

# Detailing Mass Timber Buildings for Fire Safety

## Charlotte Wood Design Symposium

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



# Course Description

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Heavy and mass timber buildings are unique in that they can have an unprotected structure while still providing a level of fire resistance required by code. However, both designers and jurisdictions tend to be unfamiliar with this approach.

This presentation aims to answer questions commonly asked about mass timber fire performance, including “delamination” and fire-resistance ratings, and how these issues relate to low- and mid-rise buildings within the size limits of the current IBC vs. high-rise buildings.

Discussion will include implementation of char calculations, considerations for connections, penetrations, joints, partitions, and the use of fire test data to demonstrate performance.

With a better understanding of the challenges and potential solutions, attendees will be able to confidently pursue exposed wood for their projects.

# Learning Objectives

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1. Review code-compliant applications of cross-laminated timber under the 2015 International Building Code (IBC).
2. Highlight available resources, including charring calculations and fire-tested CLT assemblies, to aid designers in exposed CLT building design.
3. Discuss the concept of CLT “delamination” under fire, related testing and recent changes to adhesive requirements that eliminate concerns.
4. Understand how various aspects of CLT fire performance apply (or don't) to code-compliant low- and mid-rise vs. high-rise buildings.

# What is Mass Timber ?



Glulam



Cross Laminated Timber (CLT)



Nail Laminated Timber (NLT)



LVL - Mass plywood panels

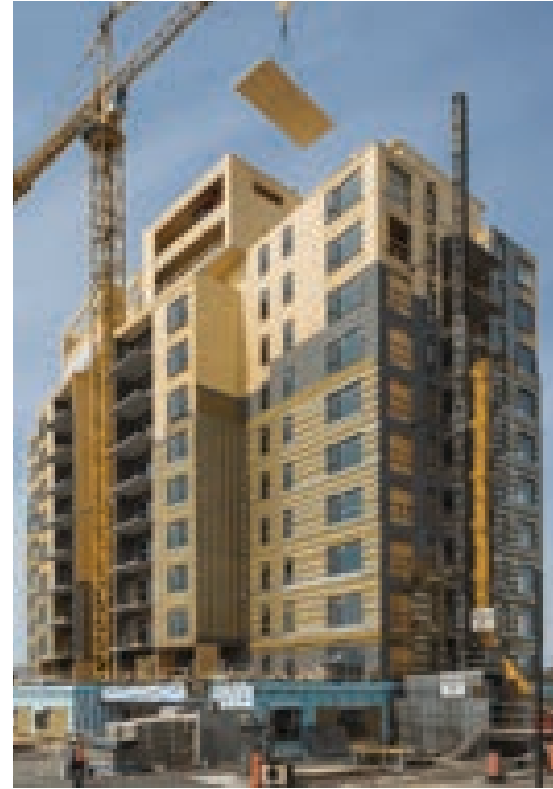


Dowel laminated timber (DLT and DCLT)



Timber-Concrete composites







UBC Brock Commons



HoHo, Austria







Albina Yards, Portland





T3, Minneapolis





U Mass, Amherst



# Mass timber and the IBC



Simple Banking HQ, Portland

# 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 IIIA and IV:

- Up to 6 floors (office) 5 floors (resi)
- Additional floors with “podium construction”
- 85ft in building height
- All timber can be exposed



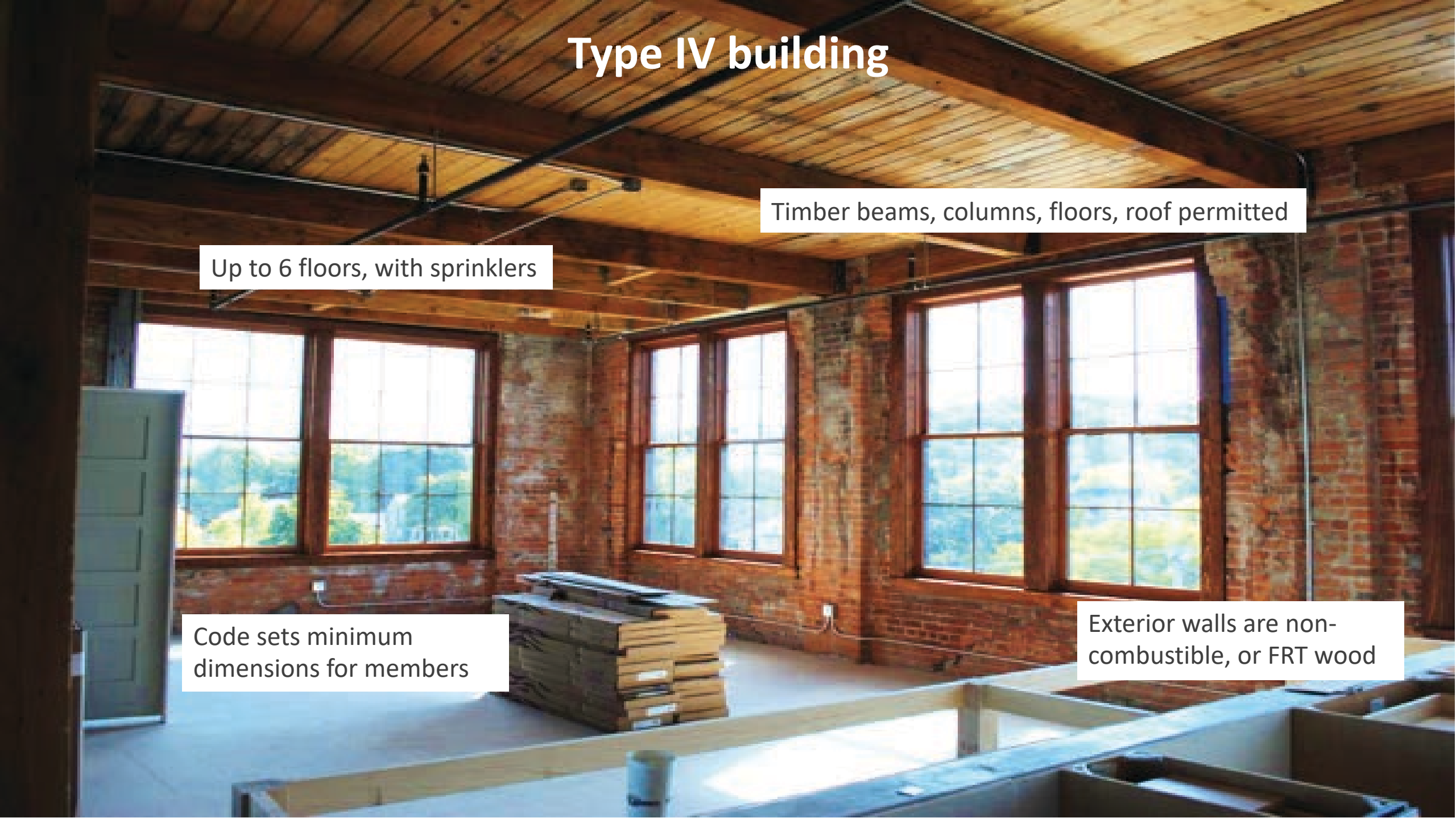
# Type IV building

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





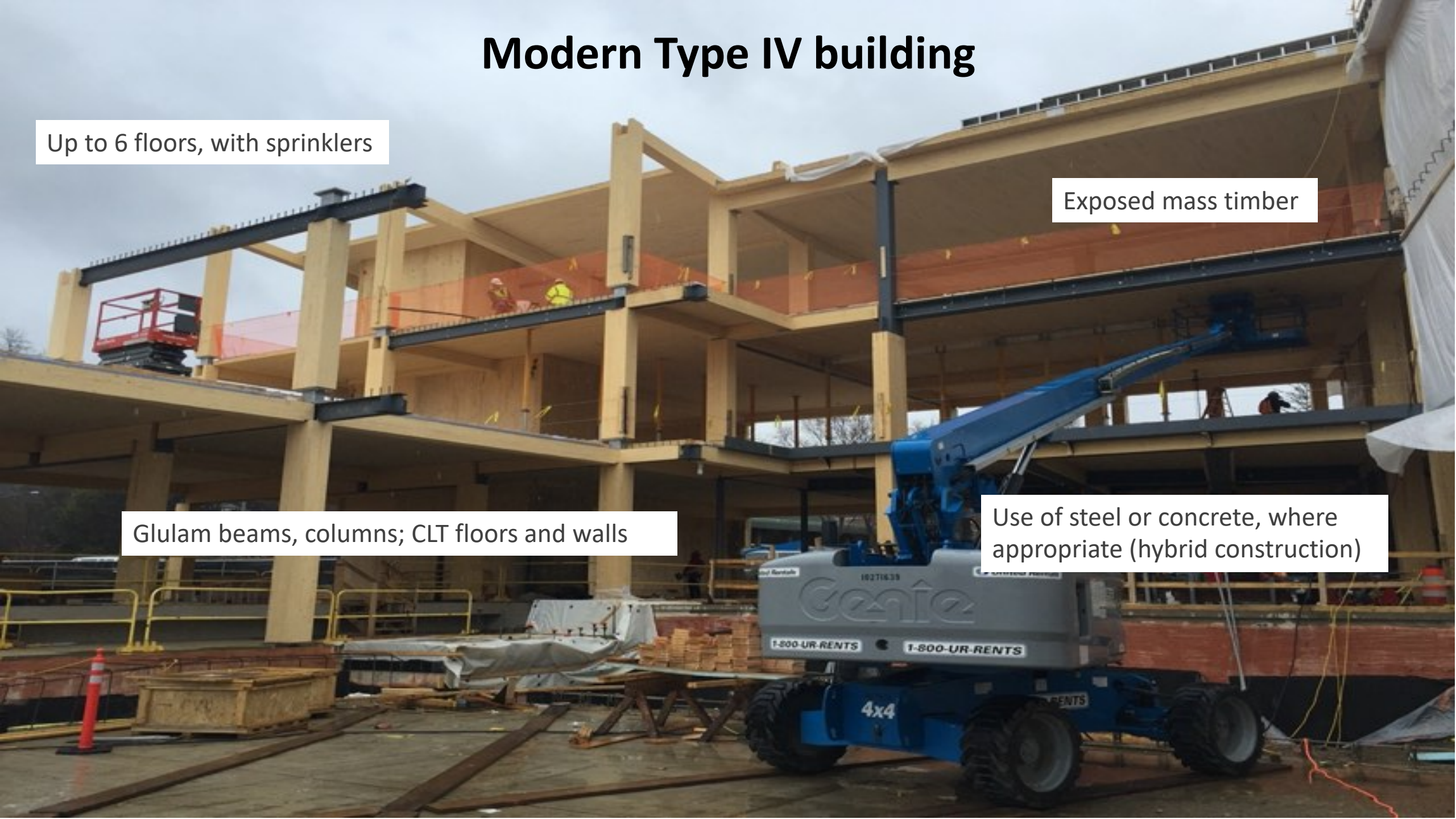
# Modern Type IV building

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)

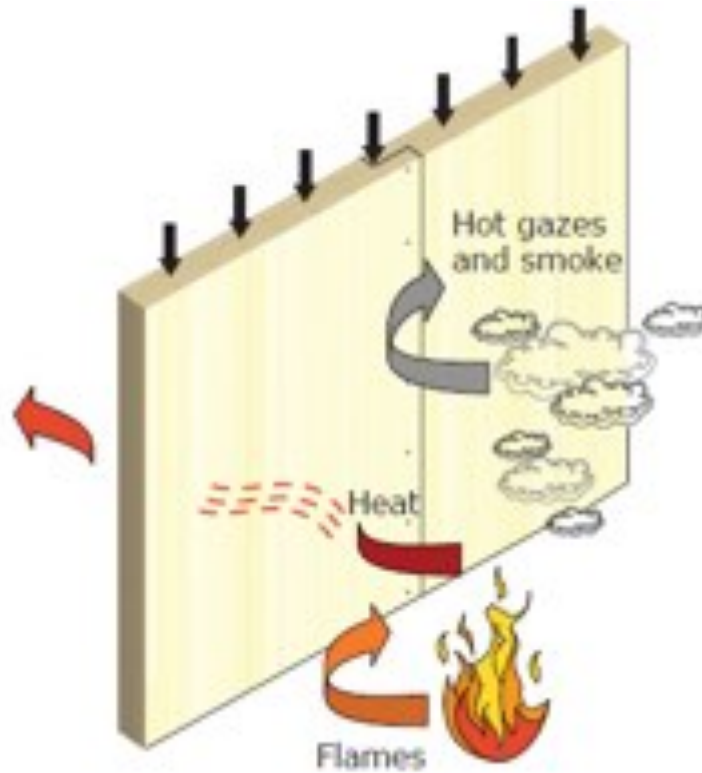


# What is a Fire Resistance Rating (FRR)?

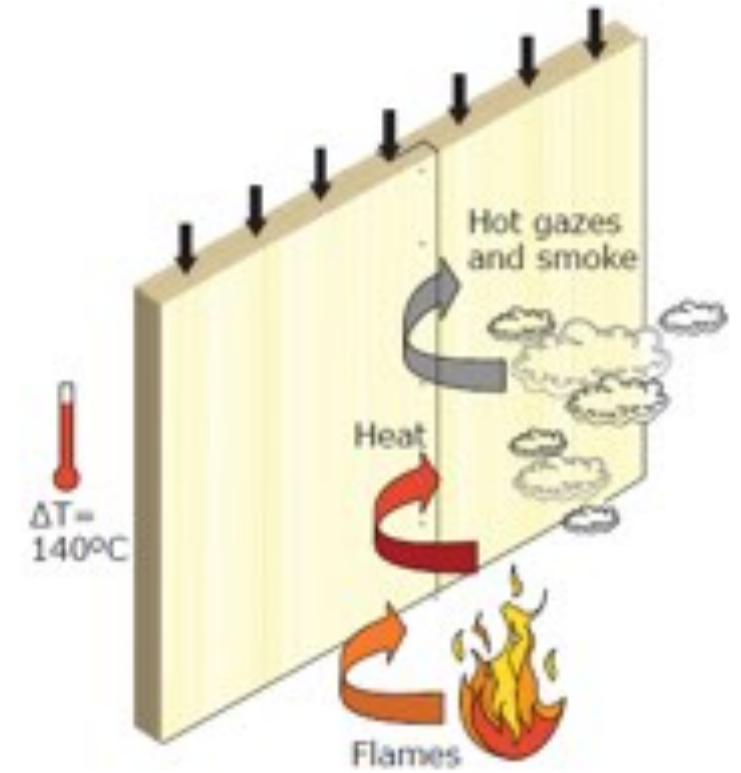


Structural resistance

(from "CLT Handbook, US Edition")



Integrity



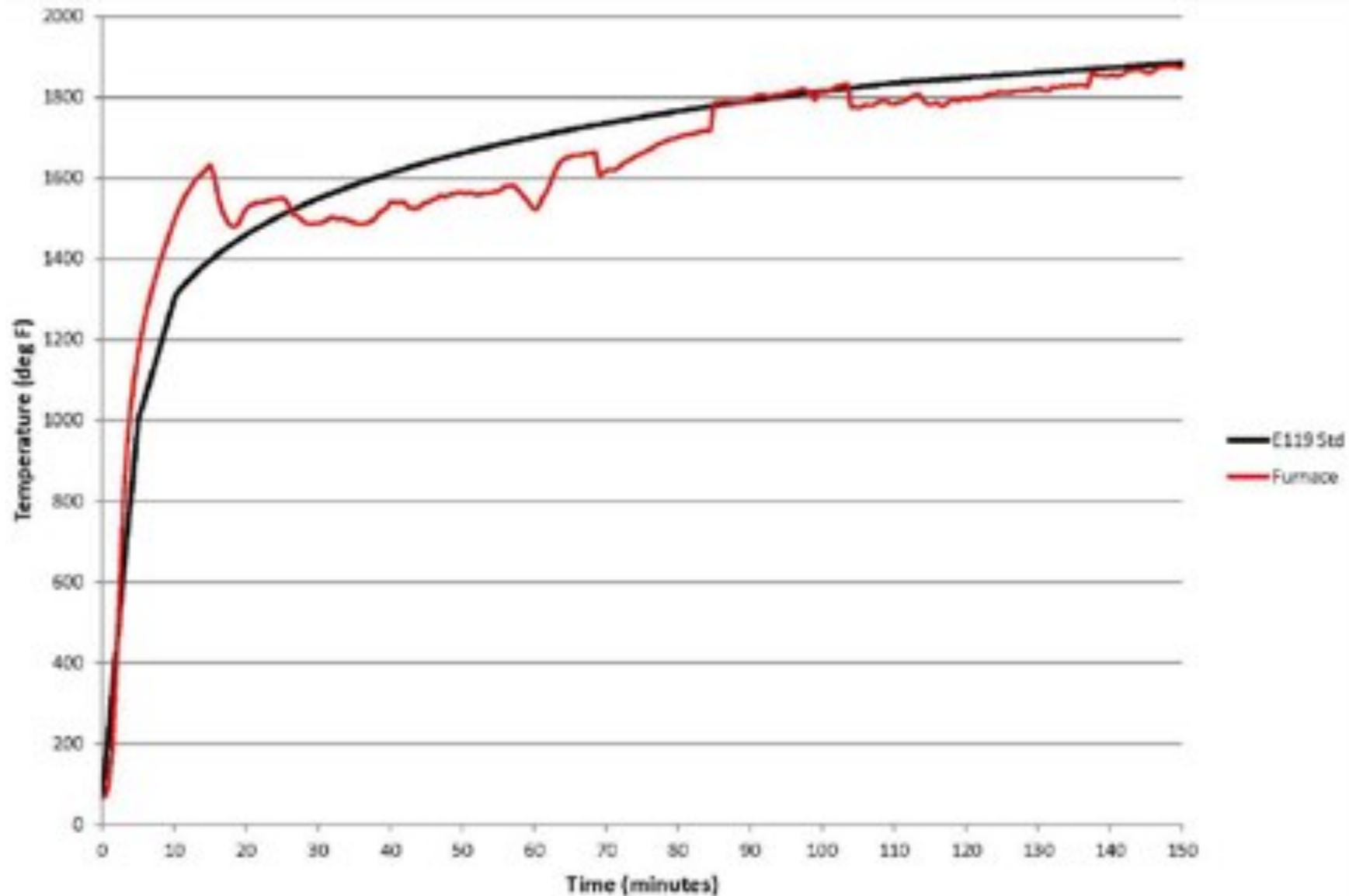
Insulation



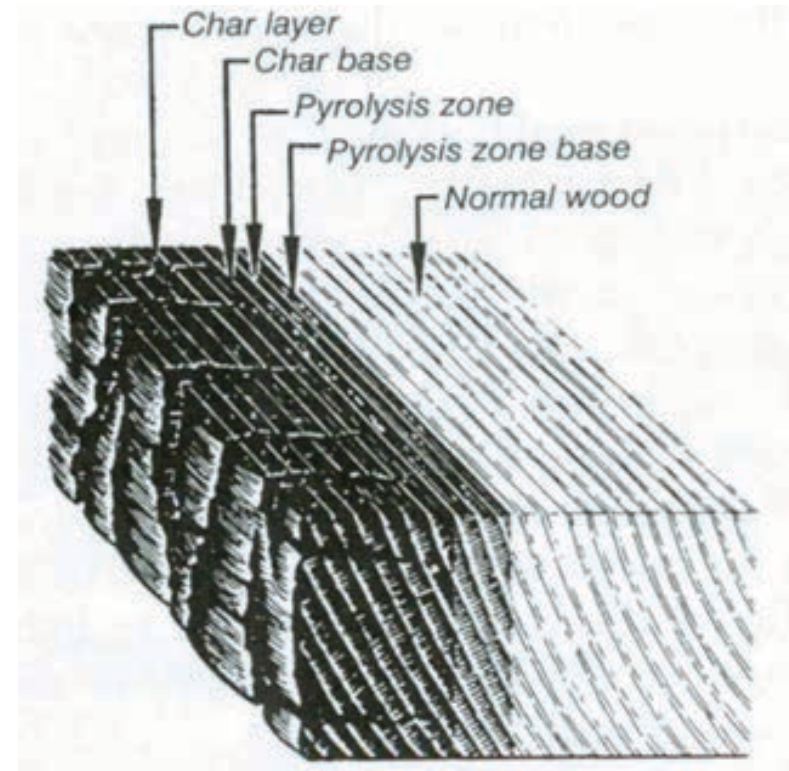




# What is a Fire Resistance Rating (FRR)?







Schaffer, 1966, Forest Products Laboratory

$$a_{eff} = 1.2 \beta_t t^{0.813}$$

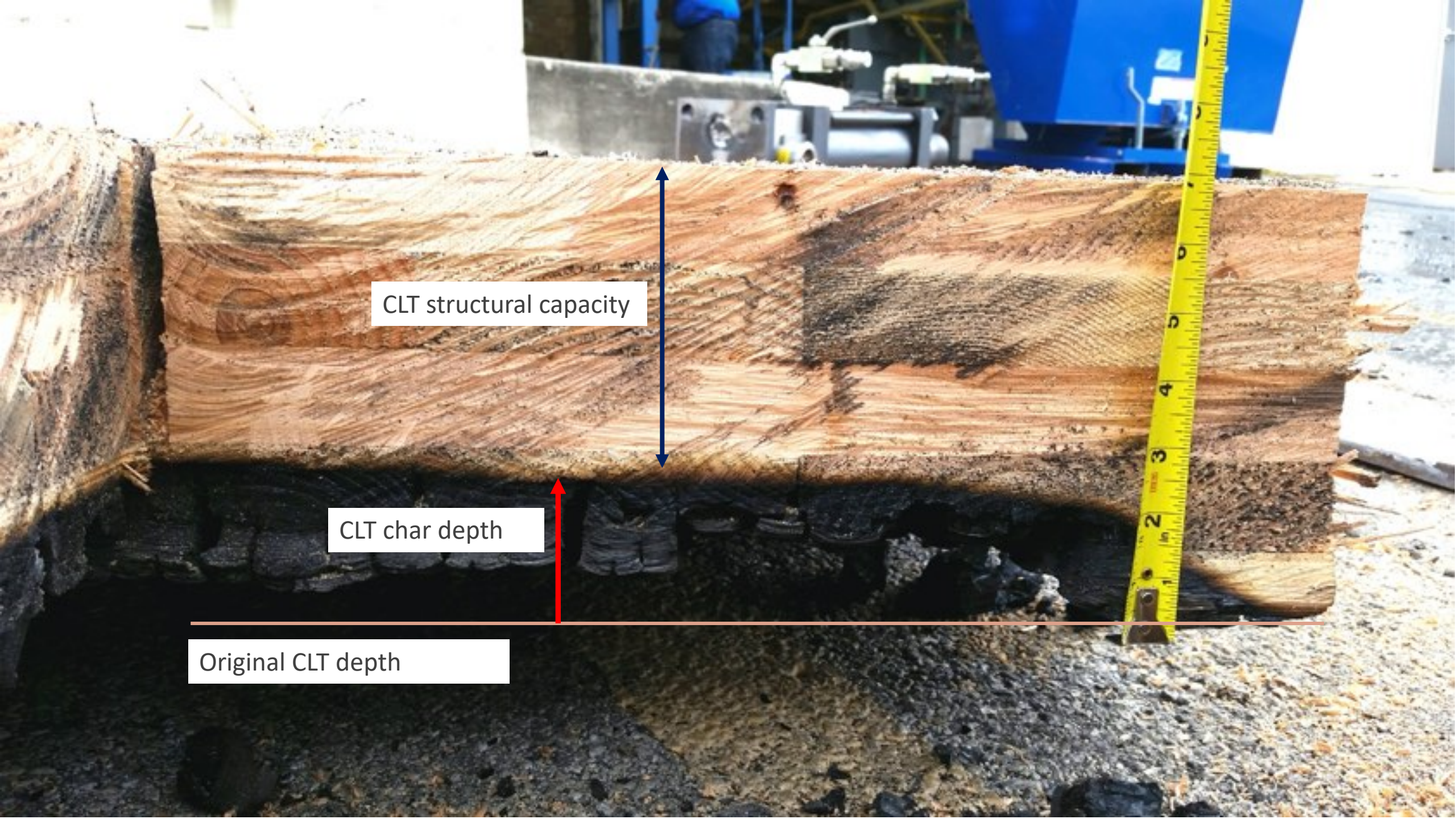












CLT structural capacity

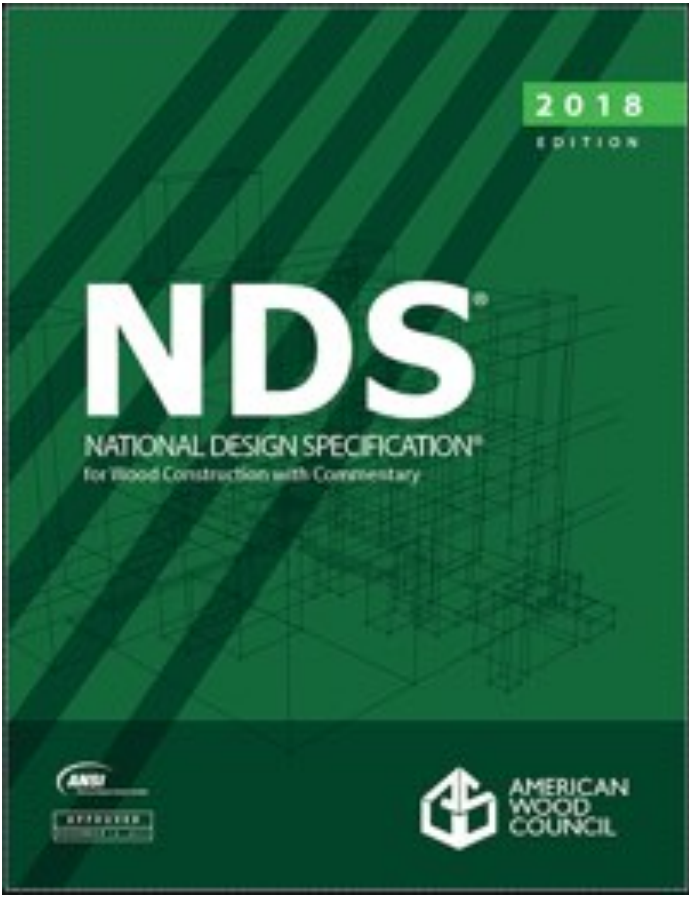
CLT char depth

Original CLT depth

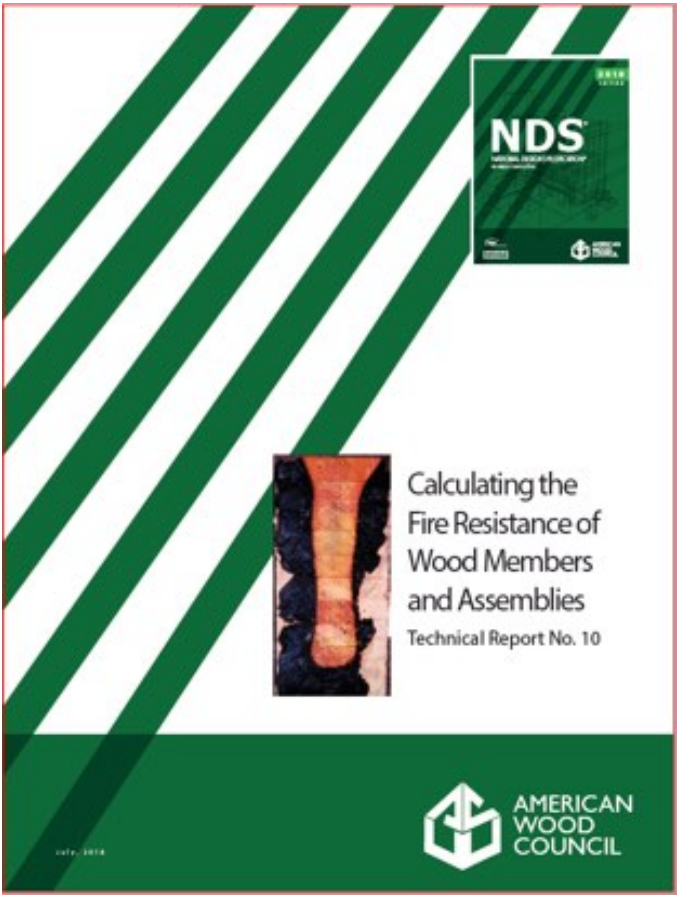




Section 721 & 722



Chapter 16







What is CLT “delamination”





E119 test, CLT floor after 2hrs, with char fall-off



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














# Detailing in mass timber buildings for fire safety

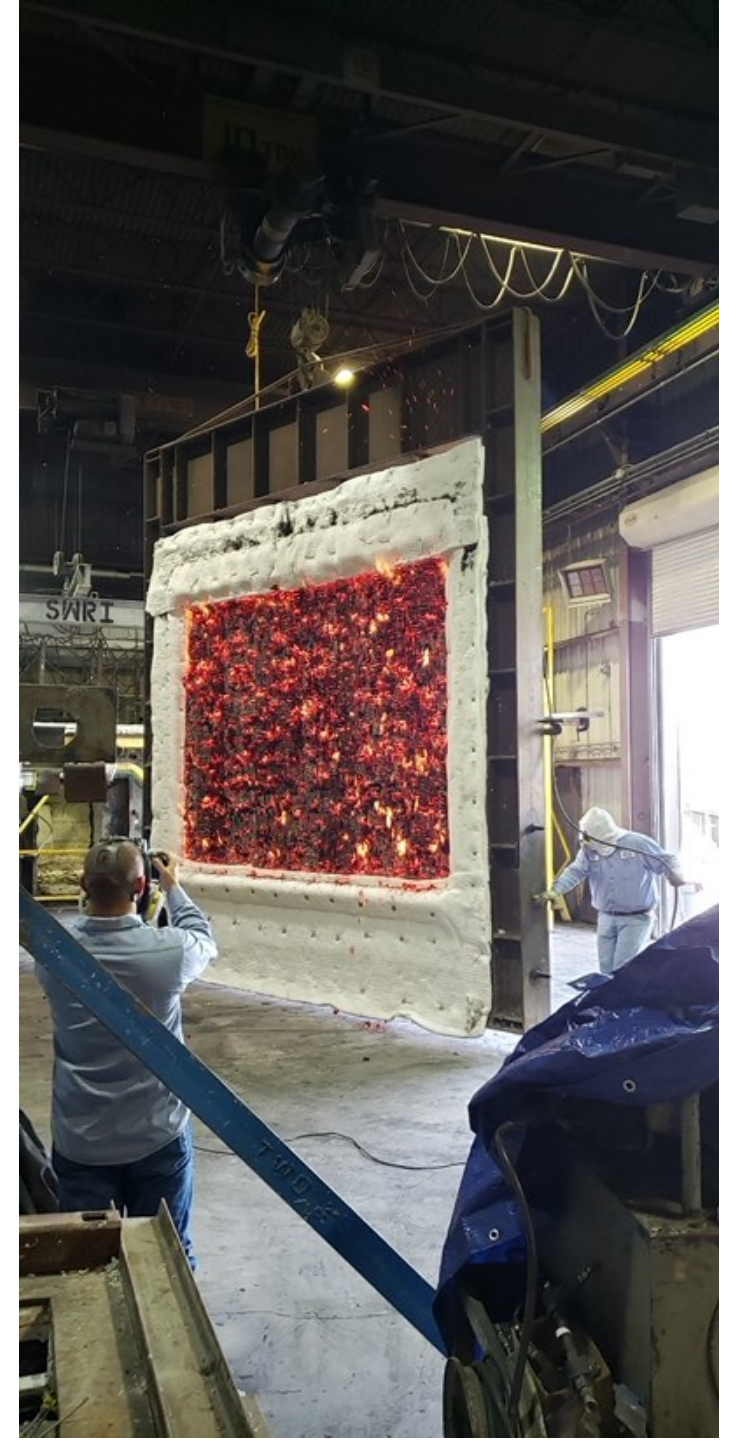


## Be careful of:

Concealed spaces within Type IV

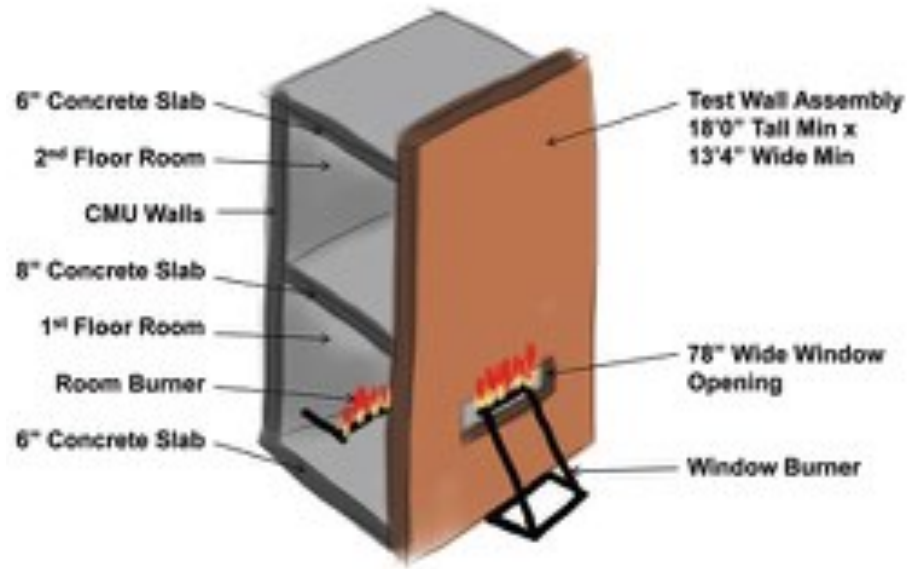
4th floor and above:

- 2hr shafts connecting to 1hr or HT floors
- Assembly use – 4th floor limit





## NFPA 285 Fire Test - Components



## 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 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

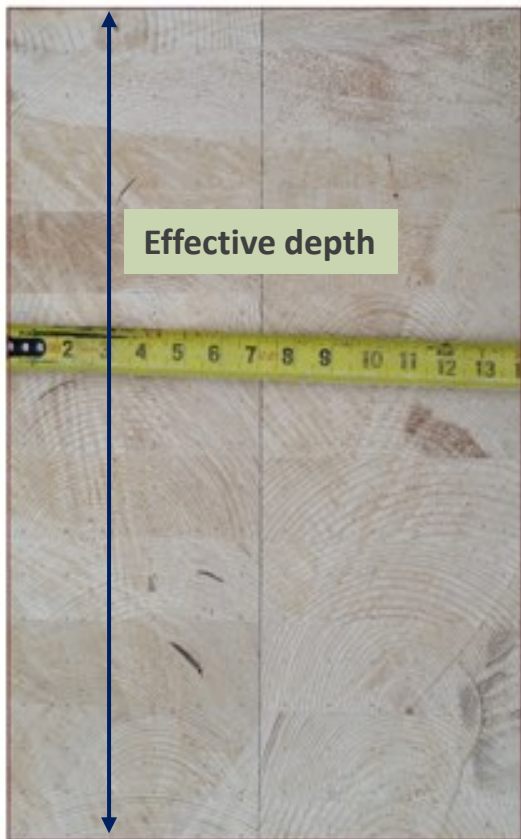
Gyp can work, if properly detailed



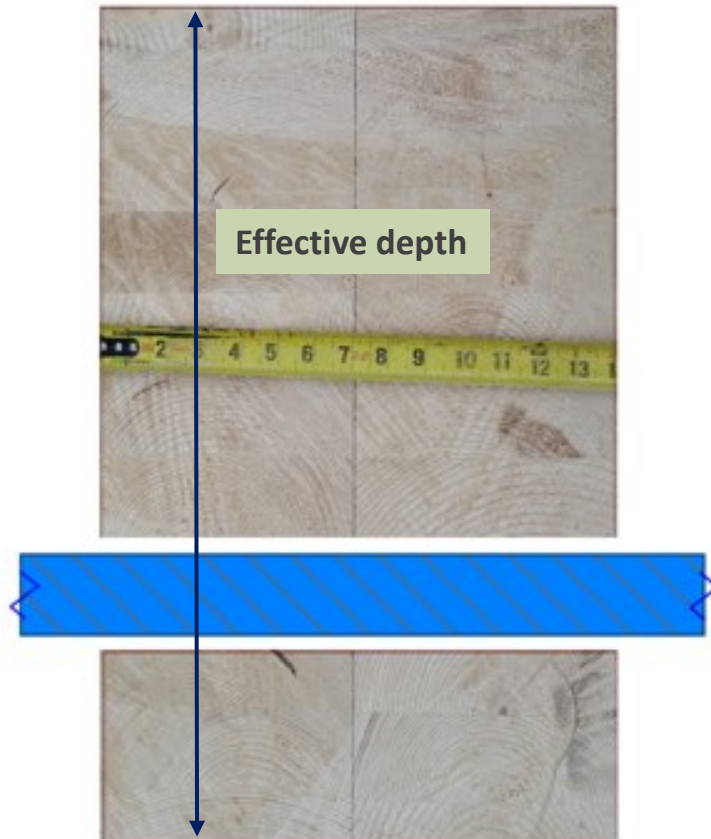








Beam



Beam + pipe



Beam + pipe + 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.....**



# > QUESTIONS?

This concludes The American Institute of  
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