The Impact of Radiative Heat Flux from Building Fires on Insurer Certified PIR sandwich panels.

Mostyn Bullock BEng CEng FIFireE

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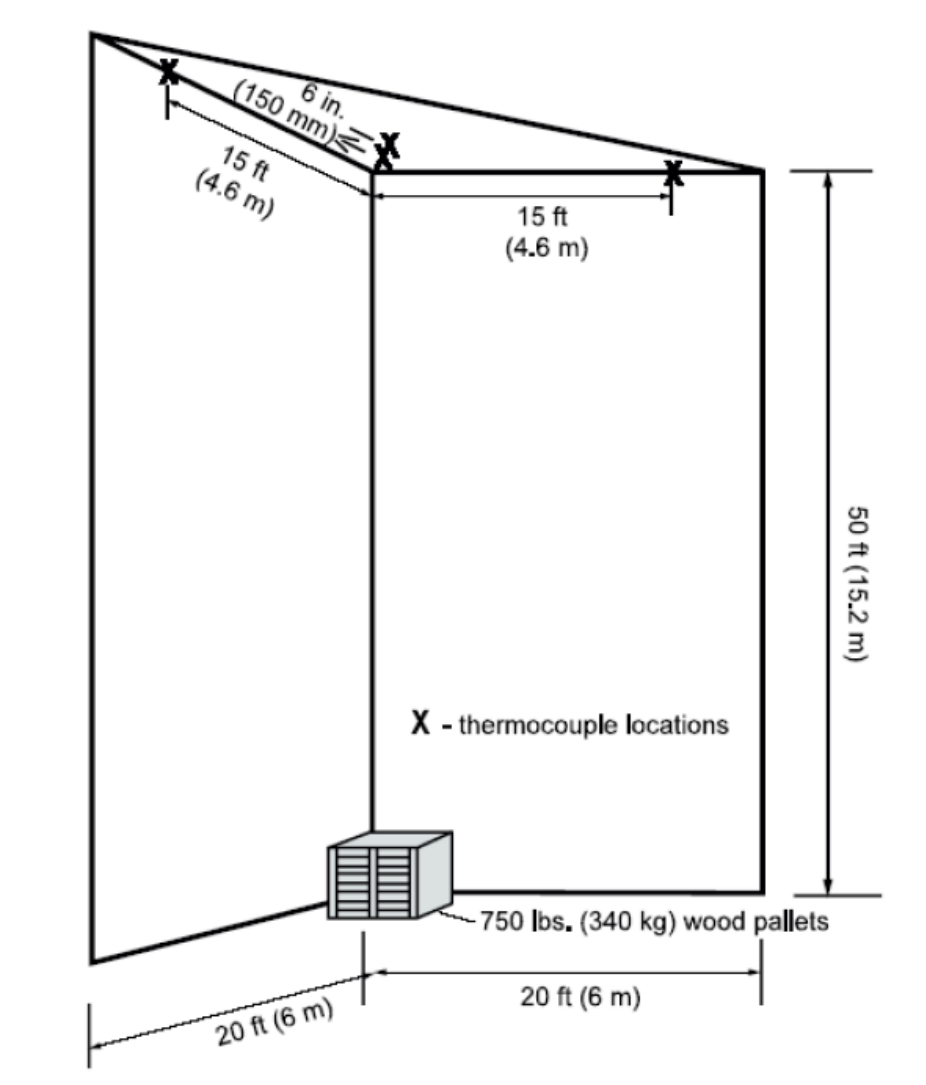
What does insurer-approved mean?



FM4880

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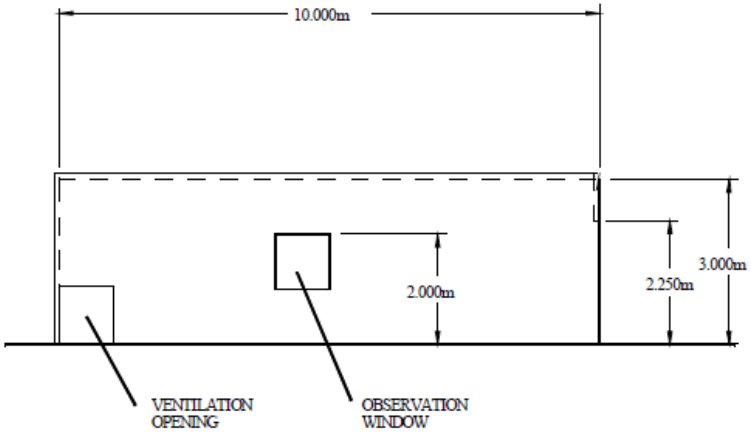
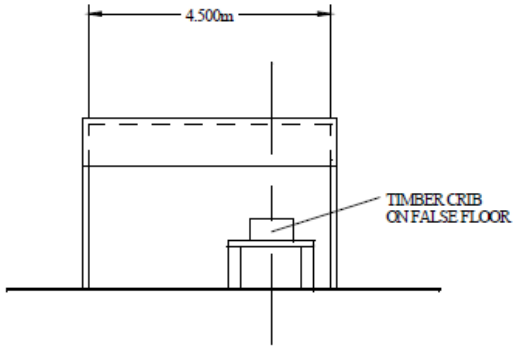
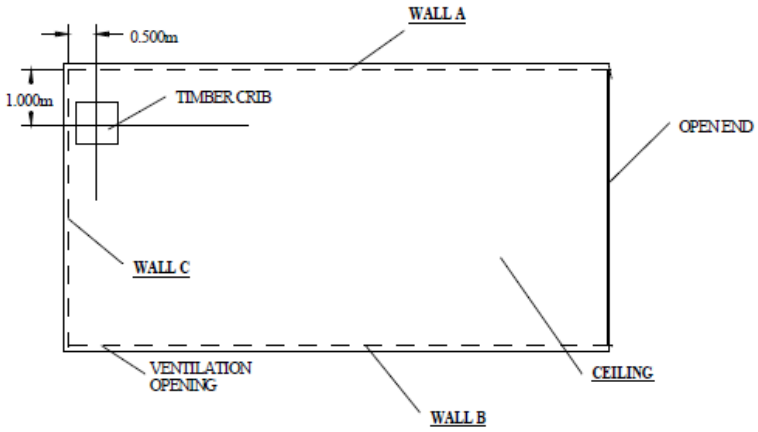
LPS1181


10.000m
2.000m
2.250m
3.000m
VENTILATION OPENING
OBSERVATION WINDOW


4.500m
TIMBER CRIB ON FALSE FLOOR


0.500m
WALL A
1.000m
TIMBER CRIB
OPEN END
WALL C
VENTILATION OPENING
CEILING
WALL B


C3.1
C2.1
C1.1

Investigation of performance in real fires

- Kingspan PIR panels
  - Kingspan polyisocyanurate (PIR) foam
  - Certified to FM 4880 and/or LPS 1181
  - The PIR foam is manufactured using a proprietary formulation of polyester polyol, methylene diphenyl diisocyanurate and specialised catalysts

- Over the course of the last 10 years a number of fires have occurred in buildings with Kingspan's PIR cored panels

- Tenos has worked with Kingspan is assessing the performance of the PIR panels in these fires.

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External fires with (predominantly) radiative heat transfer…

Spider Transport, Ireland - 2008

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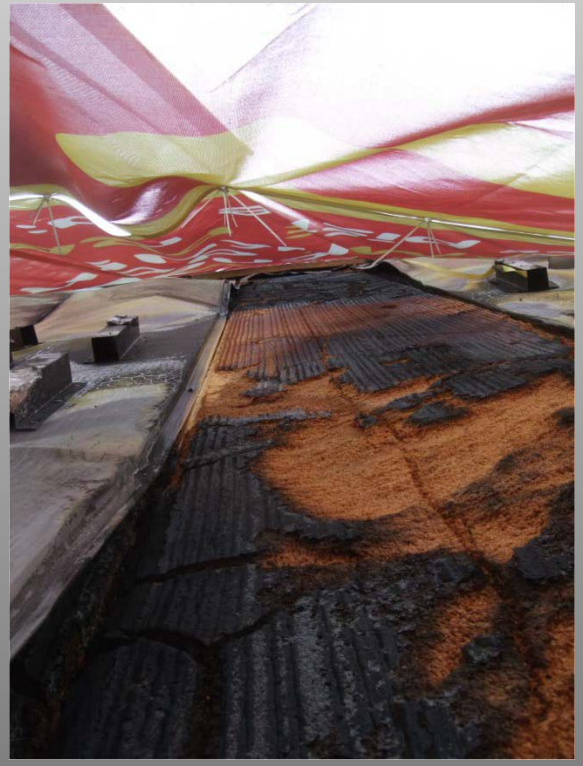
Furniture Store Slovakia - 2012

Furniture Store Slovakia - 2012

10 minute exposure 60-100kW/m^2
Charring of PIR core to 10mm depth



Furniture Store Slovakia - 2012

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Furniture Store Slovakia - 2012

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Oil facility, Netherlands - 2013

8 minute exposure
24kW/m^2
Surface charring of PIR core

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Oil facility, Netherlands - 2013

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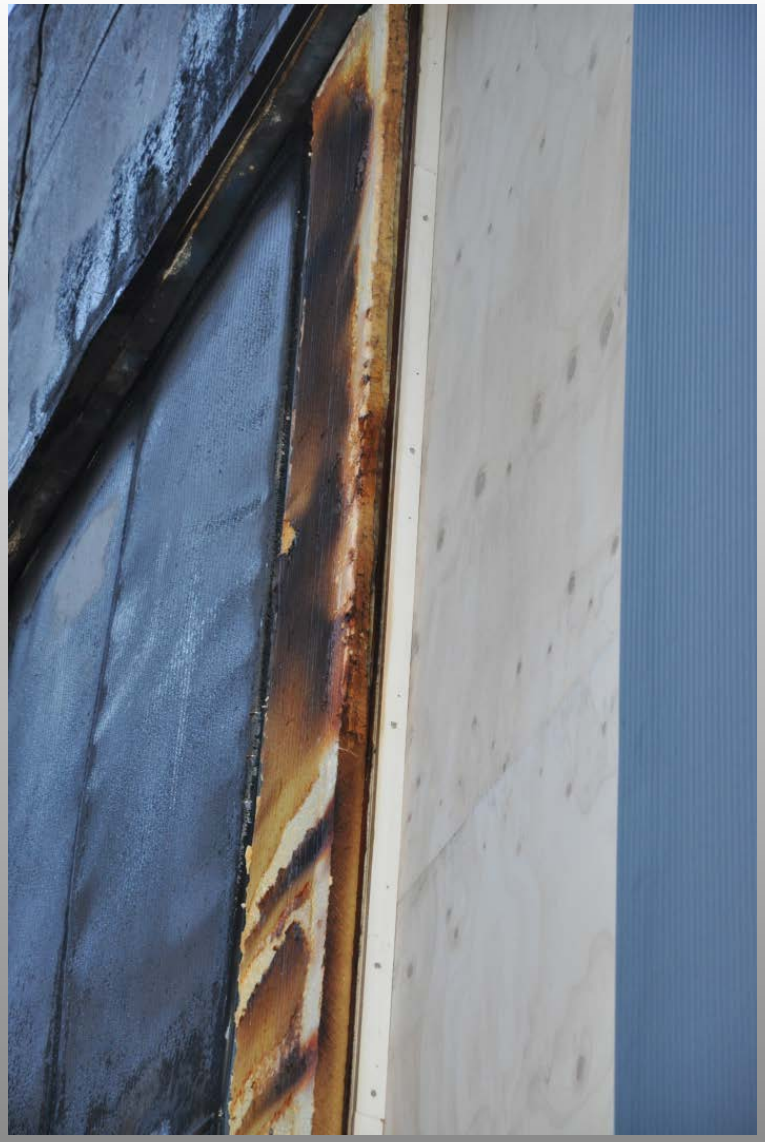
Oil facility, Netherlands - 2013



Oil facility, Netherlands - 2013

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Heining, Netherlands - 2013

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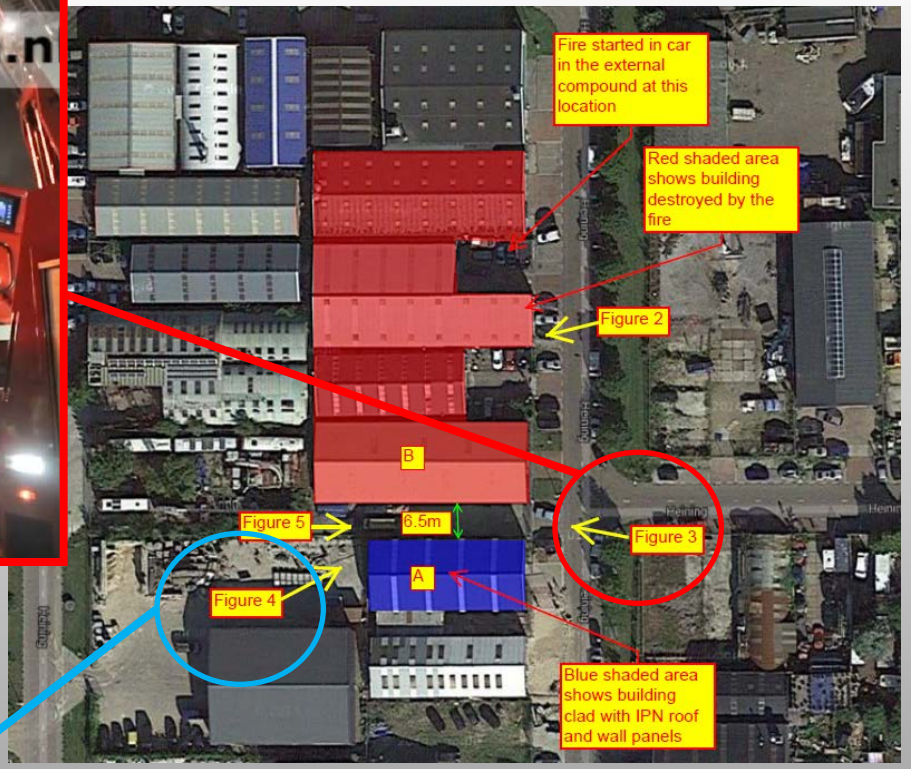
Heining, Netherlands - 2013



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Heining, Netherlands - 2013

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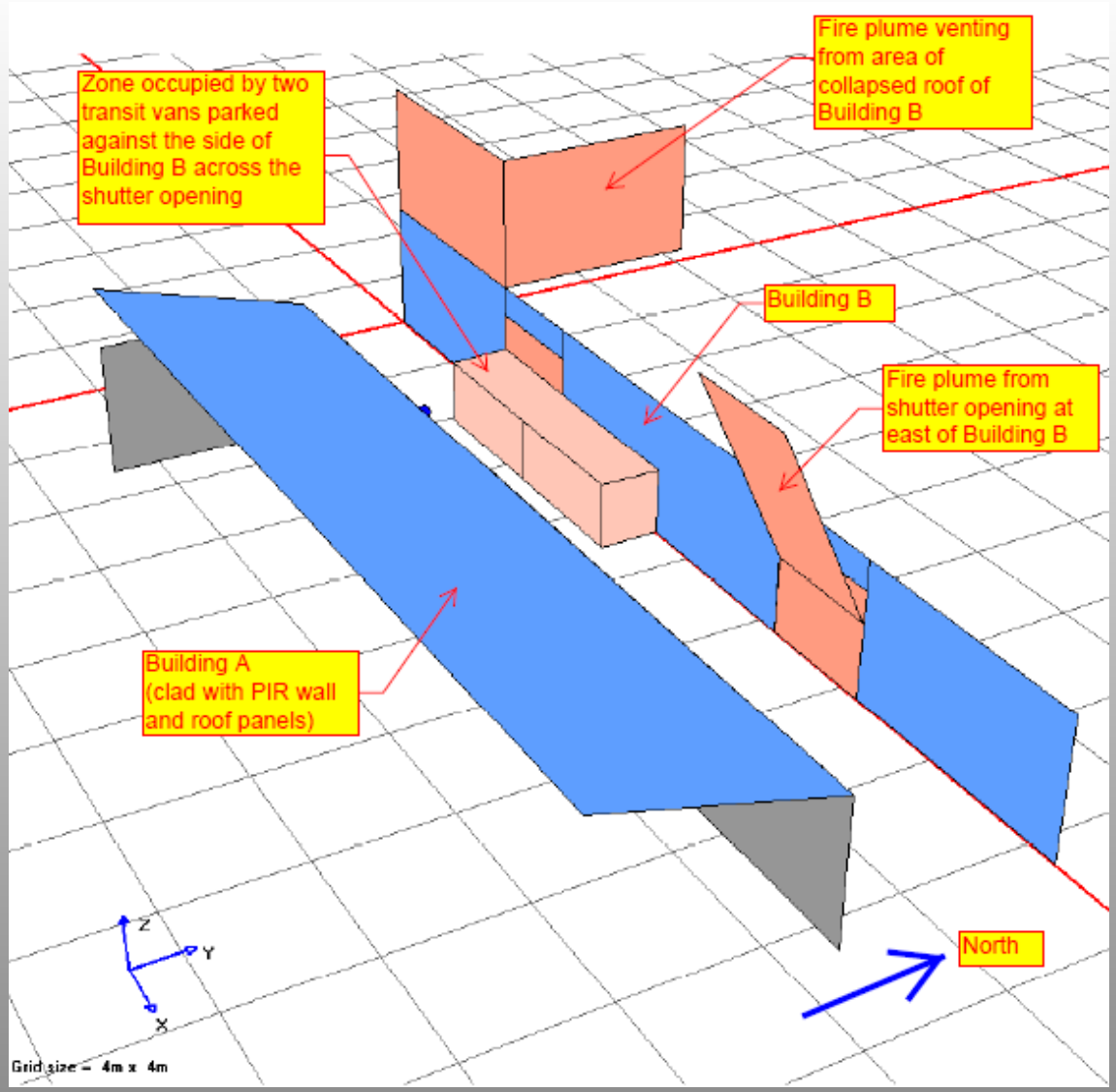
Heining, Netherlands - 2013



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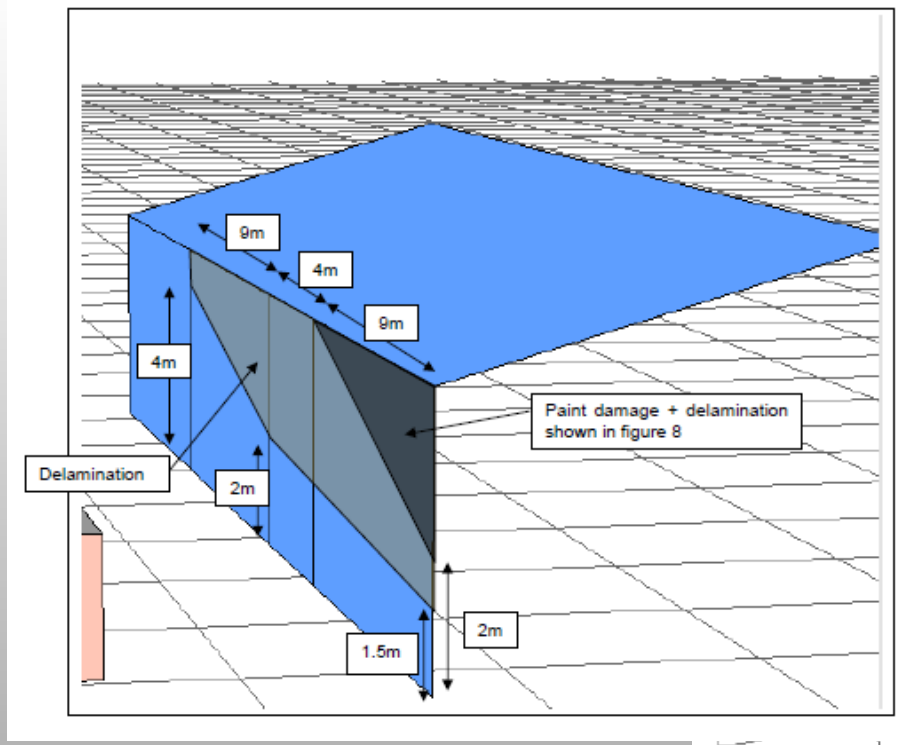
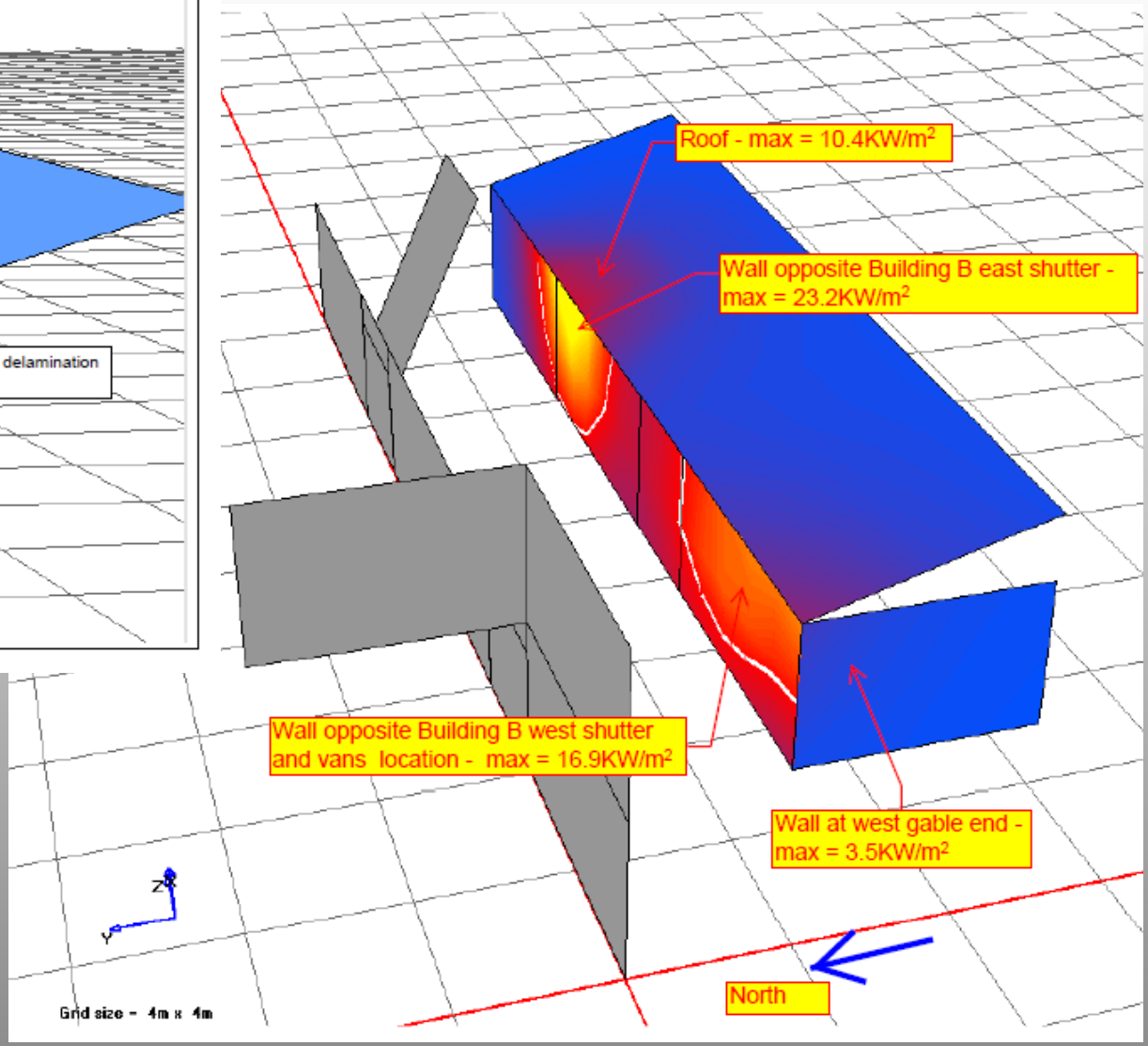
Heining, Netherlands - 2013





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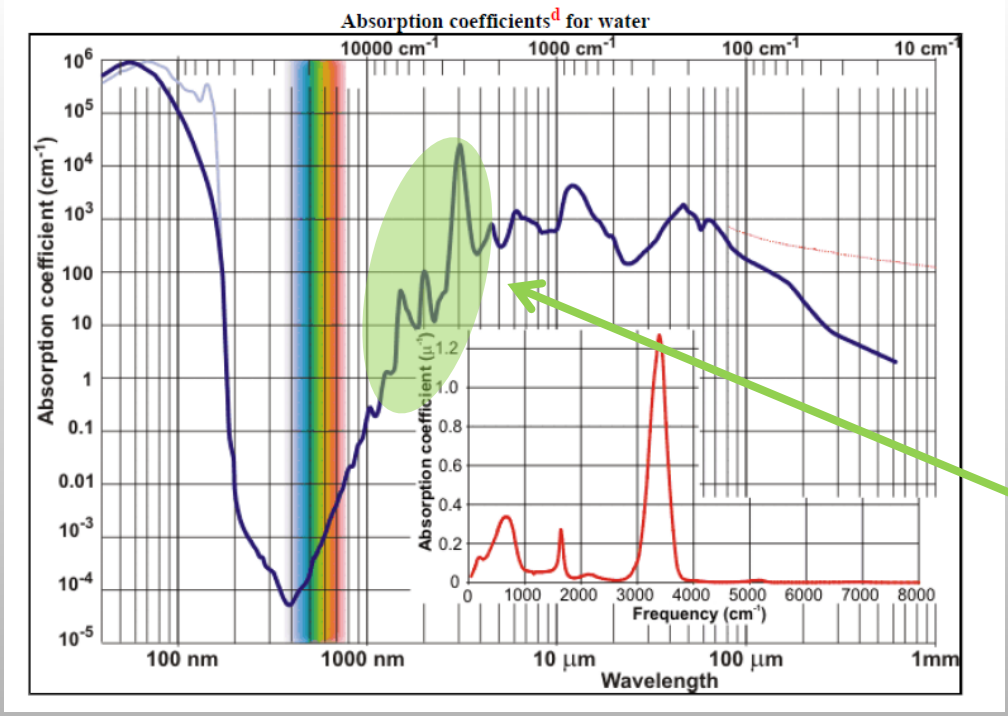
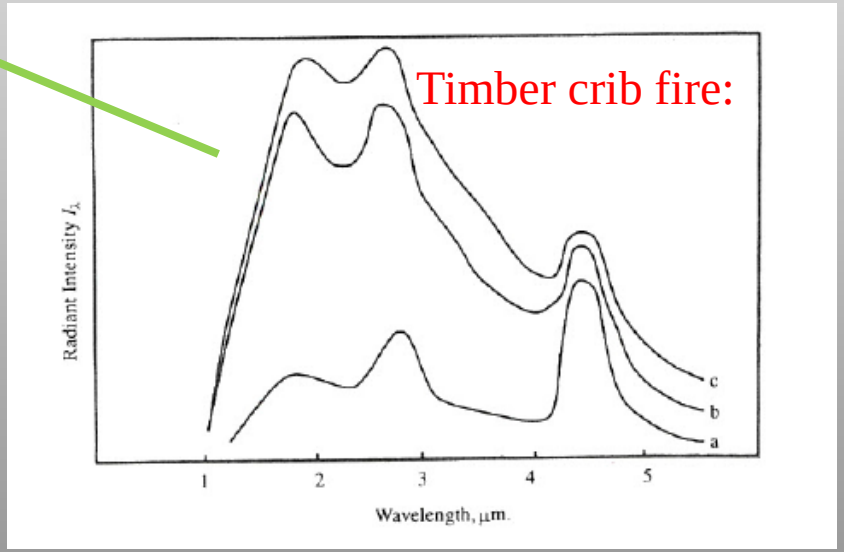
Heining, Netherlands - 2013

Heining, Netherlands - 2013





Heining, Netherlands - 2013

Assume water film spread evenly over wall surface = 0.0143mm/sec applied

Wavelength	Relative % of R_e	Incident heat flux at this wavelength range, kW/m²	Absorption coefficient, cm^{-1}	Residual Heat Flux at water/surface interface, kW/m²
1-2µm	25.2	5.85	1	5.07
2-3 µm	34.7	8.05	100	1.93
3-5 µm	40.1	9.30	1000	5.7×10^{-6}
TOTAL Incident Heat Flux		23.2	TOTAL Residual Heat Flux	7.0

Based on 4.5m wall height the flow time from top of wall to ground = 1 second (approx).

In this 1 second the water film absorbs:
23.2 - 7.0 = 16.2KJ/m²

Based on specific heat capacity of water:
Temp rise = 27ºC

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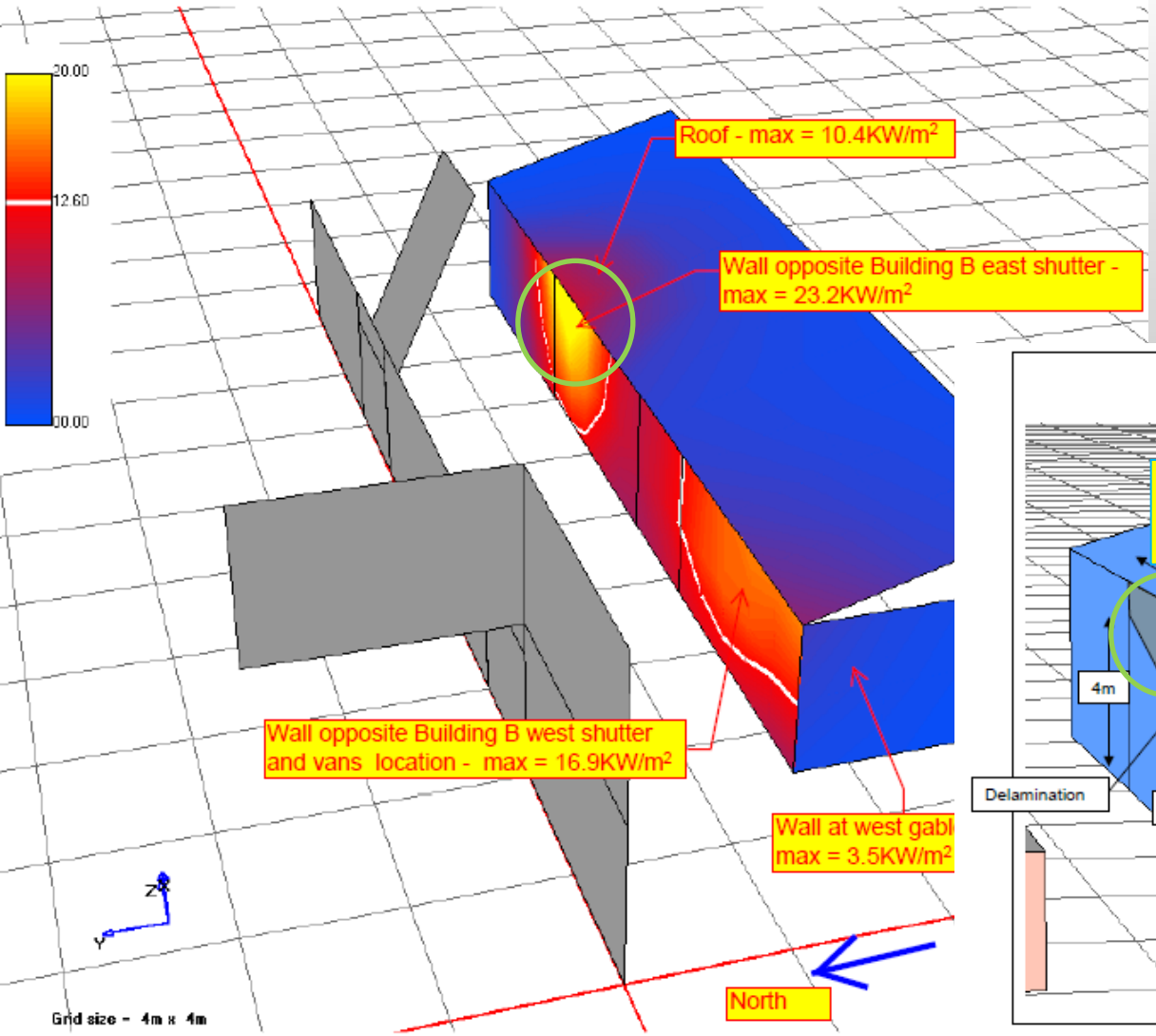
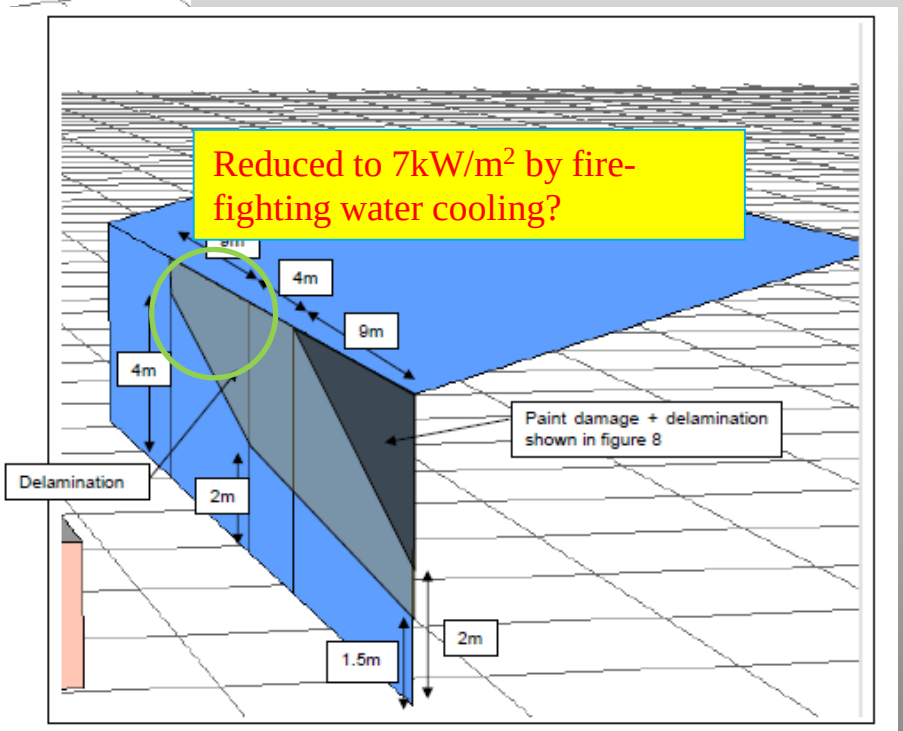
Heining, Netherlands - 2013





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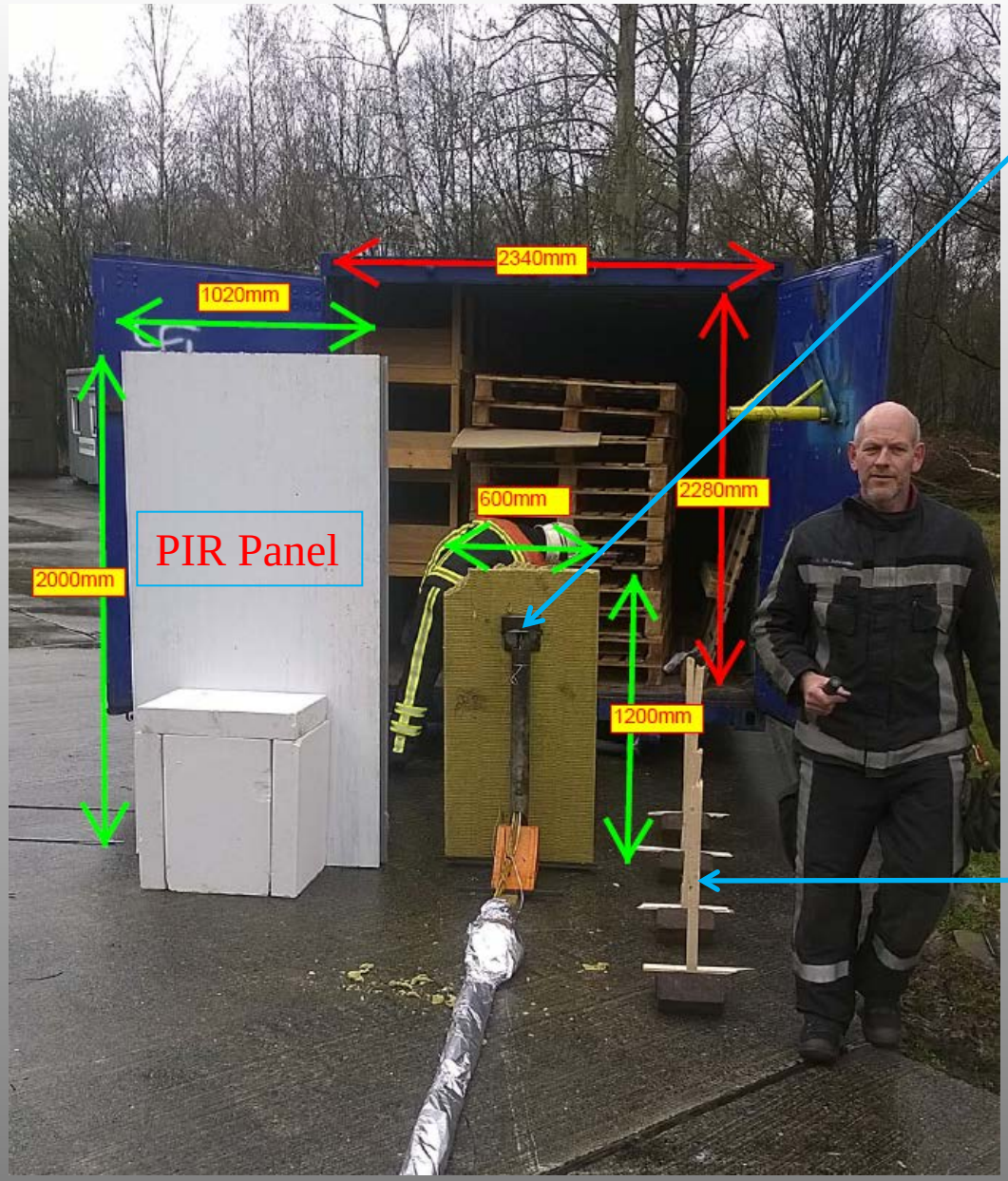
Heining, Netherlands - 2013

15 minute exposure ?
17kW/m^2 ?
Charring of PIR core?
(yet to be dismantled & inspected)

Troned – March 2014



Radiometer
(Total Heat Flux type)

Timber stick targets

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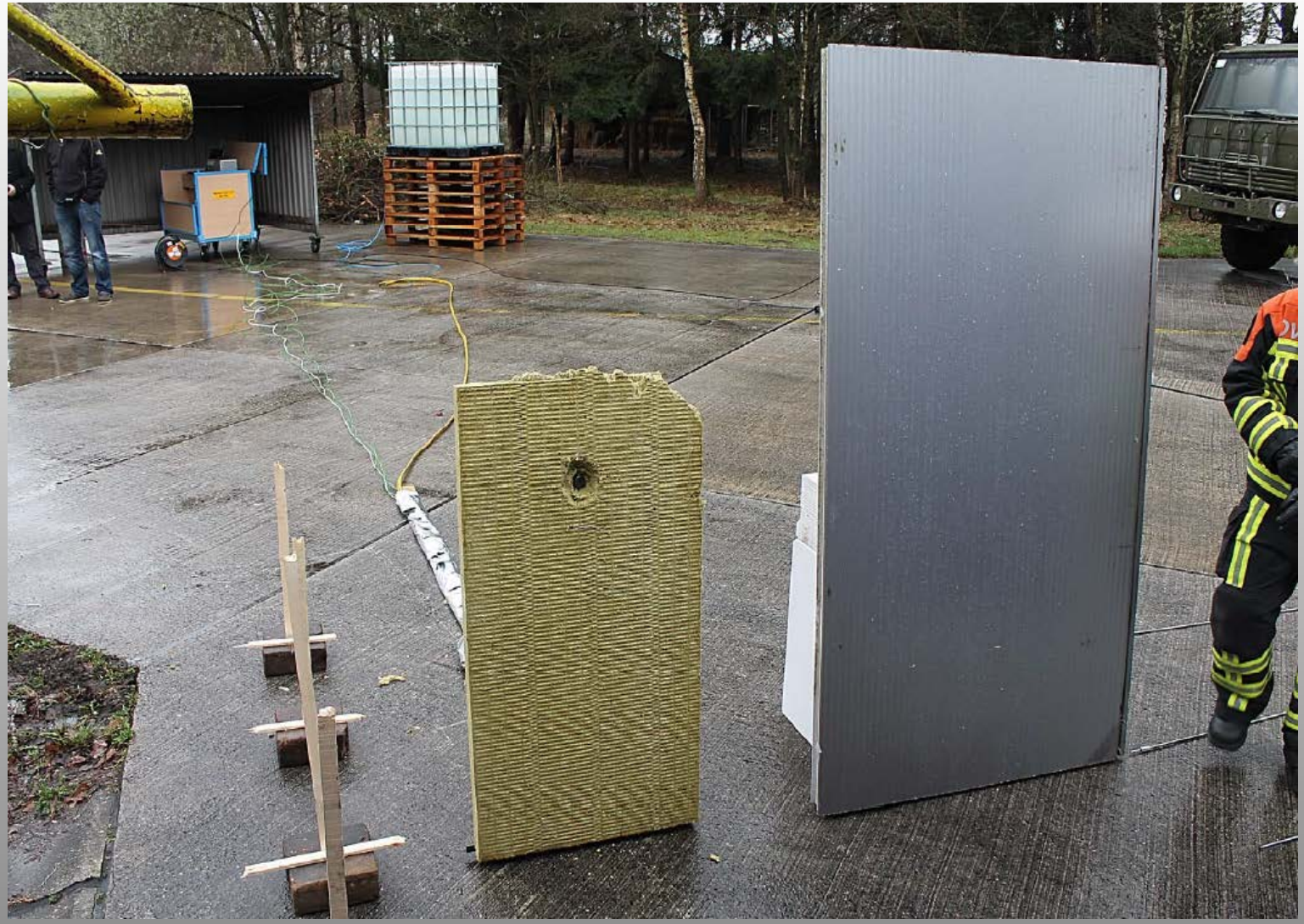
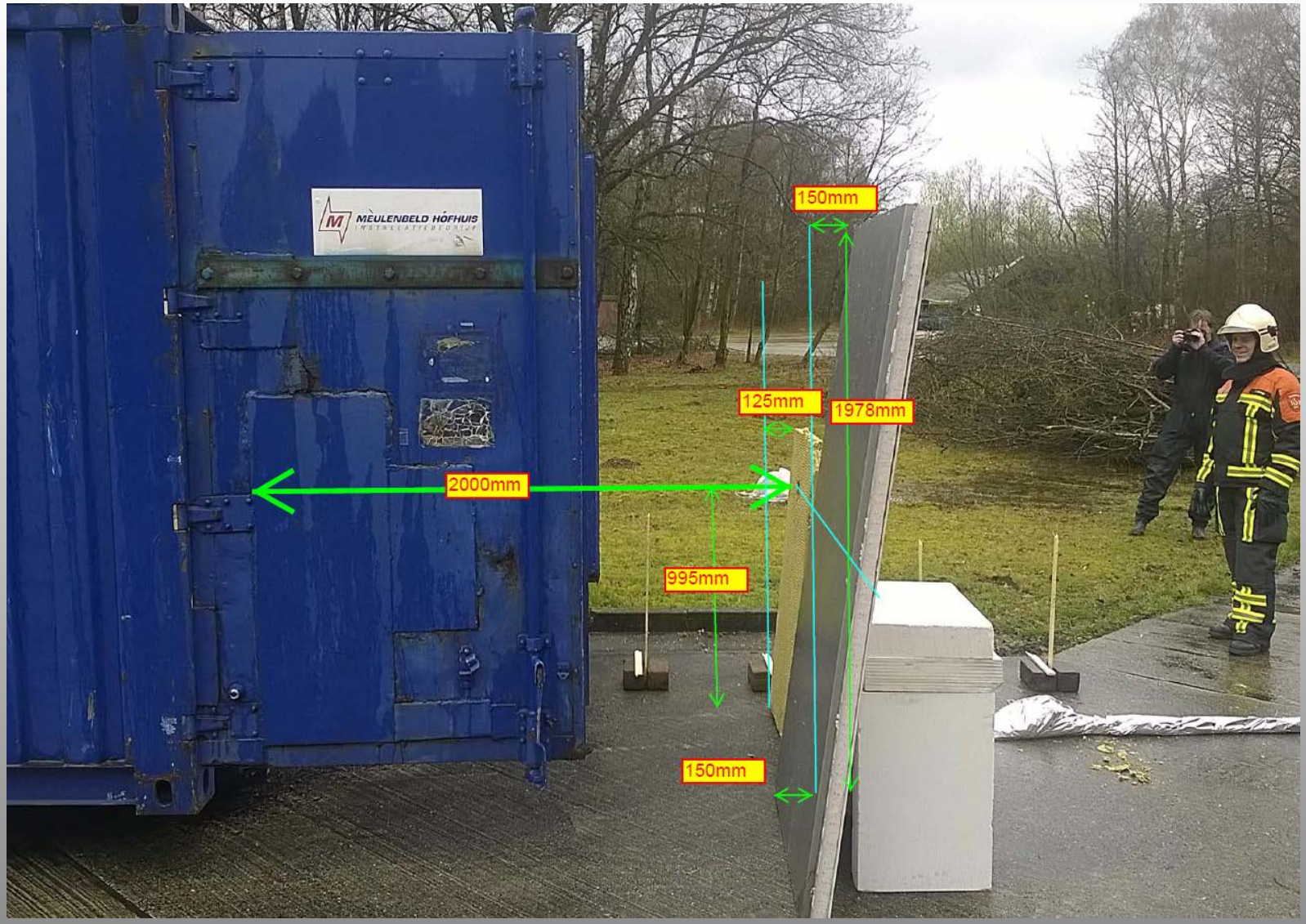


Troned – March 2014



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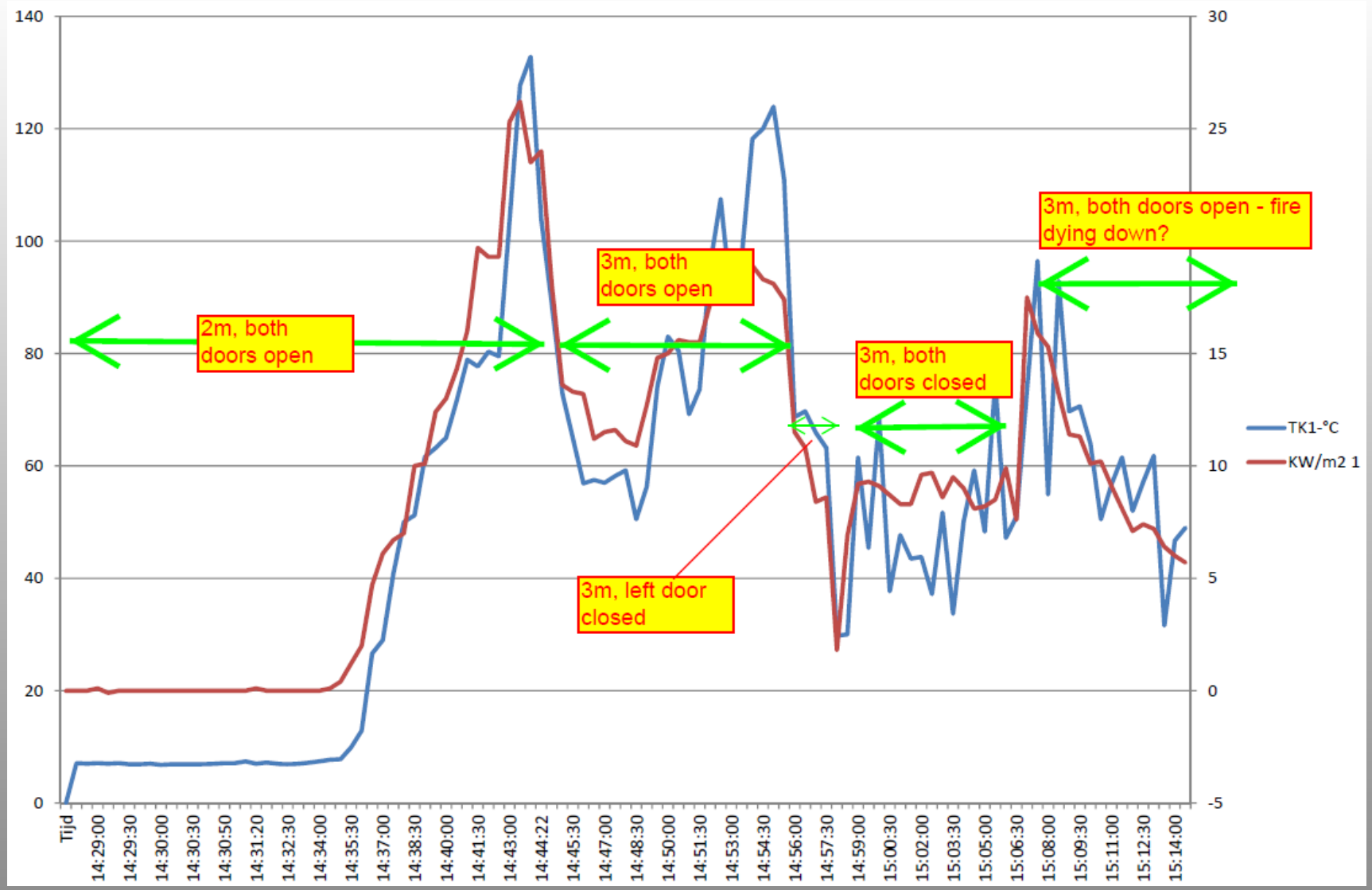

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Troned – March 2014

Plume:
Emissivity = 0.423
Heat Flux emitted = 34.5kW/m^2

Opening:
Emissivity = 1.0
Heat Flux emitted = 84kW/m^2

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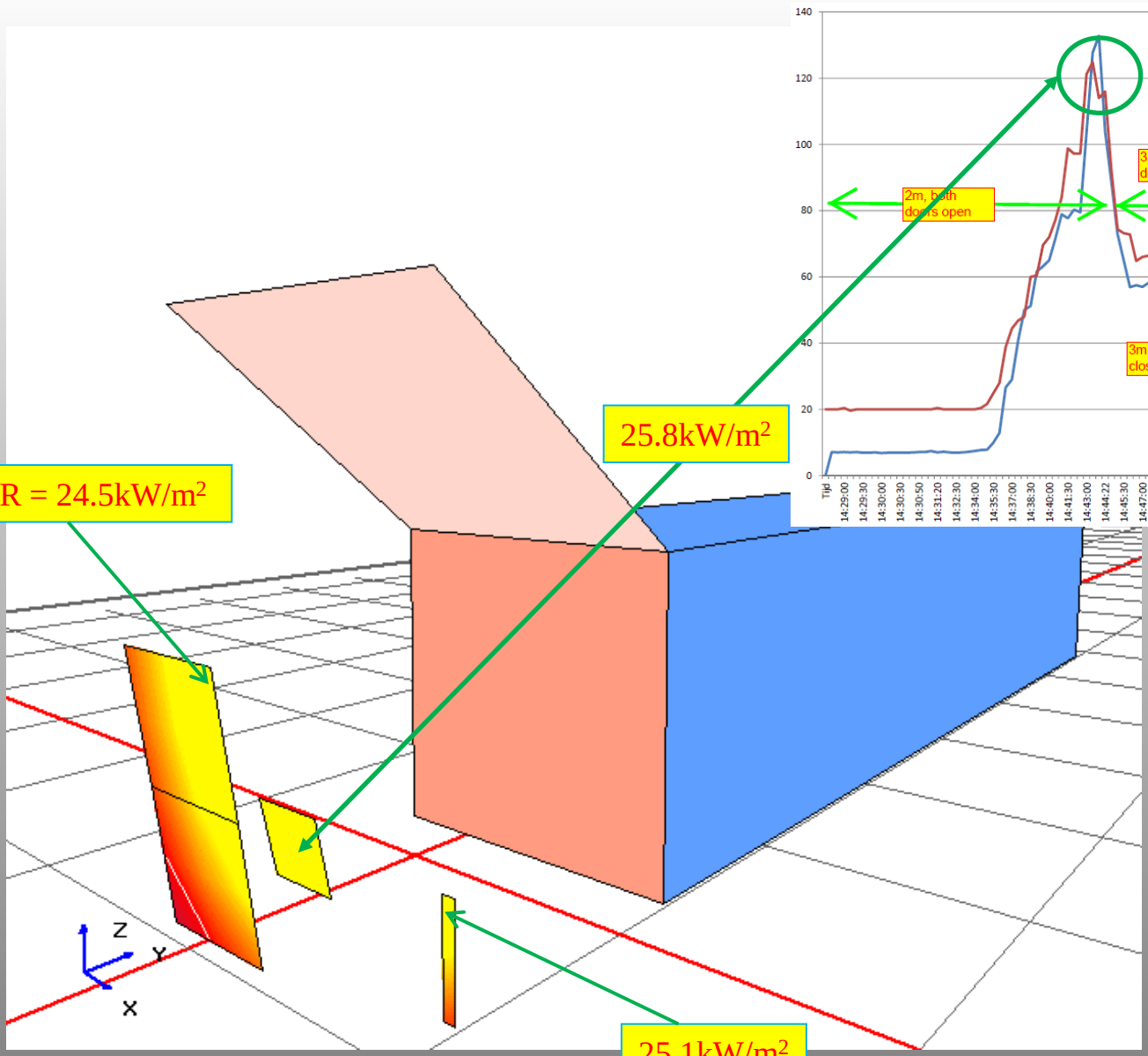
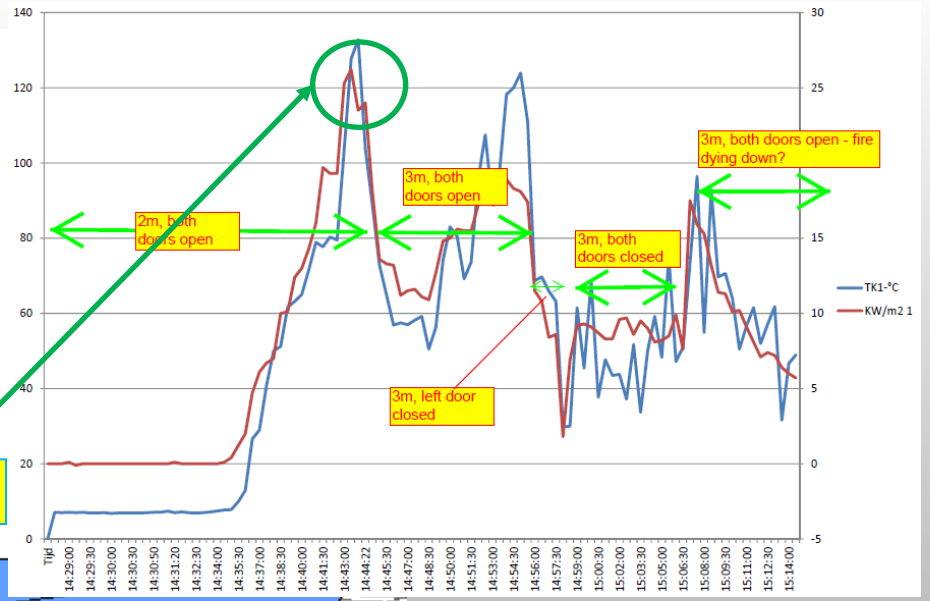
Troned – March 2014

Troned – March 2014





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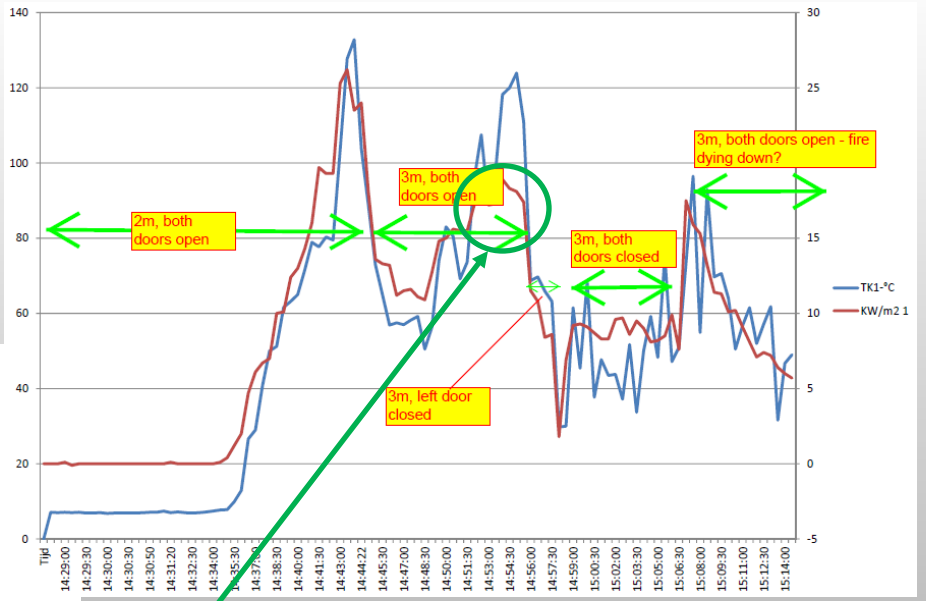

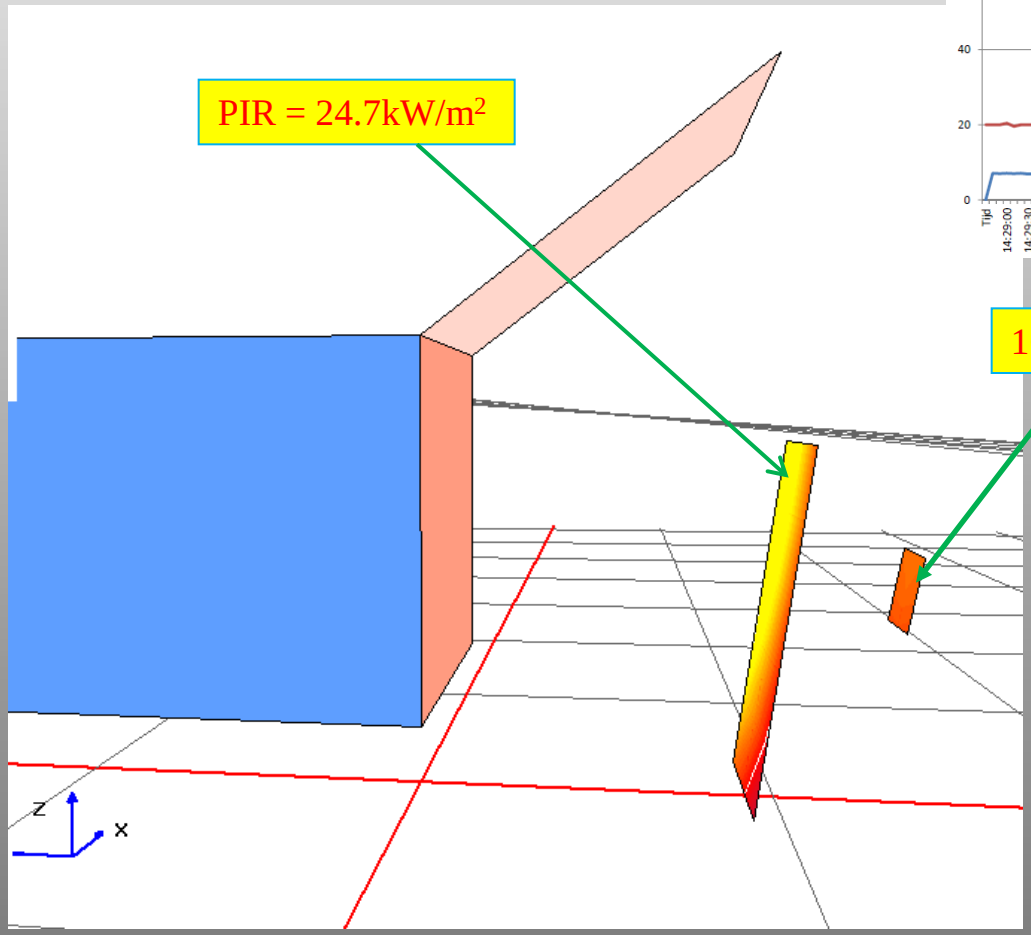

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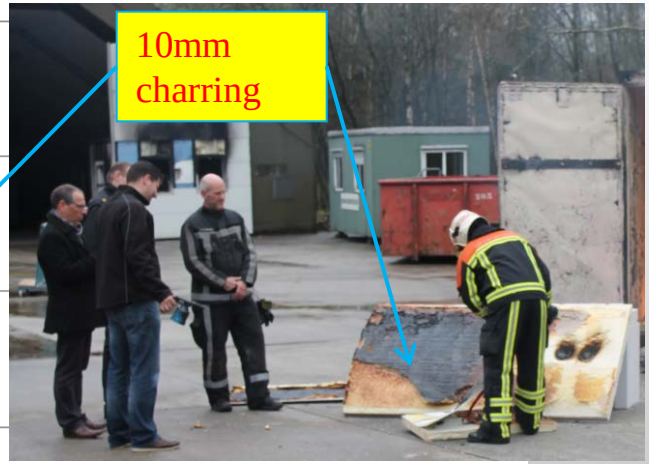
kW/m^2



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