

A wide-angle photograph of a beach at sunset. The sky is a gradient of light blue and orange. The ocean is dark blue with white foam from waves breaking in the foreground. In the distance, a city skyline is visible on a hill, silhouetted against the bright sunset. The word "RED" is overlaid in large, bold, red capital letters in the center of the image.

RED

Carl Pettersson
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MSc Risk Management



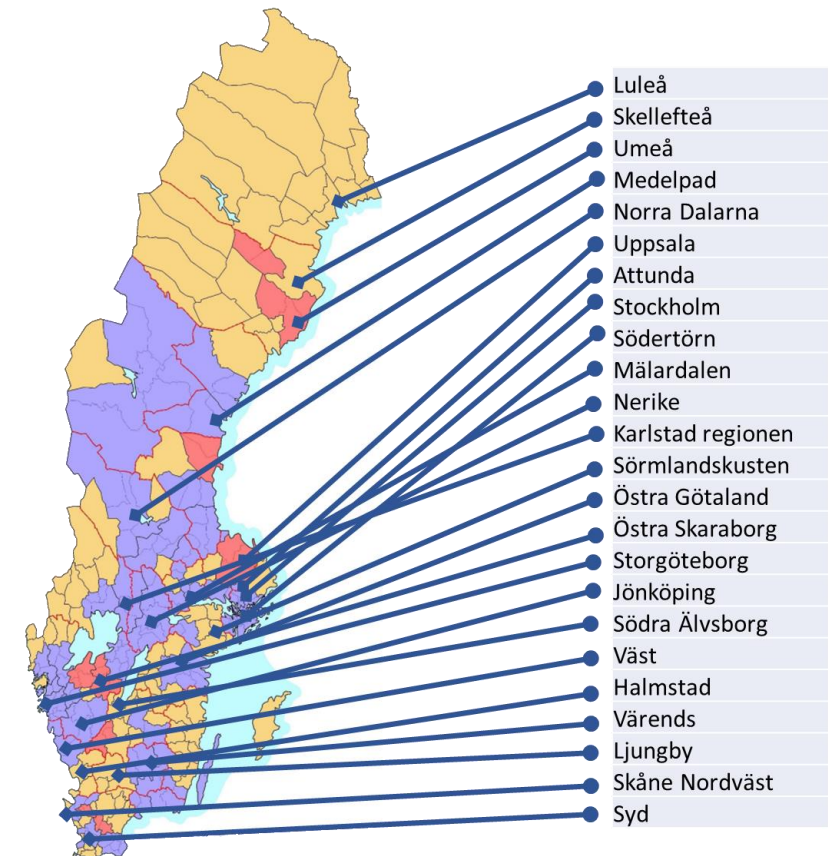
Fire Safety in Timber Buildings -
A review of existing knowledge

Carl Pettersson



Brandforsk

- **COST Action CA20139,**
Holistic design of taller
timber buildings
(HELEN)
- **Network – Fire brigades**



Gävle, Sweden, City Fire 10 July 1869
13 000 people lost their homes

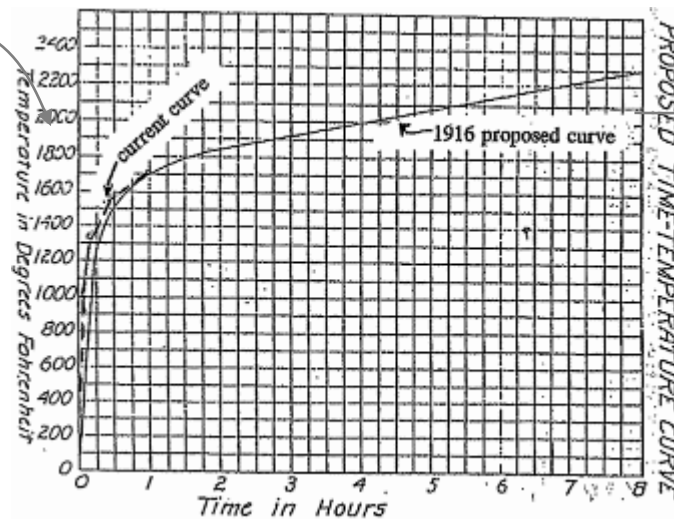


Fire resistance – temperature curve



1919
The standard
fire curve
“ASTM E119”

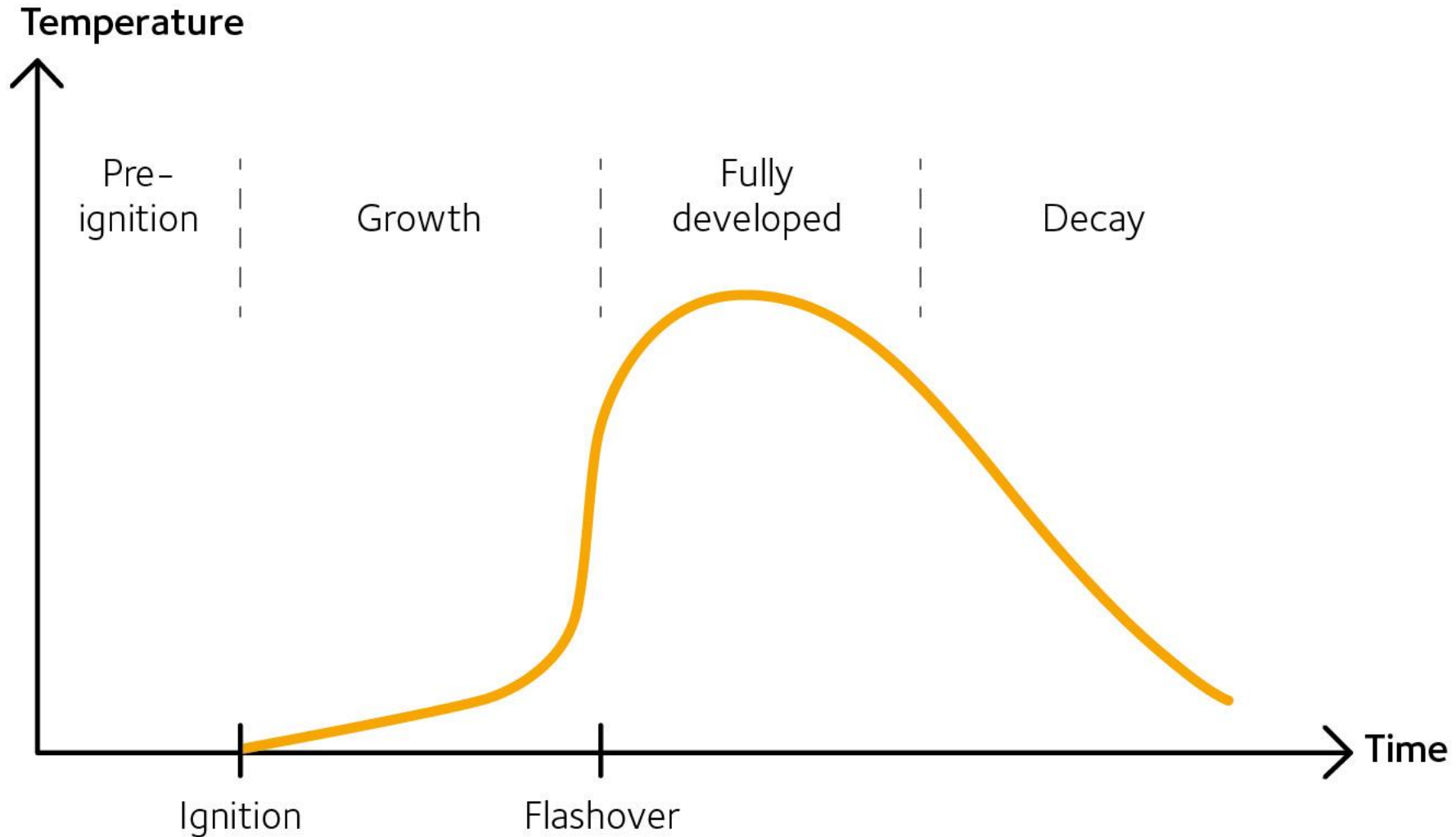
1922-1928
Simon Ingberg (US)
- Fire tests with varied
fuel load



2023



Fire resistance – temperature curve



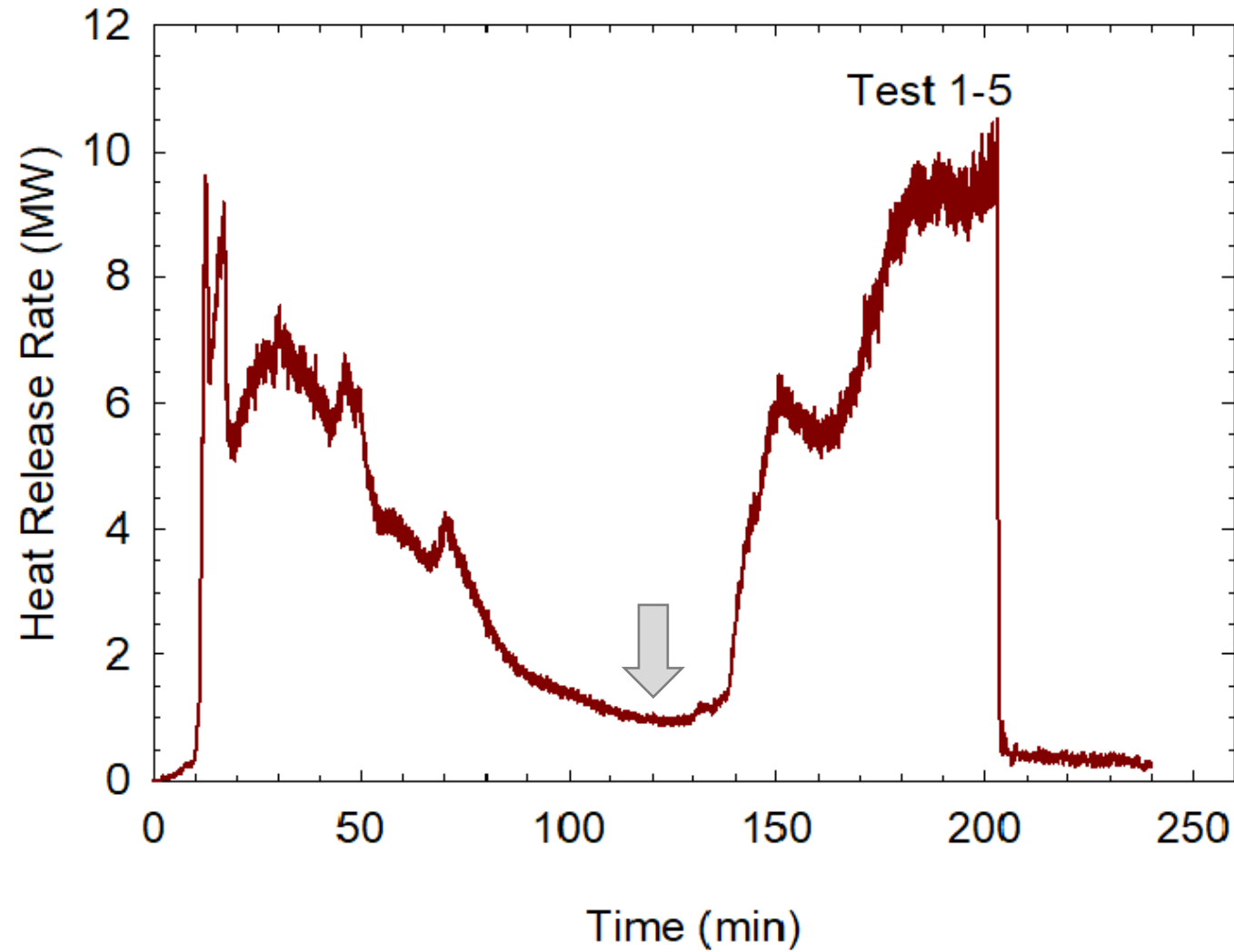
The image shows the interior of a fire test compartment. Several vertical columns are wrapped in white protective material. In the background, a fire is burning, illuminating the scene with an orange glow. A dark, bulky object, possibly a sofa, is visible in the middle ground. The floor is covered with a white protective sheet and some debris.

NIST- NRC Canada Cross Laminated Timber (CLT) Compartment Test 1-5

April 13, 2017

Exposed timber

*Fire Safety Challenges of Tall Wood Buildings – Phase 2: Task 3 -
Cross Laminated Timber Compartment Fire Tests
Fire Protection Research Foundation, the National Research Council
Canada and the National Institute of Standards and Technology*



- Geometry and ventilation
- Exposed surfaces
- Type of glue and thickness of lamellas
- Duration of fire exposure

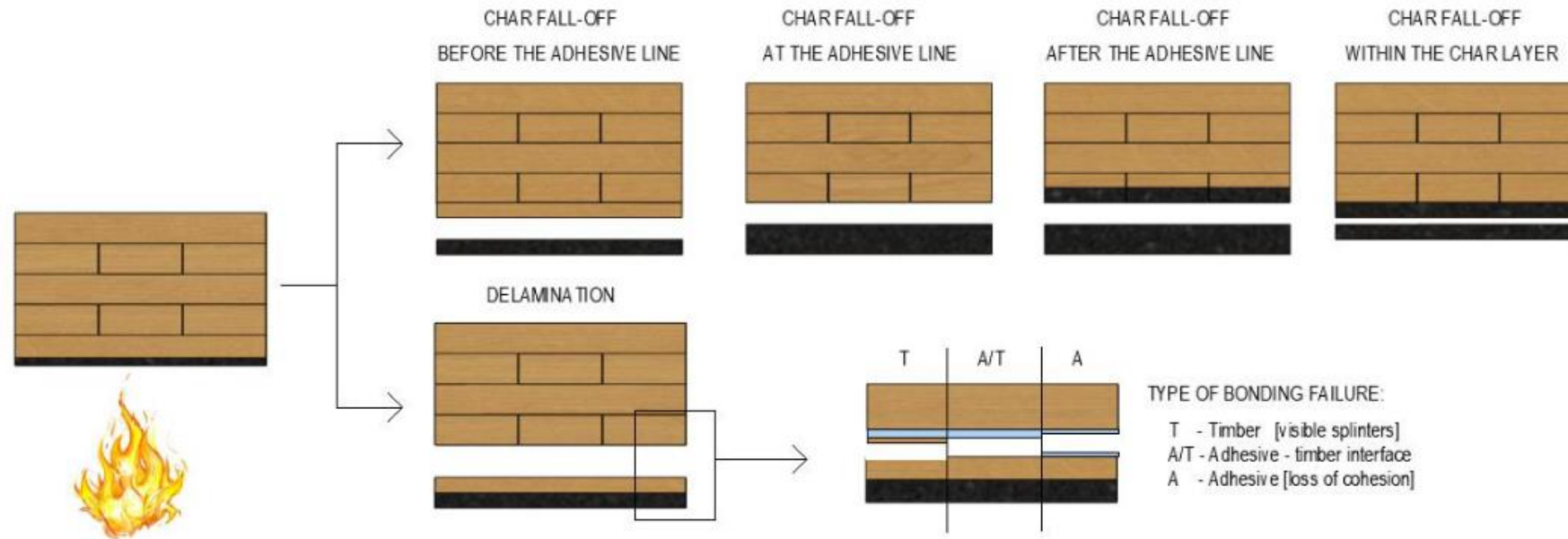
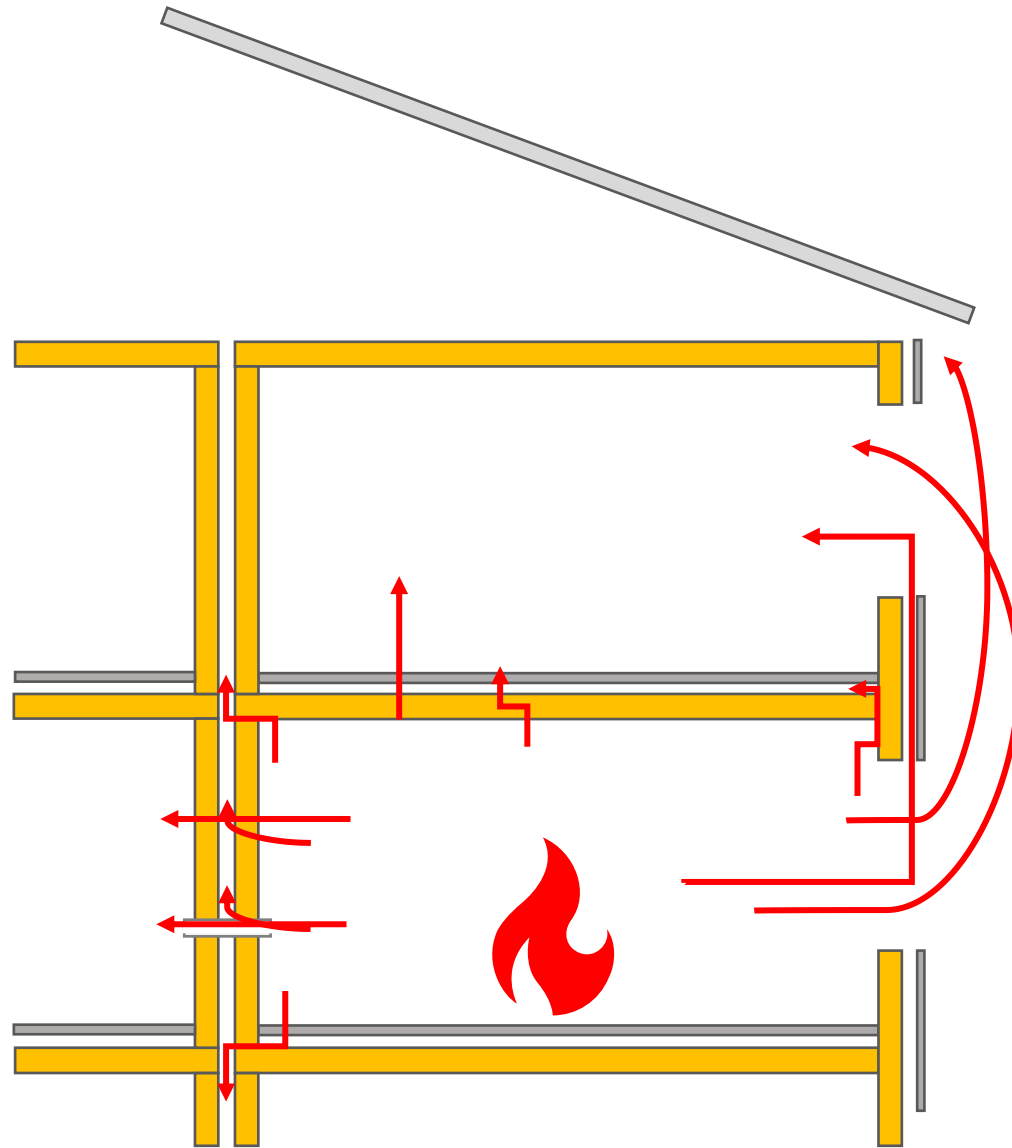


Figure 2. Debonding – the difference between char fall-off and delamination, and failure description at the bond line

Fire spread



Fire spread - facade

Barking fire - 2019

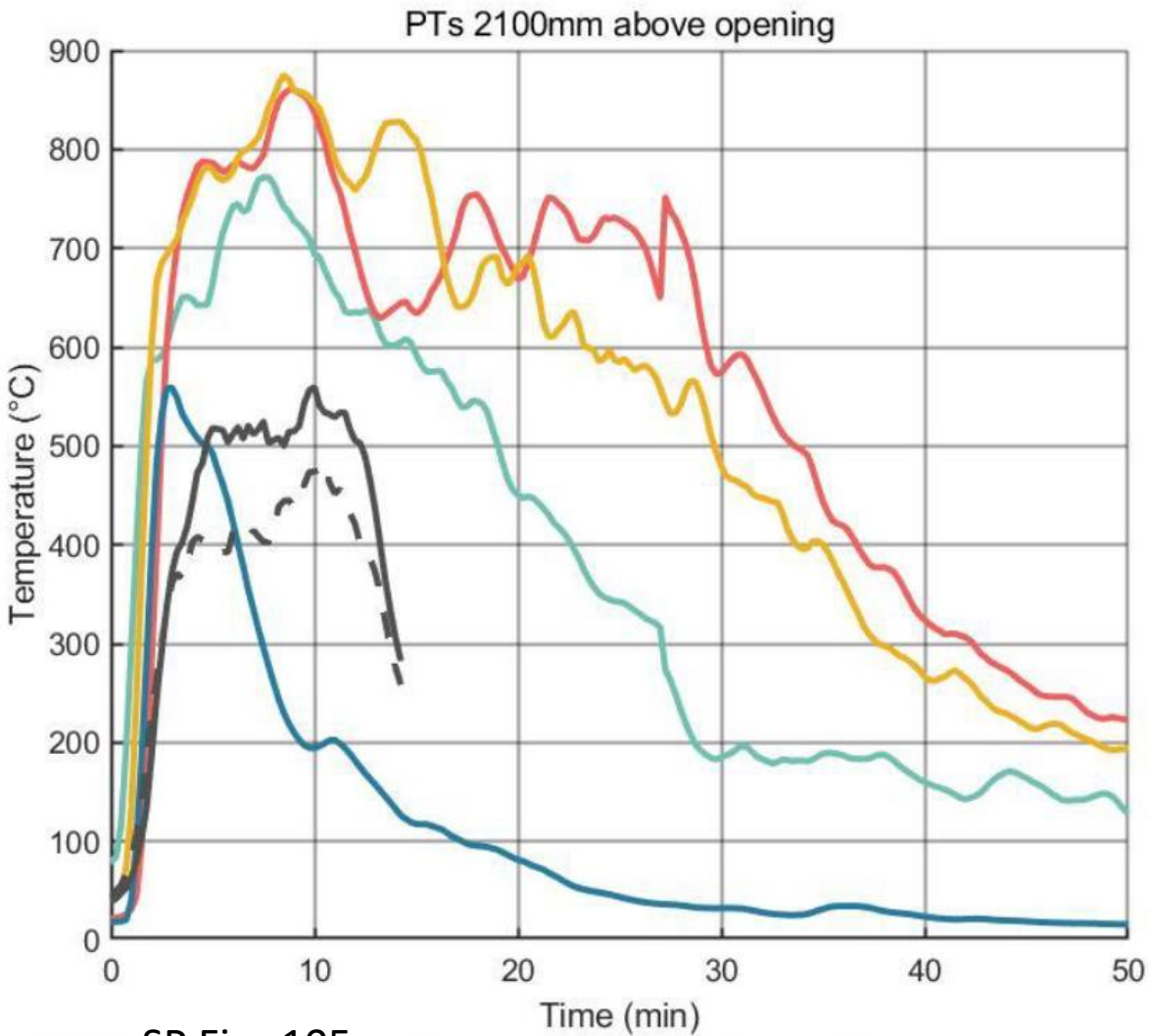
Grenfell fire - 2017

Milano fire - 2021



Fire spread - External

Exposure from mass timber compartment fires to facades
Johan Sjöström, Daniel Brandon, Alastair Temple, Emil Hallberg, and Fredrik Kahl
RISE Report 2021:39



SP Fire 105



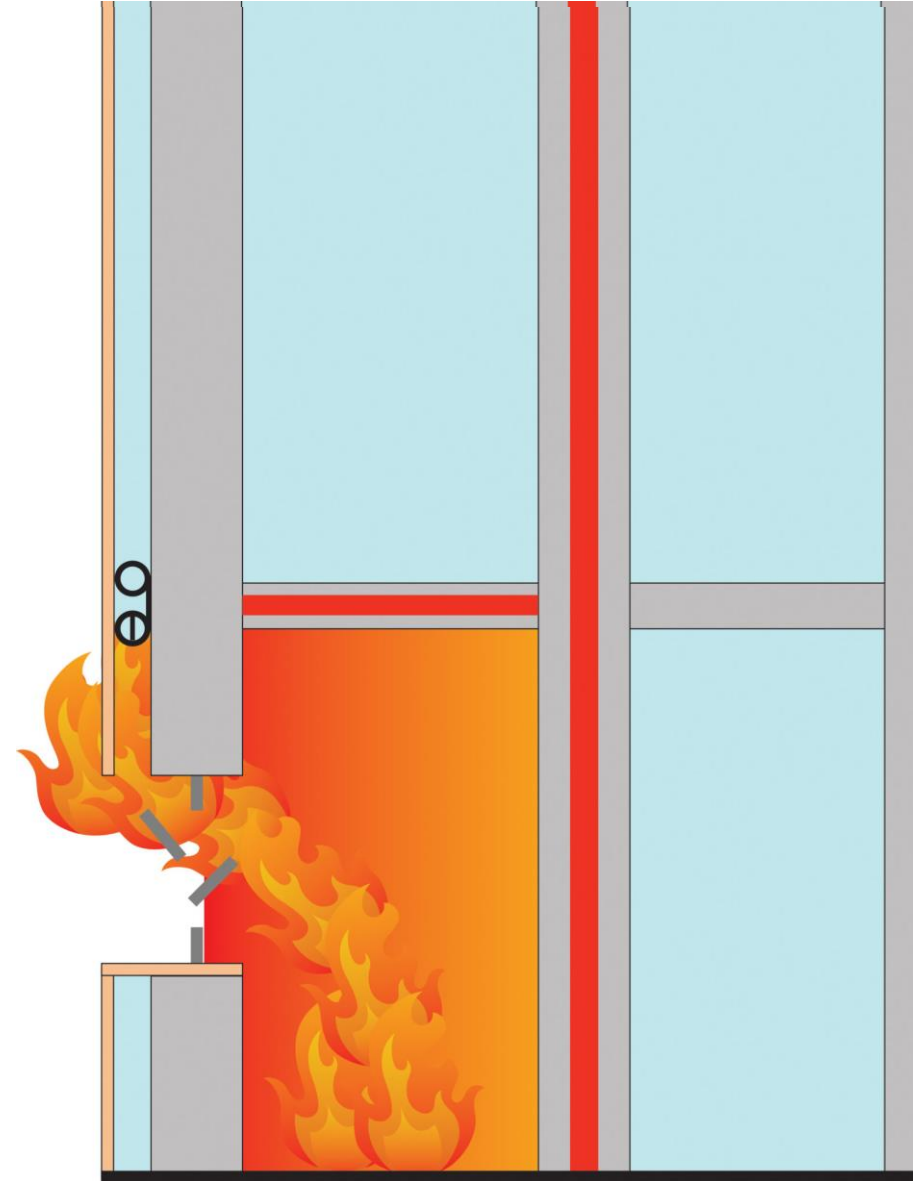
Durability of Reaction to Fire Performance



Fire spread - External

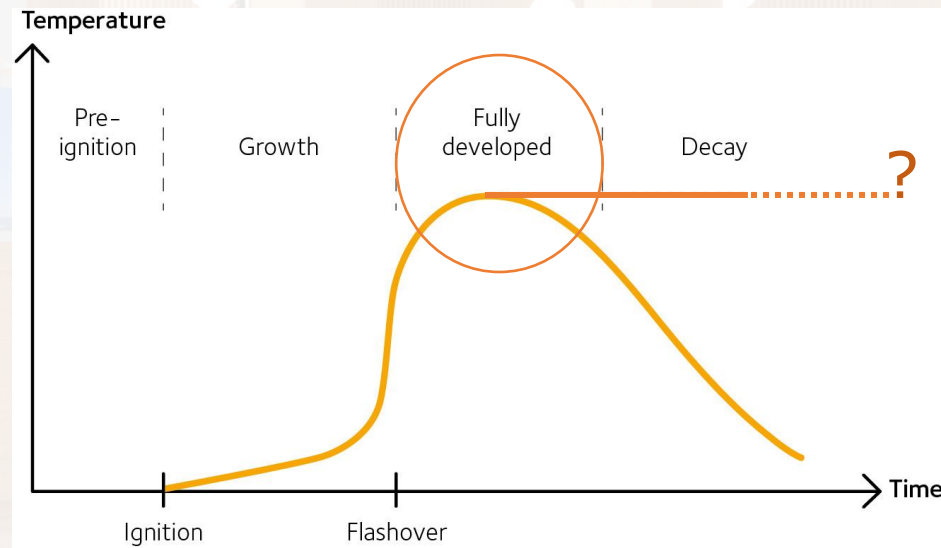


Fire spread - External



Exposed timber internally

- Fire compartments
 - Penetrations
 - Openings (doors, windows, shafts)
 - Joints
- Loadbearing capacity
 - Length of fire exposure

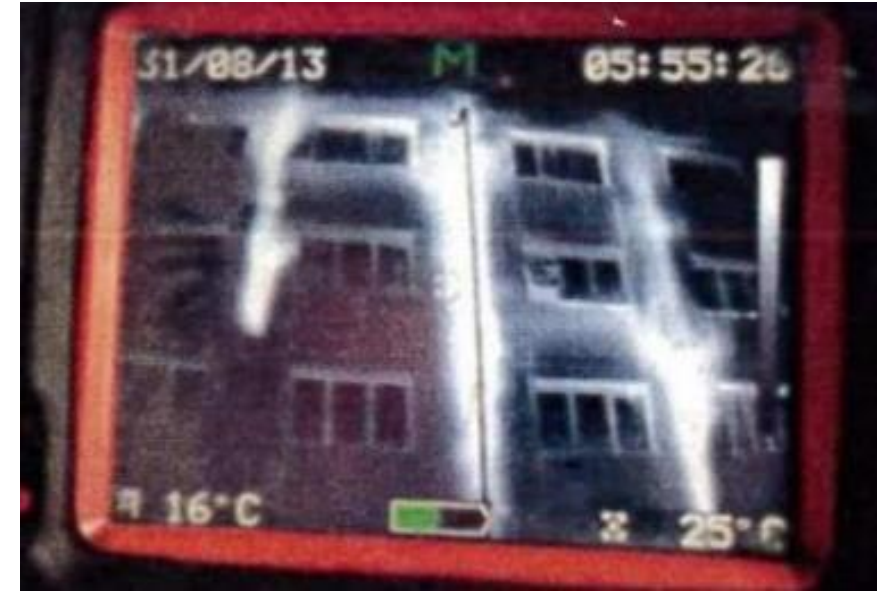


Fire spread – cavities

Summary Report Fire Safe implementation of visible mass timber in tall buildings –
compartment fire testing Daniel Brandon RISE Report 2020:94



Fire spread – cavities



Fire spread – joints

Summary Report Fire Safe implementation of visible mass timber in tall buildings – compartment fire testing, Daniel Brandon RISE Report 2020:94

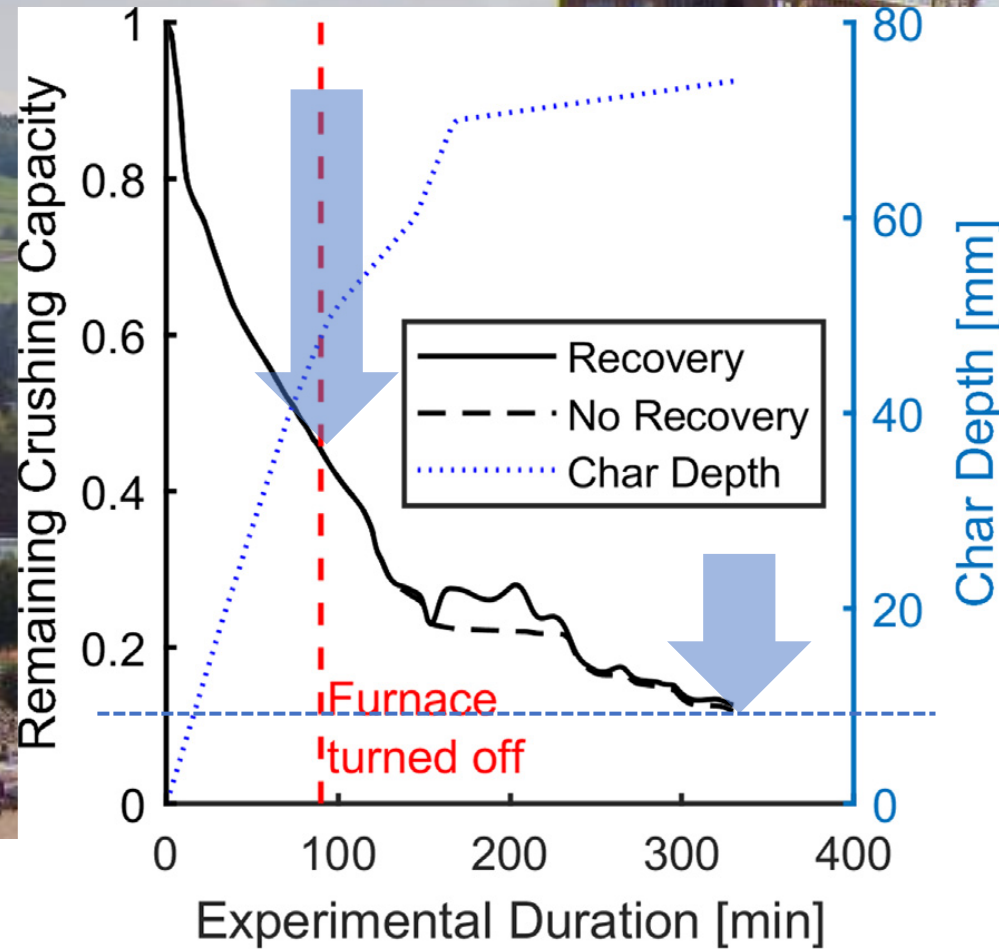
- Movement over time.
- Document the protection during built.
- Inspect and maintain protection.



Burnout?

Wiesner F., Bisby L.A., Bartlett A.I., Hidalgo J.P., Santamaria S., Deeny S., Hadden R.M. (2019), *Structural capacity in fire of laminated timber elements in compartments with exposed timber surfaces*. In: *Engineering Structures*, vol. 179, pp. 284-295. <https://doi.org/10.1016/j.engstruct.2018.10.084>

- Tested 90 min in according to fire curve
- Measured temperature during 330 min



During construction

Hemsedal 2022



“

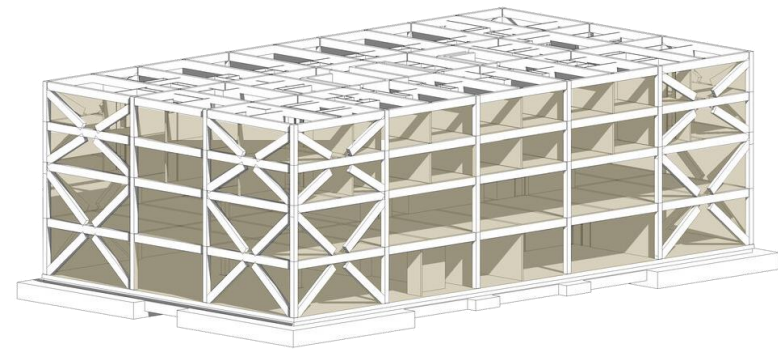
For some (predominantly combustible)
construction methods, compliance with
building regulations alone might have
little relevance to a building's insurability

”



RISCAuthority UK *Insurance challenges of massive timber construction and a possible way forward,*
Revision 1.0 January 2022

Insurance recommendations Sweden



≥ 4 storeys

OFFICE

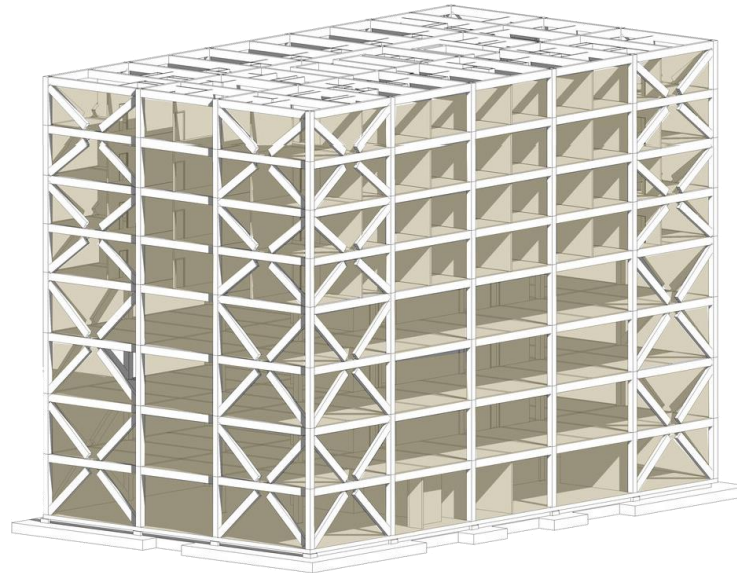
RESIDENTIAL

EN 12845

EN 16925

Automatic sprinkler system

Residential sprinkler system



8 storeys

OFFICE

RESIDENTIAL

EN 12845

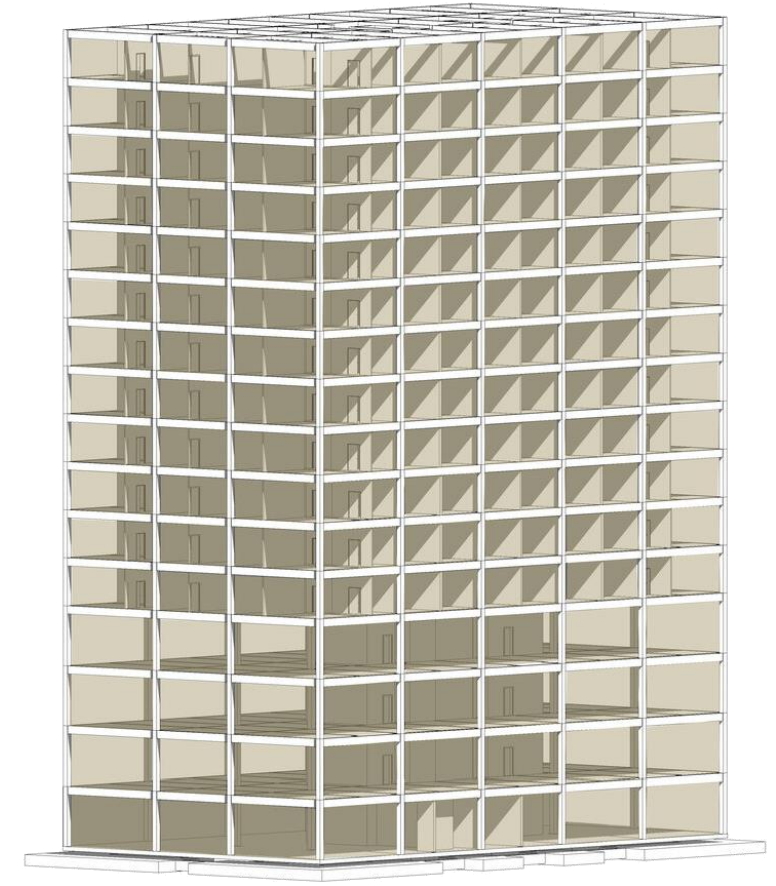
EN 16925

Automatic sprinkler system

Residential sprinkler system

EN 12845

Automatic sprinkler system



+ 16 storeys

OFFICE

RESIDENTIAL

EN 12845

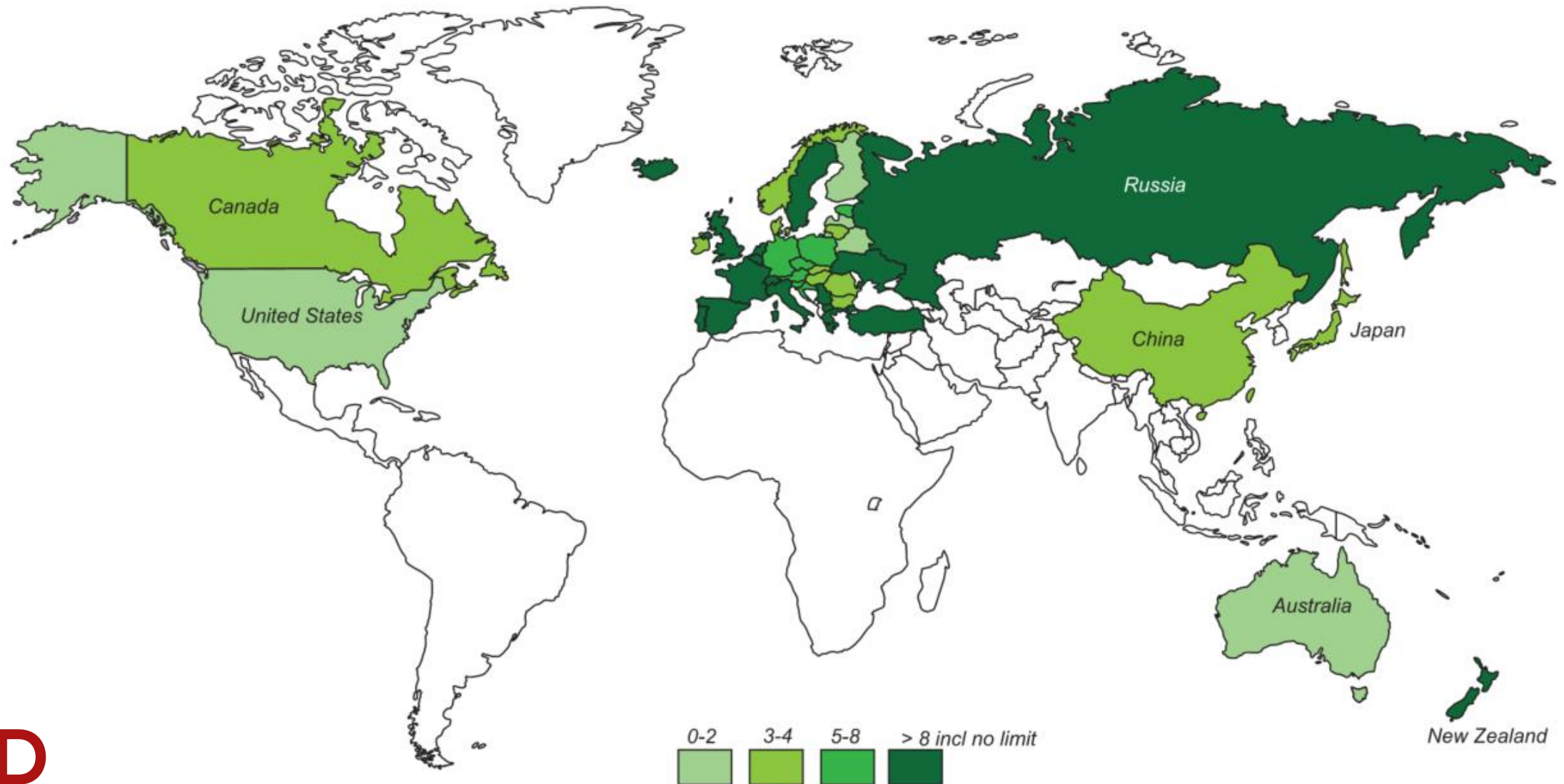
EN 12845

Automatic sprinkler system

Automatic sprinkler system

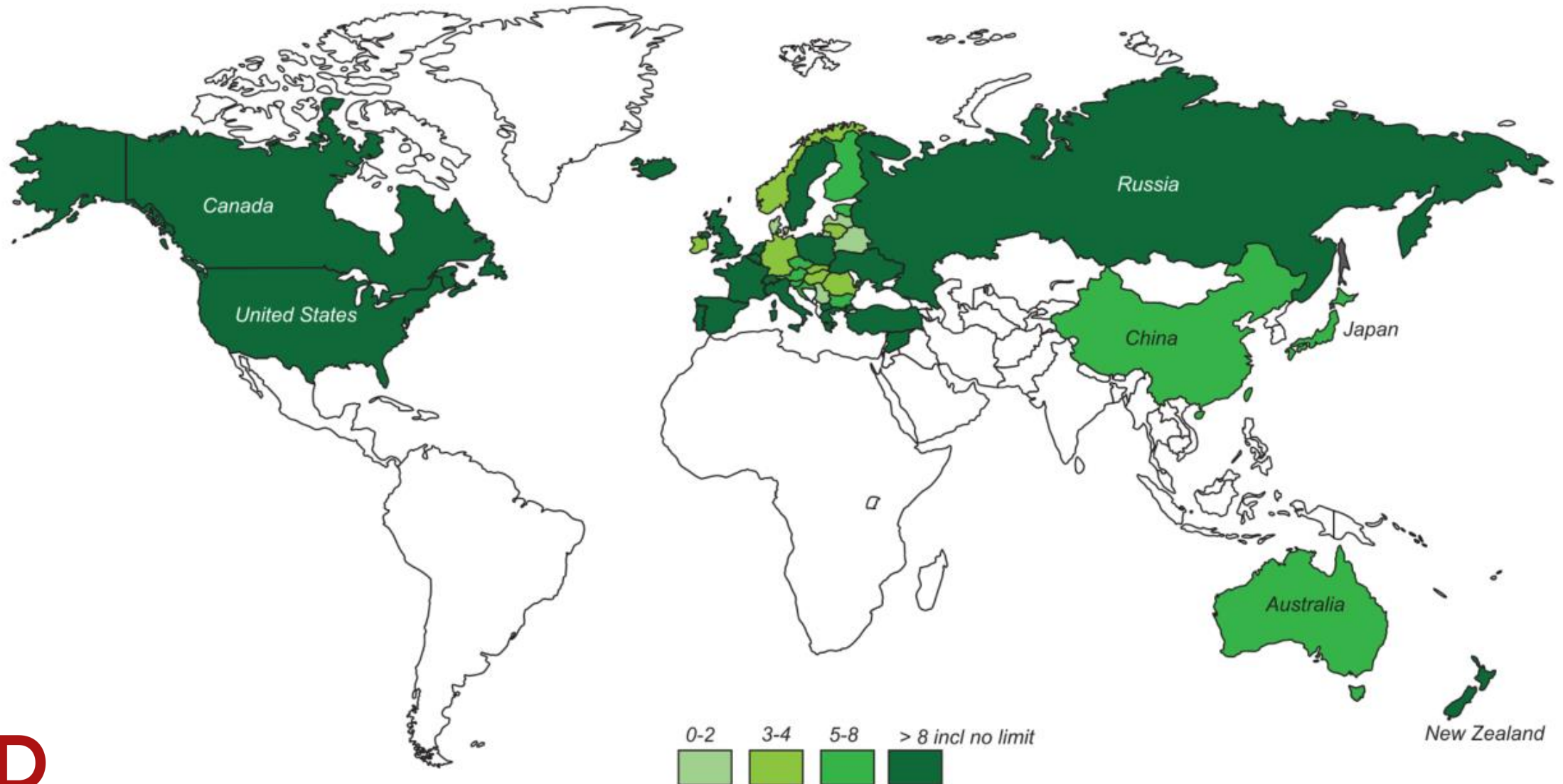


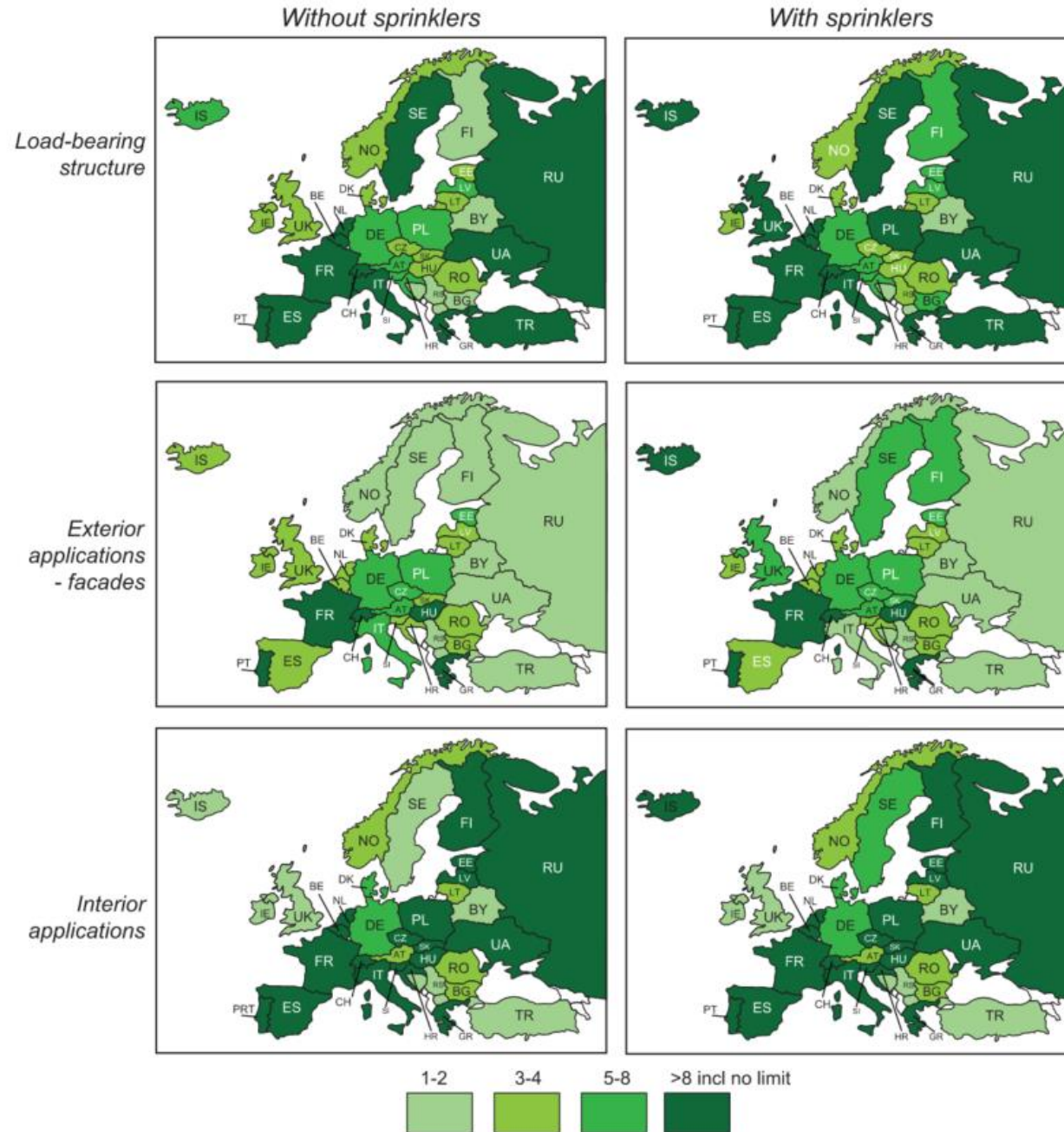
Maximum number of storeys with load-bearing timber structure in residential buildings



With sprinklers

Maximum number of storeys with load-bearing timber structure in residential buildings





To conclude

- Due to potential serious consequences, the risk of a fire in a timber building has to be mitigated and consideration must be taken of both:
 - Small fires (fire spread in cavities)
 - Large fires (extended fire duration and fire spread)
- Many factors influence fire behaviour.
- Reducing fire growth and the potential involvement of timber structures in a fully developed fire is the most effective fire safety measure.

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