VALIDATION OF CFD SIMULATION MODEL OF FRENCH BALCONY FAÇADE FIRE TEST WITH PARAPET GLASS

Lajos Gábor Takács PhD
BME Faculty Of Architecture
Department of Building Constructions

Csaba Szikra
BME Faculty Of Architecture
Department of Building Energetics and Building Services

FACADE FIRE SPREAD PROBLEMS AROUND THE WORLD

Robauix, France, 2014

Miskolc, Hungary, 2009

London, Grenfell Tower, 2017

BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

FACADE FIRE SPREAD TESTS

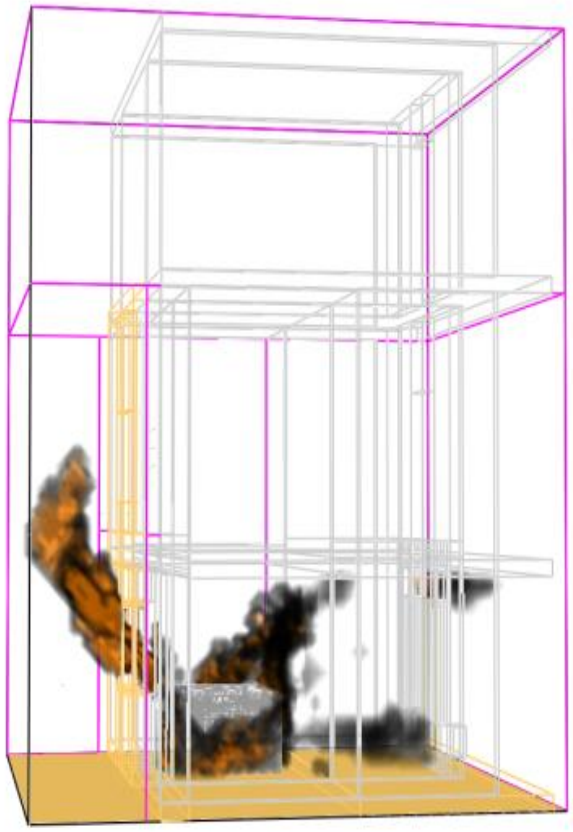
ÖNORM B 3800-5 – medium-scale test

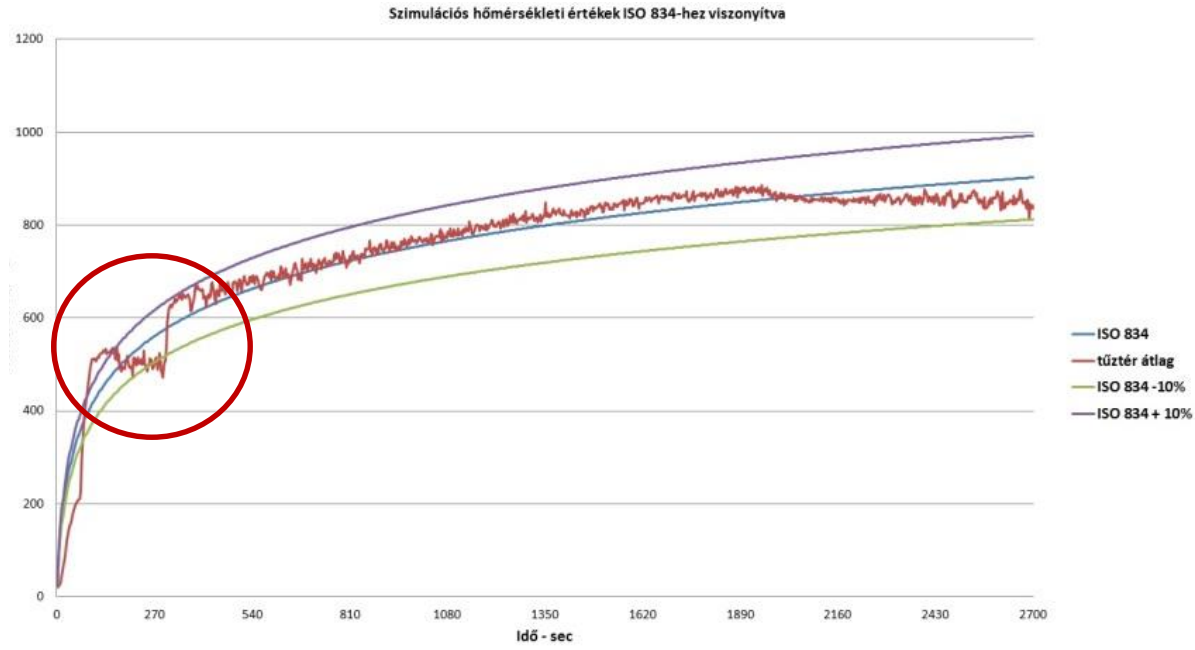
External fire exposure

- There is no common EU facade fire spread test
- MSZ EN 14800:6-2009 – Hungarian standard (see above): full-scale fire test, where the fire is spreading from the fire chamber to the facade thorough a window

BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

CFD MODELLING AND VALIDATION OF THE HUNGARIAN FACADE FIRE SPREAD TEST METHOD



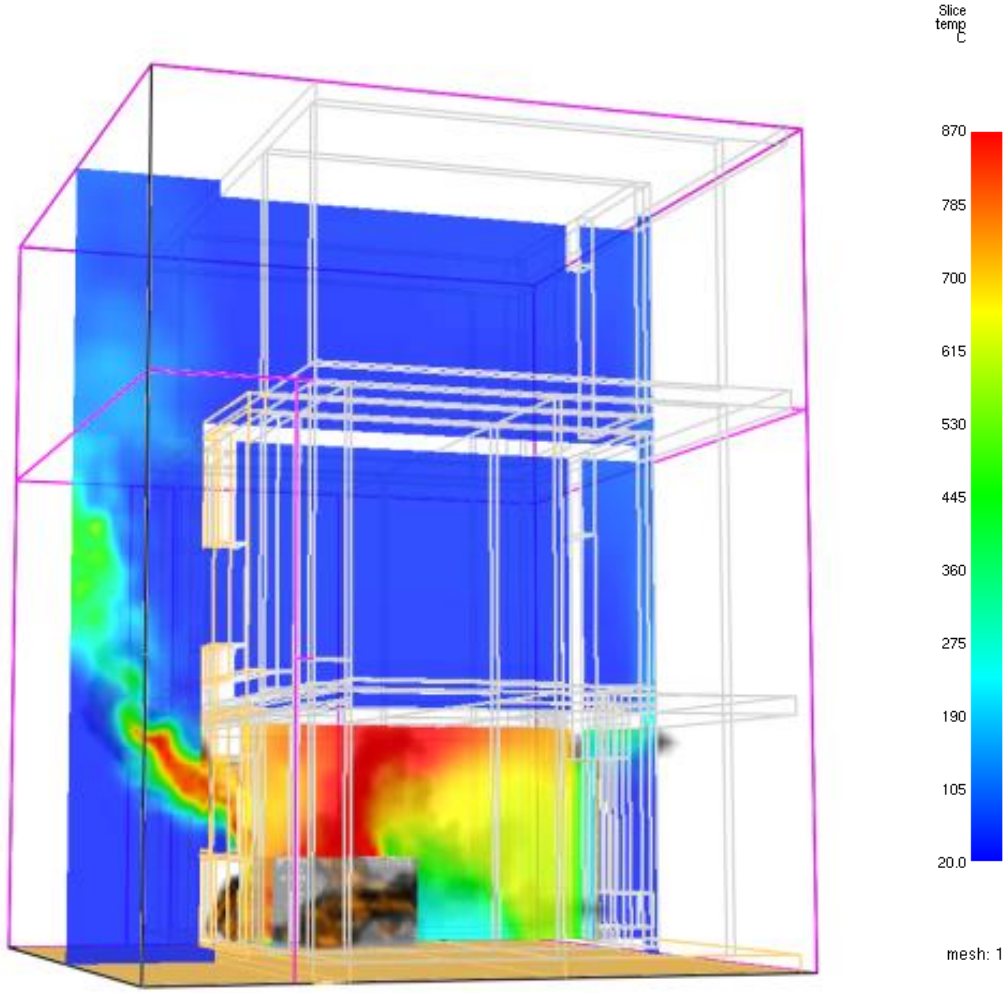


- Thermocouples in the fire chamber: average temperature should follow the ISO 834 temperature-time curve ± 10 %
- Validation of the model using temperature data of a previous real fire test
- After the 5th minute, opening of the fire chamber window causes large termperature swings – results of the CFD model and the full-scale fire test are the same

© Csaba Szikra, Lajos Gábor, Takács PhD
BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

CONCLUSIONS OF CFD MODELLING OF THE HUNGARIAN FACADE FIRE SPREAD TEST METHOD

- The method can be used only for extending the results of previous full-scale fire tests (f.i. geometrical differences)
- Assumptions:
  - validation of the simulation model is inevitable with results of a real fire test
  - CFD simulation cannot replace full-scale fire tests

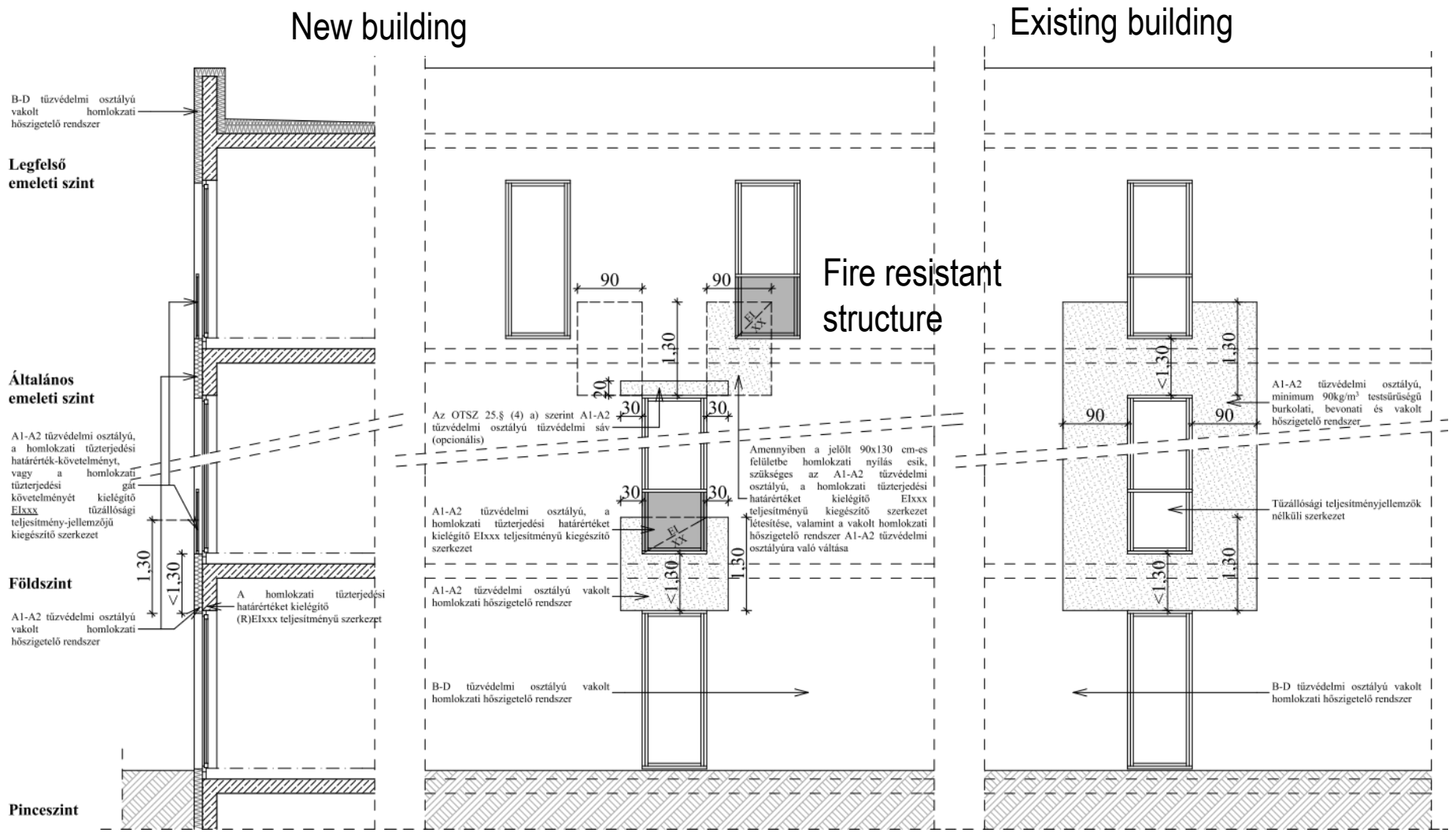


BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

VERTICAL FACADE FIRE TEST MODEL VS. VARIOUS FACADE DESIGN

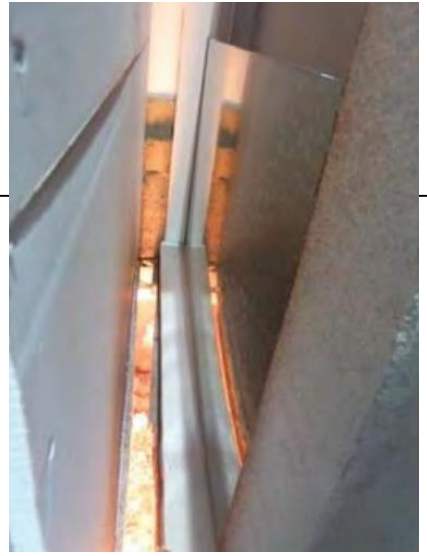
© Csaba Szikra, Lajos Gábor, Takács PhD
BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

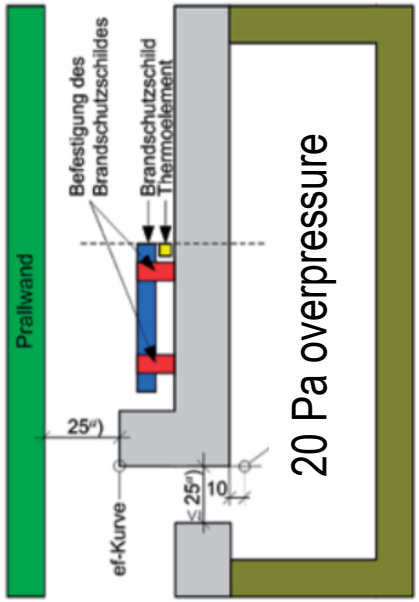
FACADE FIRE SPREAD PROTECTION OF FRENCH BALCONIES – HUNGARIAN GUIDELINE



BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

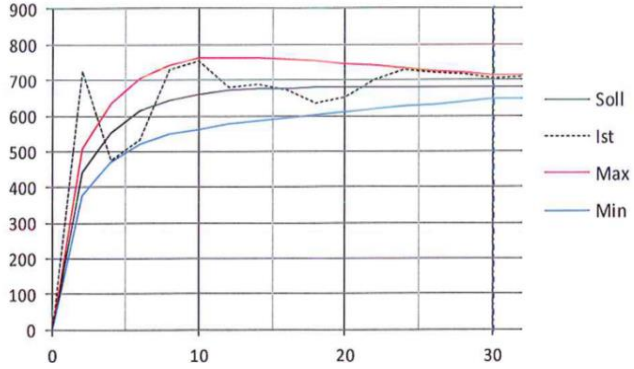
PARAPET GLASS FIRE TEST
ÖNORM B 3800-8:2013



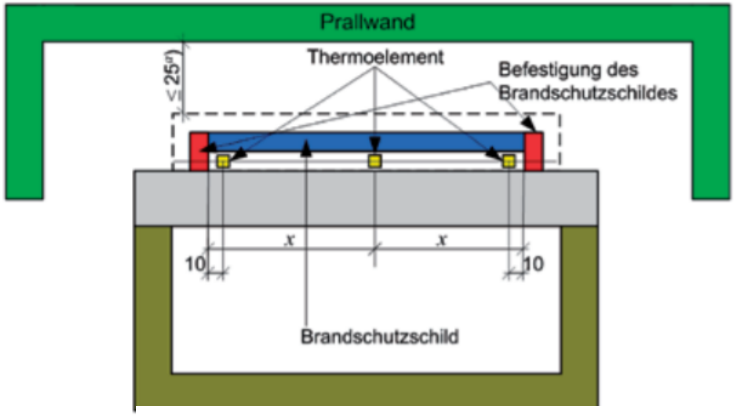


Blue: parapet glass (test specimen)

External temperature-time curve (ef)



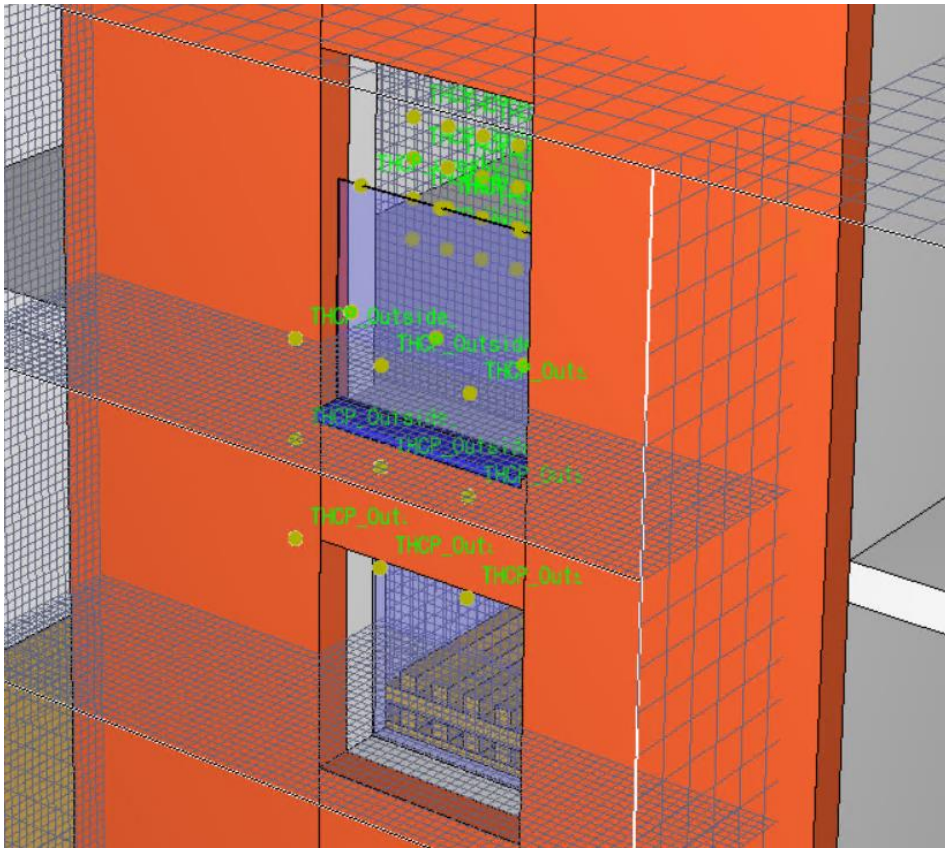
Baffle (deflector) wall



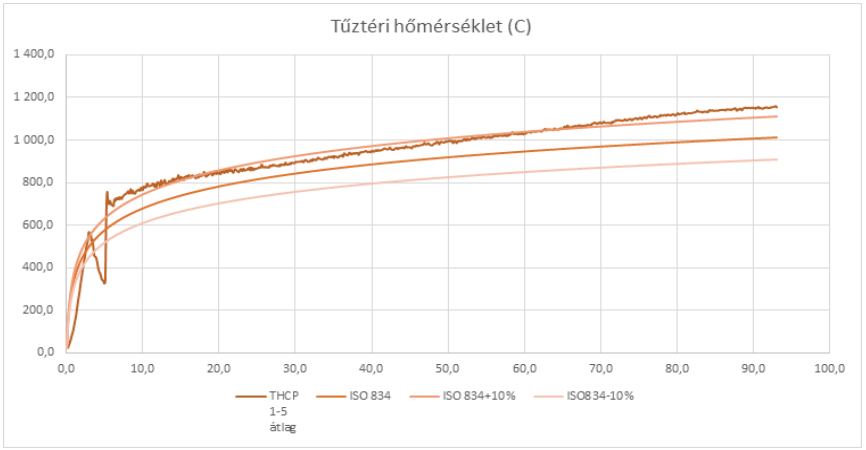
Furnace

BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

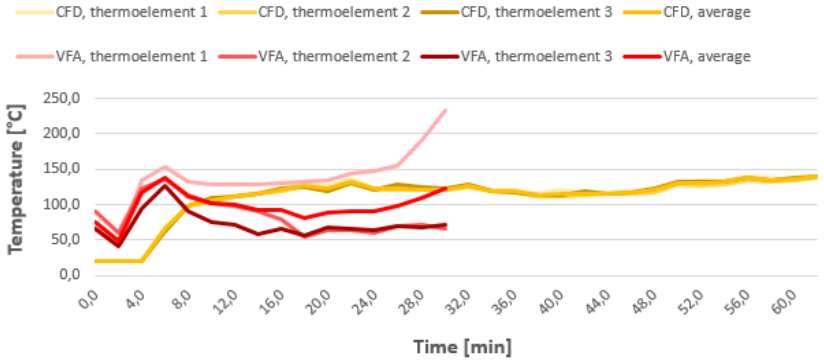
FRENCH BALCONIES
TEST RESULT EXTENSIONS WITH CFD SIMULATION



Combination of the Hungarian facade fire spread test method and the Austrian parapet glass furnace test



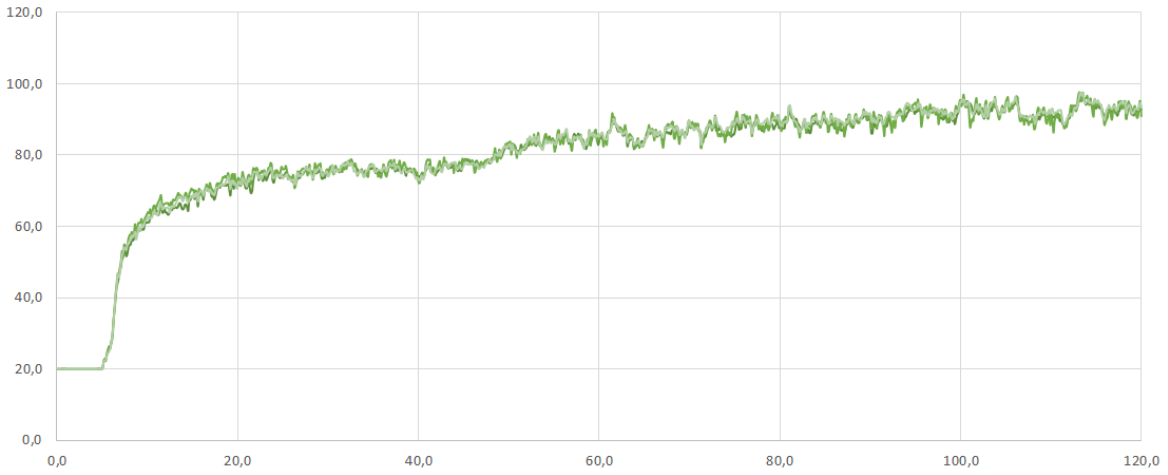
Determination of temperature exposure on the parapet glass with simulation
Average temperature-time curve in the fire chamber



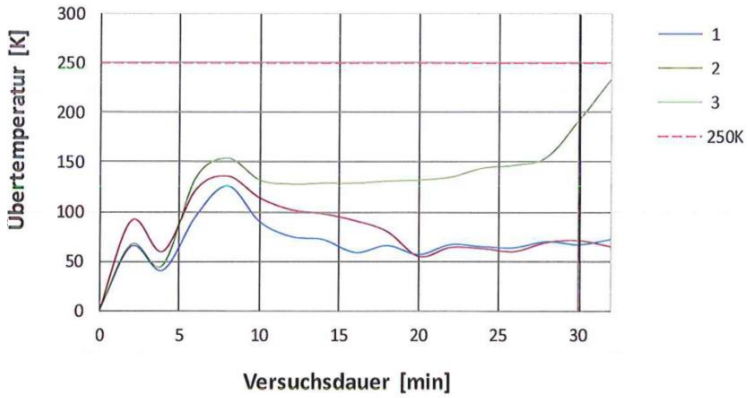
BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

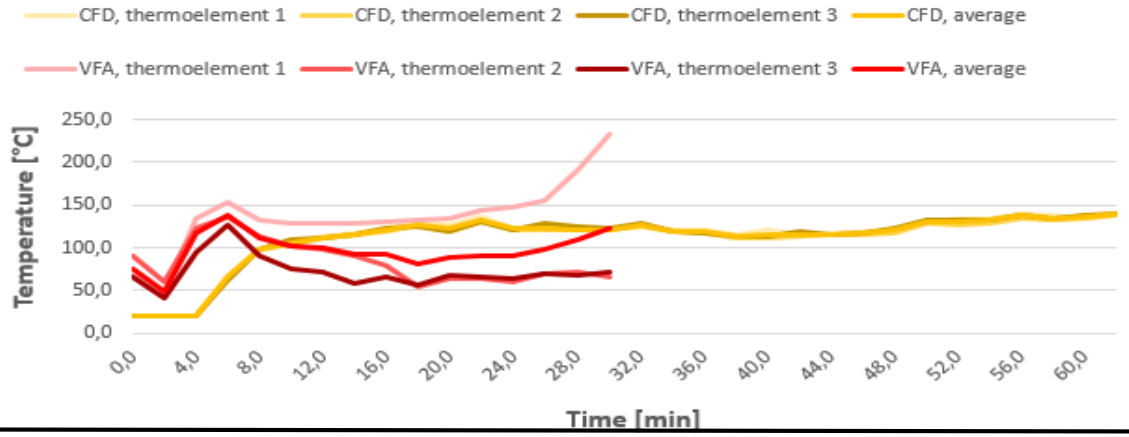
FRENCH BALCONIES
TEST RESULT EXTENSIONS WITH CFD SIMULATION

Curves of thermocouples inside the glass railing, at a height of +3.35 m copied on top of each other. It can be well seen that the average temperature does not exceed 90 °C, and with a starting temperature of 20 °C, the increase of temperature does not exceed 40-70 K over the whole test period of 120 minutes.



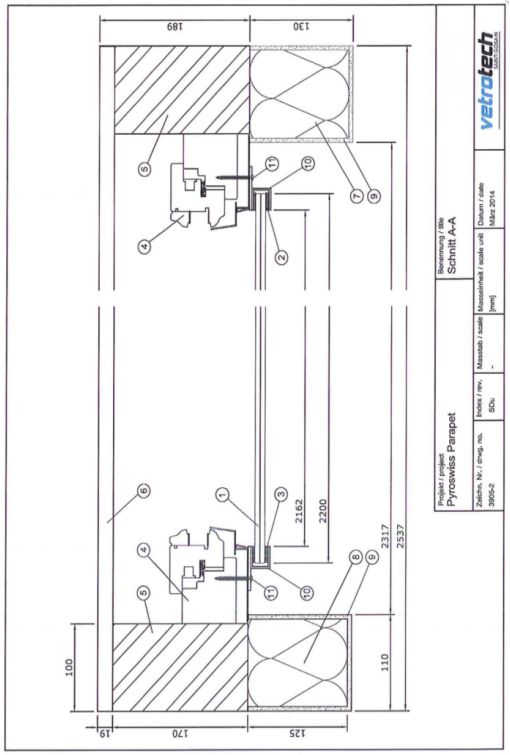
Temperature data measured on the upper edge of the parapet glass in test MA 39 – VFA 2014-0244.01 compared to our simulation results

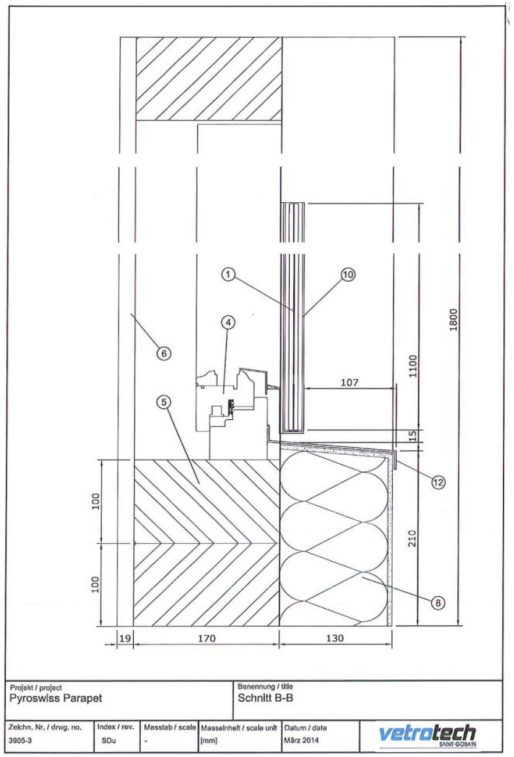




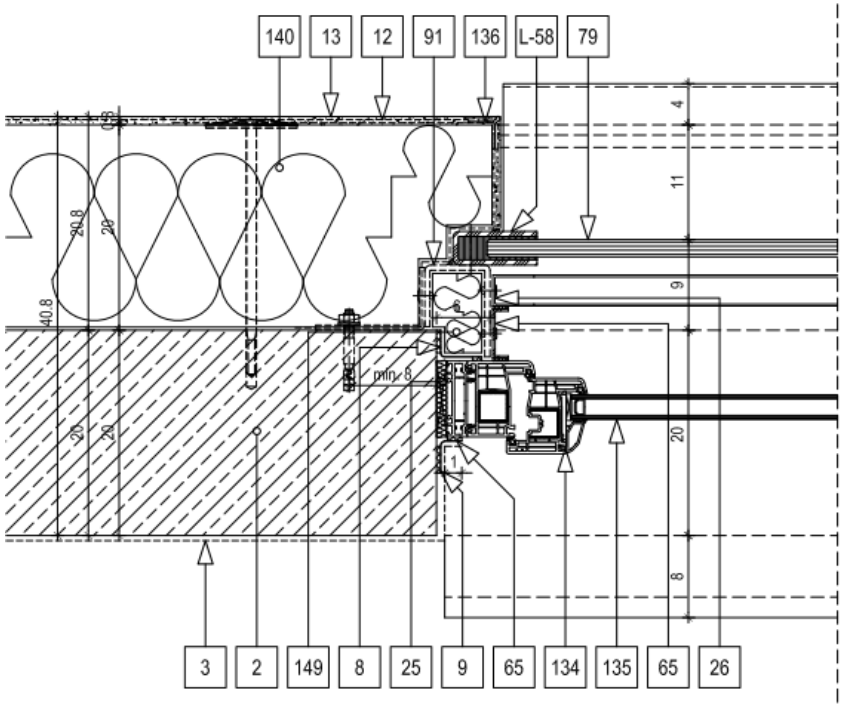
BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

FRENCH BALCONIES
TEST RESULT EXTENSIONS WITH CFD SIMULATION





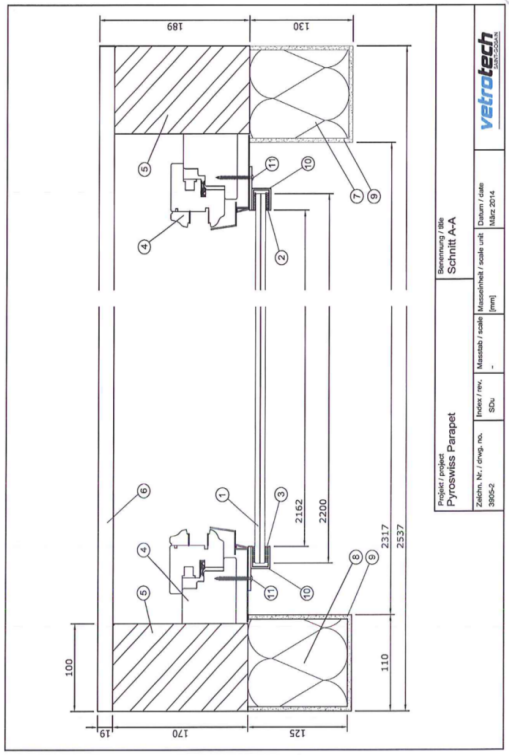
Detail drawings of the french balcony parapet glass test specimen (ÖNORM B 3800-8:2013), source: Vetrotech Saint-Gobain

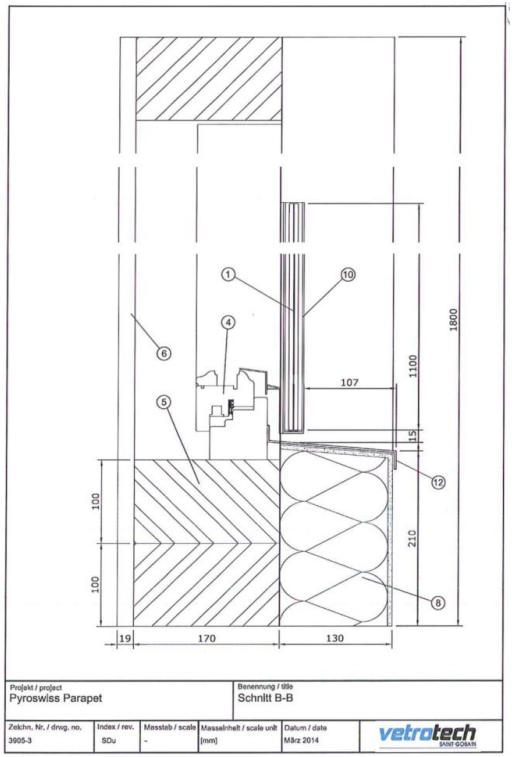


Facade detail
(design: Farsang & Dudinszky Design)

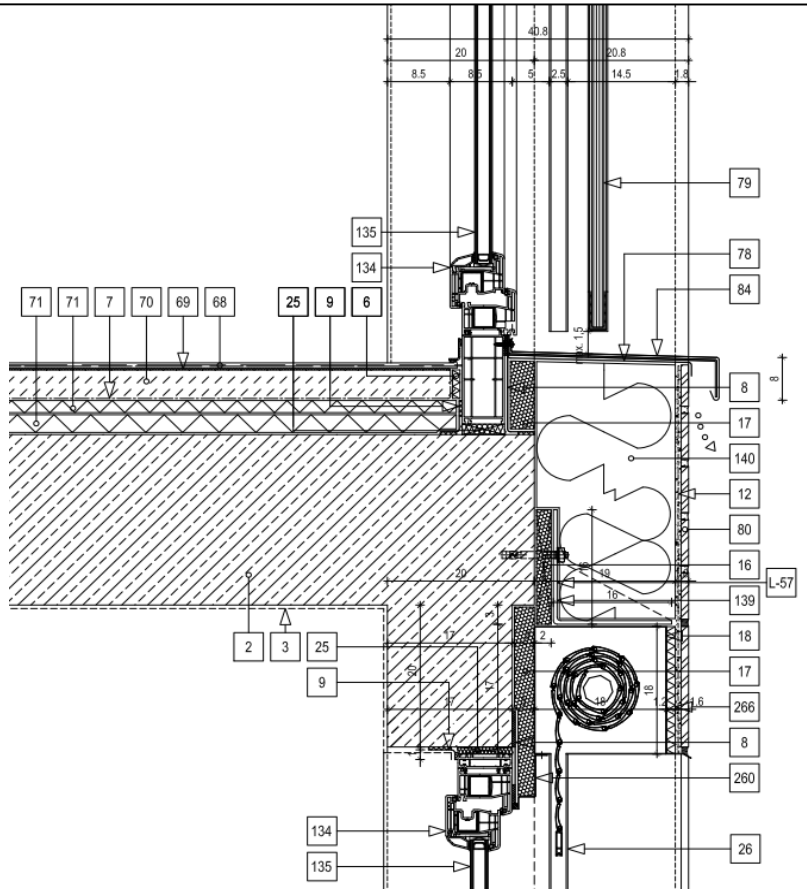
BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

FRENCH BALCONIES
TEST RESULT EXTENSIONS WITH CFD SIMULATION





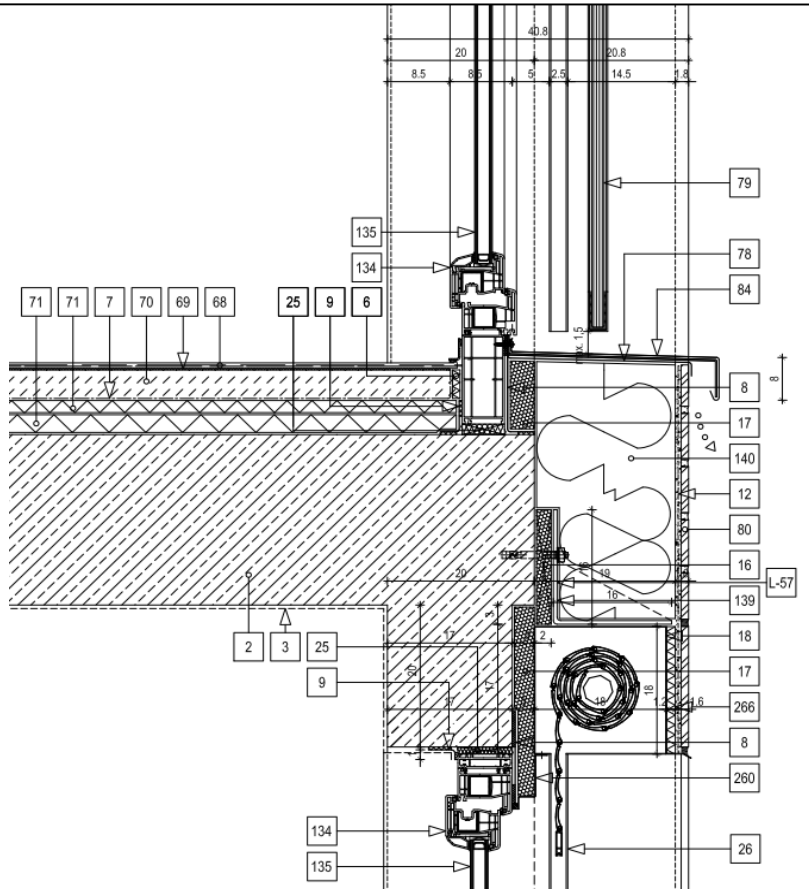
Detail drawings of the french balcony parapet glass test specimen (ÖNORM B 3800-8:2013), source: Vetrotech Saint-Gobain



Facade detail
(design: Farsang & Dudinszky Design)

BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

FRENCH BALCONIES
TEST RESULT EXTENSIONS WITH CFD SIMULATION



Facade detail
(design: Farsang & Dudinszky Design)

BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

FRENCH BALCONIES
TEST RESULT EXTENSIONS WITH CFD SIMULATION

Source: Vetrotech Pyroswiss

BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

FRENCH BALCONIES
TEST RESULT EXTENSIONS WITH CFD SIMULATION

Source: Vetrotech Pyroswiss

BME Faculty Of Architecture, Department of Building Energetics And Building Services, Department of Building Constructions

SOURCES

[1] National Fire Safety Code „OTSZ 5.0” (54/2014. (XII. 5.) BM legislative provision).

[2] MSZ EN 14800-6:2009. Fire resistance tests: Part 6. Fire spread test on facade

[4] Protection against fire spread. Fire Safety Technical Guideline (TvMI 1.2:2017.07.03.)

[3] ÖNORM B 3800-8 Ausgabe 2013-10-01. Brandverhalten von Baustoffen und Bauteilen. Teil 8: Dauerhaftigkeit von deckenübergreifenden Außenwandstreifen in Form von Brandschutzschilden im Brandfall. Anforderungen, Prüfungen und Beurteilungen

[5] Fire Dinamic Simulator (Version 6) User’s Guide. NIST Special Publication 1019-6, National Institute of Standards and Technology, U.S. Department of Commerce, 2013

[6] PyroSim User Manual. Thunderhead Engineering, 2015.

[7] Simo Hostikka and Gelb Bystkov: Numerical simulation of the ISO 13785-2 façade fire test. MATEC Web of Conferences, 46 03003 (2016), DOI: 10.1051 / matecconf / 20164603003

[8] Csaba Szikra, Lajos Gábor Takács PhD, Botond Kovács: CFD Modelling of Fire Spread on Facades. Proceedings of ÉPKO, International Conference of Civil Engineering and Architecture 2015, Csíksomlyó, Romania, 2018. június 6., p. 216-219.

[6] Magistratsabteilung 39 VFA – Labors für Bautechnik: – Laboratory test report (Laborbericht) VFA 2014-0244.01 on flame flash-over resistance of Vetrotech Saint-Gobain International AG’s Pyroswiss® Parapet VSG 66.2 French balcony glass parapet over a period of 30 minutes according to the standard ÖNORM B3800-8:2013 – March 20, 2014.

[7] Magistratsabteilung 39 VFA – Labors für Bautechnik: – Declaration of opinion (Stellungnahme) K 2014-0320 on the basis of laboratory test report VFA 2014-0244.01 on the appropriate structural configuration of Pyroswiss® Parapet VSG 66.2 French balcony glass railing – November 6, 2014

[8] IBS Institut für Brandschutztechnik und Sicherheitsforschung: test report 11070403-a on E-ef 120 minutes fire resistance of Vetrotech Saint-Gobain International AG Pyroswiss Plus type 6 mm thick glass structure – October 18, 2011