AGENDA
MASS TIMBER
BUILDING CODE, RISKS
ENVIRONMENTAL BENEFITS
HYBRID SOLUTIONS
ARCHITECTS’ DREAM

CURRENT TREND – MIDRISE WOOD

“Transportation of the Future”

“Concrete of the Future”
The fire service must be skeptical of the marketing of wood-built high-rises.

Greg Havel, Town of Burlington (WI) FD; retired deputy chief; and a 30-year veteran.
“Cross laminated timber does not have a long enough history to provide firefighters with information on their behavior during abnormal situations like fires, earthquakes, and hurricanes.”

Greg Havel, Town of Burlington (WI) FD; retired deputy chief; and a 30-year veteran.

ICC Ad Hoc Committee on Tall Wood Buildings (TWB)
USDOJ Alcohol, Tobacco, Firearms and Explosives (ATF), Fire Research Laboratory, Beltsville, Maryland

<table>
<thead>
<tr>
<th>Event</th>
<th>Time to Flame (minutes)</th>
<th>Time to Flame (seconds)</th>
<th>Time to Flames</th>
<th>Total Energy Released (Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame in Common Area</td>
<td>14.27</td>
<td>88.8</td>
<td>105.4</td>
<td>25,589</td>
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CAVEAT EMPTOR
STACK EFFECT NOT ADDRESSED

- Shrinkage, moisture and creep, common in wood products including CLT, will create unpredictable opportunities for air movement.
- Air pressure and thermal differential with the use of CLT panels can shift the neutral pressure plane.
- Air channeling into the core from the lower floors is a very real concern to the occupants when they have to "defend in place" as well as fire service if the fire egress is compromised with smoke.

WIND EFFECTS NOT ADDRESSED

- Wind can change the FLOW PATH of a fire and in some cases create a "blowtorch effect" and untenable conditions.
- Accelerated winds near high rises are caused by the "downdraft effect", where the air hits a building and, with nowhere else to go, is pushed up, down and around the sides.

EXTERIOR PROPAGATION NOT ADDRESSED

- If a fire in a heavy-timber building is not extinguished by the initial attack, a tremendous conflagration with flames coming out of the windows will spread fire to adjoining buildings by radiated heat on exterior.
- Notably missing is how the mass timber exterior assembly in buildings over 40 feet in height would comply with NFPA 285.

MOISTURE/CONNECTION CONCERNS

- Taller Buildings = more wind & rain.

CLT FIRE TESTS – NRC & NIST

- "overreaching and lack true technical support for many concepts proposed."
- "Details on safeguards during construction have not been adequately addressed."
- "The proposals lack a complete technical basis for height and stories."
- "Technical justification has not been provided to substantiate the increase in these areas."
- "Limited information has been provided regarding the life expectancy of this product."
- "There is little detail regarding elemental effect, effect under greater load, reaction to the effects of fire while under load."
- "The five (5) fire demonstrations provide limited data and does not paint a full picture of what the proposed changes are recommending."

IAFC IS OPPOSED

- "IAFC is opposed to the proposals. The technical support provided by NRC and NIST is not adequate."
- "There is a lack of understanding of how the proposals would impact the safety of the occupants and the fire service."
- "The proposals lack a complete technical basis for height and stories."
- "Technical justification has not been provided to substantiate the increase in these areas."
- "Limited information has been provided regarding the life expectancy of this product."
- "There is little detail regarding elemental effect, effect under greater load, reaction to the effects of fire while under load."
- "The five (5) fire demonstrations provide limited data and does not paint a full picture of what the proposed changes are recommending."
**NASFM IS OPPOSED**

- There is no scientific basis for increasing height and area limits beyond what is currently allowable in codes.
- There has been no live fire testing at the limits being proposed.
- There has been no "wind aided" fire testing conducted.
- There is incomplete data regarding the fire loading of test burn buildings.
- "Professional Judgement" is insufficient justification for a change of this magnitude.
- No indication that any seismic testing has been performed or evaluated which goes to the issue of resiliency and sustainability.
- To allow a proliferation of larger, taller wood buildings without proper testing and justification is premature and could impact the fire suppression environment significantly.

**SPRINKLER RISKS**

"We think we've gone too far with the trade-offs in the codes, and we're seeking to reverse that trend."

New York State Fire Administrator James Burns, president of the National Association of State Fire Marshals, USA Today 2/12/06

**Q: SPRINKLER FAILURE RATES?**

Too much Reliance on Sprinklers?

- Failure of Sprinklers
  - 12.4% in apartments
  - 17.3% in hotels and motels
  - 20.3% in educational properties
  - 20.2% in healthcare/correctional facilities


**NASFM FAIL-SAFE IMPACT OF TRADE OFFS**

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>Average Legacy Codes</th>
<th>Average I-Codes</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>6.96</td>
<td>6.00</td>
<td>-13.4%</td>
</tr>
<tr>
<td>Compartmentation</td>
<td>11.00</td>
<td>11.40</td>
<td>3.6%</td>
</tr>
<tr>
<td>Fire Safety</td>
<td>23.98</td>
<td>18.34</td>
<td>-23.4%</td>
</tr>
<tr>
<td>Means of Egress (ME)</td>
<td>40.81</td>
<td>33.32</td>
<td>-18.4%</td>
</tr>
<tr>
<td>General Safety (GS)</td>
<td>41.62</td>
<td>36.13</td>
<td>-13.2%</td>
</tr>
</tbody>
</table>

**STRUCTURAL RISKS**

CLT panel in Peavy Hall fails

Building and Construction

CLT Panel Fails in Timber Building Project

Associated Press

Panel fails during construction of College of Forestry building at Oregon State University

Associated Press

Published 1/11 p.m. PT March 25, 2019
**INSURERS EQUATE WOOD WITH RISK**

<table>
<thead>
<tr>
<th>City</th>
<th>Total Builder's Risk Insurance Premium</th>
<th>Annual Property Insurance Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edgewater, NJ</td>
<td>$52,080</td>
<td>$52,080</td>
</tr>
<tr>
<td>Towson, MD</td>
<td>$55,440</td>
<td>$55,440</td>
</tr>
<tr>
<td>Orlando, FL</td>
<td>$29,540</td>
<td>$29,540</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>$30,660</td>
<td>$30,660</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>$32,620</td>
<td>$32,620</td>
</tr>
</tbody>
</table>

- **Total Builder's Risk Insurance Premium** for Reference Building
- **Annual Property Insurance Premium**

**CLT WISE CHOICE FOR STUDENT HOUSING?**

**FUTURE REUSE**

**GREEN MATERIALS**

- **Recycle Content**
- **Local Material**
- **Low Carbon**
  
  (also renewable, organic, edible, fashionable...)

**ENVIRONMENTAL BENEFITS**
RISK: EPDS MAY NOT REPORT ALL IMPACTS

SUSTAINABILITY – WOOD CLAIMS

- Wood sequesters carbon
- Each year, 10-45 million tons of CO2 are stored in new wood products.
- A big advantage of the product is that it is more sustainable than traditional building materials, such as concrete and steel, because of wood’s capacity to store carbon.

SUSTAINABILITY – REALITY

- Volume of wood used: 950 m³ = 33,549 ft³
- Carbon stored in the wood (CO₂e): 760 metric tons
- Avoided greenhouse gases (CO₂e): 320 metric tons
- Total benefit (CO₂e): 1,080 metric tons

So if we reverse that and built with concrete:
If the carbon sequestration of wood products is only 15.2% (A. Ingerson, 2007), given the losses to soil, manufacturing and transportation, then the stand of trees remaining in the ground would have stored 5,000 metric tons of CO₂ (instead of the 320 metric tons from cutting them down).
If the building was built with concrete then the avoided carbon emissions of keeping the trees in the ground would have been 5,000 - 320 = Potential Carbon Benefit of 4,680 metric tons of CO₂ by keeping the trees in the ground.
**SUSTAINABILITY – CARBON UPTAKE**

- CO₂ reabsorbed into concrete throughout lifetime
  - Small amount during service life
  - Significantly more from crushed concrete (increased surface area)
- Process is called **carbonation**
- 33% to 57% of CO₂ emitted from calcination is reabsorbed through carbonation over 100-year life

**THE MASS TIMBER-CONCRETE HYBRID**

**HYBRID SOLUTIONS**

**QUANTIFYING ENVIRONMENTAL IMPACTS OF STRUCTURAL MATERIAL CHOICES USING LIFE CYCLE ASSESSMENT: A CASE STUDY**

- LCA software “Tally.”
- “Cradle to Gate” and “Cradle to Grave”.
- 60 year life cycle.
Conclusions:

Making a decision on a sustainability "winner" with LCA information is not appropriate. Designers should choose materials that are most materially efficient for the intended building use, and then optimize and economize.

ARCHITECTS' DREAM

GREAT NEW YORK FIRE 1835

GREAT CHICAGO FIRE 1871
Questions?

Please complete the session evaluation on the CONEXPO – CON/AGG Mobile App. This is the same place you can log Professional Development Hours (PDH).