Fire safety & Facades – What are the challenges?
The demand for high performance, resilient, healthy, energy efficient buildings has changed building envelope designs that incorporate increased amounts of combustible material in cladding, insulation and water-resistive barriers (WRBs).

Fire codes have become integral with updates to the International Building Code (IBC).

Building science has focused on the “envelope” in response to the movement of air, water vapor and thermal conditions.

Understanding how to deliver high-performance, code compliant buildings can be complex and confusing.
Life Safety!

High Rise fires have become far too common

- Building codes are too lax (outside US)
- Building codes are not enforced
- Products changed out by contractor
2012 IBC Combustible Component Requirements

- Air & Water Barriers
  - §1403.5

- Combustible Claddings
  - EIFS - §1408.2
  - MCM - §1407.10
  - FRP - §2612.5
  - HPL - §1409.10

- Foam Plastic Insulation
  - §2603.5.5

Within a building enclosure, the following components are combustible and subject to NFPA 285 testing.

Image courtesy of DuPont Building Innovations
International Building Code (IBC)

For combustible materials to be used, assembly MUST pass NFPA285

Type I, II - Non-combustible materials for structural framework, bearing walls, floor and roof construction Type I is more stringent than Type II (longer fire resistive ratings)

Type III - Exterior walls must be non-combustible but interior can be any material allowed by code

Type IV - Exterior walls are non-combustible, interior walls are solid or laminated wood without concealed spaces (heavy timber construction)

Type V – Combustible construction, limited to 1 – 2 stories
What does the standard say?

1.3.1
This Standard shall be used to evaluate the fire propagation characteristics of exterior non-load bearing wall assemblies and panels used as components of curtain wall assemblies that are constructed using combustible materials or that incorporate combustible components within the wall assemblies as specified in the following:

1. The ability of the wall assembly to resist flame propagation over exterior face of the wall assembly.

2. The ability of the wall assembly to resist vertical flame propagation within the combustible components from one story to the next.

3. The ability of the wall assembly to resist vertical flame propagation over the interior surface of the wall assembly from one story to the next.

4. The ability of the wall assembly to resist lateral flame propagation from the compartment of the fire origin to the adjacent compartments or spaces.
No testing required:

- Any non-combustible material
- Steel
- Aluminum
- Zinc
- Copper
- All Metals
- Gypsum
- Mineral Fiber
- Glass

Testing Required:

- Any “combustible” material
- Foam Plastic Insulation
- Plastics
- WRB materials
- Air Barrier Materials
- Coatings
- Spray Foam
- ACM
- MCM
No testing required:

- Any non-combustible material
- Steel
- Aluminum
- Zinc
- Copper
- All Metals
- Gypsum
- Mineral Fiber
- Glass

Testing Required:

- Any “combustible” material
- Foam/Plastic Insulation
- Plastics
- WRB materials
- Air Barrier Materials
- Coatings
- Spray Foam
- ACM
- MCM

Typically the combustible materials companies are doing the testing!
Deemed to satisfy – Setting the scene

- Tick-box solution
- Accuracy and scalability of small tests questionable
- ‘Silo’ approach to design

❖ A Material performance not a system approach.
Small Scale Testing ignores the chimney Effect

“If flames become confined or restricted by entering cavities within the external cladding system, 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 length regardless of the materials used to line the cavities.” BR 135
System testing required

✓ Combustible cladding and combustible insulant

BS 8414-1

✓ Passed

tested at system level?
Deemed to satisfy system

- Only non-combustible components

X Failed

BS 8414-1
Fire tests with Aluminium Composite Material post Grenfell
Ventilated Facades - What is ACM Cladding?

Ventilated Façade:
- Insulation
- Cavity
- Cavity Barriers
- External Cladding

ACM External Cladding:
- Aluminium Composite Material
- 3 common core types PE/FR/A2
- No insulation properties
BR135 to BS8414
<table>
<thead>
<tr>
<th>Test</th>
<th>Build up</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>100 mm PIR – PEcore ACM</td>
<td>Fail - 8.45 mins</td>
</tr>
<tr>
<td>Test 2</td>
<td>180 mm MF – PECore ACM</td>
<td>Fail - 7.09 mins</td>
</tr>
<tr>
<td>Test 3</td>
<td>100 mm PIR – FRcore ACM</td>
<td>Fail - 25.12 mins</td>
</tr>
<tr>
<td>Test 4</td>
<td>180 mm MF – FRCore ACM</td>
<td>Pass</td>
</tr>
<tr>
<td>Test 5</td>
<td>100 mm PIR – A2 core ACM</td>
<td>Pass</td>
</tr>
<tr>
<td>Test 6</td>
<td>180 mm MF – A2 Core ACM</td>
<td>Pass</td>
</tr>
<tr>
<td>Test 7</td>
<td>100 mm PF – FRcore ACM</td>
<td>Fail – 28.14 mins</td>
</tr>
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### DCLG Testing according to BS8414-1

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<tr>
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<td>Fail - 7.09 mins</td>
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</tbody>
</table>
DCLG Testing according to BS8414-1

PIR – FRACM [Test 4]

RockFibre – FRACM [Test 5]

Phenolic – FRACM [Test 7]
DCLG Testing according to BS8414-1

PIR - FRACM

RockFibre - FRACM

Phenolic - FRACM
Facade mock-ups fire tests equipped with ACM based claddings post Grenfell
• Comparative tests
• Same test set-up as DCLG test
• 3 insulants / 3 ACM types
• 30 minutes / 100 KW
• 3 fire stages (development, intensity, decay)
Build-up

Lamatherm by Siderise
# K15 with ACM Claddings

<table>
<thead>
<tr>
<th></th>
<th>1 min</th>
<th>5 min</th>
<th>10 min</th>
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<td>A2</td>
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[https://www.youtube.com/watch?v=K7XVt42C-V0&app=desktop](https://www.youtube.com/watch?v=K7XVt42C-V0&app=desktop)
K15 with ACM Claddings

HRR K15 with ACM Claddings

- K15-PE
- K15-FR
- K15-A2
K15 with ACM Claddings
Polyethylene cored ACM

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Polyethylene cored ACM

HRR PE Cladding

Axes Title

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Polyethylene cored ACM

PIR  K15  Stonewool
Maximum HRR of the 9 tests

Figure 7 - Maximum heat release rate (contribution of burner removed)
HRR curves of the 3 Insulants with ACMA2

HRR A2 Cladding

Axis Title

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Full paper available in Fire and Materials

Special thanks to the authors of the Fire and Material paper:

Eric Guillaume, Talal Fateh, Renaud Schillinger, Roman Chiva, Sebastian Ukleja
Stonewool A1 vs Kingspan K15 with ACM A2

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https://www.youtube.com/watch?v=BoO9KRucUbs
Thank-you

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