Improvement of Fire Regulations in France: Research and Applications

May 13th 2025

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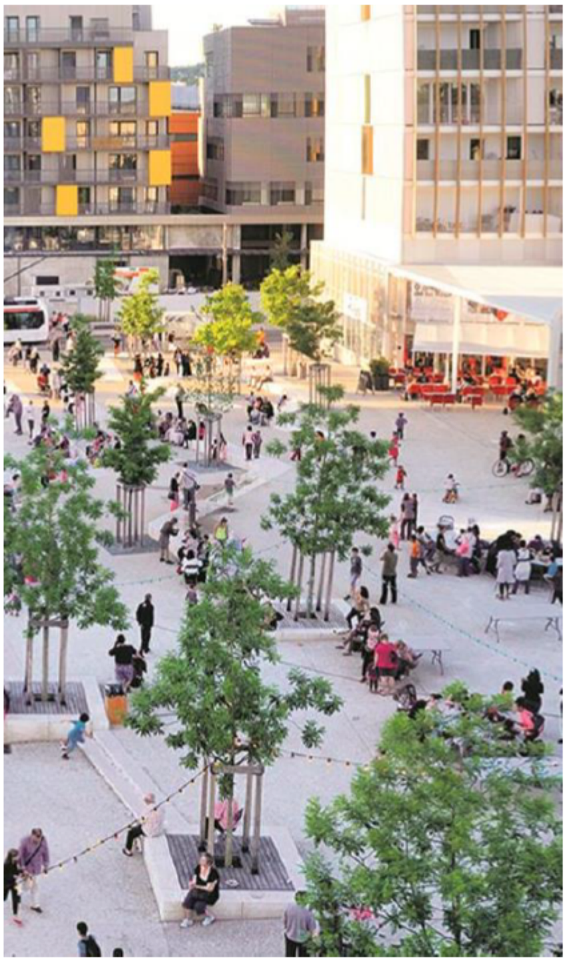
Overview

Current technical work for the improvement of the French fire regulation concerning the timber buildings:

- ✓ A long process: recent history, some major concerns and improvement in the short term
- ✓ Some recent fires in France
- ✓ One of the research axes at CSTB



A long process: recent history, some major concerns and improvement in the short term

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Timeline

~2015-2021

2021-2024

2025

Technical work groups

Many topics :
- ✓ Assemblies
- ✓ Exposed timber
- ✓ Delamination
- ✓ Protections

Regulation work groups

Same topics and :
- ✓ Concerns about several fires
- ✓ New data about columns
- ✓ Debate about the cooling phase

New regulation about timber construction published ?

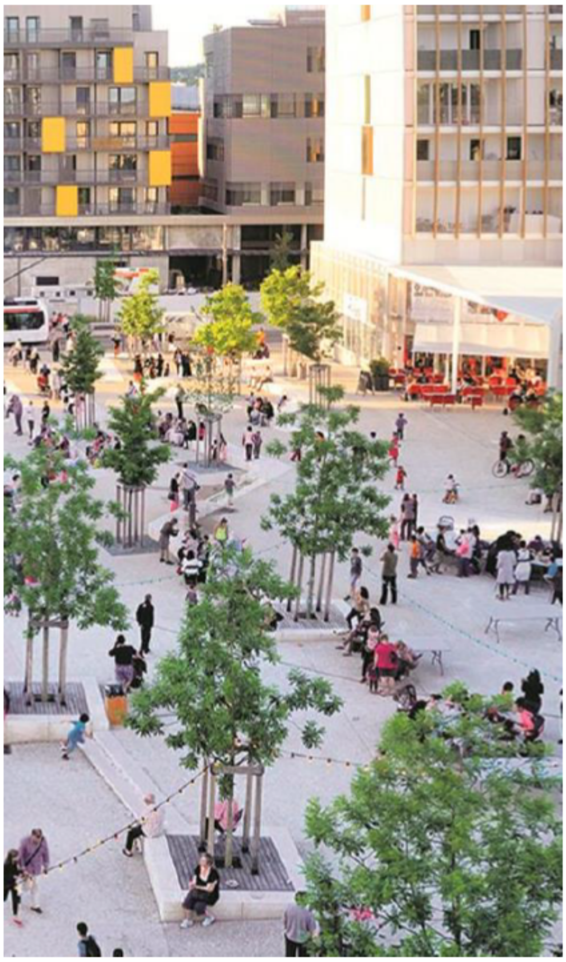
Improvement in the short term

Prescriptive 'Acceptable Solutions' (sometimes called 'deemed-to-satisfy' solutions: DTS). Main topics :

- ✓ 13 solutions for low rise buildings (essentially for façades)
- ✓ Limitation of the exposed timber : max 25% of the whole fire-resistant walls.
- ✓ Rules for protected timber : < 250°C
- ✓ Increase of the fire-resistance rating for some stairwells.
- ✓ Limitations for the use of timber frame buildings.
- ✓ Rules for the façade renovation

Performance-based Design

- ✓ Opening to the performance base design with the minimum of limitations
- ✓ New documents to explain the objectives of the design
- ✓ New documents to explain the main axes of the design report and the third-party verification. (based on the international standards)



Some recent fires

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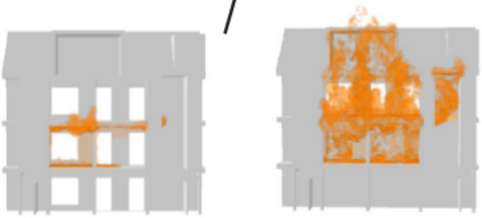
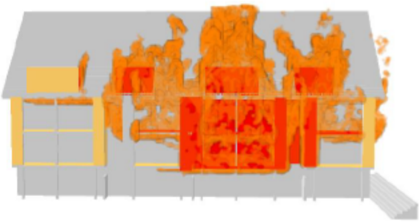


First phase: balcony fire + façade then apartment fire



Second phase: façade fire that becomes widespread

Third phase: widespread conflagration and Spread to the nearby "E" Building

T0 — T0 of the fire Hypothesis 3:36 p.m.

T0+10 — **15h46**
Departure of the intervention forces following the report of a balcony fire at R+1 of a type R+3 building.

T0+19 — **15h55**
According to the return of the local SDIS, the fire spread to the entire façade of buildings F and G at that time.

T0+35 — **16h11**
The entire façade is still in flames, with a spread to the side and inside the building.

T0+44 — **16h20**
The entire façade is still in flames, with a spread to the side and inside the building. Spread to Building E

T0+81 — **16h57**
Gradual collapse of roof elements, interior partitions and facades.

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Lateral propagation observable before roof effect

Probable kinematics of propagation on the roof then joist collapses and propagation towards the lower floors

Illustrations – Other Affected Buildings

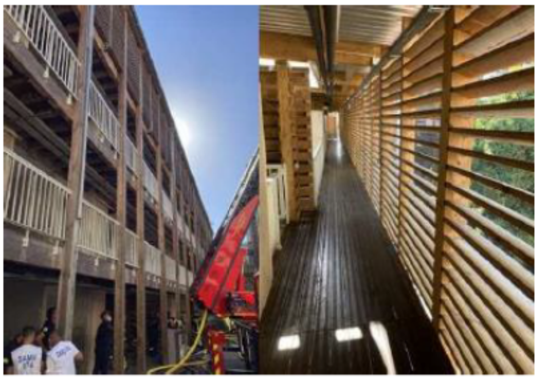
Beginning of pyrolysis or even combustion of organic materials on building A. Ignition of the façade prevented only by the intervention of the firefighters.

Distance of 15 m between G and A.

In particular, it can be seen from this photo that for building E, the second frame is not affected on the façade but that the sitting dog is clearly impacted. This lends credence to the hypothesis of a rapid spread of the fire on the roof.

Comparison with other fire

Draguignan

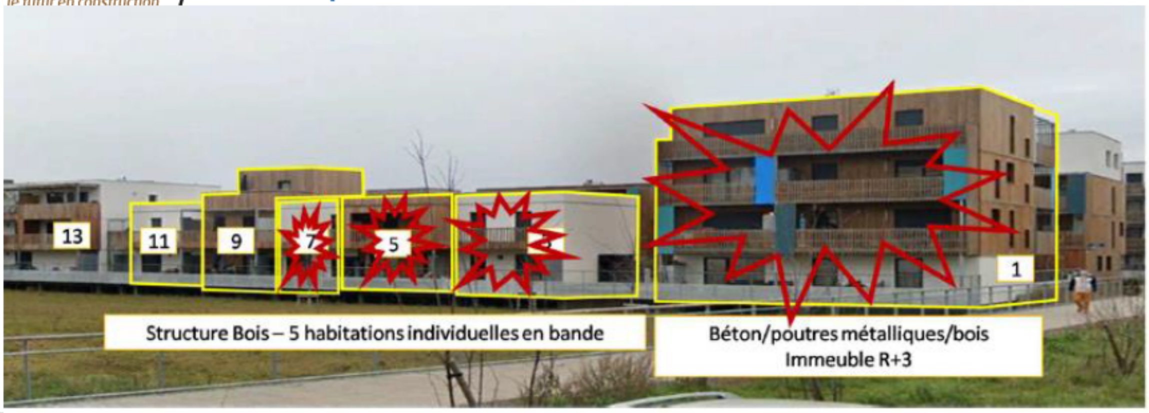


Montgaillard

Coursives du bâtiment B côté Sud

« Ilot » G, avec la passerelle bois et la varangue avec le sapin de noel

Comparison with other fire



Oswald

Montfermeil

Comparison with other fire

Montreuil

Wintzenheim

Conclusion of the comparison

1) The added elements on the façade played an important role

2) The fire that enters the roof is very difficult to control

3) The intense radiation slows down the emergency response a lot

4) Outdoor fires are poorly taken into account in the French regulation

Analysis of the benefits and risks of using structural timber from a national low carbon strategy and fire safety perspective.

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Performance-based design and reliability
Example on probabilistic approach to assess fire safety

(Fire Safety in Timber building, Technical guidelines, FireInTimber, 2010)

Really deamed-to-satisfy

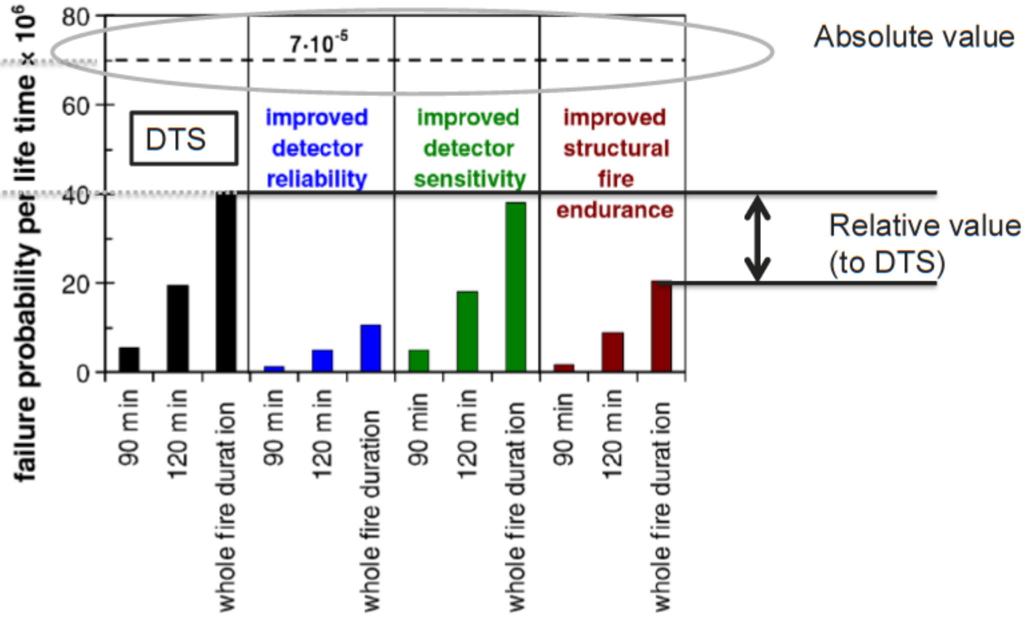

Fig. 9. Beam failure probabilities for the building lifetime (50 years) for the different fire-safety-provision cases.

Jukka Hietaniemi - 2007 - Probabilistic simulation of fire endurance of a wooden beam - Structural Safety 29 (2007) 322–336

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Performance-based design and reliability
Configurations and criteria for parametric performance studies

Configurations:

- Type of timber structure
  - CLT
  - Light frame (COB)
  - Post & Beams
  - CLT slab (Y/N)
- %of exposed timber (& DTS)

Parameters:

- F(fire load)
  - ERP (public)
  - BUP (office)
  - HAB (dwellings)
- F(openings)
  - Opening factor
  - Time of fail off
  - Wind environment
- F(dimensions)
- F (Sprinklers SFEAE)
- F ($Perf_{detection}$)
- F($T_{intervention}$ Brigade)
- F(protection efficiency)
  - Quality
  - Degradation SLS
  - User degradation
- F(structure redundancy)

Objective (criteria):

- Resistance Time
  - 90'
  - 120'
  - Whole fire duration (20°C or $T_{extinction}$)
- Internal spread
  - T°C unexposed side of wall
- Exterior spread
  - Neighbouring buildings (T°C / Φ kw/m² @m)
  - Façade (T°C / Φ kw/m² @m)
- ~~$T_{évacuation}$~~
- ~~$Q_{fumées}$~~

Fire action calculations
Experiment check (e.g. CNRC)

Figure 30. Furnished studio suites for Test 1 and Test 2.

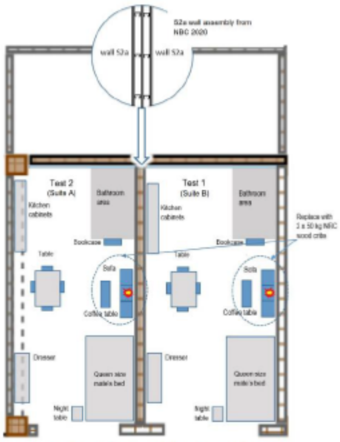
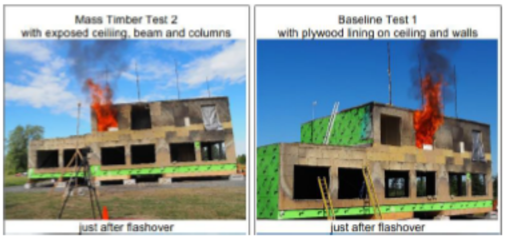


Figure 29. Studio suites and fuel load for Test 1 and Test 2.



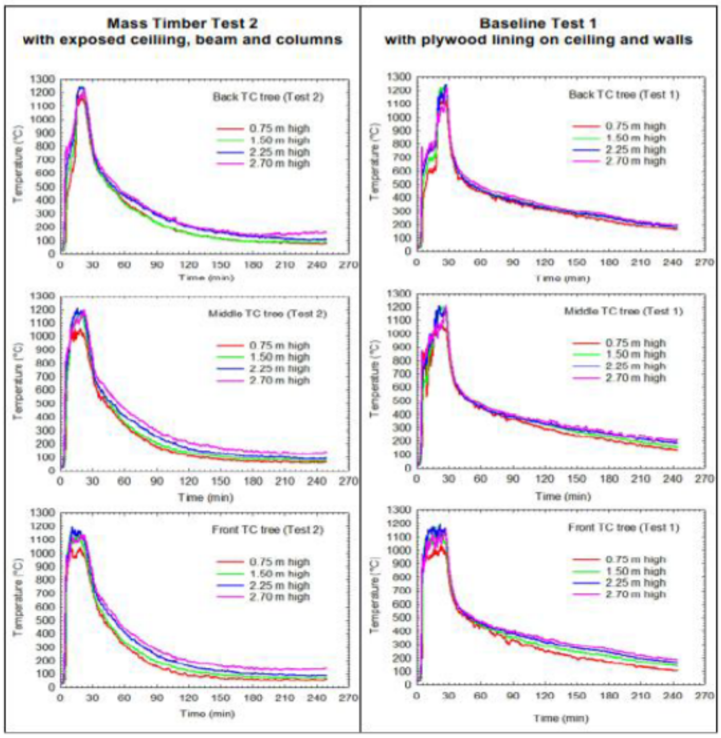


Figure 37. Comparing Test 2 with Test 1 – Room temperatures.

Timber contribution in fire

Tested Methods:

1. **LG Method (initial) « LG 1»**
2. **Add wind effect & manual Gypsum Time off fall-off « LG 2»**
3. **Replace in contribution law flux by gas temperature with total (radiant + convective) flux given by two zone (Brisk) model « FLUX »**
4. **Replace contribution law by Mass Loss Rate approach (Cstb paper: AN EMPIRICAL CORRELATION FOR BURNING OF SPRUCE WOOD IN CONE CALORIMETER FOR DIFFERENT HEAT FLUXES) « MLR* »**
5. **New Annex A EN1995-1-2 method « EC5 »**

Python programming chained with Brisk and CFAST (two-zone fire simulation models)

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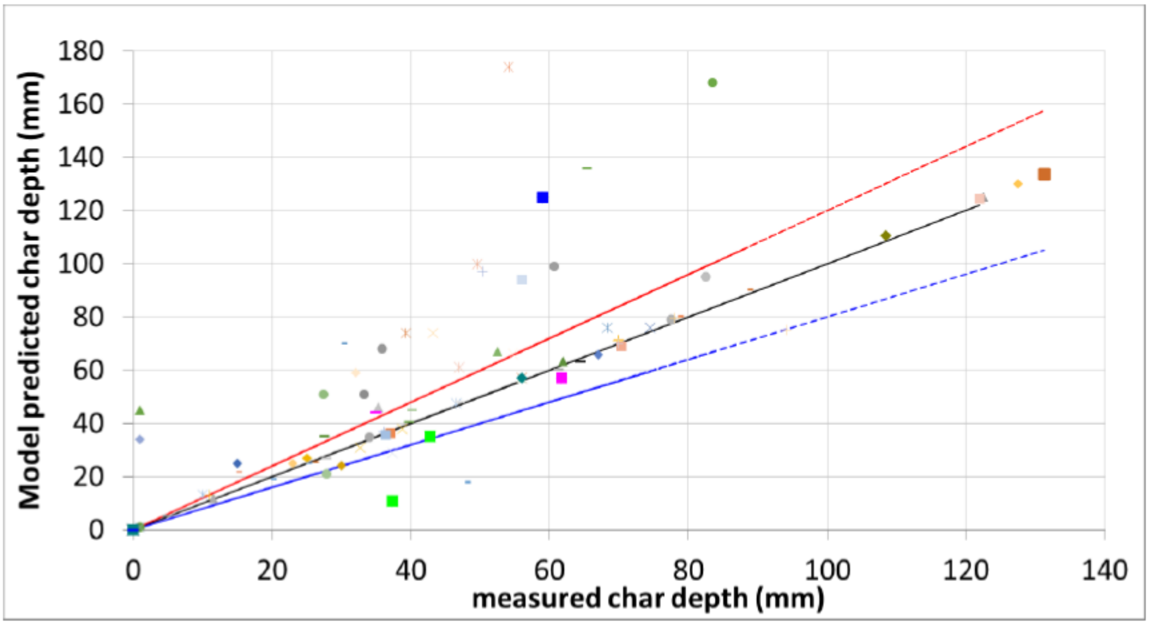
Timber contribution in fire « Flux »
Validation & improvement : First results



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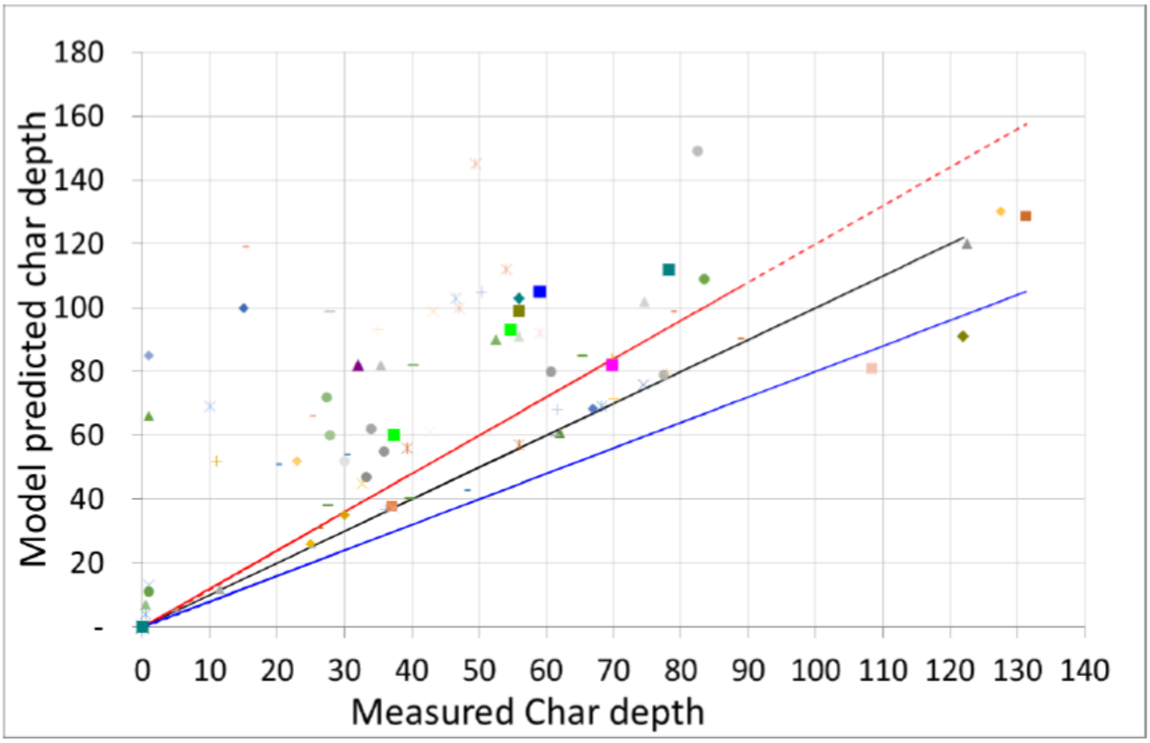
Timber contribution in fire « EC5 »
Validation & improvement : First results



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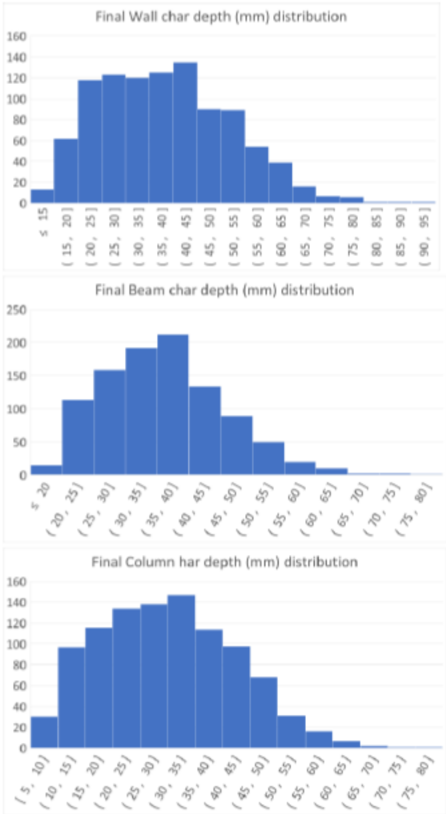
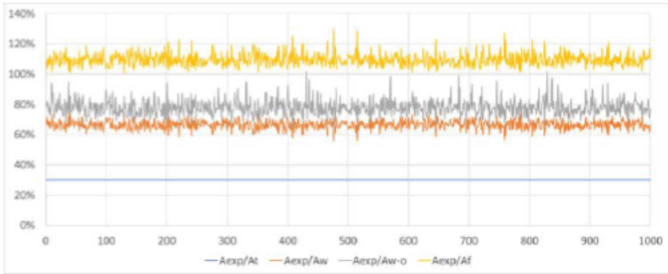
Stochastic study: first results for dwellings





R [min]	$d_{char,n}$ [mm]	P_{fire}	P_{fail}	P	$<P_{a}=$ $72.3\ 10^{-6}$
60	42	$5.3\ 10^{-4}$	0.386	$205\ 10^{-6}$	NO
90	63	$5.3\ 10^{-4}$	0.043	$23\ 10^{-6}$	YES
120	84	$5.3\ 10^{-4}$	0.002	$1\ 10^{-6}$	YES

Conference / Papers

WCTE 2025 :

- **Improved method predicting contribution to fire growth and stability of structural timber in natural fires.**
- **A performance design and stochastic analysis method for determining th allowable percentage of exposed structural mass timber in a building.**

Accepted

Interflam 2025:

- **Performance based design and stochastic analysis to determine the reliability of buildings in fire. Comparison of different typologies of dwellings with mass timber structure exposed to fire.**

Accepted

IAFSS:

- **15th Symposium on Fire Safety Science (8-12 June 2026 in La Rochelle France**

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Timber contribution in fire
Validation & improvement : international check / exchanges

Canada :

Christian Dagenais (FP Innovation)
Luc Girompaire (Université de Laval)

New Zeeland:

Colleen Wade (Halliwell / Fire Research)
Nick Appleton (BRISK)

Sweden:

Daniel Brandon (Lund University
Halliwell / Fire Research)

Japan:

Japan International Association for the Industry of Urban Development, Building and Housing (JUBH)

WOODRISE ?

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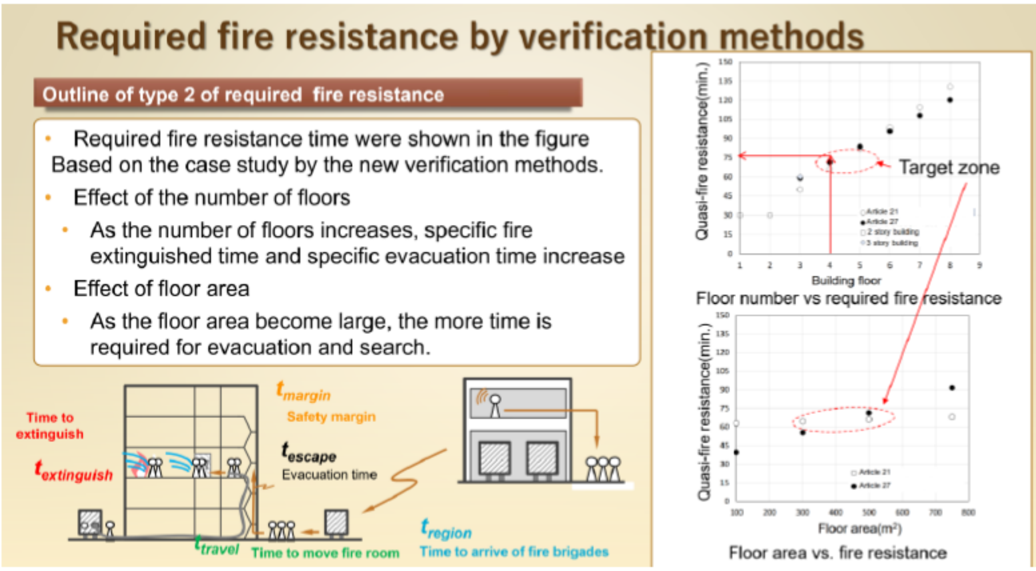
Timber contribution in fire
Japan works (Jun-ichi SUZUKI Senior Researcher, Fire Standards Div., NILIM)

WOODRISE

How are set (BSL 2019,6 formulas)

t_{region} & $t_{extinguish}$?



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