Measuring House Loss Risk at the Interface

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CSIRO - Bushfire Research

Context

• Objective to define a safe space for the occupant during the main fire impact
  - House become an envelop around this safe space
Context of community & urban design

• Lifestyle diversity
  – Community lifestyle value systems
  – Tradition practices
  – Land use planning
  – Economics

Difference from calculation and reported data (around 100)
The calculation does not include influence of slopes

House Loss vs Weather

Number of house loss (logarithmic scale)

FFDI

House loss greater than 50

□ Difference from calculation and reported data (around 100)
□ The calculation does not include influence of slopes
Vulnerability – evidence from surveys

1996/97 Land Use of Australia (Version 1)
Non-agricultural and interpretive agricultural land use
Physical modeling Hazard - Embers attack

- Intensity of active embers/m²
- Time
- Distance

Hazard – Radiation attack

- Radiation
- Time

Arrival event | Interface hazard model | Vulnerability model

- Wind
- Forest
- House
- Fence
- Shed
Brushwood fence impact on houses
Research on house performance (Laboratory and full scale simulation)

- BCRC work to date
  - Glazing system design
  - Timber decking design solution
  - Active spray system

- Future Work
  - Roof system
  - Behavior of domestic gas bottle

Window Performance – Exposure Profiles

Example radiant heat exposure curve

Radiation (kW/m²)

Time (seconds)

- 40 kW/m²
- 29 kW/m²
- 19 kW/m²
- 12.5 kW/m²
Decking Performance – large scale tests

Joist-deck “U” connection tested in Mass loss cone calorimeter

Decking Performance – Small-Scale Ember Tests

Methenamine tablets used to simulate embers
### Embers Attack Points (Sydney 1994)

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Items ignited</th>
<th>Ignitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>embers only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber decks</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Eave fascia boards and or gutters</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Timber window frames</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Rough saws western red cedar cladding</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Timber door frames</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Exposed timber beams (eave structure)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Timber shingle roofs</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Timber stairs</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Coir door mat</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Plastic roof panel</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Bitumen roof membrane</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Canvas awning</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Toilet roil (ember entry through unscreened window)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52</strong></td>
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### Fence Radiation & Embers Attack
(Sydney 1994)

<table>
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<tr>
<th>Ignition Mechanism</th>
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<th>Ignitions</th>
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</thead>
<tbody>
<tr>
<td>Embers with fence radiation assisting or causing opening</td>
<td>Contents via broken window</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Timber window frame</td>
<td>2</td>
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<tr>
<td></td>
<td>Timber door frame</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Eave fascia boards and or gutters</td>
<td>1</td>
</tr>
<tr>
<td><strong>total</strong></td>
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<td><strong>7</strong></td>
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### House Radiation & Embers Attack
(Sydney 1994)

<table>
<thead>
<tr>
<th>Ignition Mechanism</th>
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<th>Ignitions</th>
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</thead>
<tbody>
<tr>
<td>Embers with adjacent house radiation assisting or causing opening</td>
<td>Eave fascia boards and or gutters</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Timber window frame</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Contents via broken window</td>
<td>2</td>
</tr>
<tr>
<td><strong>total</strong></td>
<td></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>
Quantifying house to house spread

Radiation emitted from house

2 metre eaves
2 metre window
4 metre eaves
4 metre window
6 metre eaves
6 metre window

Window failure
Peak flaming from window at eaves