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Guidance on Façades and Fires

Clarifications and Audits

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Safety & Security Design in Buildings

Intersec Conference

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Course Context

In this presentation the speaker reiterates several baseline fire performance characteristics that have evidently been misunderstood; in particular the difference between ‘reaction to fire’ and ‘fire resistance. He then proceeds to address several characteristics of aluminium composite paneling (often problematically involved in façade fires), references key testing requirements and proposes what should consequently be involved in a fire safety audit pertaining to facades specifically.

COURSE DESCRIPTION (1)

Fire Resistance versus Reaction to Fire

Reaction to Fire

Reaction to fire tests tend to be small-scale test methods on materials, evaluating – ignitability, flame spread, heat release, smoke development and toxicity.

Samples tend to be small in size (mm rather than m) and relate to the development stages of a fire.

Fire Resistance

These tests are generally used to determine the fire resistance of complete systems (eg. a wall, ceiling, floor structure, jet fan, fire damper, ducting etc). Specimens tend to be large in size (m rather than mm).

They generally evaluate the duration of time that a complete structure will hold back a fire (eg. how long a fire will take before breaking into the adjacent room). Fire resistance tests integrity, and/or insulation and/or load bearing capacity (all measured in minutes)

It relates to performance in a fully developed fire.

COURSE DESCRIPTION (3)

Fire Rating – This general term is defined and clarified.

Aluminium Composite Paneling
This is a type of metal composite material used as a facing or lining material. Limiting its flame propagation characteristics is extremely important. The characteristics are explained herein.

The Requirement for Full Fire Resistance
Full fire resistance is mainly required were there is a specific need to:
- protect the inside space from an external fire (eg. where adjacent buildings are close, or there is another defined and elevated risk)
- protect the outside space from an internal fire (eg. if the adjacent external space forms an escape corridor)

Most modern buildings don't need a façade with full fire resistance because buildings can be spaced apart sufficiently.
Fire resistance is usually more focussed on internal partitioning than exterior wall.
Several glass types are available, with differing characteristics.

Perimeter Firestopping
This is an important fire resistance element that is required normally – preventing vertical flame spread.
It has historically been poorly provided and needs full integration with the wall.

COURSE DESCRIPTION (4)

Reaction to Fire – Flame Spread

Flame spread on an exterior wall must be understood and controlled.
A wall doesn't have to have a full fire resistance performance to do that (although perimeter firestopping is likely to be a requirement).
Both the components and the full system should be evaluated (in that order).
It is important to understand the performance of all parts of composite materials, eg. the core of a composite panel.
Appropriate test standards are proposed.
Performance criteria are proposed and should be developed for local application.

Fire Safety Reviews and Audits

An overall strategy is suggested.
A list of items recommended with the process is provided.
A series of considerations are also given as potential for thought and next steps related to mitigating factors.

Presenter

Andy Dean has over 25 years of experience in the field of Building and Construction, ranging from structural testing within the nuclear industry to fire testing.

Having established the Dubai Facade Technology Centre and Laboratory in 1997, and operated it for 10 years, he has particular knowledge of heavy structures testing and weathertightness testing of cladding, curtain walling and building envelope systems; and business in the Middle East. He also established and operated a local branch of an international fire testing and certification organisation; thus marrying his knowledge of façades with fire performance.

Andy is a Fellow of the Chartered Institute of Building, Fellow of the Society of Façade Engineers (CIBSE) and member of the Glass and Glazing Federation; holding committee positions in the local chapters of these organisations.

As a façade consultant he continues to provide input into the UAE code and is a regular speaker at industry technical seminars across the region.

Learning Objectives

1. Important fire performance principles – 'Fire Resistance' versus 'Reaction to Fire'
2. Clarification of 'Fire Rated' terminology
3. Aspects of ACP highlighted – components, performance, concerns, testing, appropriate functions
4. Perimeter firestopping identified
5. Façade related fire safety audits – strategy, elements, mitigation opportunities.

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarise the content of the presentation and the main learning objectives.

These may be used to update CPD records for relevant organisations including, for example, the Chartered Institute of Building (CIOB).

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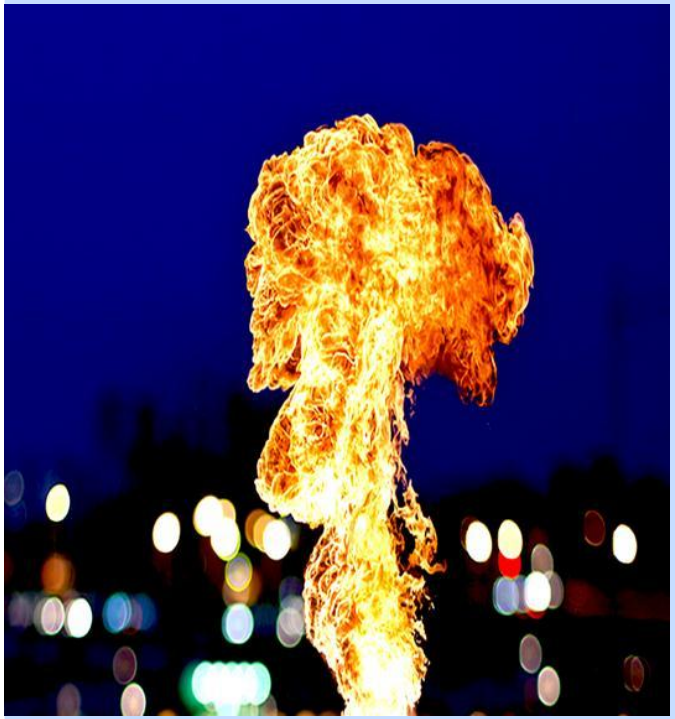
Middle East 2016

THE PRINCIPLES OF FIRE PERFORMANCE

→Key Principles



- →Reaction to fire
- →Fire resistance

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REACTION TO FIRE vs FIRE RESISTANCE

Source: Exova Warringtonfire

Reaction to Fire

- Usually materials
- Fire development
- Various measurement formats
- Ignitability
- Surface spread of flame
- Smoke development
- Toxicity
- Combustibility

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REACTION TO FIRE TESTING (1)

Source: Exova Warringtonfire

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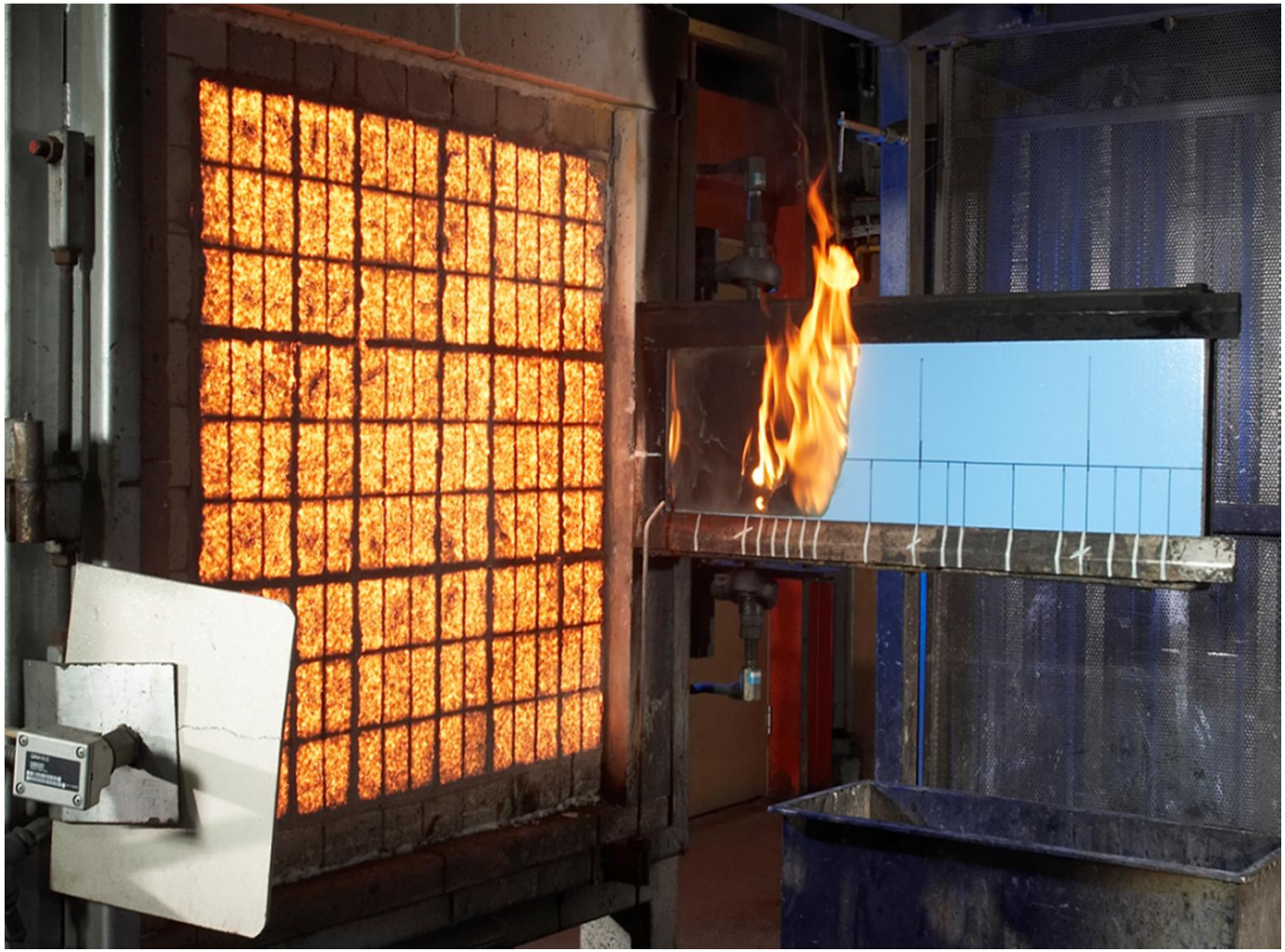
REACTION TO FIRE TESTING (2)



Source: Exova Warringtonfire

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REACTION TO FIRE TESTING (3)

Source: Exova Warringtonfire

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REACTION TO FIRE TESTING (4)

Source: Exova Warringtonfire

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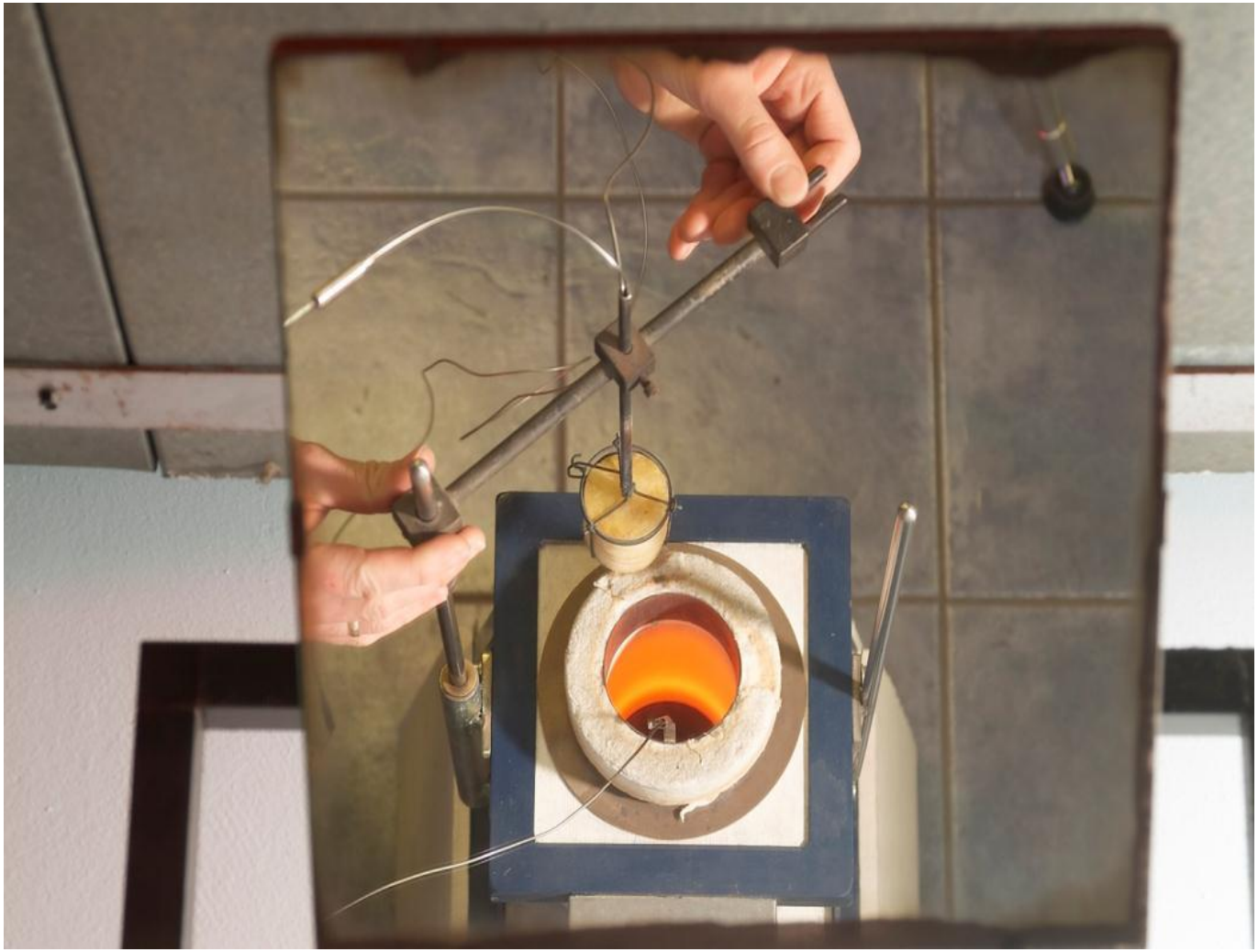
REACTION TO FIRE TESTING (5)



Source: Exova Warringtonfire

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THE REQUIREMENT FOR REACTION TO FIRE PERFORMANCE - FACADES

- Limit ignitability
- Limit flame spread (propagation)
- Limit smoke production
- Limit toxicity of smoke
- Limit falling, flaming debris

- Combustibility? (Should a façade be fully non-combustible?)
  - Non-combustible – ideally for large components (glass, panels, insulation)
  - Some limited-combustible components practically are required – sealants, gaskets, shims, setting blocks, etc
    - These present a very small surface area and hence create very limited contribution to spread of flame

REACTION TO FIRE vs FIRE RESISTANCE

Source: Exova Warringtonfire

Fire Resistance

- Usually systems
- Preventing a fully-developed fire from getting from one compartment into an adjacent one
- Compartmentation – internal fire spread
- Walls, doors, windows, floors, ceilings, penetration seals
- Measured in time (temperature, integrity, structural, heat radiation, insulation)
  eg, 30mins, 45mins, 1 hour performance etc

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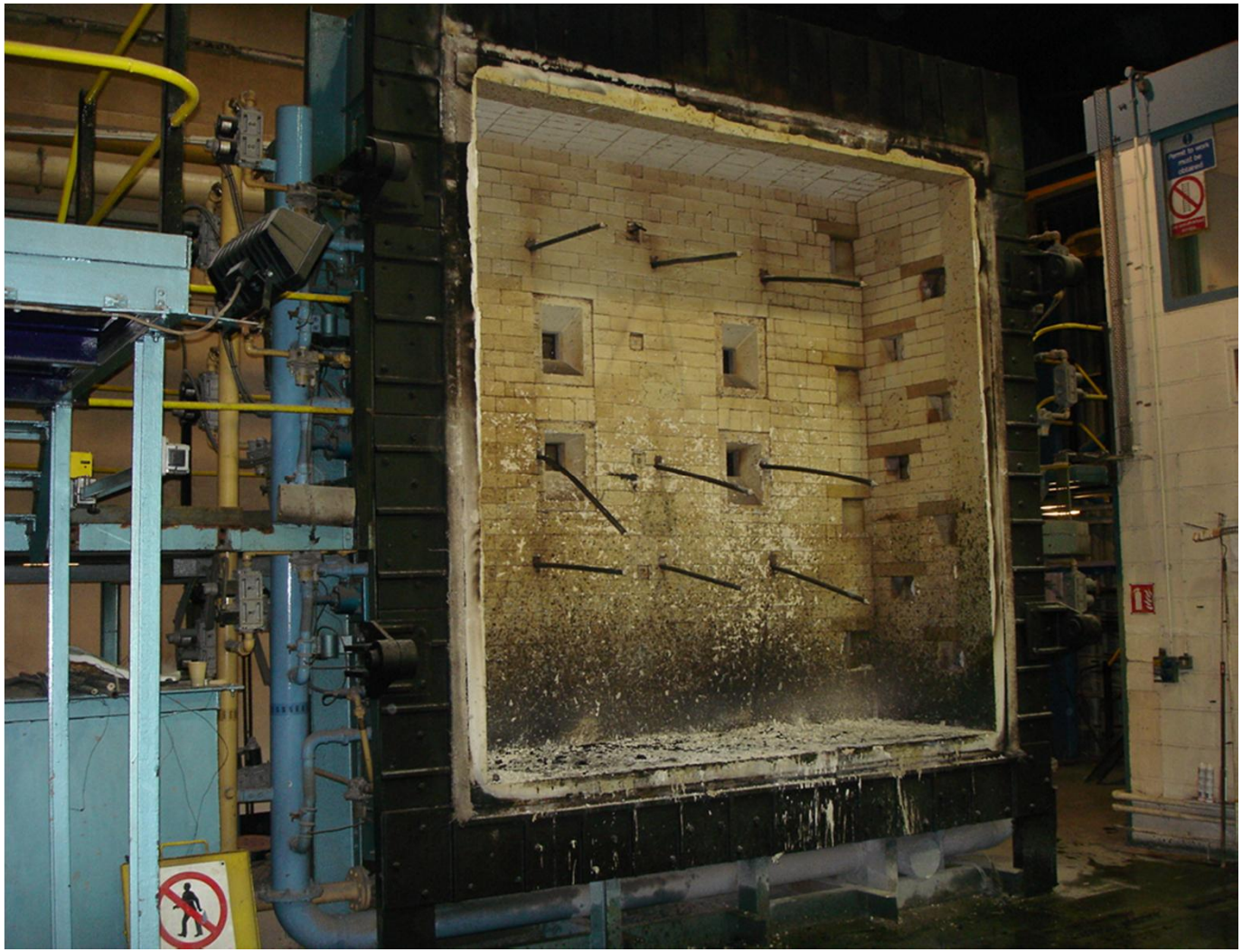
FIRE RESISTANCE TESTING (1)



Source: Exova Warringtonfire

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FIRE RESISTANCE TESTING (2)

Source: Exova Warringtonfire

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FIRE RESISTANCE TESTING (3)

Source: Exova Warringtonfire

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FIRE RESISTANCE TESTING (4)

Source: Exova Warringtonfire

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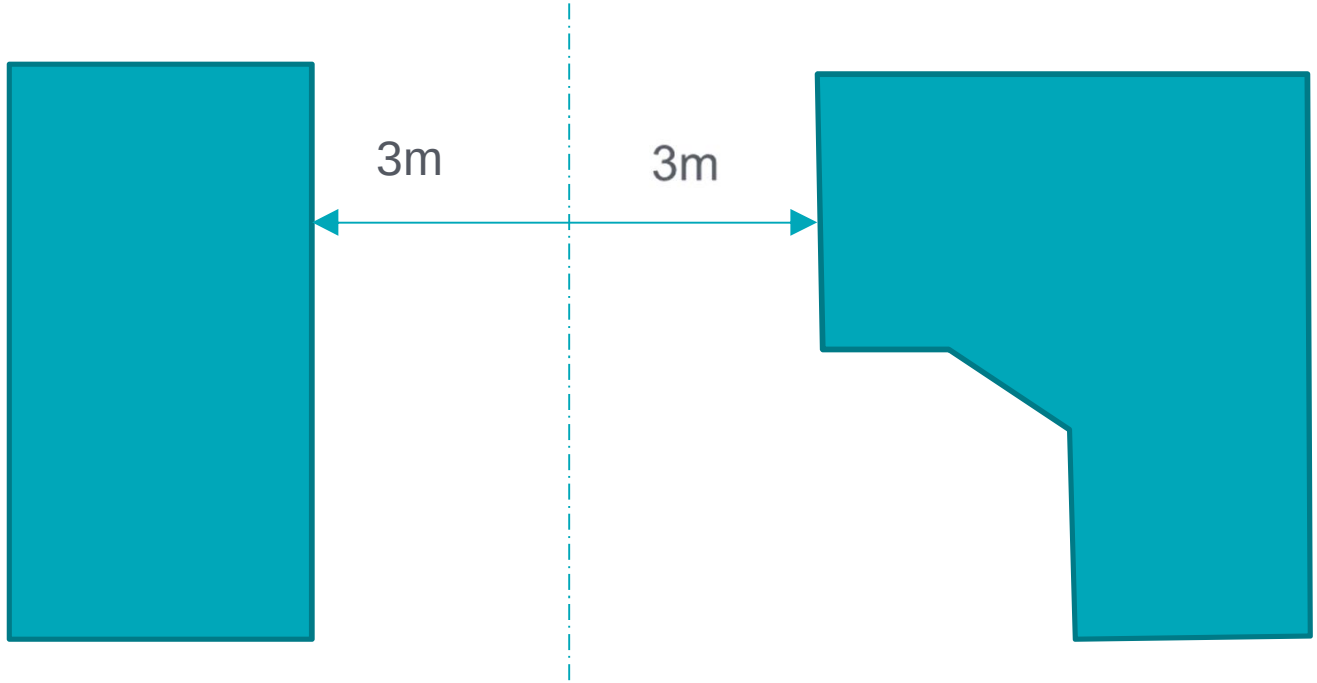
THE REQUIREMENT FOR FIRE RESISTANCE - FACADES

- Preventing flame spread out of, or into, a building
- Protecting an essential space (internal or external)



- Certain sections may need to be fire resistant, on a project-specific basis
- More frequently an internal requirement (internal partitions)

FIRE RESISTANCE
- CLASSIFICATIONS

- Accompanying the time value, the European classifications deal with various aspects of fire effect (on the non-fire side)
  - **integrity** – openings and flaming
  - **radiation** – radiated heat
  - **insulation** – surface temperature
- **E Integrity only**
- **EW Integrity with radiation limitation**
- **EI Integrity with insulation**

- **Consider these carefully**
  – they are extremely important

Source: Efectis

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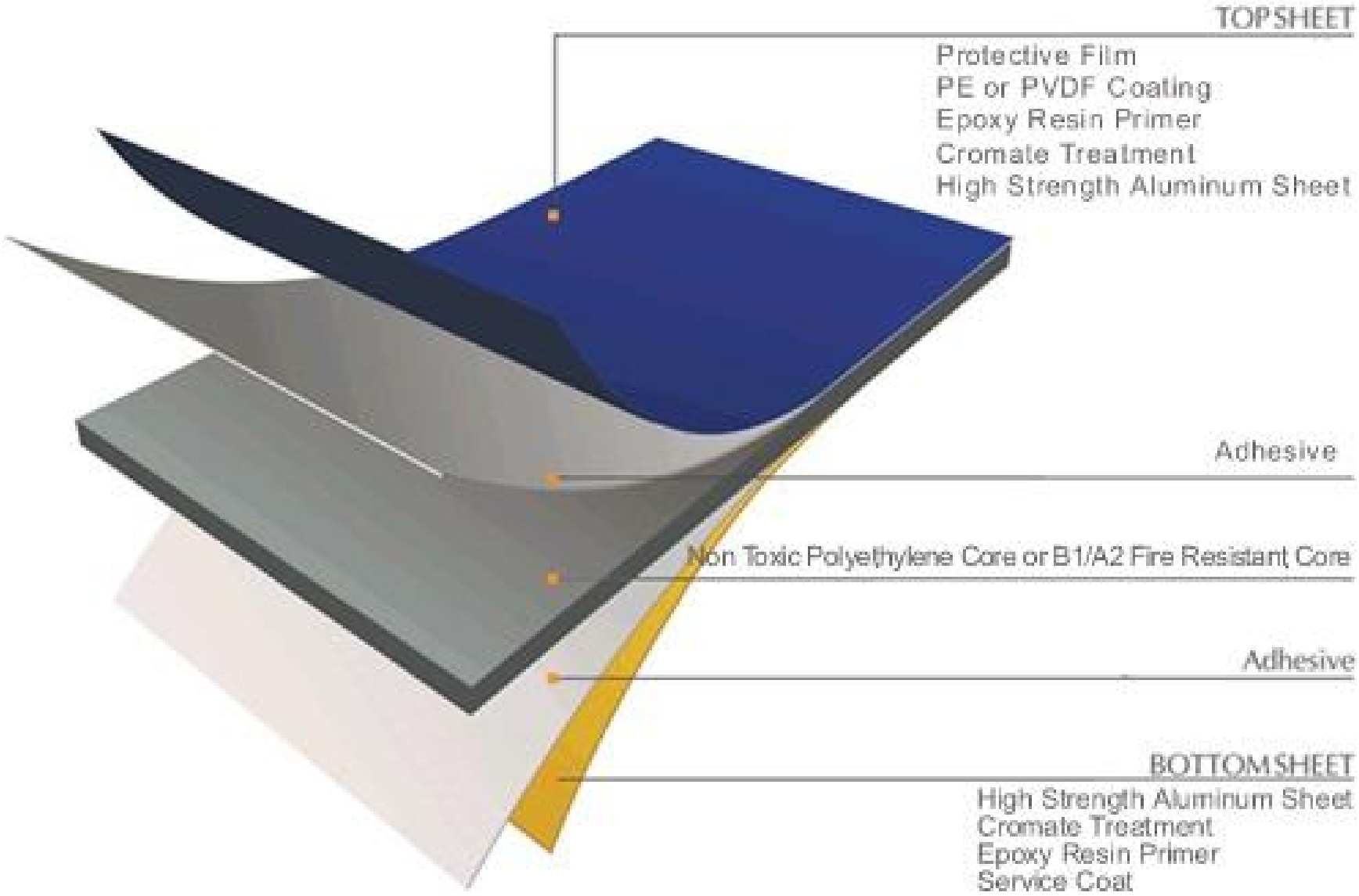
OTHER TERMINOLOGY EXPLAINED (1)

- **Fire rated…**
- - the material / system being considered has some quantified fire performance characteristic
- - note that this can be acceptable or not acceptable for the authorities or the project
- - it could be a ‘reaction to fire’ or ‘fire resistance’ characteristic

WHAT IS ACP?

- ACP = aluminium composite paneling
- It is a type of MCM (metal composite material)
- Internal and external skins of metal (in this case aluminium, although there are others). Typically 0.5mm thick each.
- A core of polymer or polymer plus some other materials (typically 3 to 5mm thick)
- Basic ACPs have a core of 100% low density PE
  - often formed from recycled plastic (green ✓)

WHAT IS ACP?


TOP SHEET
Protective Film
PE or PVDF Coating
Epoxy Resin Primer
Cromate Treatment
High Strength Aluminum Sheet
Adhesive
Non Toxic Polyethylene Core or B1/A2 Fire Resistant Core
Adhesive
BOTTOM SHEET
High Strength Aluminum Sheet
Cromate Treatment
Epoxy Resin Primer
Service Coat

ASPECTS OF ACP (1) – FIRE RESISTANCE

- This is a lining or facing material
- It is not principally an insulating material

ASPECTS OF ACP (1) – FIRE RESISTANCE

- This is a lining or facing material
- It is not principally an insulating material
- It does not have a substantial fire resistance performance

ASPECTS OF ACP (2) – HEAT POTENTIAL

- Polymer content and mineral type have a bearing on fire performance:
  - polymer content = heat potential
  - mineral type = fire retardancy

Product	Core Calorific Value (J)	Comparison with Best Performer	% Higher than Best Performer
Product 1	13,580	1.00	0%
Product 2	23,060	1.70	70%
Product 3	24,010	1.77	77%
Product 4	15,300	1.13	13%

- Current experience suggests a 30% polymer content is the threshold for passing an intermediate scale test.
  This is a subject for more study.

ASPECTS OF ACP (2) - TESTING

- Testing required:
- - small scale (ASTM E84, EN 13501-1, BS 476 Part 6/7)
  may not adequately test the system – will test surface only
- - large (intermediate) scale (NFPA 285, BS 8414)
  this is the salient test, and properly evaluates the system
- Must be supported by certification and ultimately Municipality / Civil Defence approved as a system

ASPECTS OF ACP (2) INTERMEDIATE SCALE TESTING – BS 8414

Source: Exova Warringtonfire

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ASPECTS OF ACP (3) – GEOMETRY AND SYSTEM EFFECTS

- Vertical continuity
  - is the system continuous up the building (linking floors)?
- Horizontal continuity
  - is the system continuous around the building (linking areas)?
- Internal corner
  - reflecting heat back into the source
- Cavity barriers
  - fire in an untreated cavity will extend the fire internally and heat the panels from both sides
- Exposed edges
  - these allow access to the core
- Sealants and gaskets
  - probably have a limited effect (low presented surface area)
- The detail at the window head
  - known to be the point of greatest intensity in a fire

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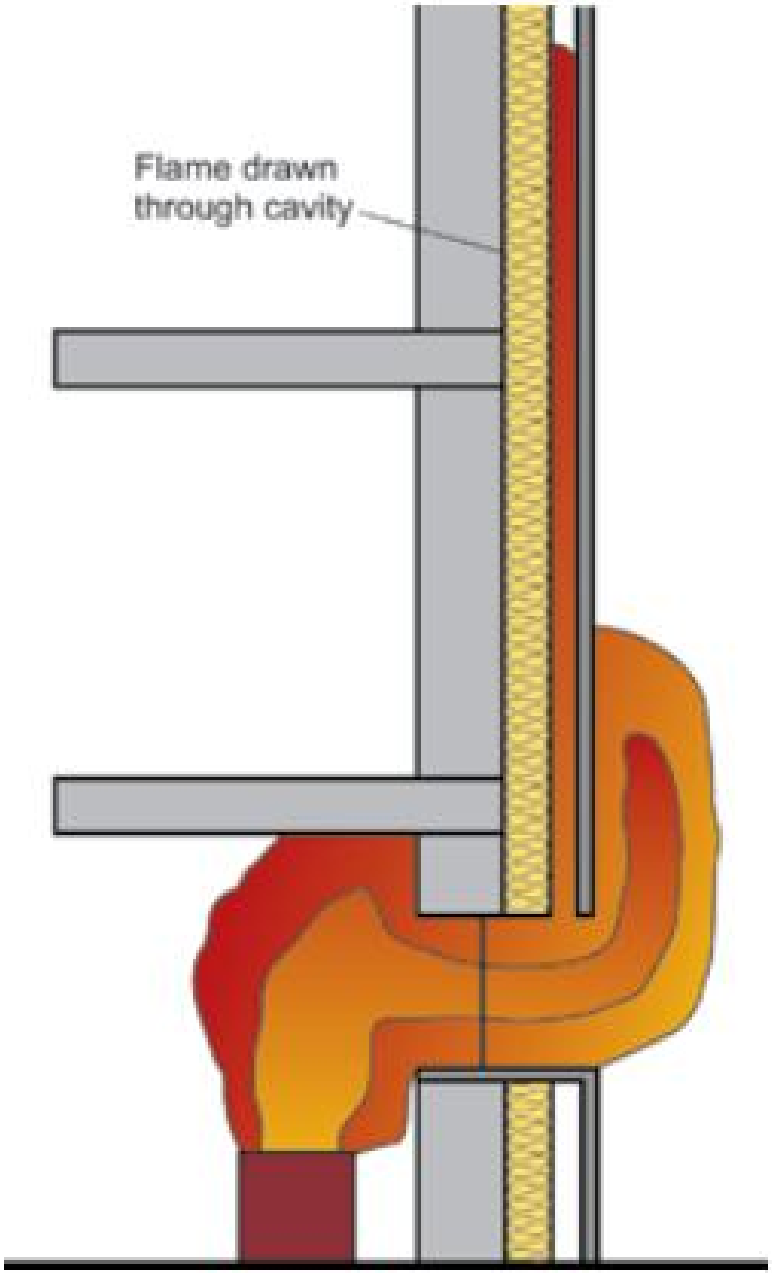
ASPECTS OF ACP (3) – CAVITY BARRIER EFFECTS



Source: BRE 135

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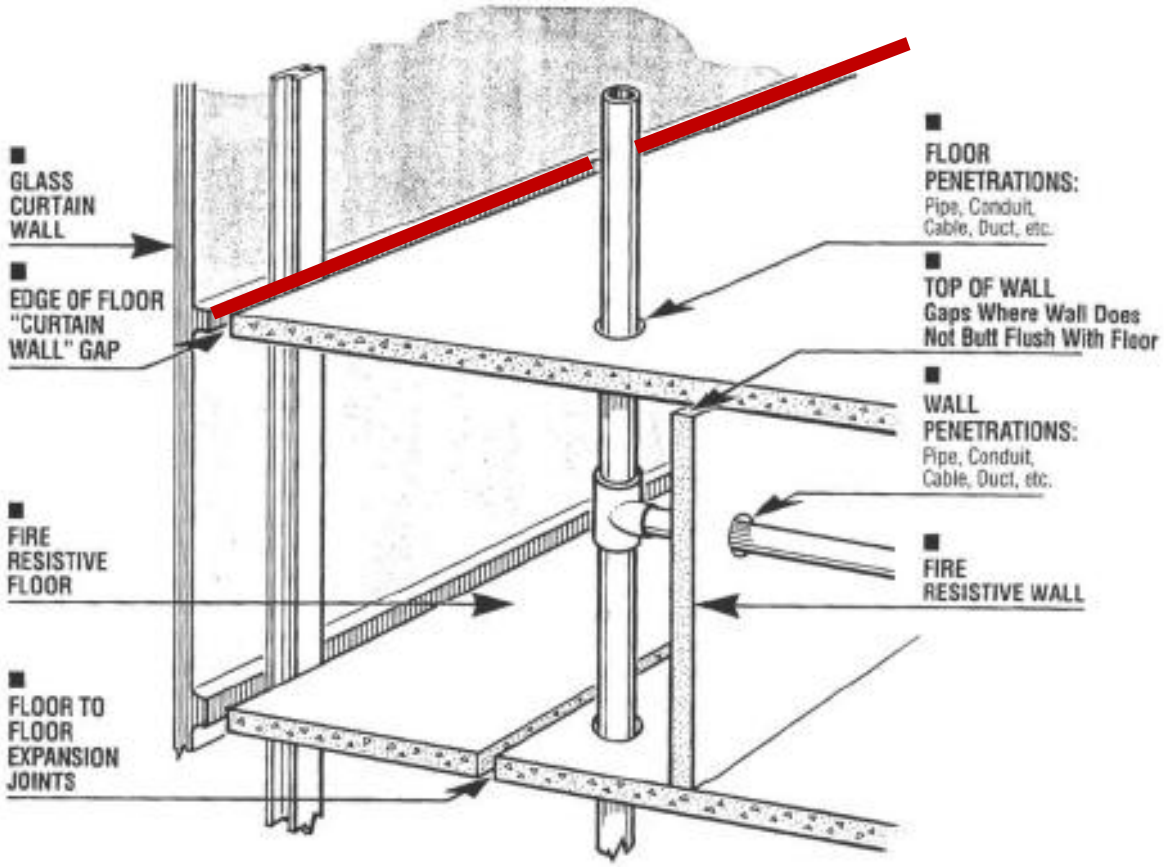
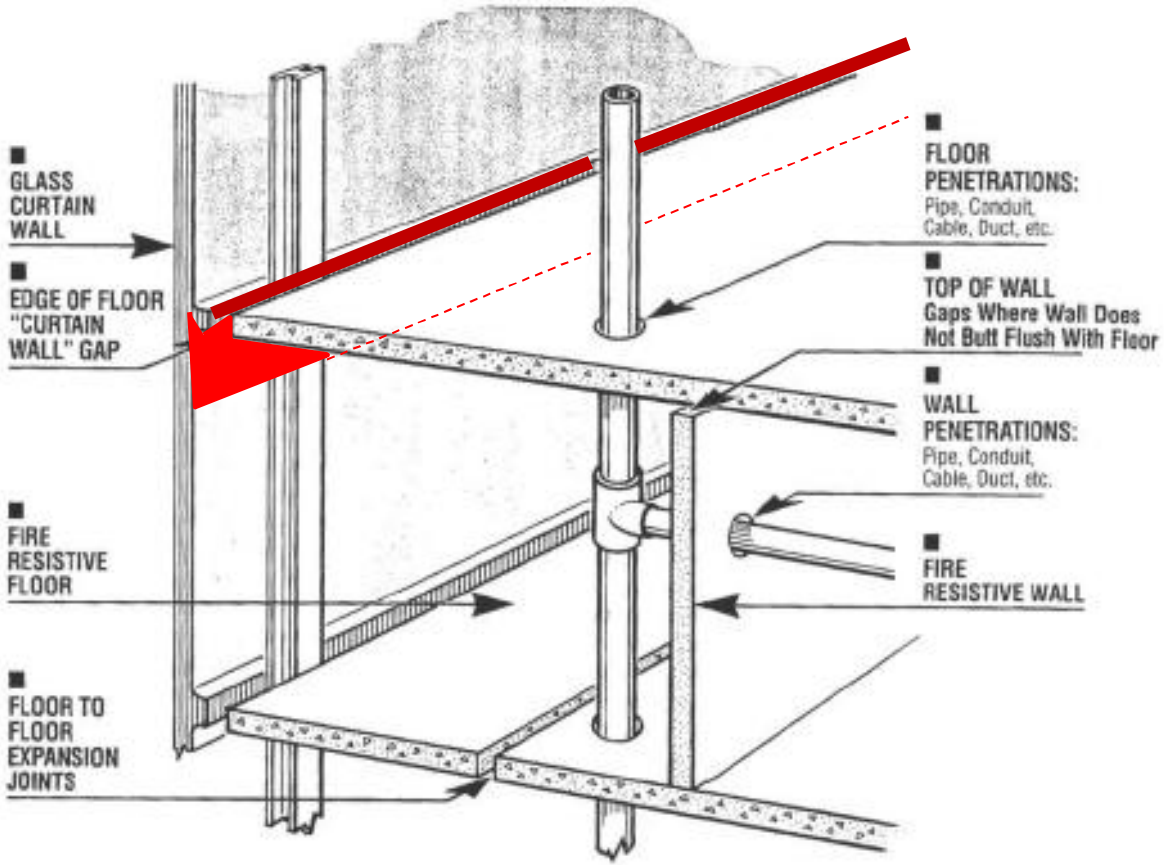
WHAT IS PERIMETER FIRESTOPPING?

- A horizontal barrier providing a fire resistance performance, limiting vertical flame spread
- A specialized linear joint seal between the slab edge and the façade



PERIMETER FIRESTOPPING – PERIMETER AREA PROTECTION

- It is practically likely that the backpan and brackets will have to be protected too, to pass the tests



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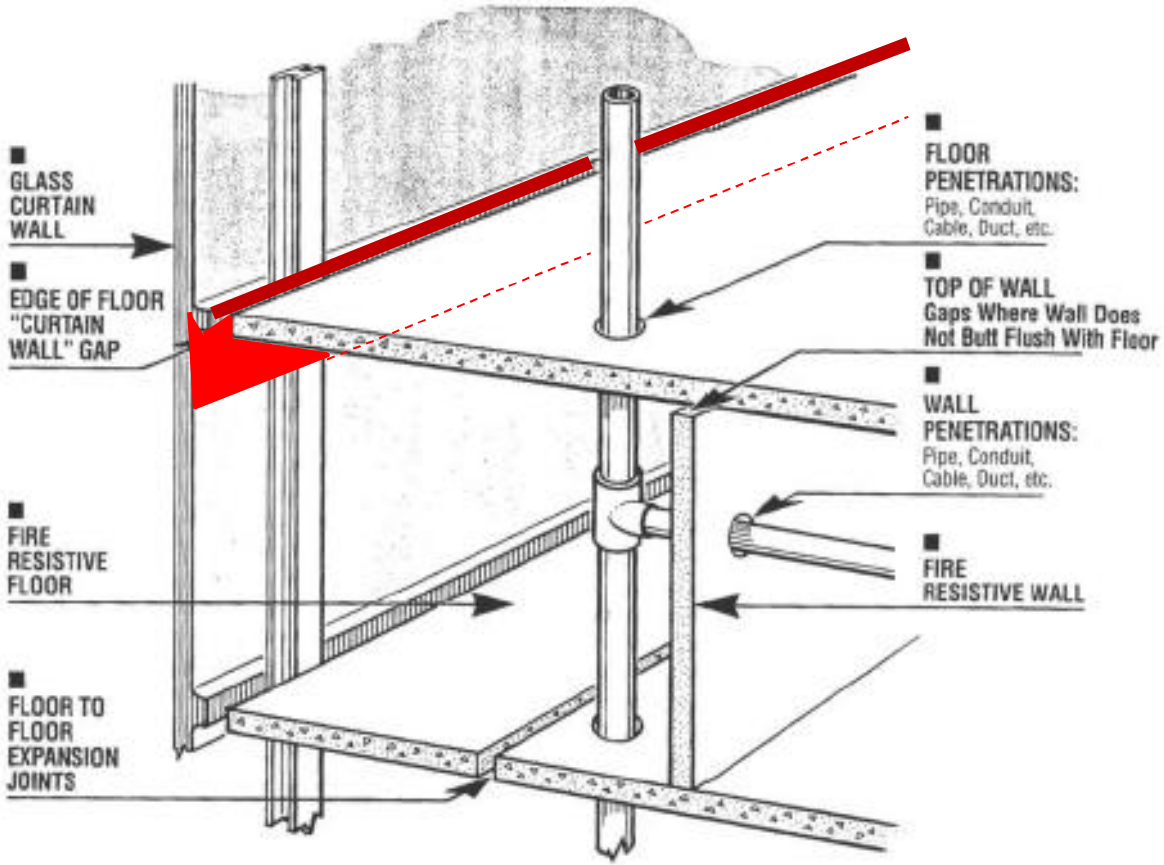
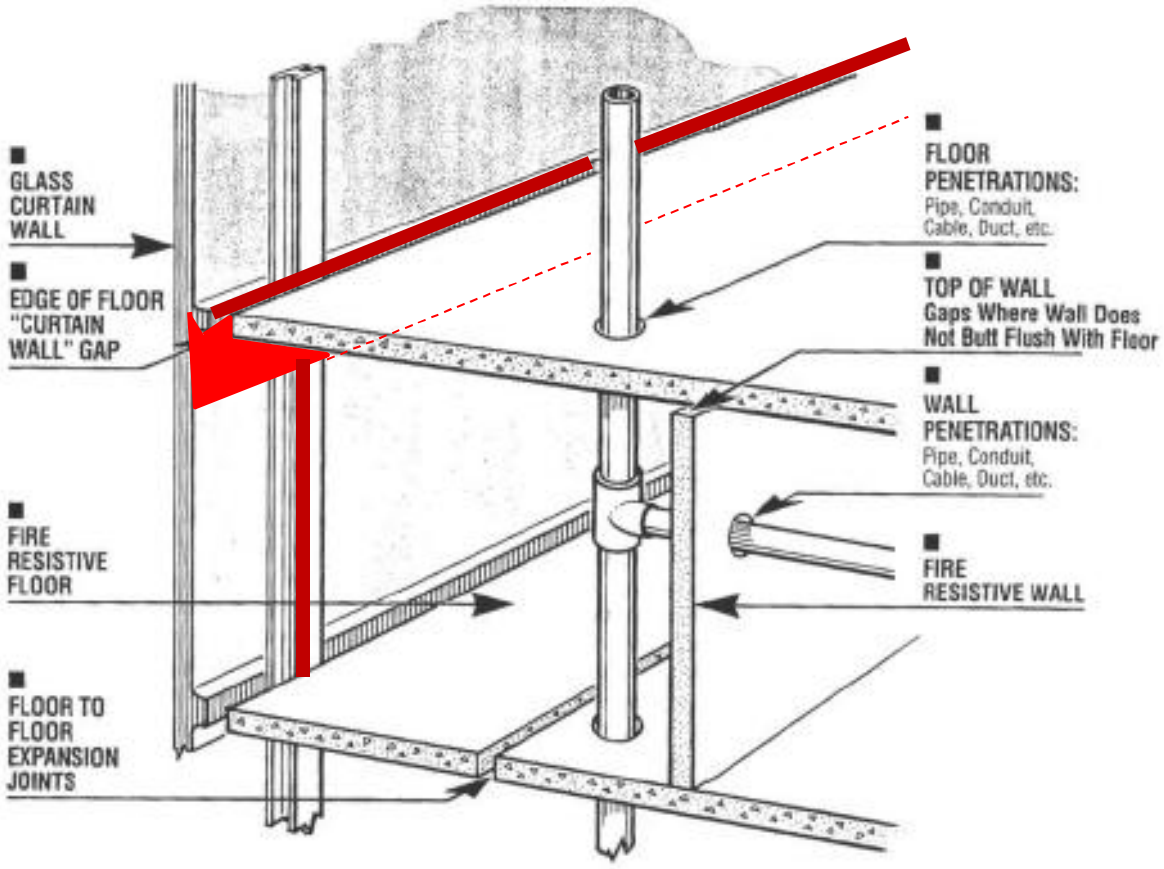
PERIMETER FIRESTOPPING – TEST METHODS

- EN 1364-4 (Part 3 if testing with a fire resistant façade)
- or ASTM E2307)



PERIMETER FIRESTOPPING – VERTICAL SEPARATION

- Don’t forget about horizontal separation (between adjacent spaces on the same floor)
  - review the fire safety strategy



FAÇADE FIRE RISK EVALUATIONS (1)

Source: Khaleej Times

Review and Audit Process

- Fire safety strategy review
  - identification of:
    - project-specific particular aspects
    - façade materials
    - façade geometry
    - façade component arrangement
    - perimeter firestopping
    - fire resistance facades

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FAÇADE FIRE RISK EVALUATIONS (2)

Review and Audit Process

- Document review
  - information may be incomplete
  - information gaps must be filled
- Site inspections
  - may have to be visible only
  - may be iterative
- Material testing
- Identification of strengths and weaknesses
- Recommendations

- Common audit process?

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FAÇADE FIRE RISK EVALUATIONS (3)

Mitigating Opportunities - Existing

- Provided within the ‘Recommendations’
- There may be limited opportunity for dismantling and replacing parts of the façade.
- Fortification of the fire safety strategy
  - making sure the installed systems work
    - suppression systems
    - fire alarms (no false alarms)
    - familiarity (drills) clarity (signage)
    - knowledge of the risks
    - access to and from the building
    - properly maintained passive systems (firestops, coatings, lighting, etc)

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FAÇADE FIRE RISK EVALUATIONS (4)

Mitigating Opportunities

- Introduced and proven additional construction
  - new passive or active systems
  - additional compartmentation
  - material replacement (total or partial)

- Introduced and unproven
  - external coatings?
  - external sprinklers / deluge systems?
  - partial replacement?
  - new ideas?

- These all need proving before we use them
  - needs research – needs funding

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FAÇADE FIRE REVIEW GUIDANCE

→ **RECAP**

- → ‘Fire Resistance’ vs ‘Reaction to Fire’
- → FR and R2F requirements
- → Clarification of ‘Fire Rated’
- → ACPs – explained and limitations clarified
- → Perimeter firestopping highlighted
- → Fire safety audits - considerations

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Thank you

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