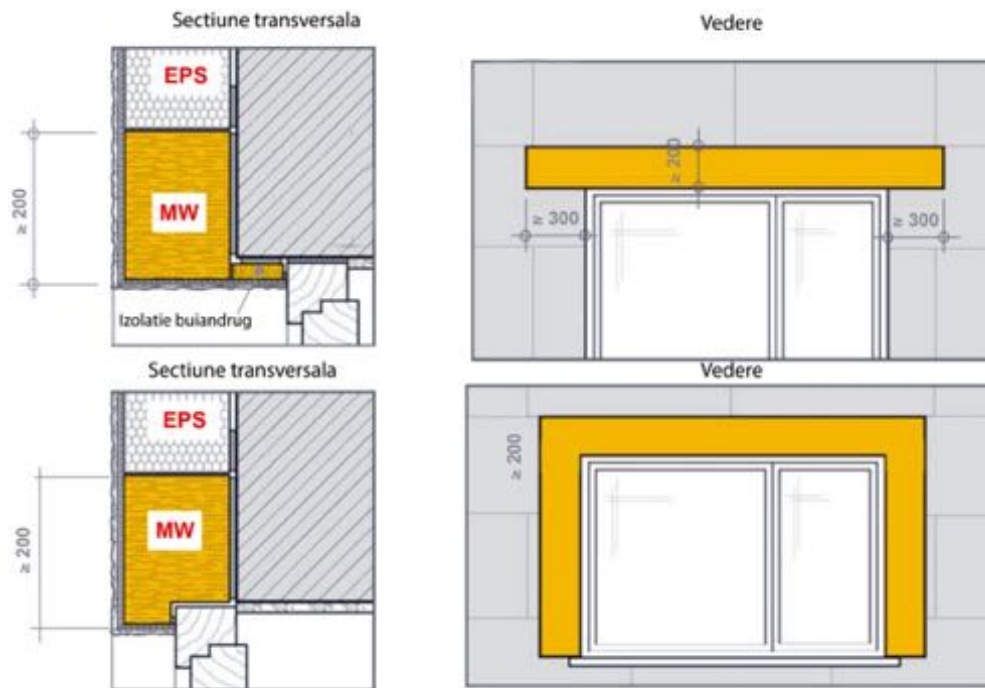
## Design recommendations

- Design recommendations in Romania



## Design recommendations

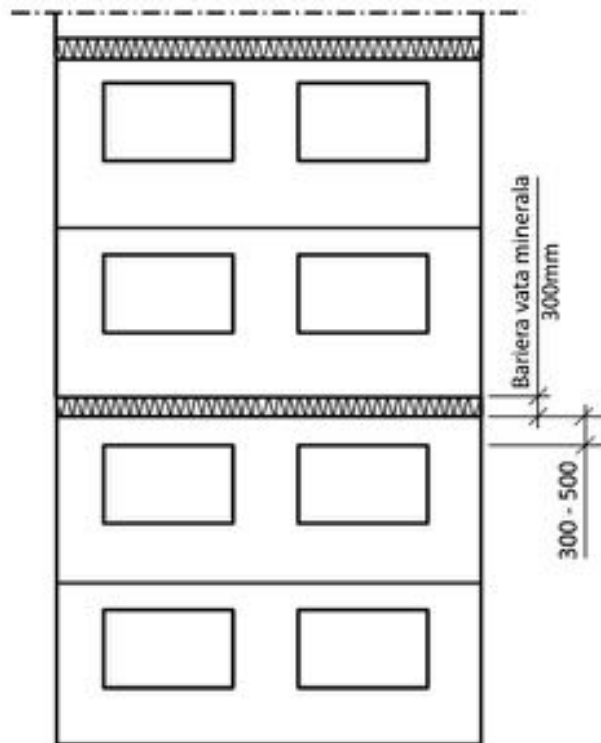
- Design recommendations in Germany



## Design recommendations

- Design recommendations proposed by VTT Finland

Installation on facades



Experimental research



## Large Scale Standard Testing

LEPIR II Large  
Scale test



BS 8414 Large  
Scale test





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**Experimental research –  
medium scale, large scale and  
modelling**

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## Experimental Research - Medium Scale Tests

- System I – ETICS, no fire barrier

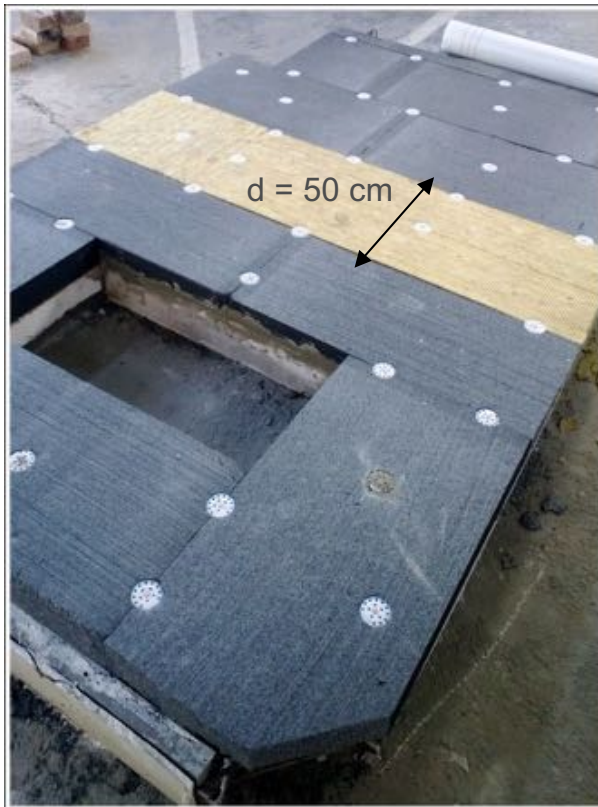


- System II – ETICS with fire barrier,  $d = 30$  cm



## Experimental Research - Medium Scale Tests

- System III – ETICS, with fire barrier,  $d = 50$  cm

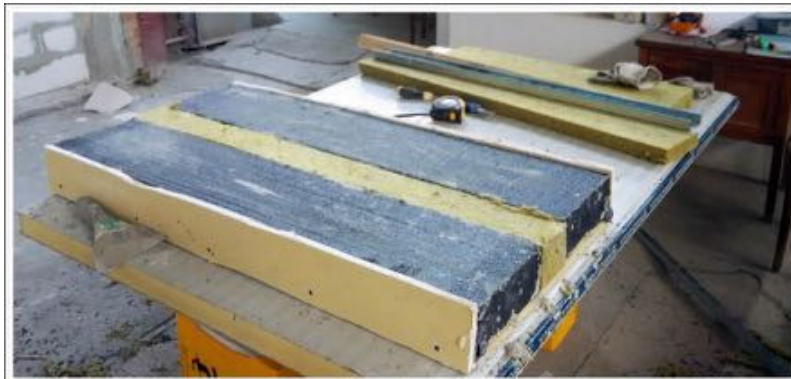
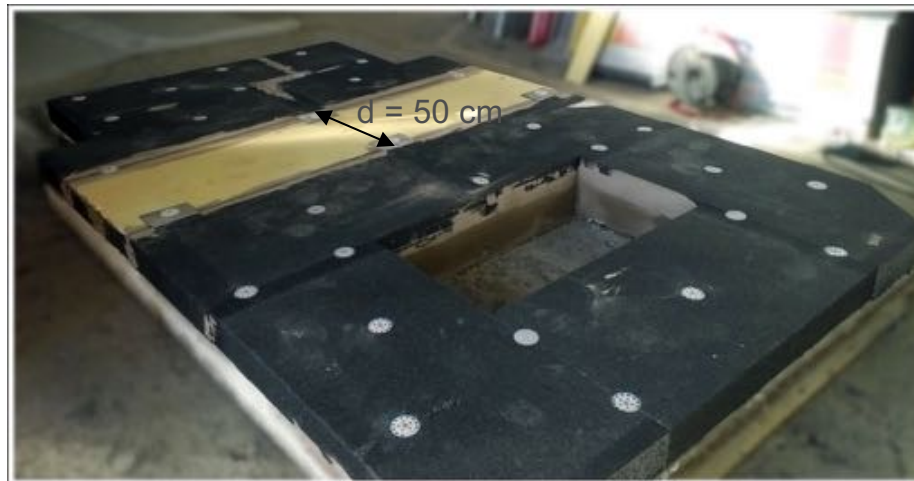


- System IV – ETICS with fire barrier,  $d = 30$  cm

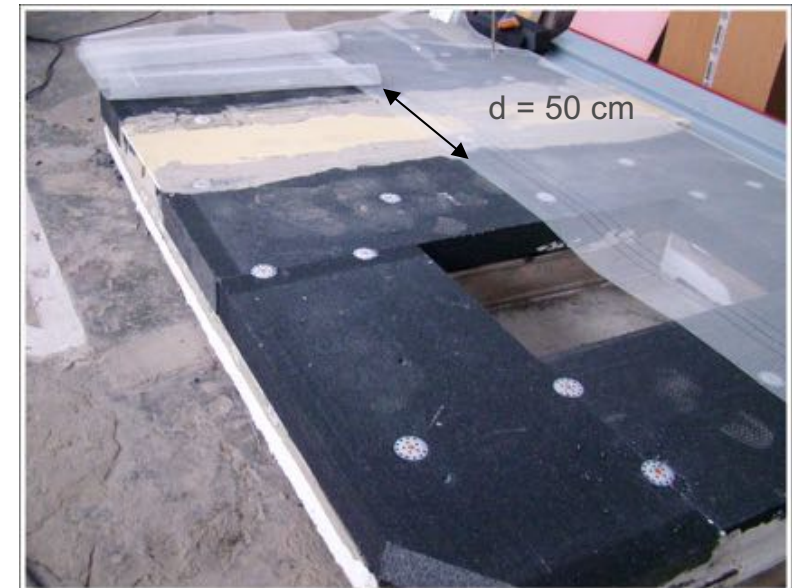


## Experimental Research - Medium Scale Tests

– System V – ETICS, with composite fire barrier,  $d = 50$  cm



– System VI – ETICS with composite fire barrier,  $d = 50$  cm



## Experimental Research – Medium Scale Tests

System I



System II



System III



## Experimental Research – Medium Scale Tests

System IV



System V



System VI



## Experimental Research – Medium Scale Tests

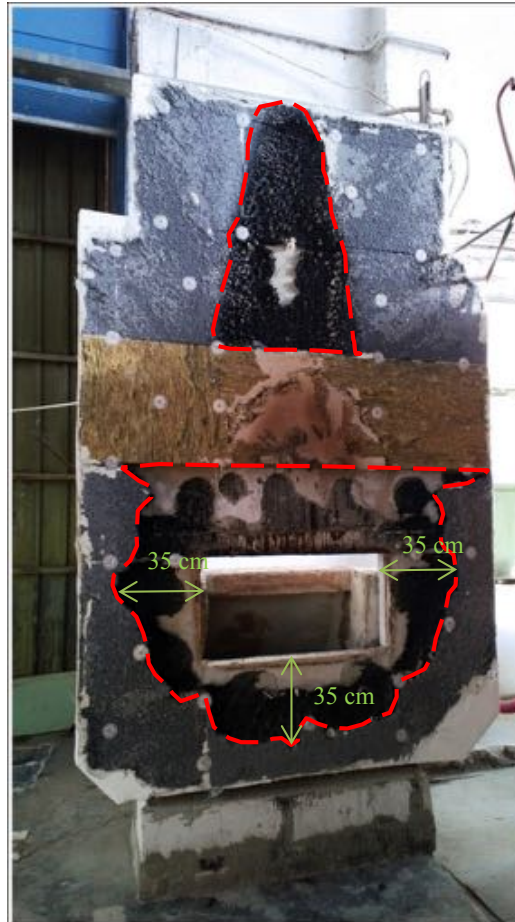
System I



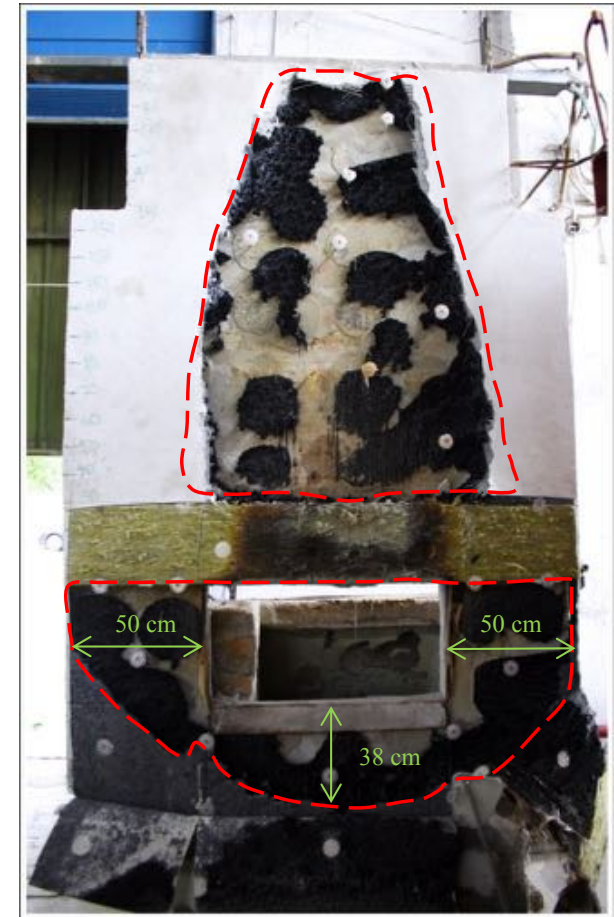
System II



System III

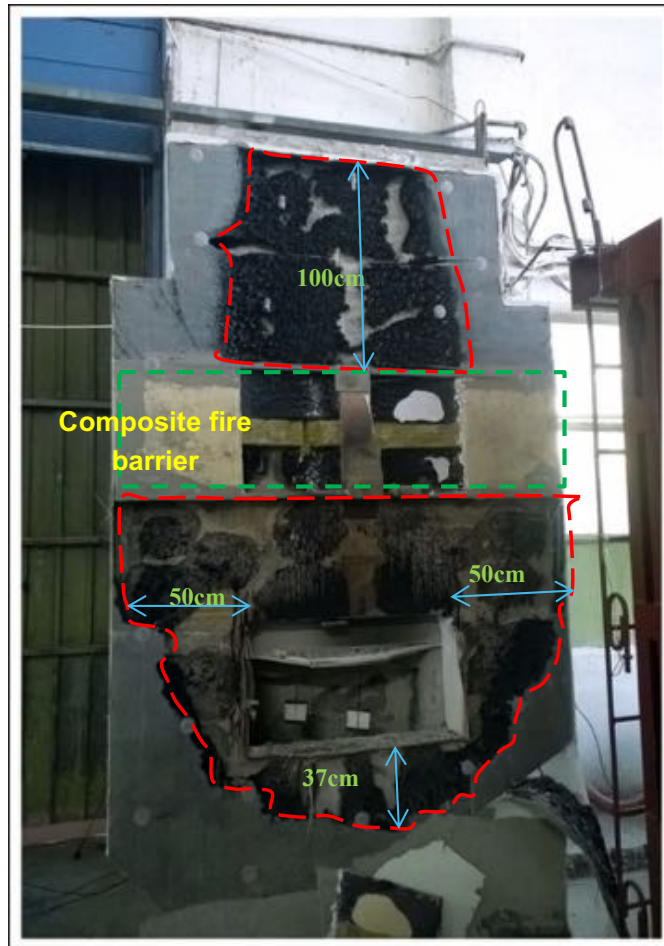


System IV



# Experimental Research – Medium Scale Tests

System V

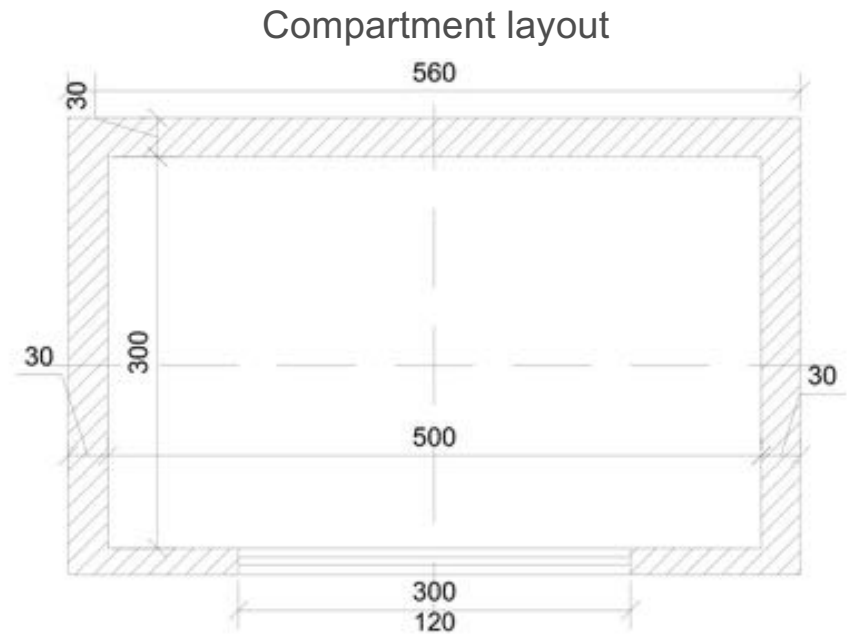


System VI





## Experimental Research – Large Scale Test



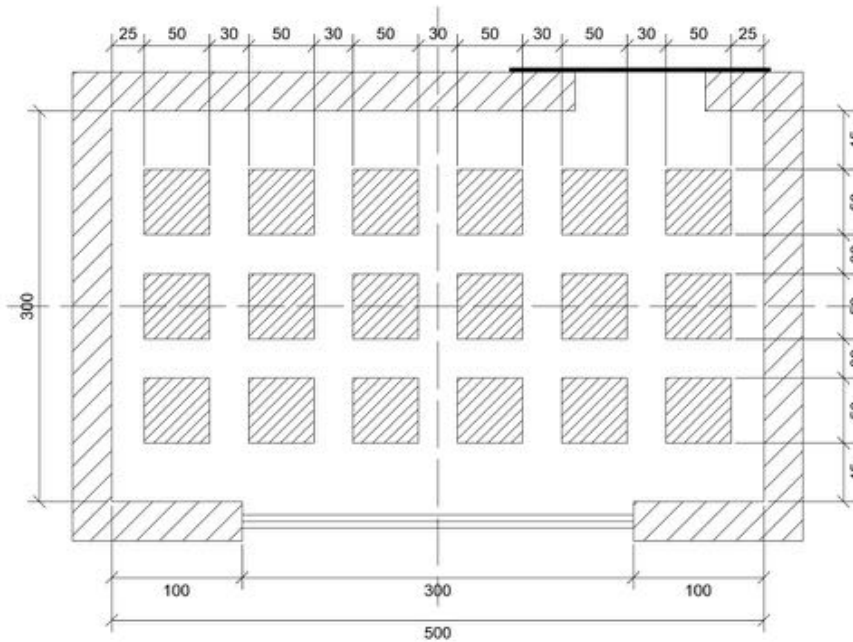
## Experimental Research – Large Scale Test

ETICS with composite fire barriers



# Experimental Research – Large Scale Test

Fire load distribution



## Experimental Research – Large Scale Test

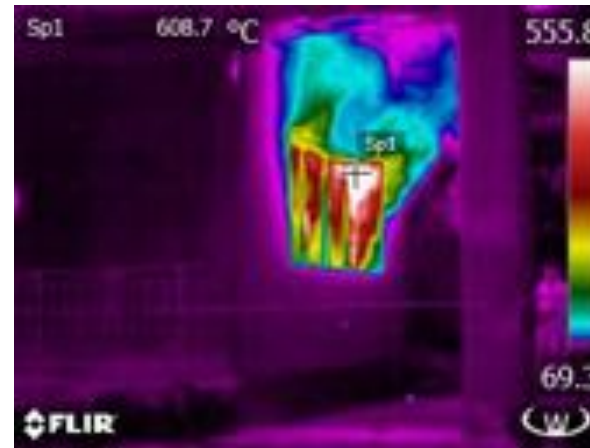


The fire is limited by the oxygen level  
min 16,5 / t=990s

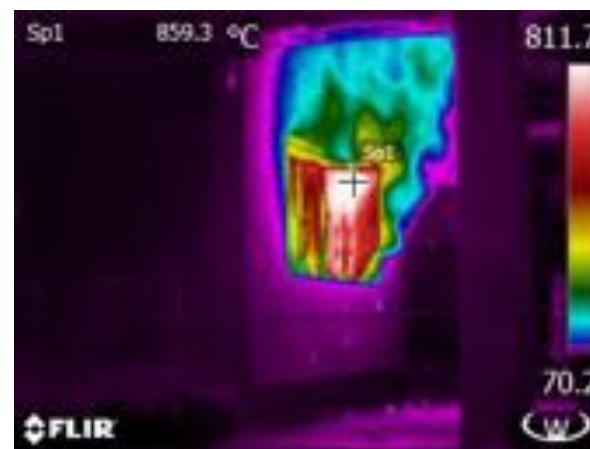


Ventilation procedure – development phase  
min 23,5 / t=1410s

## Large Scale Experimental Research



Flashover at  
min 29 / t=1740s



Fully developed phase  
min 32,5 / t=1950s



## Large Scale Experimental Research

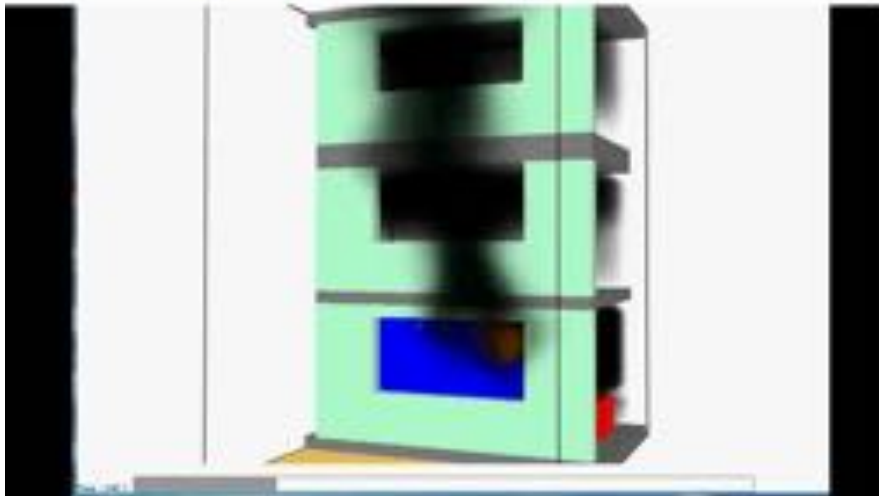


Cooling phase  
min 57,5 / t=3450s



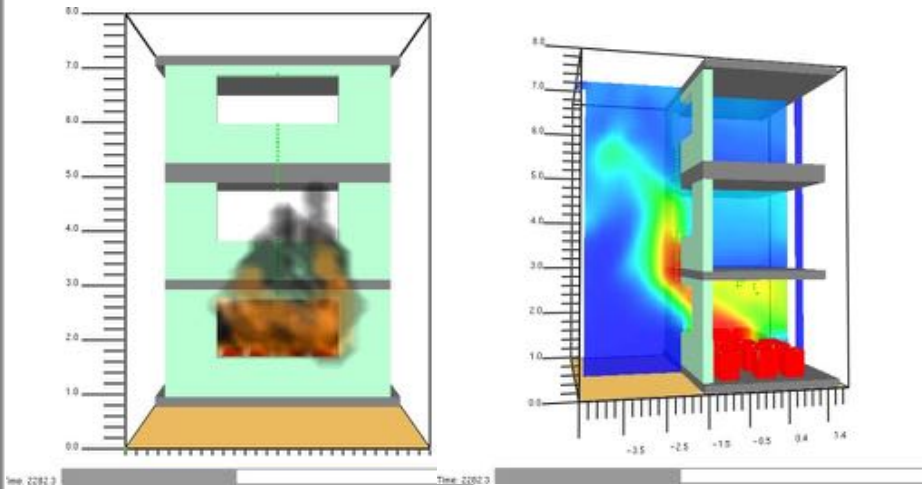
Cooling phase  
min 70,5 / t=4320s

## Large Scale Experimental Research

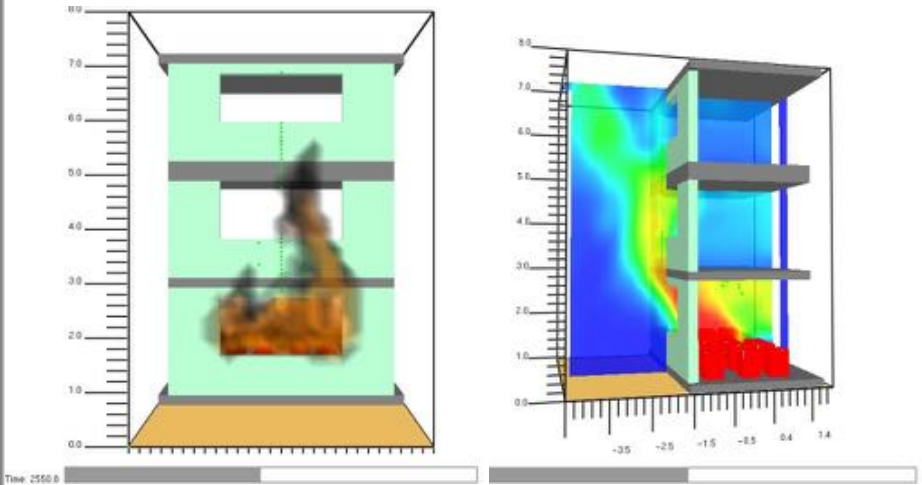




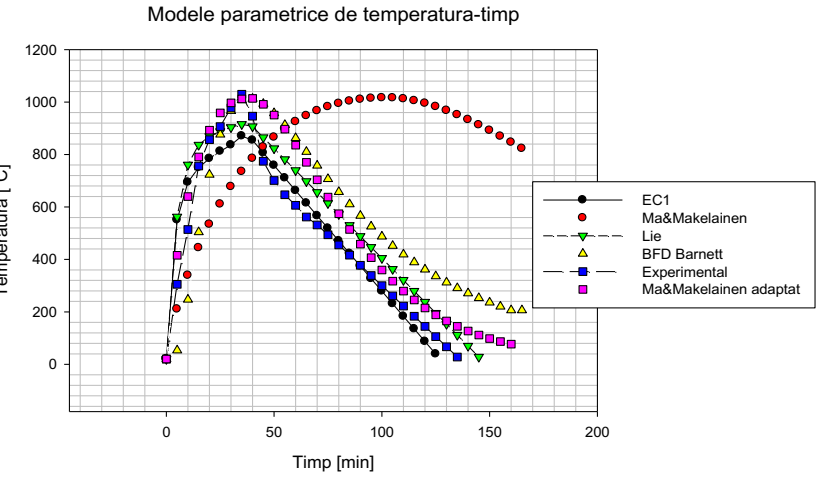
# Large Scale Experimental Research - results



min 38 / t=2280s



min 42,5 / t=2550s



## Large Scale Experimental Research

Post-fire analysis



# Large Scale Experimental Research

Post-fire analysis



Second floor



First floor



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Conclusions

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## Conclusions

- The use of combustible materials in the façades systems of tall building represents an increase risk of fire spread
- Real behaviour of façades can be determined only through large-scale testing
- There is a need of harmonised European large-scale testing method for façade systems
- The risk of vertical fire spread on façades can be reduced by appropriate design solutions – fire barriers
- A new design composite fire barrier has been tested and the results shown that it has the potential to reduce vertical fire spread

**Thank you for your attention!**

QUESTIONS