Are Façade Fires An Unavoidable Consequence Of Modern Architecture?

Combustible Cladding – Compliance, Challenges and Risks
CIBSE SA, Adelaide, 8th of November 2018

Sponsored by IFE and CIBSE
Presenter:
Nages Karuppiah
MFS Senior Fire Safety Engineer & Vice President of IFE Australia
BE (Mechatronics) Hons., ME (Fire Safety), MIAust, MIfireE

INSTITUTION OF FIRE ENGINEERS (IFE)

• The Institution is an international organisation for fire engineering, firefighting and fire safety professionals
• Through its Engineering Council licence as a Professional Engineering Institution, IFE registers suitably qualified IFE members as Chartered Engineers (CEng), Incorporated Engineers (IEng) and Engineering Technicians (Eng Tech) which are internationally recognised
• For further information on the IFE, please visit our website at www.ife.org.au
• Founded in 1918 - 100 years old in 2018 - IFE Australia recently held our very successful Centenary Conference in Sydney
• IFE Australia is currently working in conjunction with EA SFS at a national level in collating and providing comments on the new draft Fire Safety Verification Method (FSVM) released by ABCB
TOPICS

- Role of the MFS Under the Legislation
- Aluminium Composite Panels
- Expanded Polystyrene
- AS 5113-2016 vs BS 8414 & BRE 135
- Complexity of Modern Facades
- Full Scale Façade Tests by BRE and ABI
- Fire Fighting Challenges
- Why are Façade Fires Unacceptable?

Role of the MFS under the Legislation (Reg 28)

Reg 28 – The Relevant Authority must refer the application to the relevant fire authority if –

- A Performance Solution requires assessment against a Performance Requirement which provides for fire fighting operations.

(v) the number of storeys in the building; and
(vi) its proximity to other property; and
(vii) any active fire safety systems installed in the building; and
(viii) the size of any fire compartment; and
(ix) fire brigade intervention; and
(x) other elements they support; and
(xi) the evacuation time.
Aluminium Composite Panels (ACPs)

- ACPs commonly comprise two outer aluminum skins and a low density infill such as polyethylene or other core material. The panels are typically between 3mm to 6mm and the aluminum sheets are normally 0.5mm thick.

Expanded Polystyrene (EPS)

- Polystyrene or Styrofoam panels are combustible
- They are typically rendered or otherwise coated and appear similar to masonry construction
- Whilst not further discussed in this presentation, they do also need to be considered when assessing compliance
Compliance Pathways

- **DTS provisions** – The product complies with AS 1530.1 and/or the concessions under Clause C1.9.
- **Performance solutions** that demonstrate compliance with the performance requirements (Clause A0.5(b)(ii)).
- **BCA Verification Method CV3** - External wall system to achieve an ‘EW’ classification per AS 5113 (Clause A0.5(b)(i)).
- **Codemark certification** – meets evidence of suitability requirements of part A2.2 of the BCA (Clause A0.5(a)).

**AS 5113-2016 VS BS 8414**

- AS 5113 is **not a test method**
- It is a standard that nominates the **performance criteria** for a product being tested
- AS 5113 references ISO 13785-2 and BS 8414 standards as the **test methods**
- These referenced standards **does not specify performance (pass/fail) criteria** but simply describe the test methods
- The BRE 135 Standard specifies the **Performance Criteria** for the BS 8414 standards
TEST STANDARDS – ISO 13785-2 & BS 8414

PERFORMANCE STANDARDS – AS 5113 & BRE 135
PERFORMANCE STANDARDS – AS5113 VS BRE 135

- AS 5113 requires all 9 pass/fail criteria to be met to achieve an EW classification.
- Results in a test report from a Testing Laboratory is expected to look similar with an ‘EW’ classification if the product has met all the criteria un AS 5113.

<table>
<thead>
<tr>
<th>Classification Criteria</th>
<th>Related classification measure</th>
<th>Result in test</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4.5(a) Base</td>
<td>≥1500°C</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>5.4.5(b) Transfer</td>
<td>≥2500°C</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>5.4.5(c) Temperature</td>
<td>≤180°C Rise</td>
<td>81°C</td>
<td>Pass</td>
</tr>
<tr>
<td>5.4.5(d) Flaming</td>
<td>No flaming</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>5.4.5(e) Openings</td>
<td>No openings</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>5.4.5(f) Spread</td>
<td>No spread beyond specimen</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>5.4.5(g) Debris Burning</td>
<td>≤10 s</td>
<td>9 s</td>
<td>Negligible Pass</td>
</tr>
<tr>
<td>Classification</td>
<td>≤2 kg</td>
<td>Negligible</td>
<td>EW</td>
</tr>
</tbody>
</table>

PERFORMANCE STANDARDS – AS 5113 VS BRE 135

- BRE 135 requires 3 pass/fail criteria to be met and 1 criteria (mechanical performance) to be assessed via a risk assessment.
- There is no pass/fail criteria for mechanical performance.
PERFORMANCE STANDARDS – AS 5113 VS BRE 135

- Results in a test report from a Testing Laboratory is expected to look similar with observations noted for criteria B2.4 - Mechanical Performance.

<table>
<thead>
<tr>
<th>Classification Criteria</th>
<th>Related classification measure</th>
<th>Result in test</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2.2 External Fire Spread</td>
<td>Rise of TS of external TC's at level 2 exceeding 50°C for 30 seconds within 30 minutes of fire</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>B2.3 Internal Fire Spread</td>
<td>Rise of TS of internal TC's at level 2 exceeding 50°C for 30 seconds within 30 minutes of fire</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>B2.4 Internal Fire Spread</td>
<td>Flaming for more than 60s on the internal surface above a height of 0.5m above the combustion chamber within 15 minutes of fire</td>
<td>Did not occur</td>
<td>Pass</td>
</tr>
<tr>
<td>B2.4 Mechanical Performance</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

If the external cladding does not contribute to flame spread, the risk of secondary fires are limited.

If the external cladding contributes to the flame spread, there is a risk of secondary fire spread to other levels.
CAVITIES

• Cavities may be incorporated within the cladding or formed by the delamination in a fire
• If flames become confined by entering cavities, they will become elongated as they seek oxygen and fuel to support the combustion process
• This process can lead to flame extension of five to ten times that of the original flame lengths, regardless of the materials used to line the cavities
• Rapid fire spread (unseen) through the cladding if appropriate fire barriers can not been provided

COMPLEXITY OF MODERN FACADE

❖ Energy conservation has been the driver for today’s façade systems
❖ Facades are complex. It is dependent on:
  • skilled labour; and
  • cost
❖ They are multipurpose:
  • Energy efficient
  • Stable
  • Durable
  • Provide the required comfort levels
  • Act as a fire barrier
  • Insulated from sound & vibration etc.
Modern day façade - The outer envelope of the building is separated from its loadbearing structure.

**Curtain Wall**
- Structure can be partitioned at will (multiple considerations)
- Suspended or supported façade structure
- Span across single or multiple floors

**Load-bearing floor system**
- Reinforced concrete, steel or composite structure

**Connecting component**
- Connections at slabs or columns
- Usually stainless steel

**Facade Structure**
- Mainly light weight materials
- Extruded aluminium, steel frames
- Composite materials
COMPLEXITY OF MODERN FACADE

The “GAP”

- The gap between the façade structure and the connection to the slab is a potential failure point.
- The larger the gaps are, the more ‘expensive’ these are to fill.
- The more complex the fixing methods are, the more failure points.
- Achieving compartmentation and resistance to fire spread for a complex system is a challenge.

Modern methods of construction:

- More components
- More interfaces
- Less historic data/testing/familiarity
- More complexity of design and geometry

It requires a holistic approach.

Risk of failure
Following the Grenfell Tower fire, the British government has commissioned 6 full-scale façade tests (in July 2017) with 3 types of ACPs and 2 commonly used insulation.

<table>
<thead>
<tr>
<th>Aluminium Composite Material (ACP) with...</th>
<th>Insulation</th>
<th>PIR Foam</th>
<th>Phenolic Foam</th>
<th>Stone Wool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmodified polyethylene filler (Cat. 3 in screening tests)</td>
<td>Test 1 failed</td>
<td>6 Buildings</td>
<td>Report and Advice</td>
<td>N/A</td>
</tr>
<tr>
<td>Fire retardant polyethylene filler (Cat. 2 in screening tests)</td>
<td>Test 3 failed</td>
<td>8 Buildings</td>
<td>Report and Advice</td>
<td>Test 7 failed</td>
</tr>
<tr>
<td>Limited combustibility filler (Cat. 1 in screening tests)</td>
<td>Test 5 passed</td>
<td>0 Buildings</td>
<td>Report and Advice</td>
<td>N/A</td>
</tr>
</tbody>
</table>

"As the large-scale test using the phenolic foam insulation as a backing to an FR core ACP didn’t pass, one might have cause to be concerned about other low combustibility products used in combination; such as a combustible sarking combined with an FR core ACP."
Look out for the disclaimers!

Certmark disclaimer:
https://certmark.org/articles/2017/06/cmi-advisory-note-combustible-facades/

Reaction to Fire: This Certification relates only to the subject wall elements reaction to fire, and no evaluation has been made of any other wall system elements used in conjunction with the subject of this Certification. As there may be a potential for multiple combustible elements to be incorporated in constructing the wall system, a review of the proposed wall system, in its entirety, to verify its compliance to relevant fire safety clauses of the Building Code, should be undertaken by an appropriately qualified Fire Safety Engineer as well as the projects authority having jurisdiction.

FULL SCALE FAÇADE TESTS
BY ASSOCIATION OF
BRITISH INSURERS (ABI)

On 24th of April 2018, The Guardian published an article on a critical report published by the Association of British Insurers (ABI) from full scale façade tests (BS 8414).

Some of the key findings:

• Changing the fuel load to include plastic material has demonstrated to elongate the length of flame ejections, increase the peak heat release rate, and the maximum temperatures achieved (HRR = Q = Δh.m).

• The inclusion of a standard kitchen / bathroom type vent into the test allows access of flame into the cladding void directly before failure of the external cladding panels.

• The design differences between systems destined for the test and on-building use can be many.
MFS’S RESPONSIBILITY - FIRE AND EMERGENCY SERVICES ACT 2005

Division 2—Functions and powers
26—Functions and powers
(1) SAMFS has the following functions:
   (a) to provide services with a view to preventing the outbreak of fires, or reducing the impact of fires, in any fire district.
   (b) to provide efficient and responsive services in any fire district for the purpose of fighting fires, dealing with other emergencies or undertaking any rescue.
   (c) to protect life, property and environmental assets from fire or other emergencies in any fire district.
   (d) to develop and maintain plans to cope with the effects of fires or emergencies in any fire district.

FIRE FIGHTING OPERATIONAL HAZARDS

• Vertical and lateral fire spread.
• Hazards presented by falling debris, such as falling burning products onto fire fighters.
• Wind conditions can aggravate fire spread in a building – may need to expand our ‘hot zone’ and protect neighbouring buildings and/or vehicles etc.
• Rapid fire extension to the interior of the building through balconies, windows or other openings that are open or fail due to thermal stress.
FIRE FIGHTING RESOURCES

Larger numbers of resources required to manage the following:

- evacuations
- search and rescue
- fighting the fire on multiple floors – internal & external
- crew recycling and rehabilitation (hydrate and rest before redeployment)
- media management
- water supply

FIRE FIGHTING CHALLENGES

Fire service can encounter the following challenges during an event:

- Restricted access around the building
- Insufficient reach from our aerial appliance – Max 37m
- Insufficient water supply – poor maintenance / overrun
- Inadequate access into a building
  - single stair in a tall building
  - no access into the building required under 25m
- Search and rescue in a smoke filled environment on multiple levels
WHY ARE FACADE FIRES UNACCEPTABLE??

External fire spread compromises all of the following:

• Compartmentation
• Protection of paths of egress
• Sprinkler protection
• Structural integrity
• Egress
• Fire Brigade Intervention

FOOD FOR THOUGHT

• Given the complexities involved in modern design and architecture, my question to you is – who’s responsibility is it in ensuring building fire safety?
• Fire Safety Engineering need to be considered during the very early concept design stages.
• Using “Fire Safety Engineering” as a band-aid solution to obtain approval is not the way forward!
• We need innovative, robust and practical solutions, not just ‘compliant’ solutions.
Questions?

Thank you for your time!