Welcome to this FRIC webinar!

2023-12-14
The webinar will start at 11 am

Please notice that the webinar will be recorded

• During the webinar, your microphone and camera will be turned off by default, by the host.

• Please use the Q&A to ask your questions:
Why cross-laminated timber?

- Become very popular in recent years.

- Many advantages
  - Low CO$_2$ footprint
  - Prefabricated elements
  - Easy to work with
  - Aesthetic look

- Some disadvantages
  - Moisture
  - Fire
How has fire testing with CLT historically been conducted?

- 70% less than 25 m²
- 86% less than 50 m²
- 86% ventilation-controlled

Not representative of all CLT buildings

Limited knowledge of fire dynamics and fire spread of larger compartment fires with exposed CLT

Experimental setup

- #FRIC-01 - exposed ceiling
- #FRIC-02 - exposed wall and ceiling
- 19 m x 5.0 m x 2.5 m (ca. 95 m$^2$)

Wood crib as variable fuel load

Inert facade walls

Photo: FRIC
Exposed ceiling

Photo: FRIC

#FRIC-01
A travelling fire

Average fire spread rate before ignition of the ceiling – 54 mm/min
Ignition of ceiling
→ Change in fire dynamics
→ Faster fire spread rates
→ 4 flashing waves
→ 54 mm/min to 1.2 m/min
Fully developed fire
Self-extinguishment of flames at the CLT
#FRIC-02 – exposed wall + ceiling

Photo: FRIC
Changes in test setup

• Exposed wall and ceiling
• Larger ignition source.
• More wind, but still ordinary conditions (2 m/s).
Ignition of CLT ceiling
Flame spread under ceiling
Fire spread
Fire spread rate

Average: 12 m/min

The accelerating flame spread rate indicates that significantly larger compartments would not necessarily take significantly more time to ignite under similar conditions.
External flames

- Strongly non-uniform
- Especially large outside Window 4
- High intensity and short duration
- Likely affected by wind conditions and the very rapid spread
- A need to better understand how wind could affect external flames

Photo: RISE Fire Research
Self-extinguishing of CLT occurred within 15 minutes after flashover in both experiments.
Self-extinguishment of CLT

All temperatures below 500 °C
Self-extinguishment of CLT

Ceiling

550 – 850 °C
Delamination of the different layers

1st lamellae
2nd lamellae
3rd lamellae
4th lamellae
5th lamellae

End wall
Back wall
Layer

[mm] 1 2 3 4 5
40 20 20 20 40

Temperature [°C]

Time [min]

TC BW1 X1.0 Y4.9 Z2.4
TC BW2 X3.0 Y4.9 Z2.4
TC BW3 X5.0 Y4.9 Z2.4
Summary

• Exposed CLT play a significant role in fire dynamics.
• Fire spread might occur very fast after ignition of the exposed CLT.
• Time to ignition of the CLT plays a key role – what parameters influence this time?
• Large external flames might occur still with large window openings.
• Self-extinction of flaming combustion of CLT within 15 minutes after flashover.
• Second flashover might occur after a long decay phase (PUR adhesive).
• Note: No automatic extinguishing system was installed, and no attempt was made to put out the fire before 3 and 4 hours.

Thanks to Stora Enso, Rockwool, Gyproc, Hunton and Byggmakker for contribution with materials.
Further work

• These experiments have gained new knowledge to how exposed CLT affects the fire dynamics and fire spread, but there are still several unknowns, and continued research on several topics are needed.

• What you have seen today is just one of many possibilities of how a fire would develop.

• Important parameters that would affect fire dynamics and fire spread rates are:
  • Ventilation conditions (window breakage, size of openings, wind)
  • Ceiling height
  • Size of ignition source
  • Type and distribution of the fuel load
  • Orientation and number of CLT surfaces
Questions or collaboration?
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