Wood buildings can be as safe as concrete and other construction materials

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Types of Building

- Wood Building
  - majority of the structure is wood
- Concrete Building
  - majority of the structure is reinforced concrete
- Steel Building
  - majority of the structure is steel
Wood - Fire Properties

- Combustible
- When burns forms protective char insulating core – (Massive timber can have high inherent fire resistance 60min+)
- Tends to shrink when exposed to heat
- Generally temperature induced deflections substantially less than steel and concrete
- Fire resistance can be increased by cladding or coatings
Steel Fire Properties

- Non-combustible

- Inherent fire resistance of unprotected steel depends upon the surface area : mass ratio typically less than 15min). Additional fire protection normally required.

- Expands when heated – differential heating can induce large deflections or stresses if restrained
Reinforced Concrete – Fire Properties

- Non-combustible
- Concrete protects steel reinforcement (generally additional protection not required)
- Tendency to spall under certain circumstances – can expose reinforcement
Combustibility - most significant potential impact

- **Fire Starts**
  - small proportion of fire starts include structural members,

- **Fire Growth Rate**
  - Performance specified in NCC prescriptive solutions can be achieved by wood (higher performance may require treatment of wood or application of coverings)

- **Fire Severity / Duration**
  - Can be addressed through fire protective coverings / encapsulation and / or automatic suppression

- **Fire Spread through Cavities**
  - Can be addressed by:
    - Avoiding Cavities (carefully detailed massive wood construction)
    - Fire protective coverings (protecting the wood)
    - Cavity barriers (preventing uncontrolled spread)
    - Automatic fire sprinklers (while fires relatively small)
    - Use of non-combustible insulation within the cavity (protecting combustibles within voids)
Fire Protective Coverings

Steel
- 2 layers of 13mm plasterboard
- steel studs
- non-combustible insulation

Wood
- 2 layers of 13mm plasterboard
- timber studs
- combustible insulation
Demonstration test

- **Enclosure dimensions**
  4 m x 4 m x 2.4 m high.

- **Opening**
  2 m wide x 1.2 m high.

- **Fire Load 740 MJ/m²**
30 minutes

Steel test

Wood test
Enclosure temperature

Fire Room Average Gas Temperature

![Graph showing average gas temperature over time for Steel and Wood materials. The graph indicates a higher temperature for Steel compared to Wood, with Steel peaking at around 1200°C and Wood at around 1000°C.]
Structural Element Temperature

Average temperature of unexposed face of the unexposed side of the wall

- Steel
- Wood
To provide a deemed-to-satisfy option for mid-rise timber buildings that:

- Enhances life safety and property protection compared to current deemed-to-satisfy provisions.
- Is economically viable
- Facilitates consistent approaches to mid-rise timber buildings.
- Facilitates Sustainable Construction practices
- Is compatible with existing BCA approaches
- Achieves broad support from relevant stakeholders
Fire Stages and Protection Options

- Fire Brigade Intervention
- Fire Resistant Construction
- Smoke Resistant Construction – Passive smoke control
- Fire Detection & Alarm
- Automatic Suppression
- Manual Suppression
- Lining and material controls
- Evacuation
- Active smoke control
- Fire Brigade Response
- Fire Brigade Intervention
- Initiation
- Development
- Fully Developed
- Decay
- Time
- Flashover
NCC 2016 Proposal for Change
Summary of Key Provisions

- Building effective height of not more than 25m.
- Protected by automatic fire sprinklers complying with Specification E1.5 of the BCA.
- Fire Protected Timber used in applications where the BCA DtS requires the element to be of non-combustible construction or concrete or masonry.
- Cavity Barriers specified for timber framed construction to address risk of fire spread via cavities.
- No reductions in FRLs proposed despite provision of automatic fire sprinklers.
Generic Apartment Building for comparative analysis
Outcomes of Analysis

**Impact of Fires inside SOU of Fire Origin – based on US statistics**

<table>
<thead>
<tr>
<th>Normalised Expected Risk to Life</th>
<th>Control</th>
<th>Timber Frame</th>
<th>Massive Timber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2</td>
<td>1</td>
<td>0.17</td>
<td>0.17</td>
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</table>

**Impact of Potential Fully developed Fires outside SOU of Fire Origin**

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<tbody>
<tr>
<td>Class 2</td>
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<td>0.091</td>
<td>0.061</td>
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**Impact of Potential Fully developed Fires outside SOU of Fire Origin**

<table>
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<tr>
<th>No of occupants exposed to potential untenable conditions</th>
<th>Frequency / annum x 10^{-6}</th>
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<tbody>
<tr>
<td></td>
<td>Control</td>
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<tr>
<td>Class 2 1-10</td>
<td>164.7</td>
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<tr>
<td>Class 2 10-100</td>
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Fires During Construction

- Only addressed to a limited extent in NCC.
- More detailed approach considering a broader range of issues required under WHS legislation.
Conclusions

- Wood buildings can be as safe or safer than buildings of steel or concrete construction
- As is the case with other materials it is a matter of
  - designing to a material’s strengths and
  - implementing protection measures.
    - to address its limitations
    - account for uncertainties and,
    - achieve the required level of safety