Detailing Mass Timber Buildings for Fire Safety

Chicago Wood Design Symposium

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Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
What is Mass Timber?

- Glulam
- Cross Laminated Timber (CLT)
- Nail Laminated Timber (NLT)
- Mass plywood panels (MPP)
- Dowel laminated timber (DLT and DCLT)
- Timber-Concrete composites
Why Mass Timber?

**Sustainability**
- Low carbon footprint
- Possible local material
- Lightweight solutions

**Aesthetics**
- Structure = finish
- Biophilia & natural patterns
- Market differentiator

**Speed**
- Pre-fabrication of engineered wood composite & hybrid solutions
- Speed on site
HoHo, Austria
What is a Fire Resistance Rating (FRR)?

- Structural resistance

- Integrity

- Insulation
What is a Fire Resistance Rating (FRR)?
What is a fire?

NRC, Canada
Schaffer, 1966, Forest Products Laboratory

\[ a_{eff} = 1.2 \beta_t t^{0.813} \]
1 hr exposure = 1.8 in/hr
2 hrs exposure = 1.58 in/hr
1 hr exposure = 1.8 in/hr
2 hrs exposure = 1.58 in/hr

Original CLT depth
CLT char depth
CLT structural capacity

Original CLT depth
Mass timber and the IBC
IBC limits for mass timber construction

Non-combustible construction – Type I, II
Combustible construction – Type III, IV, V

Mass timber - Code compliant use in Types III, IV, V

Type IV – Heavy Timber:
- Up to 6 floors (office) 5 floors (resi)
- Additional floors with “podium construction”
- 85ft in building height
Type IV building

- Timber beams, columns, floors, roof permitted
- Up to 6 floors, with sprinklers
- Code sets minimum dimensions for members
- Exterior walls are non-combustible, or FRT wood
Modern Type IV building

- Up to 6 floors, with sprinklers
- Exposed mass timber
- Glulam beams, columns; CLT floors and walls
- Use of steel or concrete, where appropriate (hybrid construction)
IBC: Heavy timber = mass timber

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Solid or laminated timber (Chapter 23) – LVL, glulam, CLT
Type IV – mass timber can be exposed (Chapter 8)
# Mass timber construction -

**TABLE 601**

<table>
<thead>
<tr>
<th>BUILDING ELEMENT</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
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<td>B</td>
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<td>B</td>
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<td>Nonbearing walls and partitions</td>
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*a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z*
Detailing in mass timber buildings for fire safety
Be careful of:

Concealed spaces within Type IV

4th floor and above:

- 2hr shafts connecting to 1hr or HT, for mass timber
- Assembly use – 4th floor limit
Exterior walls:

- Can CLT be used in an exterior wall?
  - Chapter 6 – CLT can be used in Type IV (not Type III)
  - Chapter 14 – limits timber to 40ft, or 60ft with FRT, or pass NFPA 285

- Keep timber columns and beams out the exterior wall
Fire resistance for glulam connectors:

Fire test reports – very few to choose from and only one for 2hrs (Framework connector)

Calculation methodology – see TR-10 (Part V, Example 9)

Cannot just add “char layer” to a concealed connector

Intumescent paint on steel connectors does not work

Gyp can work, if properly detailed
Beam

Beam + pipe

Beam + pipe and char
And there are also:

Joints between concrete slabs and CLT
Fire barrier or partition wall meeting glulam or CLT
Curtain wall edge details
Kitchen exhaust shafts
CLT encapsulation by gyp ceiling - edge details

and many more......
This concludes The American Institute of Architects Continuing Education Systems Course

Please contact me with any mass timber fire questions:

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Photo credits:
Type IV
• Max 85ft
• 6 floors (timber)
• Timber fully exposed

Type IV-C
• Max 85ft
• 8 floors
• Timber fully exposed
• 2hr FRR

Type IV-B
• Max 180ft
• 12 floors
• Timber partly exposed
• Protected timber shafts
• 2hr FRR

Type IV-A
• Max 270ft
• 18 floors
• Timber fully protected
• Concrete shafts
• 3hr FRR
E119 test, CLT floor after 2hrs, with char fall-off

E119 test, CLT floor after 2hrs, with no char fall-off