Safety awareness of firefighters and their perception of fire risks in cladding fires

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Background

• The increased frequency of façade fires in high-rise buildings have significantly raised global awareness in the combustibility of high-performance polymer-based building materials.
• There remains a non-compliance issue with these rapidly evolving materials which have demonstrated to be very difficult to regulate.
• There is an urgent need for a cladding replacement program that faces many challenges.
• Several hundred buildings in Melbourne and Sydney have been identified and residents are anxious and of heightened alert.
Cladding Fire Risks

- The fires in the Grenfell Tower, and other high-rise buildings in Australia and internationally have exposed many of the flaws and negligence in the current building regulations and fire safety protocols.

- All the incidents have all involved composite panels (ACPs), which contain highly flammable core material:
  - Polyethylene (PE)
  - Polyurethane (PUR)
  - Polystyrene (EPS)
  - Polyisocyanurate (PIR)

- All cases exhibit the following characteristics:
  - Rapid surface propagation
  - Flame spread through cavities within the exterior wall system
  - Fire re-entry on multiple levels
Current state on combustible claddings

- The cladding task force for each state released statistics on their audit for non-compliant building materials in 2018.
  - Victoria, in 1369 buildings, 770 were referred to an expert panel for further determination and, of those, 44 were placed in a higher risk category [1].
  - New South Wales, 1184 buildings were identified to have aluminium cladding, including 58 high-rise residential buildings necessitating further investigation [2].

- Legislation and building codes have yet to catch up with the requirements for assessing the fire risks involved in these buildings.
- Urgent need to resolve the present fire risks of existing building products and develop economically viable solutions.
- It is also a massive risks to first responders such as firefighters during the operation of fire events.

Survey on Safety awareness of Fire Fighters and their perception of fire risks in cladding fires

- An internet survey was conducted to investigate the fire risk perception of firefighters associated with combustible cladding material.

- The aim is to provide a greater understanding of the attitudes, beliefs and perception of firefighters toward fire risks associated with combustible cladding materials.

- It was approved by the UNSW Human Research Ethics Advisory Panel (approval number HC180884).

- The survey was conducted on March 20 - May 20, 2019.

- It was completed by a total of 439 participants consisting of firefighters from major state and rural fire agencies around Australia.
An 18-item questionnaire was constructed to investigate the risk perception associated with highly combustible cladding materials.

It can be subdivided into four major parts:

- **Demographics**
  - Participant's fire agency, experience and rank

- **Risk awareness and identification**
  - Can they identify buildings at risk?
  - Are they aware of the risks related to non-compliant building products, especially those involving combustible cladding products?

- **Perceived risk**
  - How likely do they think it is for them to respond to such a fire?
  - How dangerous/severe do they feel are the consequences?
  - Do they have such buildings in their zone?
  - What are their greatest concerns in such an event?
  - How willing are they to put their own safety at risk to save lives? property?
  - How confident are they in being able to manage an incident of this kind?

- **Risk mitigating behaviour**
  - How prepared are they for such an event?
  - Have they prepared PIPs (Pre-incident planning) for cladded buildings in their area?
  - Have they performed HFSC (Home Fire Safety Checklist) in affected buildings or delivered any Community Engagement educational programs to the community?

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**Questionnaire**

- The survey consists of an 18-item questionnaire.

- It can be subdivided into four major parts to investigate different aspects of risks:
  - **demographics**
  - **Risk awareness and identification**
  - **Perceived risk**
  - **Risk mitigating behaviour**

- It is distributed through Qualtrics web-based survey tool.
Participants

- 439 participants which includes 287 (66.90%) from Fire and Rescue New South Wales (FRNSW) and 78 (18.18%) from Queensland Fire and Emergency Services (QFES) and 64 (14.92%) from other Fire Services in Australia.

- Additional demographic questions were asked specifically for FRNSW participants. There is a good distribution of different ranking officers and zone locations.

<table>
<thead>
<tr>
<th>Rank</th>
<th>%</th>
<th>Count</th>
<th>Zone / Response Area</th>
<th>%</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruit firefighter</td>
<td>0.35%</td>
<td>1</td>
<td>Metropolitan East</td>
<td>35.18%</td>
<td>95</td>
</tr>
<tr>
<td>Firefighter to Leading Firefighter</td>
<td>41.61%</td>
<td>119</td>
<td>Metropolitan South</td>
<td>11.11%</td>
<td>30</td>
</tr>
<tr>
<td>Station Officer or above</td>
<td>32.52%</td>
<td>93</td>
<td>Metropolitan North</td>
<td>12.96%</td>
<td>35</td>
</tr>
<tr>
<td>Retained firefighter</td>
<td>15.38%</td>
<td>44</td>
<td>Metropolitan West</td>
<td>18.52%</td>
<td>50</td>
</tr>
<tr>
<td>Deputy Captain or above</td>
<td>8.04%</td>
<td>23</td>
<td>Regional North</td>
<td>7.77%</td>
<td>21</td>
</tr>
<tr>
<td>Other - Please specify</td>
<td>2.10%</td>
<td>6</td>
<td>Regional West</td>
<td>5.55%</td>
<td>15</td>
</tr>
</tbody>
</table>

Regional South 8.88% 24
Risk Awareness and Identification

“Participants were asked to identify buildings at risk of combustible cladding from list of images”

- 12 images of building structures of which 6 have aluminium composite panel (ACP) installed

- **Only 3 (0.09%) participants correctly identified all 6 images** without any additional selection in their answer.

- 178 (53.78%) had the correct 6 images in their answer of which 92 (27.79%) selected all 12 images as having ACP.

- Accuracy rate of **58.6%** which is slightly higher than random guess (50%).

- Results suggest there are still difficulty in correctly identifying ACPs.

- Based on the raw selection counts for each image, the participants tend to select images with **reflective smooth surface finish**.

<table>
<thead>
<tr>
<th>Image</th>
<th>% (count)</th>
<th>Image</th>
<th>% (count)</th>
<th>Image</th>
<th>% (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.94% (304)</td>
<td>5</td>
<td>5.68% (193)</td>
<td>9</td>
<td>6.12% (208)</td>
</tr>
<tr>
<td>2</td>
<td>9.62% (327)</td>
<td>6</td>
<td>6.30% (214)</td>
<td>10</td>
<td>8.88% (302)</td>
</tr>
<tr>
<td>3</td>
<td>7.09% (241)</td>
<td>7</td>
<td>9.86% (335)</td>
<td>11</td>
<td>9.62% (327)</td>
</tr>
<tr>
<td>4</td>
<td>9.77% (332)</td>
<td>8</td>
<td>9.80% (333)</td>
<td>12</td>
<td>8.33% (283)</td>
</tr>
</tbody>
</table>

Images with combustible cladding are highlighted in orange and without combustible cladding are highlighted in green.
Perceived Risk of critical factors associated with ACP

“Participants were asked to rate the likelihood of occurrence and the consequence for a list of critical factors widely associated with combustible cladding”

- Rating based on 5-point Likert scale (5: Very High, 4: High, 3: Moderate, 2: Minor, 1: Negligible).
- Based on the results, we can see 3 distinct groups of critical factors ranked based on the firefighters perception.

<table>
<thead>
<tr>
<th>Critical Factor</th>
<th>Mean</th>
<th>Std</th>
<th>Var</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid vertical and horizontal fire spread</td>
<td>4.4684</td>
<td>0.7352</td>
<td>0.5405</td>
</tr>
<tr>
<td>Multiple floor evacuations/rescue</td>
<td>4.4608</td>
<td>0.7466</td>
<td>0.5574</td>
</tr>
<tr>
<td>Toxic smoke affecting occupants and/or bystanders</td>
<td>4.2892</td>
<td>0.8581</td>
<td>0.7364</td>
</tr>
<tr>
<td>Difficult evacuation of immobile occupants</td>
<td>4.2319</td>
<td>0.8357</td>
<td>0.6983</td>
</tr>
<tr>
<td>Internal fire extension on multiple levels</td>
<td>4.0030</td>
<td>0.8106</td>
<td>0.6571</td>
</tr>
<tr>
<td>Obstructions causing difficult access for aerial appliances</td>
<td>3.8389</td>
<td>0.8015</td>
<td>0.6424</td>
</tr>
<tr>
<td>Overrun sprinkler and hydrant systems</td>
<td>3.8012</td>
<td>0.9121</td>
<td>0.8320</td>
</tr>
<tr>
<td>Fire spread to surrounding structures due to falling molten/burning debris</td>
<td>3.6235</td>
<td>0.8845</td>
<td>0.7823</td>
</tr>
<tr>
<td>Evacuation and warning system failure or unavailability</td>
<td>3.2681</td>
<td>0.8192</td>
<td>0.6711</td>
</tr>
<tr>
<td>Structural collapse</td>
<td>3.1476</td>
<td>0.9332</td>
<td>0.8709</td>
</tr>
</tbody>
</table>
Perceived Risk for different Building Types

“Participants were asked to rate the consequence (severity) of fires with and without involving ACP for different buildings”

- In a normal fire scenario, hospital, high-rise hotel and university dormitory is ranked highest (based on mean).
- Fires involving ACP resulted in increase rating across all building category.
- The increase in risk from ACP is most significant for Residential Buildings (over and under 25m) and High-rise hotels.

<table>
<thead>
<tr>
<th>Building Type</th>
<th>w/o ACP</th>
<th>w/ ACP</th>
<th>diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential building, over 25m</td>
<td>3.4157</td>
<td>4.5060</td>
<td>1.0904</td>
</tr>
<tr>
<td>Residential building, under 25m</td>
<td>3.4608</td>
<td>4.3886</td>
<td>0.9277</td>
</tr>
<tr>
<td>Shopping complex</td>
<td>3.4157</td>
<td>4.1295</td>
<td>0.7139</td>
</tr>
<tr>
<td>Single shop front with residential dwellings above</td>
<td>3.5904</td>
<td>4.0602</td>
<td>0.4699</td>
</tr>
<tr>
<td>Hospital</td>
<td>3.7741</td>
<td>4.3735</td>
<td>0.5994</td>
</tr>
<tr>
<td>University dormitory</td>
<td>3.8133</td>
<td>4.4337</td>
<td>0.6205</td>
</tr>
<tr>
<td>High-rise hotel</td>
<td>3.6988</td>
<td>4.5392</td>
<td>0.8404</td>
</tr>
<tr>
<td>Electrical goods warehouse</td>
<td>3.5602</td>
<td>3.9277</td>
<td>0.3675</td>
</tr>
<tr>
<td>Two-storey, terrace-style townhouse</td>
<td>3.4247</td>
<td>3.8795</td>
<td>0.4548</td>
</tr>
</tbody>
</table>
Firefighter’s priorities in a fire incident

“Participants were asked to rate to rank their priorities in a structural fire, with 1 being your highest priority and 6 being your lowest priority.”

• **Top priority** is safety of crew and the firefighter’s own safety both are statistically higher than other options.
• Followed by safety of children and disabled and adult occupants. Note that there is almost no variation in rank 3 and 4 (i.e huge majority of participants ranked them 3 and 4)
• Property and wildlife is lowest priority.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Mean</th>
<th>Std</th>
<th>Var</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety of my crew</td>
<td>1.76</td>
<td>0.68</td>
<td>0.47</td>
</tr>
<tr>
<td>My own safety</td>
<td>1.85</td>
<td>1.22</td>
<td>1.5</td>
</tr>
<tr>
<td>Safety of children and lesser abled persons</td>
<td>2.78</td>
<td>0.69</td>
<td>0.47</td>
</tr>
<tr>
<td>Safety of adult occupants</td>
<td>3.74</td>
<td>0.64</td>
<td>0.41</td>
</tr>
<tr>
<td>Protecting the property and surroundings</td>
<td>5.19</td>
<td>0.69</td>
<td>0.47</td>
</tr>
<tr>
<td>Surroundings from further destruction</td>
<td>5.69</td>
<td>0.5</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Readiness for attending incidents involving combustible cladding

“A series of questions was asked to investigate how firefighters think about their readiness attending fires involving combustible cladding.”

- Only **11.57%** of the participants that have attending a fire that involved non-compliant/combustible cladding products

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“Have you ever attended a fire that involved non-compliant/combustible cladding products?”

- Don’t know: 20%
- Yes: 12%
- No: 68%

“What do you think is the likelihood that you will attend a fire involving combustible cladding in your zone/response area?”

- Not likely, within the next year: 15%
- Likely, within the next ten years: 21%
- Within the next five years: 22%
- Within the next ten years: 57%
Readiness for attending incidents involving combustible cladding

- 72% of participants said their zone have conducted PIP on buildings with potential combustible
- Only 18.32% of participants have delivered any educational material for residents and occupants with potential combustible cladding.
Readiness for attending incidents involving combustible cladding

“How would you rate your level of preparedness in attending an incident involving highly combustible cladding?”

- **3.64%** said they were more prepared than other types of fire
- **56.97%** selected they were just as prepared as for any other fire
- **34.55%** Less prepared than for other types of fires
The participants were asked to select which options would help them feel more prepared for fire incidents involving combustible cladding.

- There is an equal distribution between the options that were given in the question.
- This suggests that all the approaches have equal importance towards improving the readiness.
- Even though majority of participants have conducted PIP for buildings at risk, they still rank accurate information such as PIP as a top priority for improved readiness.
- There is a significant amount of comments to this question that have specifically highlighted the need for **better aerial equipment and tactics**. As the fire often extend beyond the reach of firefighters when they arrive.
Key Takeaway points

- It was found that firefighters can not reliably identifying combustible cladding (ACP)s and when attending such event, it is critical to have correct intel from pre-incident planning (PIP) reports.

- Improved PIP will also lead to more effective deployment upon dispatch – ensure appropriate gear is deployed. Access to better aerial equipment have been repeatedly brought up in the survey as essential for tackling cladding fires.

- PIP have been conducted in all NSW zones regardless of population density and number of high-rise buildings and 85% of participants claim they were involved.

- However, many have commented that the current system is reactive, i.e. it relies on building managers raising the issue to fire agencies. Then experts will be sent to verify the claim. This process is slow, so we are left with many buildings with “potential” combustible cladding.

- The survey has also found that only 18% of participants have delivered any educational material for residents and occupants, this suggests that occupants should be better informed of the possible fire risks of their respective buildings, so that they would have an awareness of potential fire risk.
Thank You!

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