

Combustible Facades

A city scale problem and a strategic solution

IFE Fire Safety Conference, Wednesday 19th October 2016

Speaker: John Noone

Speaker overview

John Noone

Associate Director, Arup

John is the leader of Arup's Fire Engineering Practice in the Gulf. A Chartered Fire Safety Engineer he holds a BSc Hons in Fire Safety Engineering.

John has gained a wide range of experience in fire engineering in Middle East, Africa, UK, Ireland, Russia and across Continental Europe.

He applies his expertise primarily in fire safety design, on-site implementation and handover of Aviation, Assembly and transportation projects across the built environment. John is a visiting lecturer at Trinity College Dublin on the fundamentals of fire safety science and fire dynamics.

John's passion is for advancing the field of fire engineering in its application into the design and operation of the built environment.

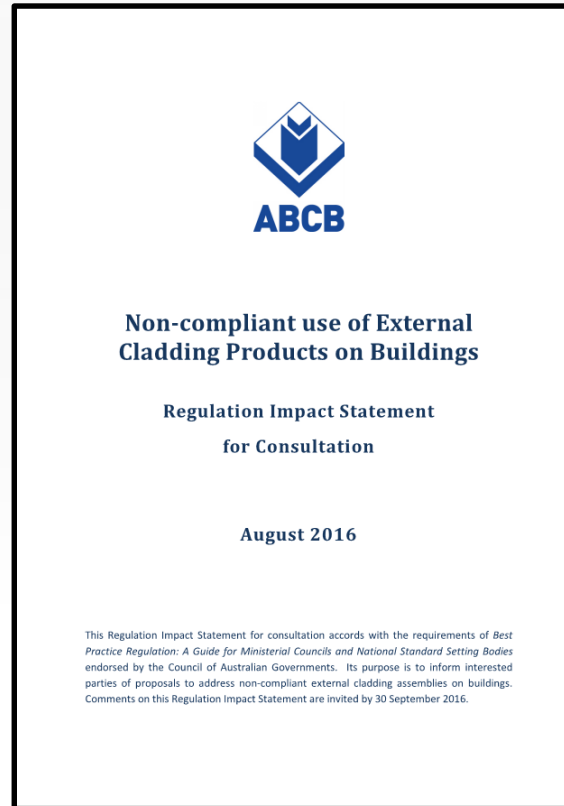
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Topic overview

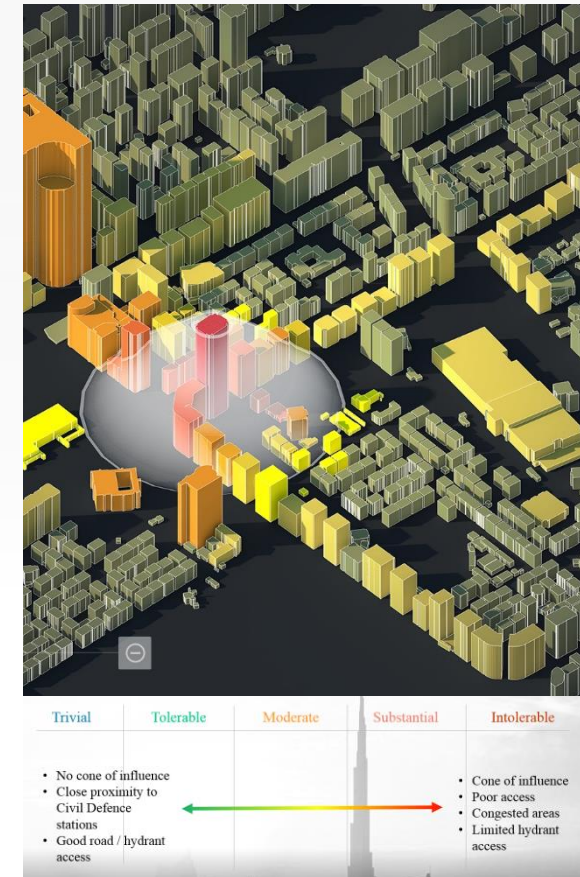
1. The Problem



2. Regulatory Environment



3. Risk Methodology



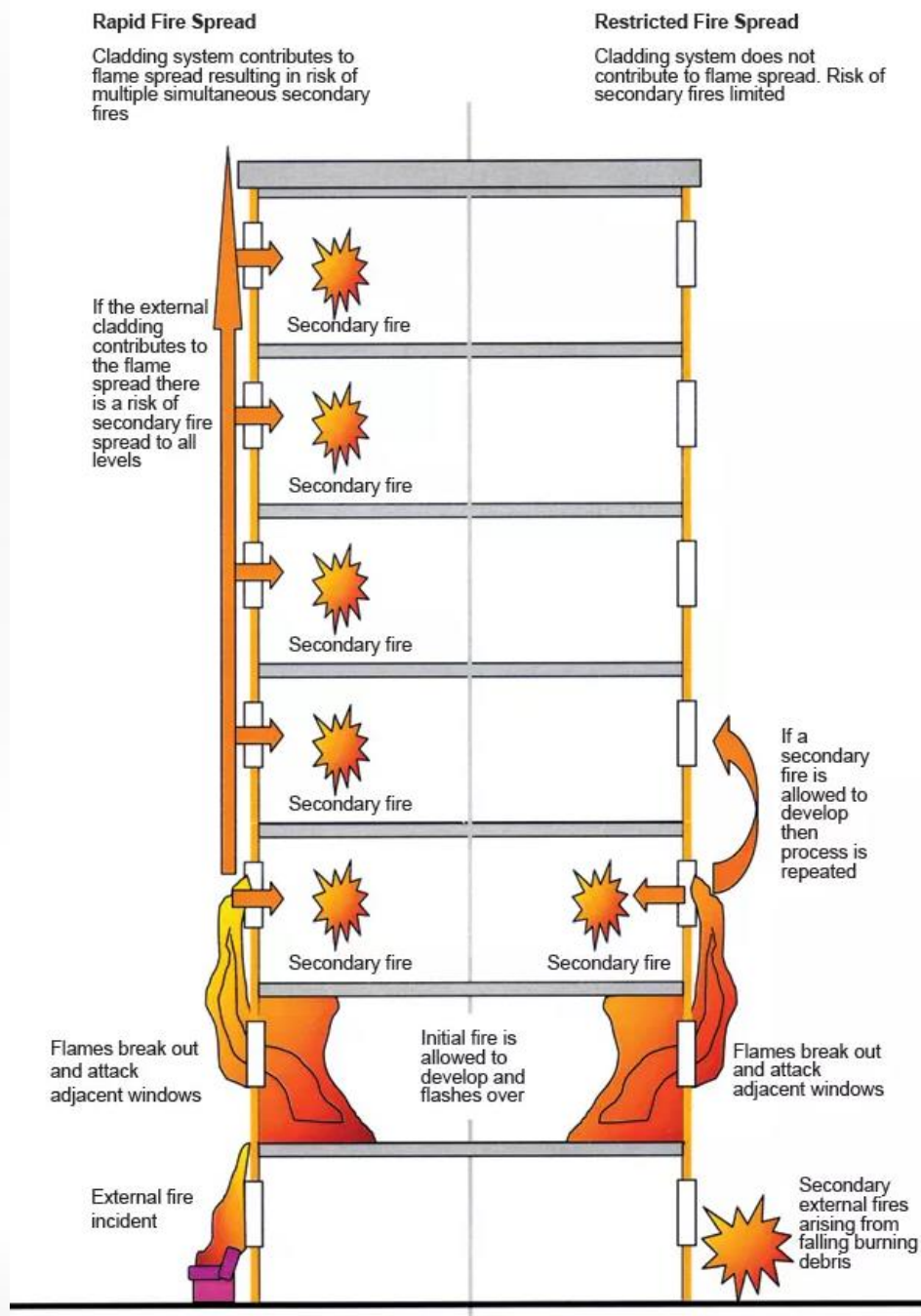
Which primary factors contribute to exterior envelope building **risk**?

How to **rank** individual buildings?



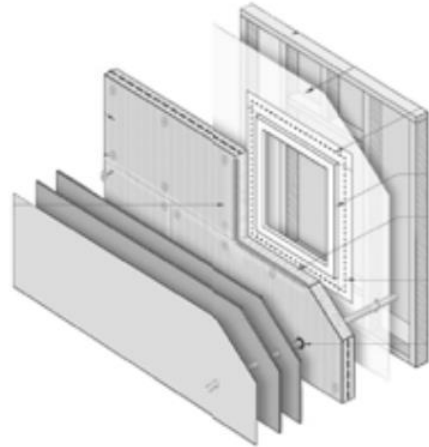
Key stages associated with exterior fire spread:

- Initiation of fire
- Fire breakout
- Interaction with external envelope
- Fire re-entry
- Fire service intervention.

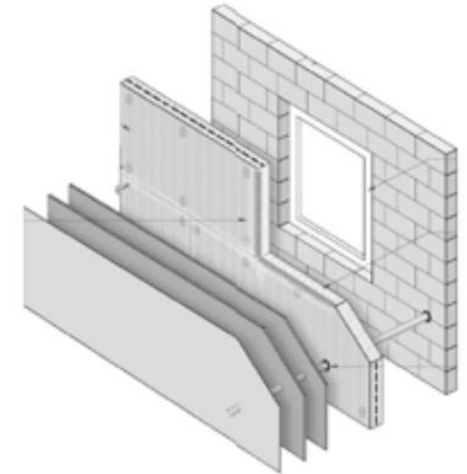


Typical Façade Types

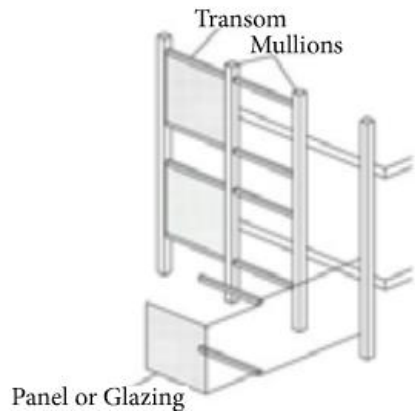
Frame Systems



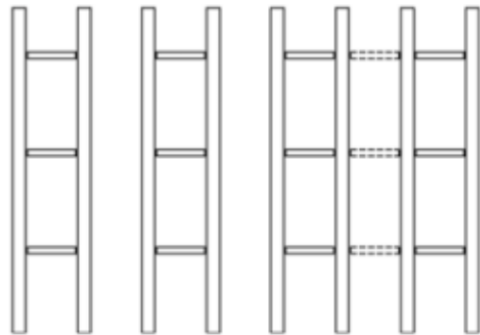
Applied External Wall System



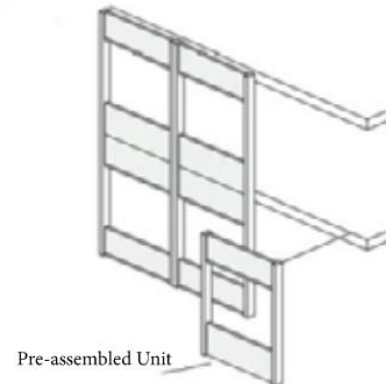
Stick System



Ladder System



Unitized System



Key Potential Combustible Components

Insulation



Cladding Panels

Weather-resistive
barrier





EPS



PIR

Knowing the
materials..

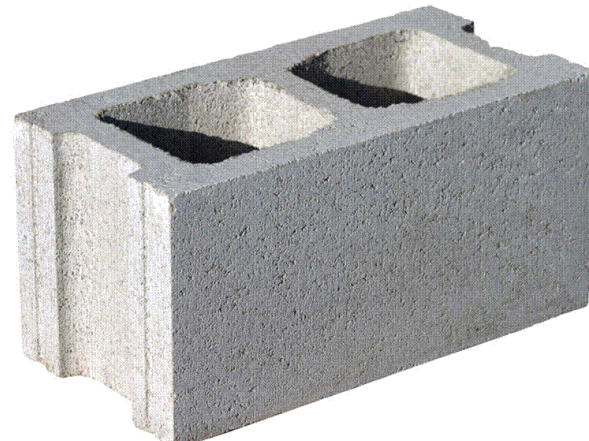
Combustible/Non-
combustible



PUR/PUR Foam

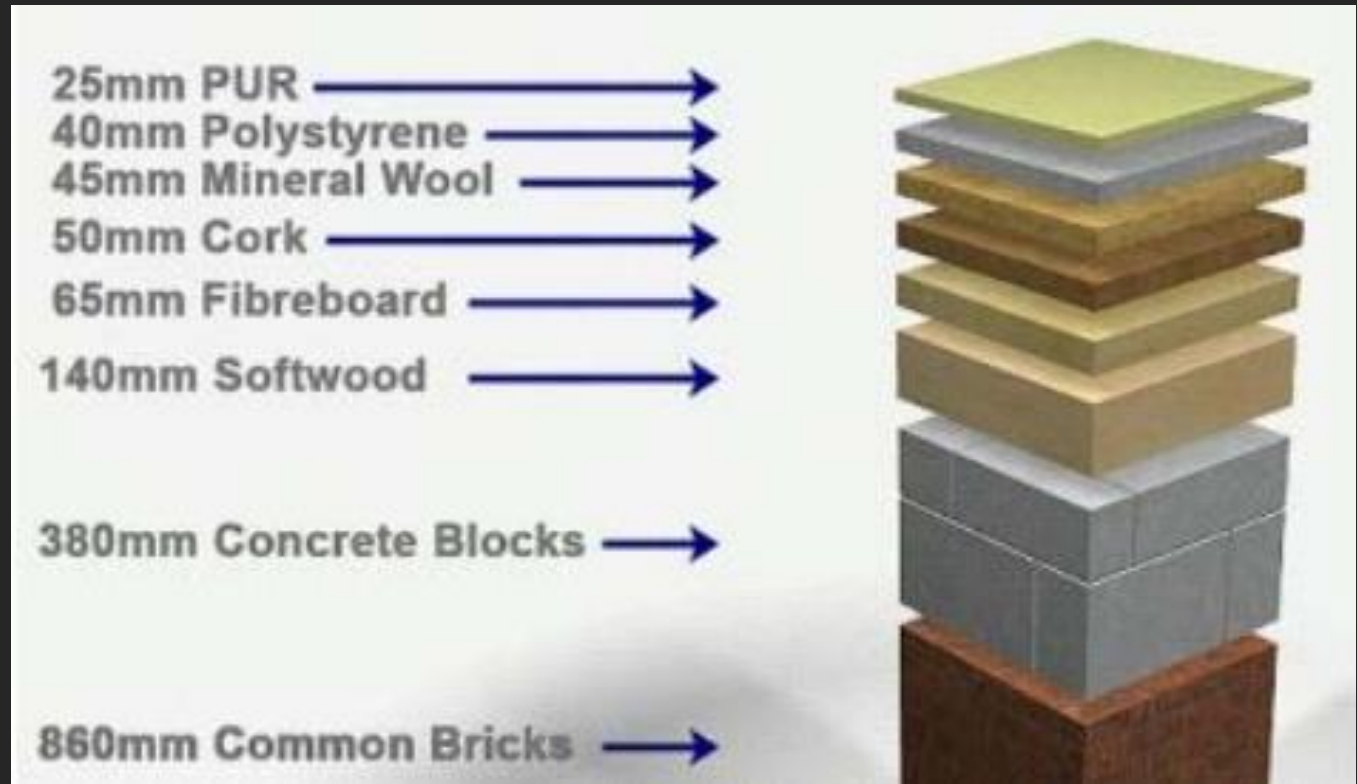


Steel



Concrete

Space



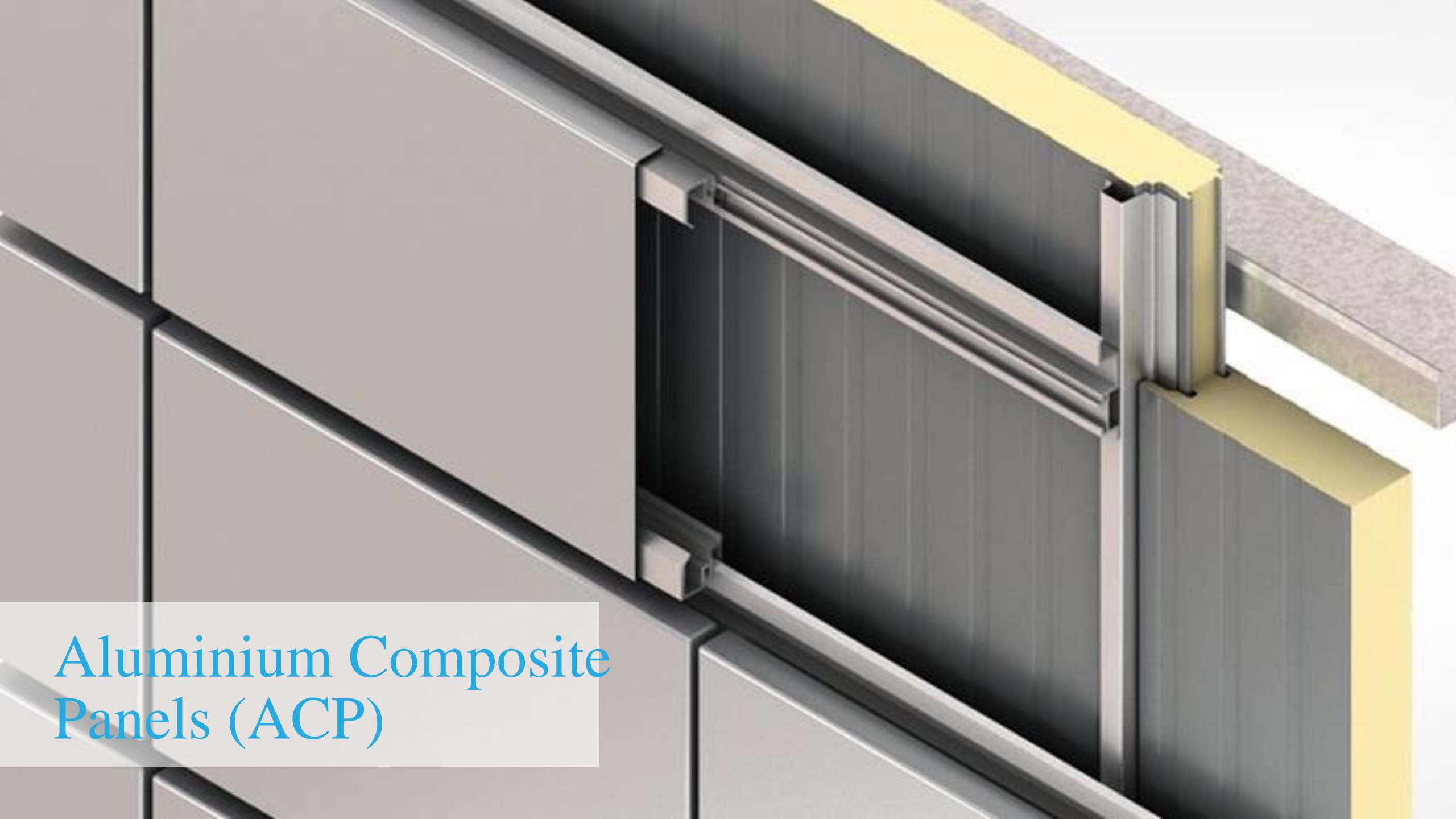


Polystyrene

Phenolic / PIR

Mineral Wool

ARUP

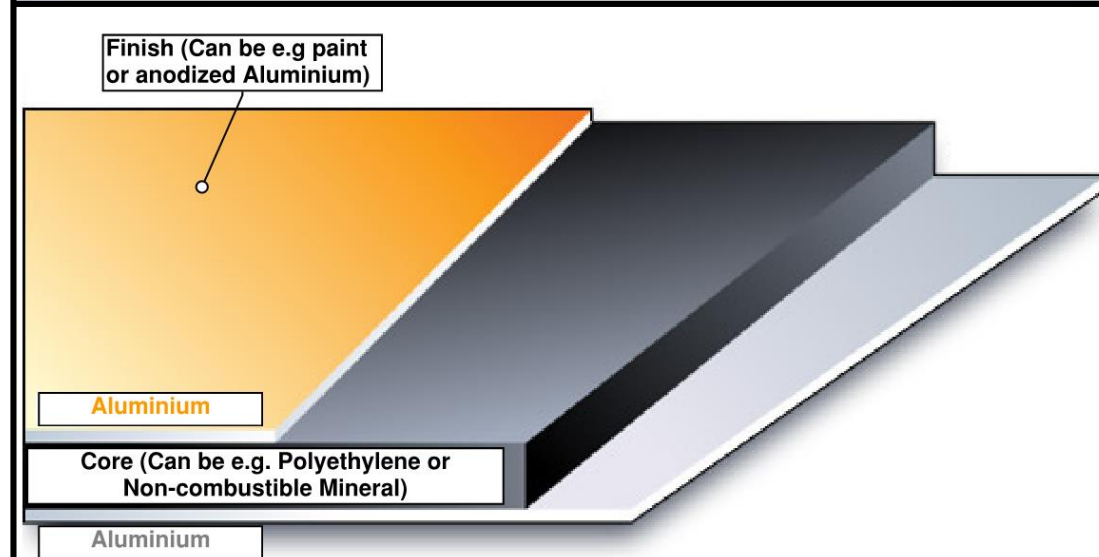
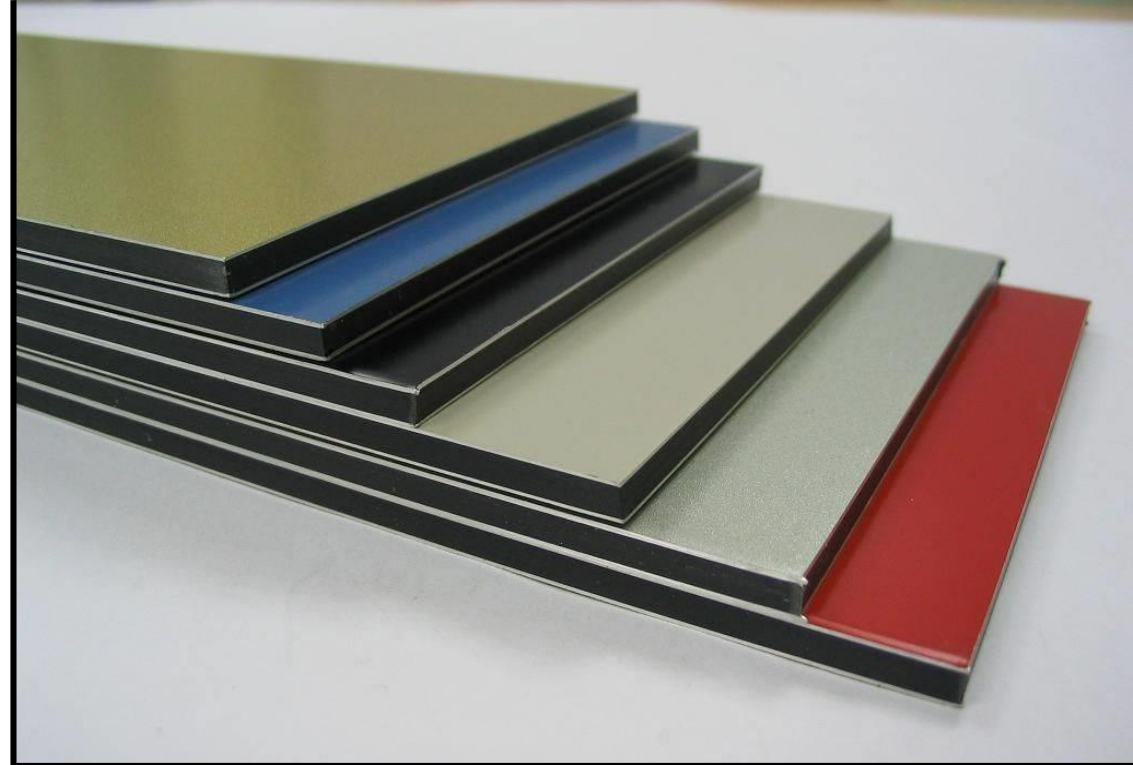
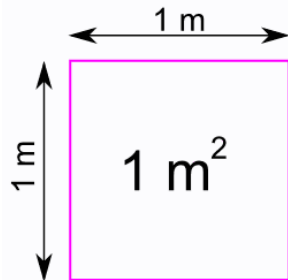


Aluminium Composite Panels (ACP)

ACP Composition

- Several components: facings, core, finish, adhesive
- Core determines fire performance:
 - Polyethylene (100%)
 - Polyethylene with inorganic filler (30/70)
 - Mineral (Non-combustible)
- Facings may degrade in fire
 - Aluminium Tm = 475-630°C
 - Zinc Tm = 375-430°C
 - Stainless steel = 1400-1450°C

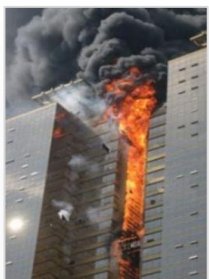
100% PE core = 1 gallon of petrol per m²



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Atlantic City
2007



Busan
2010



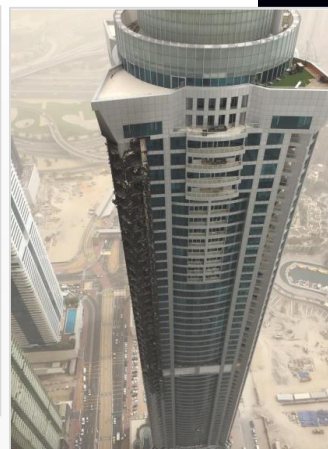
Roubaix
2012



Dubai
2012



Melbourne
2014



Marina Torch
2015



Ajman One
2016



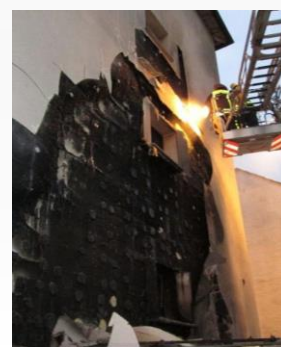
Dubai
2016

- Currently a major ACP façade fire every 4 months
- ~ 1000 buildings Dubai, 300 Sharjah, + Abu Dhabi & Northern Emirates
- ACP popular 1990 to date.
- Life span of ACP is **15-30 years** or **+2045**

Scale = Global



Neder-over-Heembeek
2016



Frankfurt
2016



Lille
2016



Epina-sur-seine
2016



Address, 2015

Fire Time Lapse



© Kirill Melezhnikov
nk87@gmail.ru

HOME » NEWS » WORLD NEWS » MIDDLE EAST » DUBAI

Dubai hotel fire: Inferno at 63-storey Address Downtown hotel near New Year's Eve fireworks display

Hundreds of Dubai's tallest buildings are infernos waiting to happen, a leading fire safety expert says, as new video of the burnt interior of the Address Hotel is released

TUESDAY, APRIL 19, 2016 | RAJAB 11, 1437



The aftermath of the Address Downtown Hotel in which half of the edifice was gutted by a fire on New Year's Eve. Jeffrey E Biteng / The National

Most Dubai towers built before 2012 'have non fire-rated exterior panels'

April 19, 2016 | Last updated 2 minutes ago

UAE firm sets up plant to produce aluminium composite panels

Published: 00:00 June 24, 2004
 Staff Report

GULF NEWS

Firefighters battle huge blaze at Ajman tower near Dubai

Building evacuated but no casualties confirmed as firefighters tackle blaze, the latest skyscraper fire in the United Arab Emirates and wider region



Two Emirati officials watch as a fire spreads up the side of the building in Ajman, United Arab Emirates. Photograph: Kamran Jebreili/AP

NEW GENERATION
 ALUMINIUM COMPOSITE PANELS

Cityscapes – Boom Time Construction

London



Hong Kong



Dubai



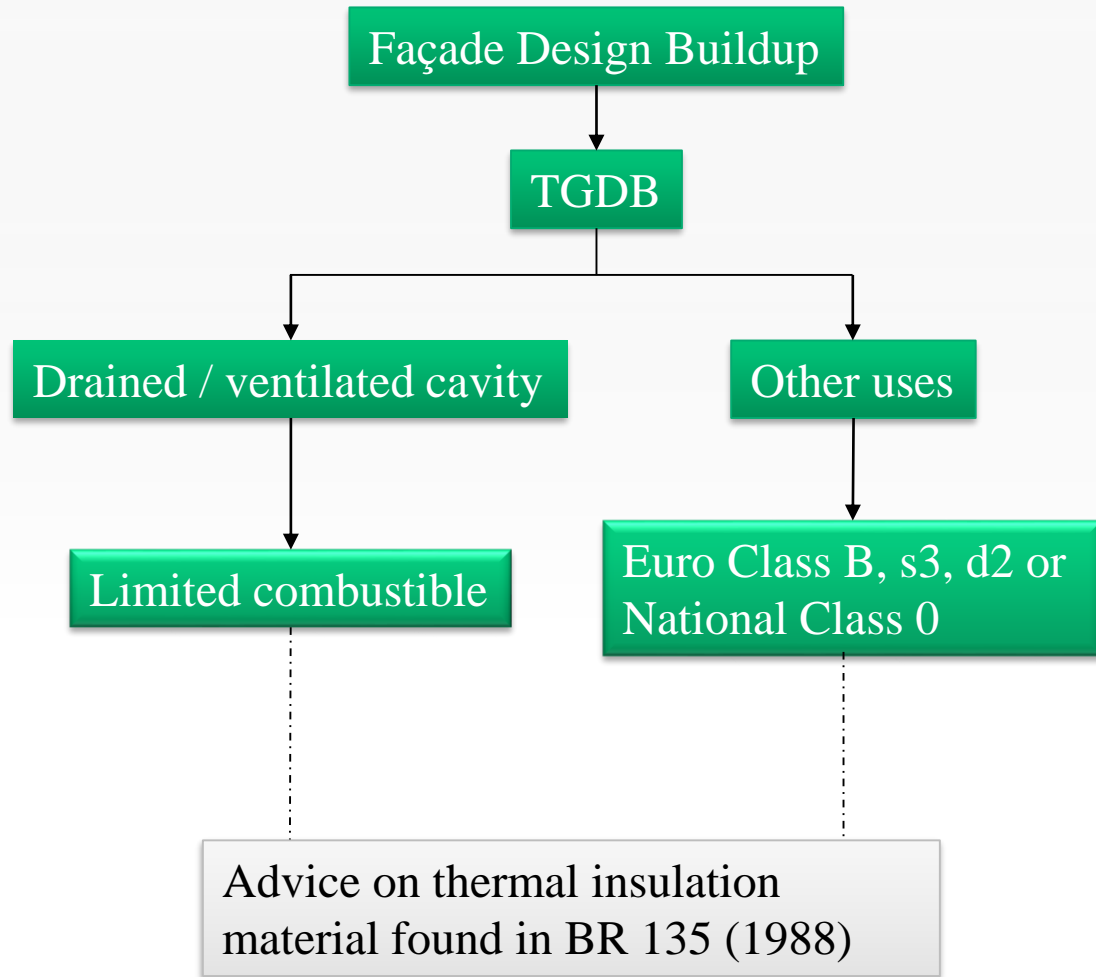
2. Regulatory Environment

International Benchmarking

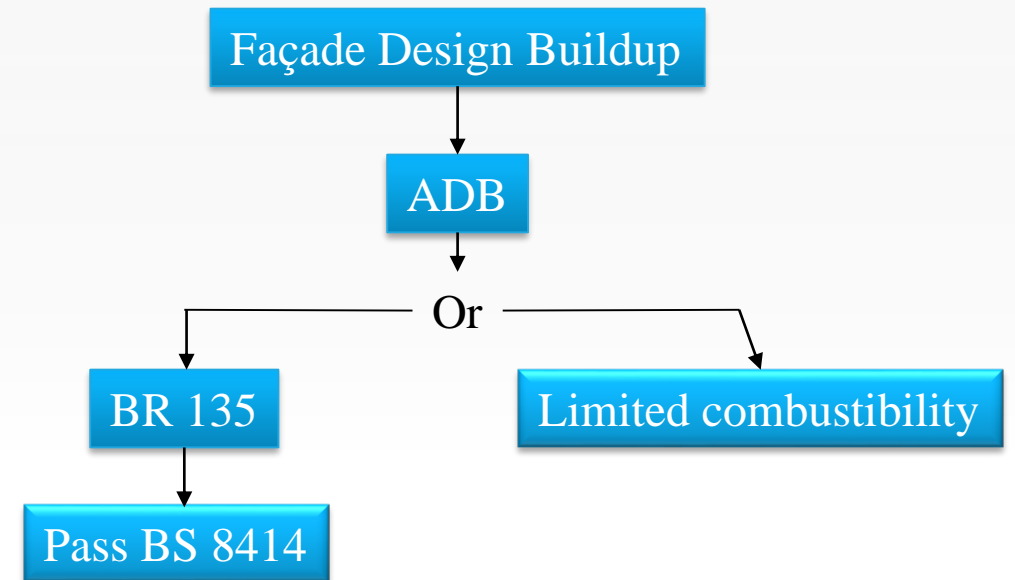
Region / Country	Reaction to fire requirement for facade	Large scale façade test alternative	Notes
Australia	Non-combustible in line with AS 1530.1:1994 -	None at present	It's understood that a large scale test alternative is proposed to be introduced, BS 8414 is viewed as the basis at present. Details of this are TBC
Middle East	ASTM E84 – Class A	BS 8414 (BR 135) / NFPA 285	Large scale test is required in addition to the reaction to fire tests. Applies to all buildings above 15 m, exceptions apply for lower buildings
UK	A2-s3,d2 to BS EN 13501-1 (limited combustible) for insulation B-s3,d2 to EN 13501-1 (combustible) for surface materials	BS 8414 (BR 135)	Applies to buildings over 18 m
Ireland	B-s3,d2 to EN 13501-1 (combustible) National class 0	BS 8414 (BR 135)	Applies to buildings over 18 m. Multiple large scale façade tests are in use in Europe (e.g. BS 8414, DIN 4201-20, ISO 13785-2 and SP 105). Their use is not mandatory

Insulation Criteria

Ireland

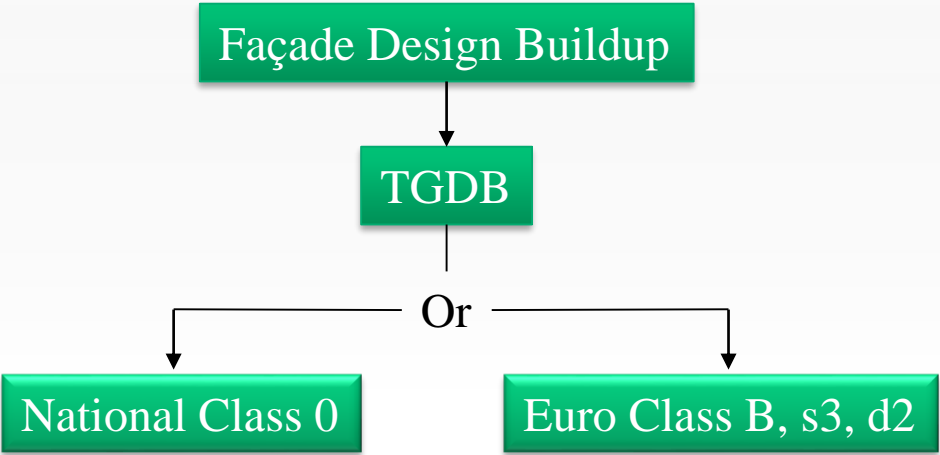


England & Wales

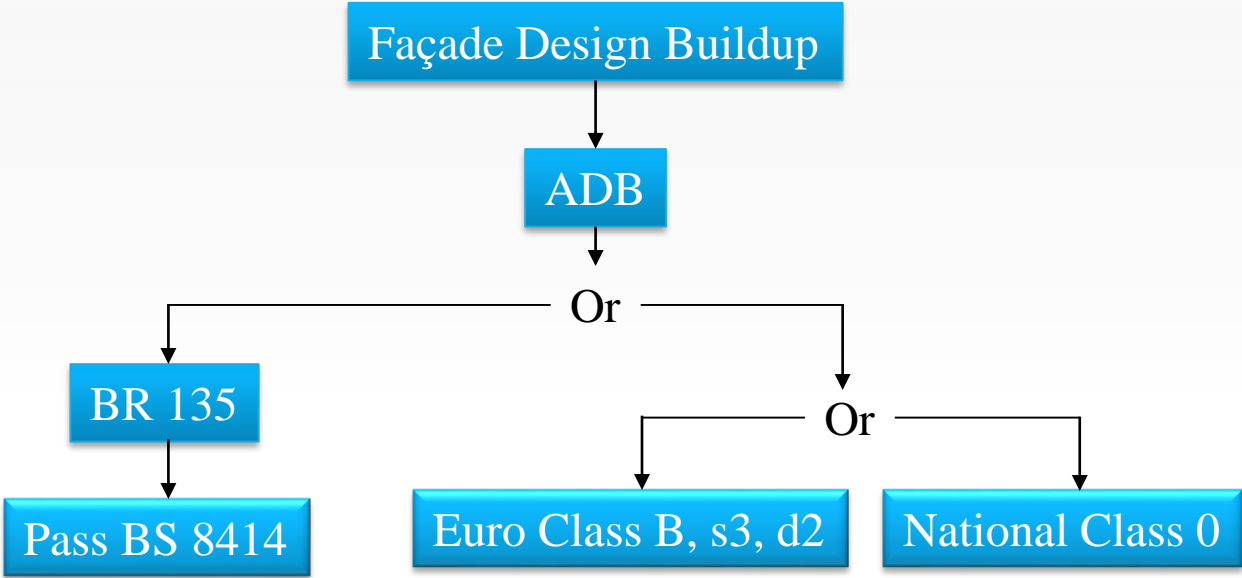


ACP Criteria

Ireland



England & Wales



UK Building Control Alliance Guidance

BCA Technical Guidance Note 18

Issue 1 Jun 2015

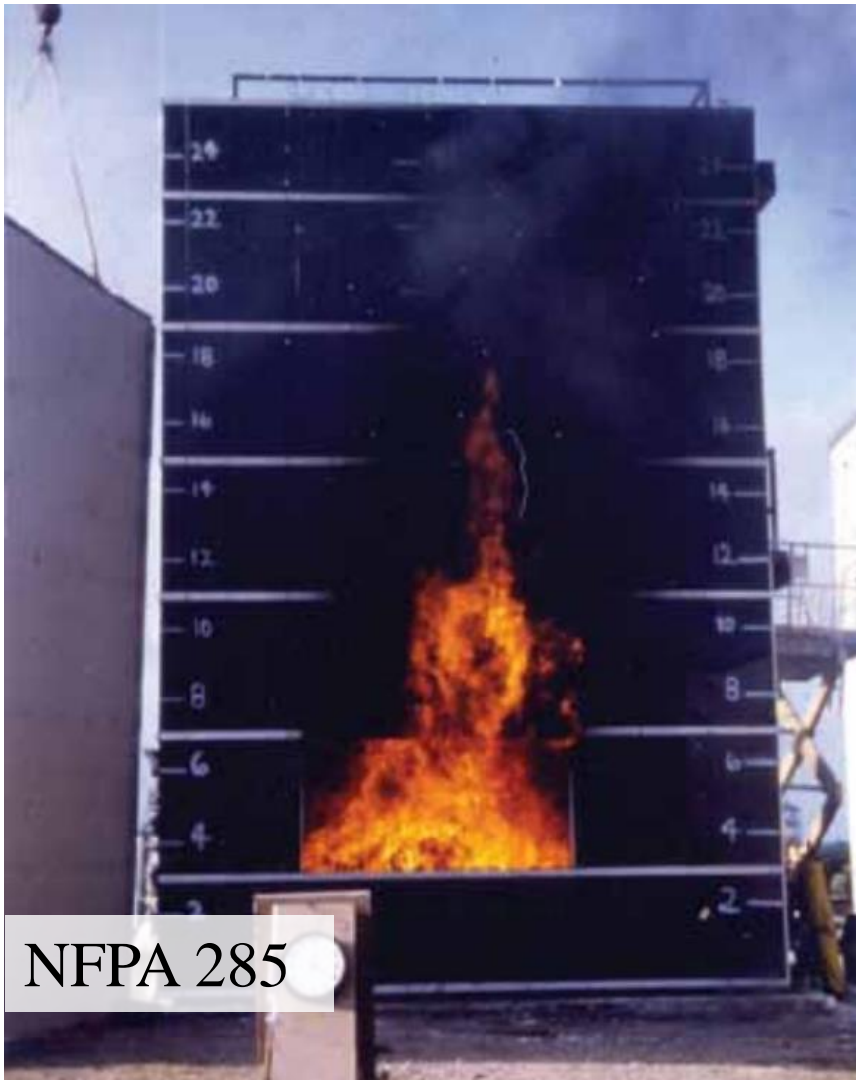
Use of Combustible Cladding Materials on Buildings Exceeding 18m in Height



Purpose

BCA technical guidance notes are for the benefit of its members and the construction industry, to provide information, promote good practice and encourage consistency of interpretation for the benefit of our clients. They are advisory in nature, and in all cases the responsibility for determining compliance with the Building Regulations remains with the building control body concerned.

This guidance note is based upon information available at the time of issue and may be subject to change. The Approved Documents should be consulted for full details in any particular case.



NFPA 285

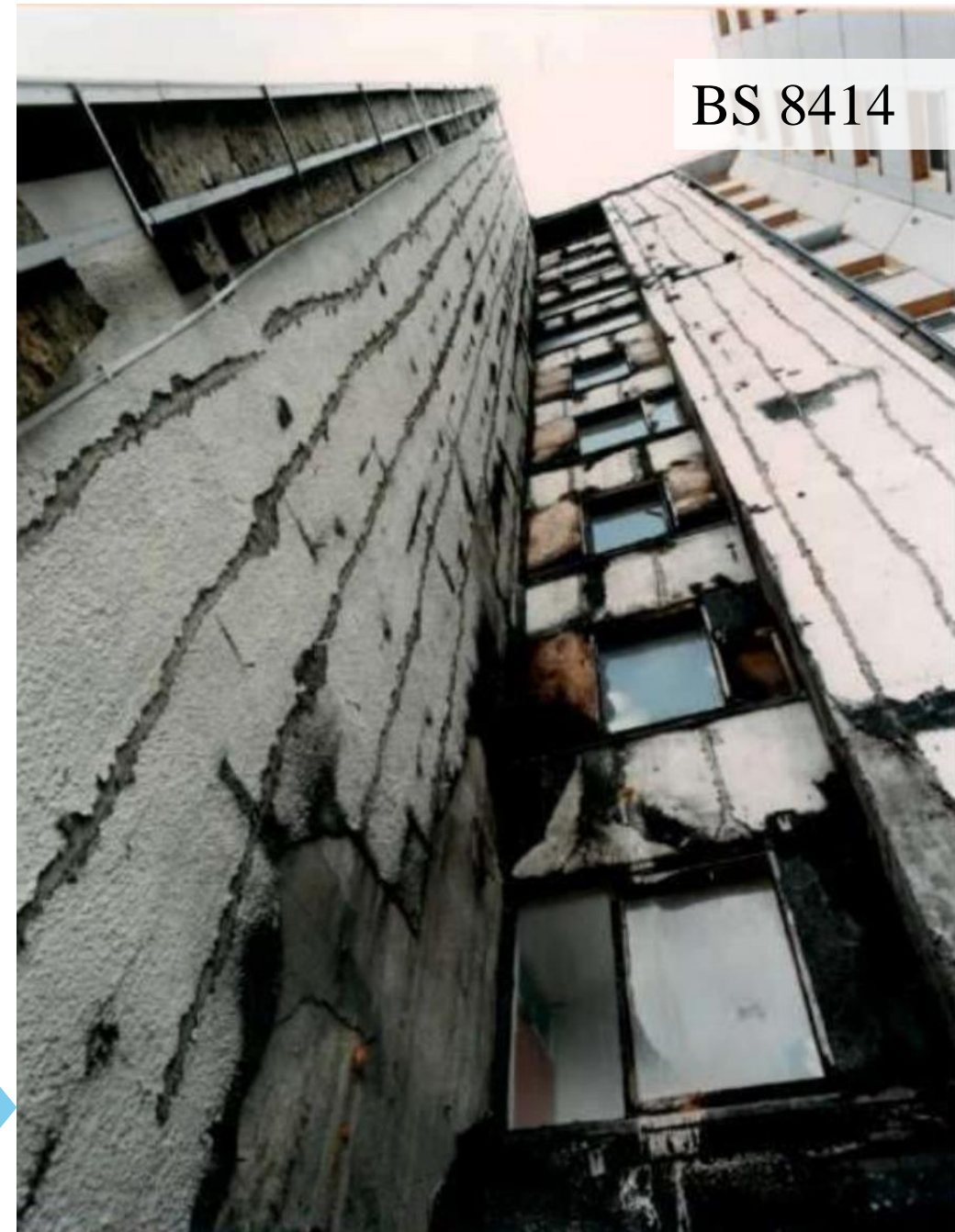
The precursor to NFPA 285 (UBC 17-6):

- Developed in the late 1970s
- Primary goal - Evaluate foam plastic performance

BS 8414 Test:

Developed following a fire in 1999.

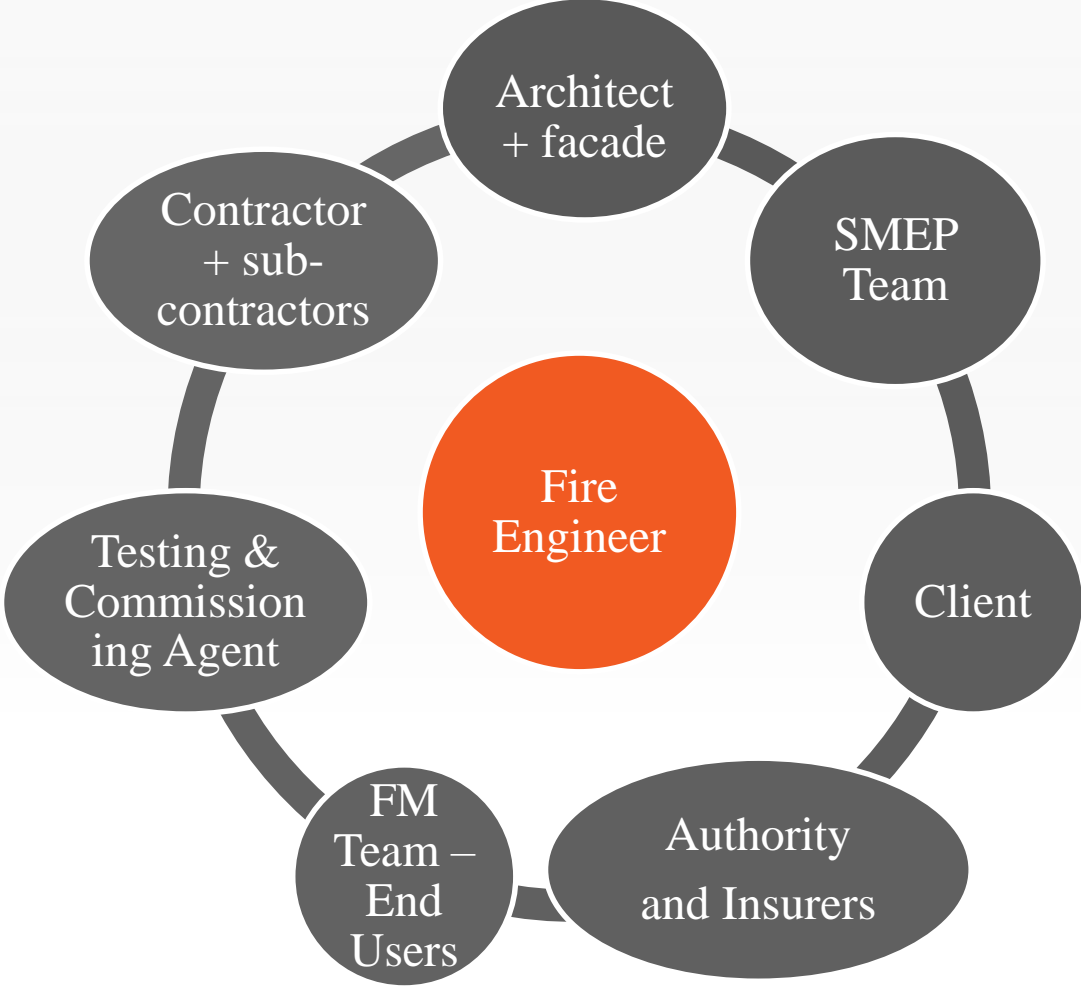
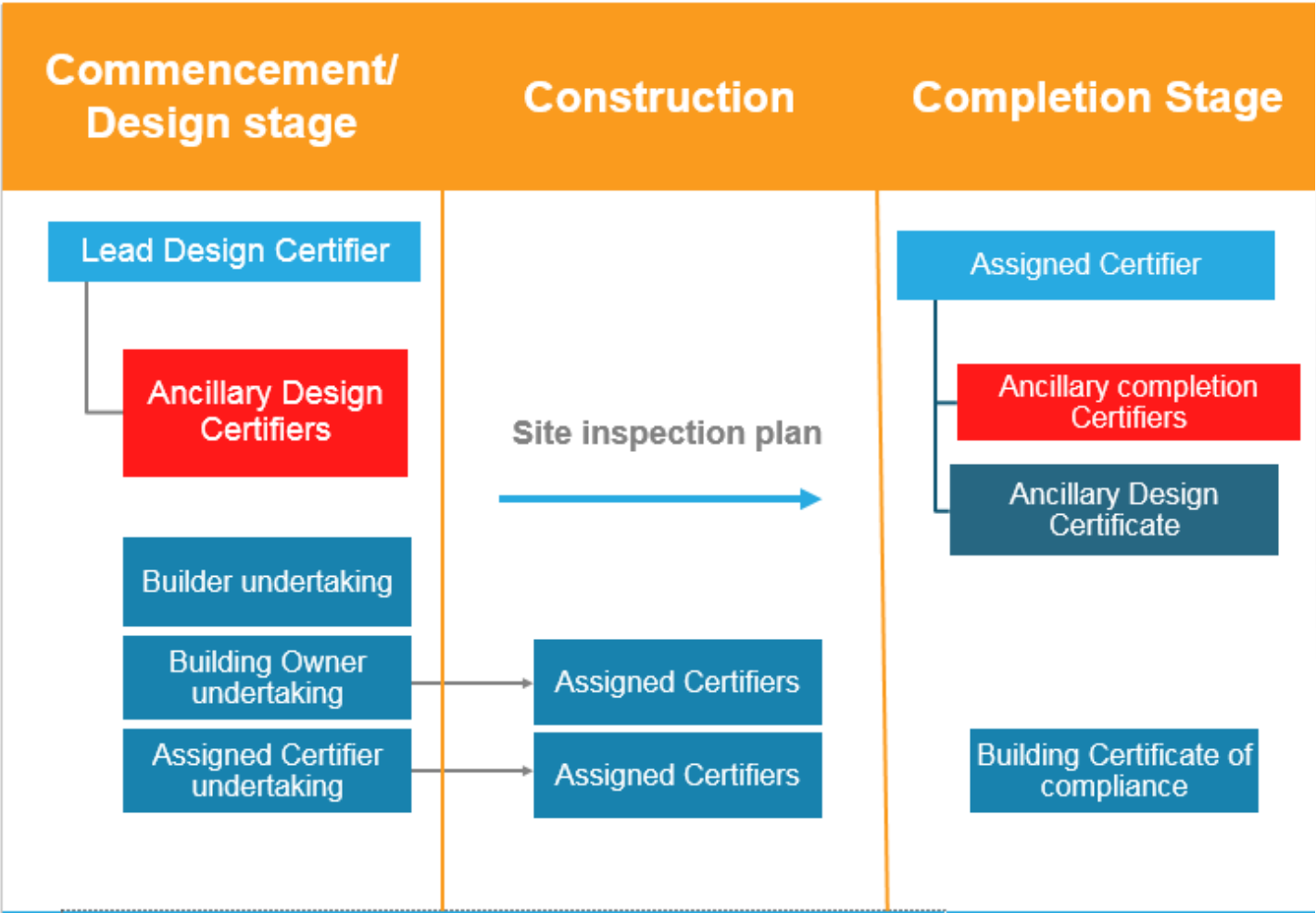
Primary goal – Evaluate foam plastic performance



BS 8414

Test Origins

Building Control (Amendment) Regulations (BCAR) 2014



Potential Pitfalls at different project stages

Design

- Designer unaware or did not understand requirements
- Designer asked for fire testing but did not ask for the correct fire test
- Fire engineer did not specify façade requirements

Approvals process

- Designer did not understand requirements
- Authority unaware of materials proposed or did not understand requirements

Procurement

- Incorrect specification
- Engineer and contractor enforcing the specification do not understand it.
- Supplier knowingly supplied product which does not meet the requirements
- The actual material shipped to site may not match with paperwork
- Product supplied not in line with specification

Construction

- Details of the assembly changed

Handover

- Handover authority unaware of material proposed or did not understand requirements.





17 February 2016

Industry Alert

Issued 24 February 2016 (Updated 28 June 2016)

External walls and BCA compliance

Updated to include reference to the publication of AS 5113 *Fire propagation testing and classification of external walls of buildings*, and clarification of the meaning of 'external wall'.

Some terms are used in this Industry Alert which are common building terms but are not defined in the Building Code of Australia. For clarity, the meanings of terms used for the purpose of this Industry Alert are:

'Attachment' means:

A supplementary element attached to an external wall or other complete building element.

'BCA' means:

Volume One of the National Construction Code.

'Cladding' means:

A non-loadbearing covering of a wall system which contributes to the functionality of the external wall, usually but not limited to weatherproofing. (Note: This aligns with common dictionary meanings.

'External wall' means:

The entire wall system which separates the interior air space of the building with the outside air space including any componentry or elements necessary for the external wall to achieve the requirements for structural performance, weather tightness, thermal performance, non-combustibility and required FRL if required by the type of construction, and any other functionality required under the BCA. This definition excludes any linings, materials and assemblies complying with Clause C1.10 or attachments complying with Specification C1.1 Clause 2.4 that may be applied to the inner or outer surface of the already fully compliant wall.

'Lining' means:

Sheet material fixed as an attachment to the external face of an external wall.

Except for 'external wall', terms in *italics* have the same meaning as in the BCA.

PURPOSE

Following the release of the Metropolitan Fire Brigade's post incident analysis report into the Lacrosse apartment fire and the completed Victorian Building Authority's (VBA) audit of Class 2, 3 and 9 buildings the VBA has become aware of considerable variation in industry understanding regarding the use of aluminium composite panels (ACP) and other *combustible* materials in the construction of external walls. The audit identified that *combustible* materials including ACP have been used in a manner that does not comply with Volume One of the Building Code of Australia.

The purpose of this Industry Alert is to clarify circumstances where ACPs and other *combustible* materials may be used in the construction of the external walls of a building in Type A and Type B construction principally in relation to Class 2, 3 and 9 buildings. It is clear from the audit that—

- Building designers, builders and building surveyors are failing to identify whether the material is being used as an integral part of an external wall, or used as an attachment to a complete wall system. This failure can lead to the non-compliant use of a *combustible* material as a component of a wall that is required to be *non-combustible*;
- Appropriate evidence of suitability in accordance with Clause A2.2 was commonly not being provided to, or sought by, relevant building surveyors;

Issued 24 February 2016
Updated 28 June 2016
www.vba.vic.gov.au

Page 1 of 6



Non-compliant use of External Cladding Products on Buildings

Regulation Impact Statement for Consultation

August 2016

This Regulation Impact Statement for consultation accords with the requirements of *Best Practice Regulation: A Guide for Ministerial Councils and National Standard Setting Bodies* endorsed by the Council of Australian Governments. Its purpose is to inform interested parties of proposals to address non-compliant external cladding assemblies on buildings. Comments on this Regulation Impact Statement are invited by 30 September 2016.

ARUP



EUROPEAN COMMISSION

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs

Industrial Transformation and Advanced Value Chains

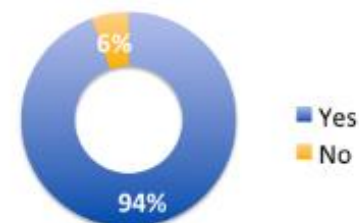
Brussels, 13/07/2016
grow.ddg1.c.dir(2016)3448477

Dear Sir/Madam,

Subject: Invitation to Tender – Call for tenders No 531/PP/GRO/IMA/16/1133/9108
- Open procedure

**Development of a European approach to assess the fire performance of
facades**

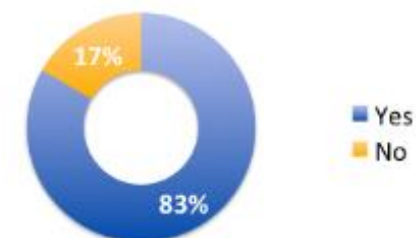
Do you think a single harmonized
façade fire test is needed in Europe?



Do you think a harmonized façade test should be
large-scale and performance based?



Do you think that a harmonized façade fire test must cover the scenarios of fire
originating from inside a room as well as fire originating from outside (e.g. in a trash
can or car)?



3. Risk Methodology

1) Upgrading knowingly



1. Do nothing

More fires, potential fatalities, much larger incident, insurance premiums, investor confidence, image, reputation

2. Prepare for the next incident

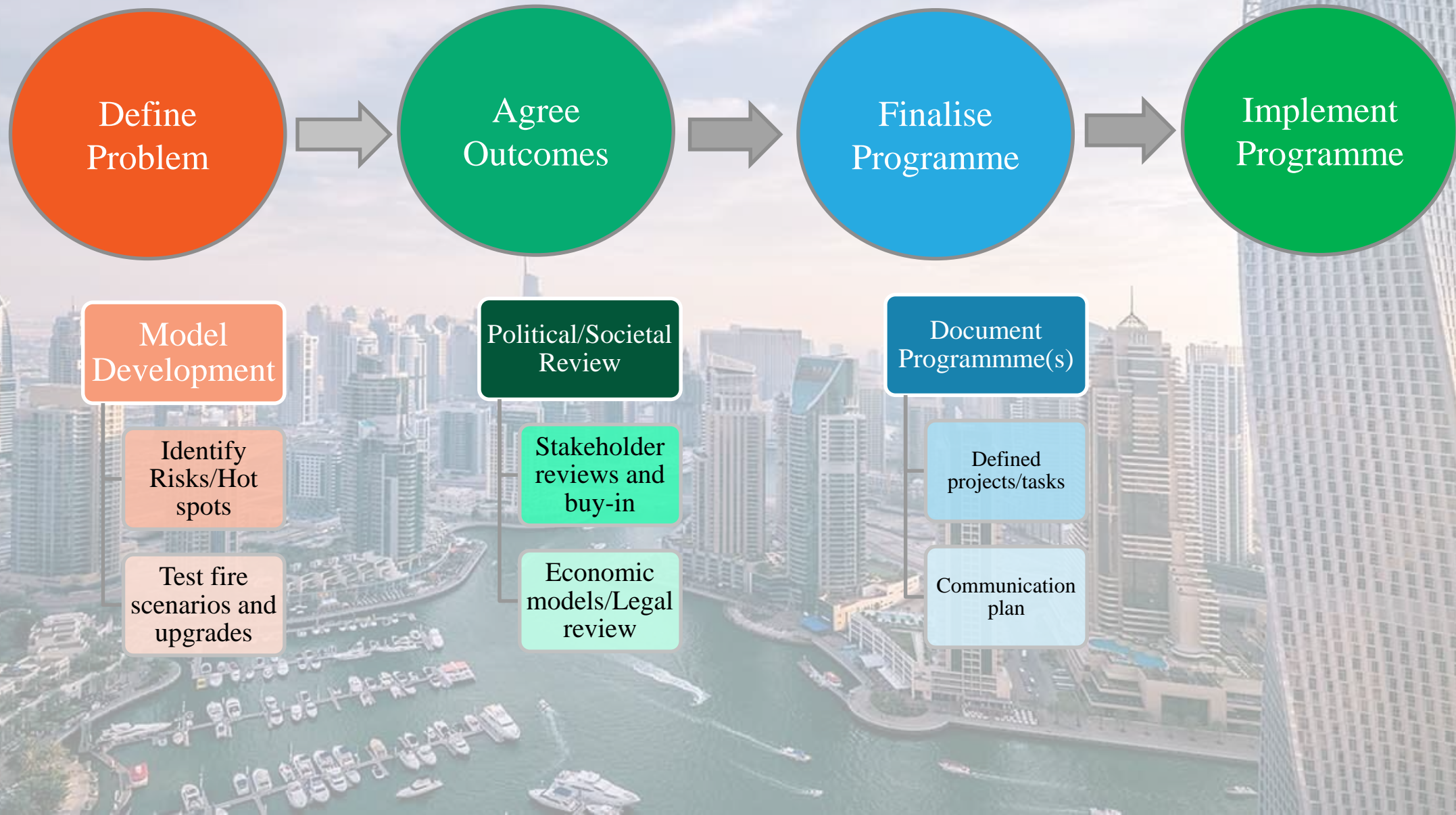
Disaster-recovery, emergency response, enforce testing & maintenance/fire drills

3. Upgrade Knowingly

Address safety, economic, political, societal risks in a planned and balanced way

4. Full upgrade of all buildings – how? when? where to start?

Way Forward - What does **Upgrade Knowingly** look like



Small/low rise
No/low fire resistance
Combustible materials ok



Risk

Large/tall
High fire resistance
Non-combustible





Horizontal ACP

Range of ACP Configuration



Large extents of ACP



Vertical connections

ARUP

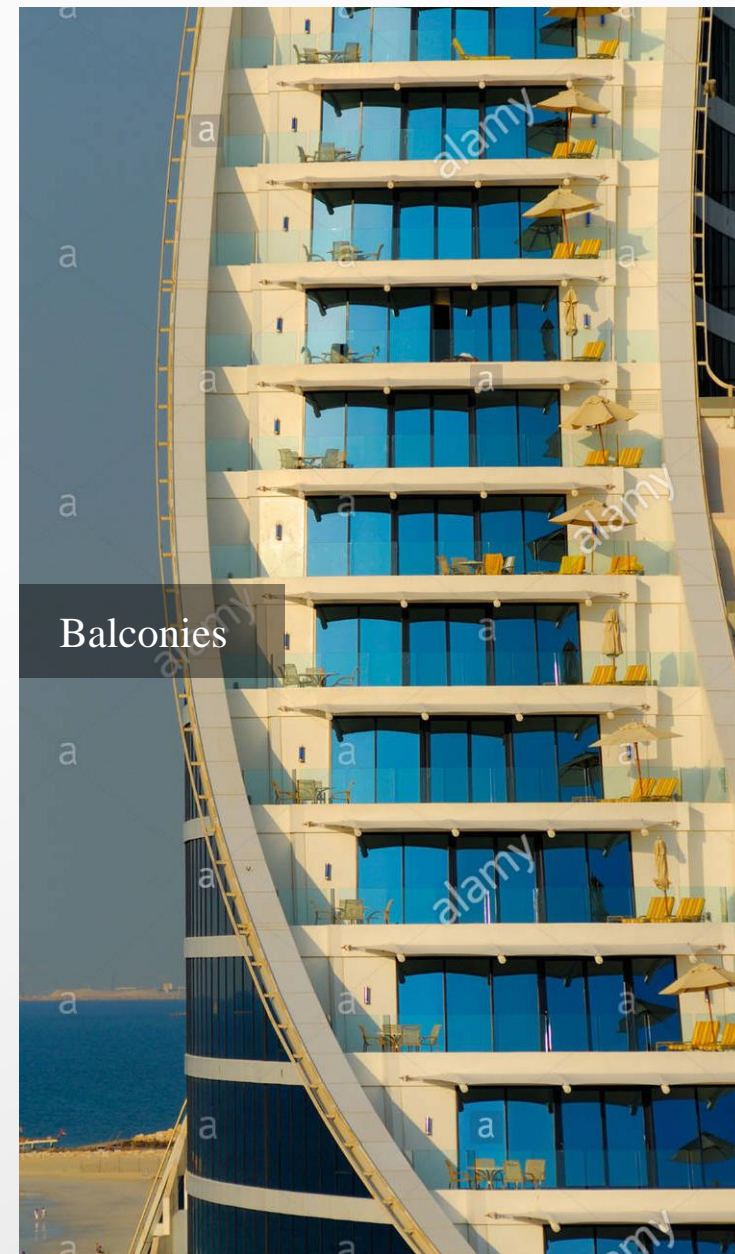
Height



Gross floor area

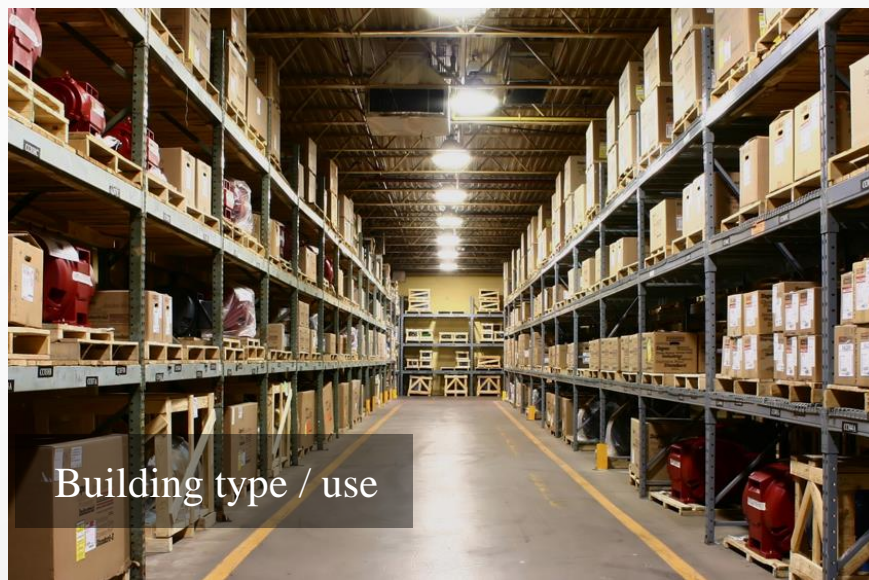


Balconies



Other building hazards

Building type / use





FACTORS

Sleeping



Wind Direction

0°

360°



Proximity Water Supply



Age of Building

<5

5-10

10-20

20+

Balconies



Height(m)

<5

5-10

10-20

20+

ALL

Proximity to CD Fire Station



▼ MORE FACTORS

Individual building mapping: Outcome



City Scale: Risk Ranking in Context

Trivial

Tolerable

Moderate

Substantial

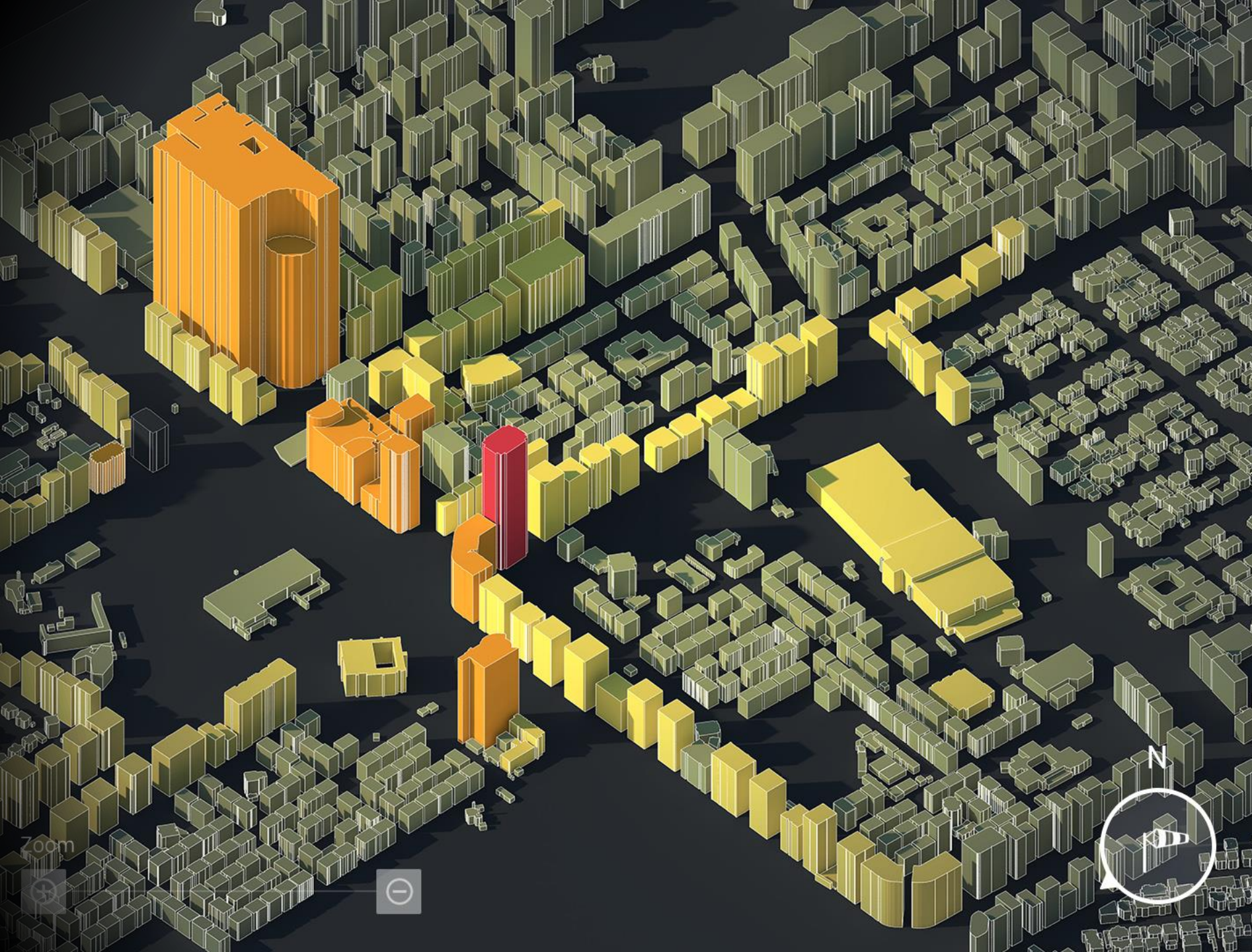
Intolerable



What could cause a medium hazard building to be intolerable?

A photograph of a tall, multi-story building at night. The building is illuminated by a bright fire on its right side, which is visible through the windows and along the edge of the structure. The fire is intense, with orange and yellow flames. The rest of the building is dark, and the sky is black. The text is overlaid on the left side of the image.

Developing City Scale Risk
Mapping: Cones of influence..



FACTORS

Sleeping ☐

Wind Direction
0° 360°
▲

Proximity Water Supply ☒ ☐

Age of Building <5 5-10 10-20 20+

Balconies ☐

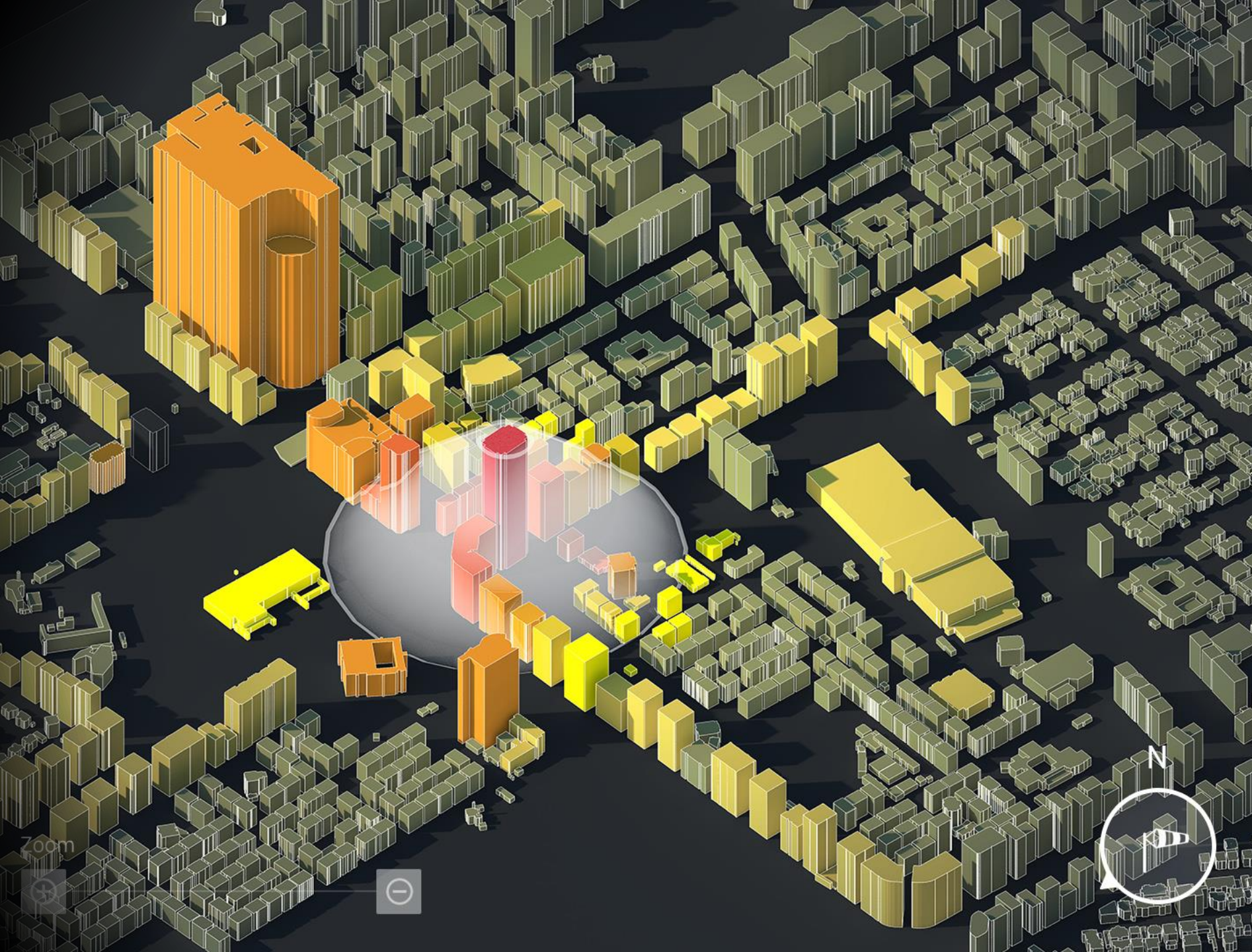
Height(m) <5 5-10 10-20 20+ ALL

Proximity to CD Fire Station ☐

▼ MORE FACTORS

Zoom





FACTORS

Sleeping ☐

Wind Direction
0° 360°
▲

Proximity Water Supply ☒ ☐

Age of Building <5 5-10 10-20 20+

Balconies ☐

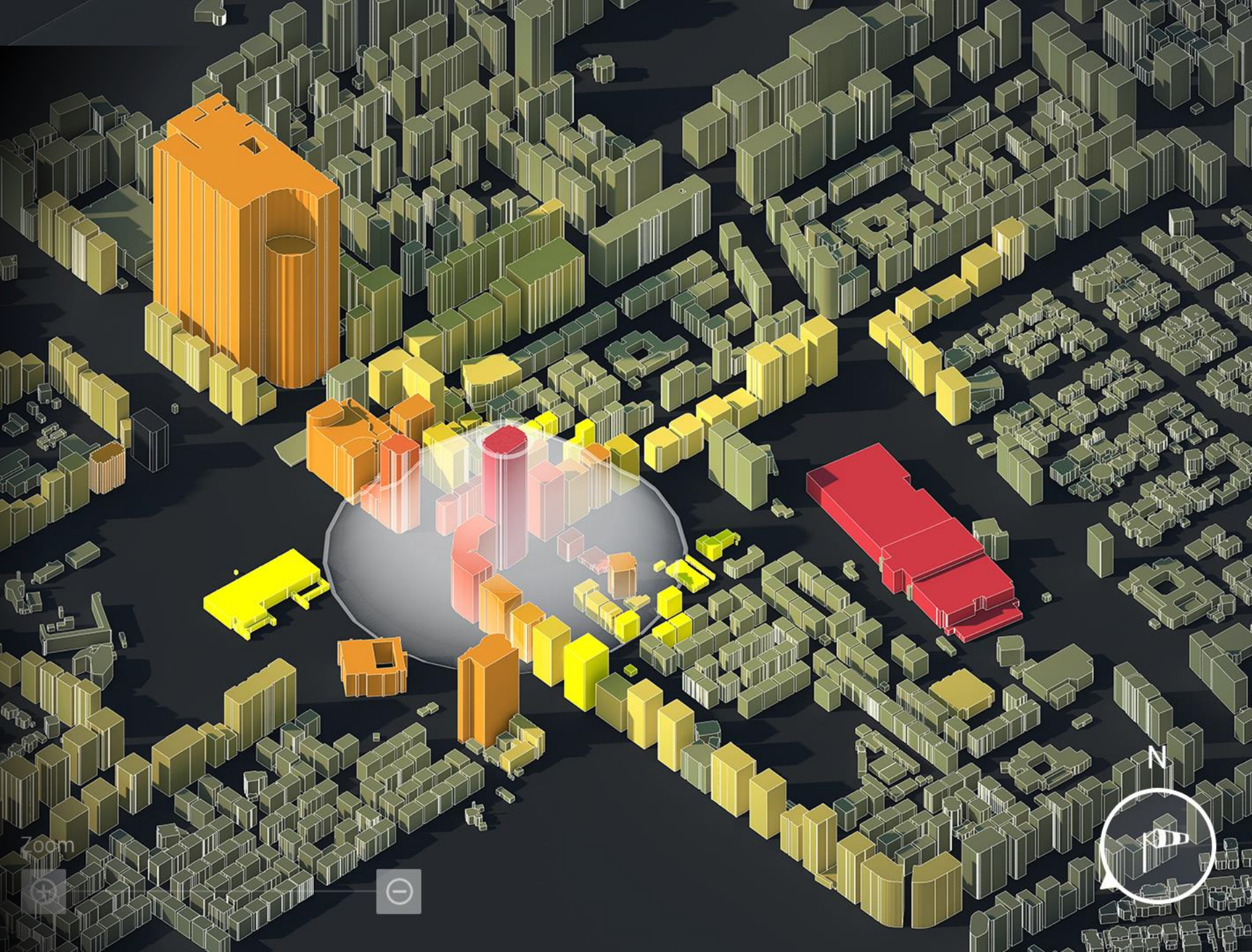
Height(m) <5 5-10 10-20 20+ ALL

Proximity to CD Fire Station ☐

▼ MORE FACTORS

Zoom





FACTORS

Sleeping ☐

Wind Direction
0° 360°
▲

Proximity Water Supply ☒

Age of Building <5 5-10 10-20 20+

Balconies ☐

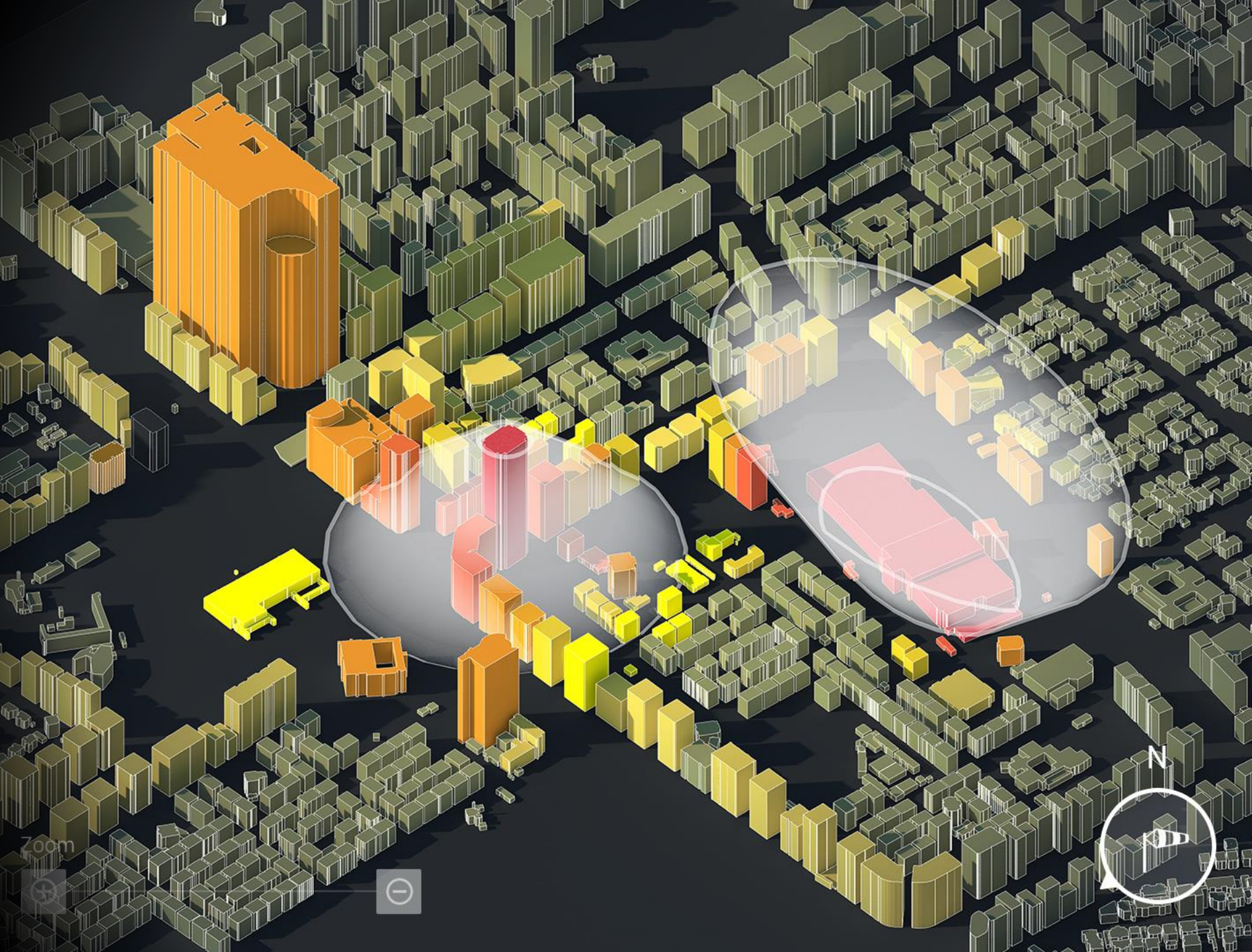
Height(m) <5 5-10 10-20 20+ ALL

Proximity to CD Fire Station ☐

▼ MORE FACTORS

Zoom





FACTORS

Sleeping ☐

Wind Direction
0° 360°
▲

Proximity Water Supply ☒

Age of Building <5 5-10 10-20 20+

Balconies ☐

Height(m) <5 5-10 10-20 20+ ALL

Proximity to CD Fire Station ☐

▼ MORE FACTORS

Zoom



City Scale: Risk Ranking in City Context

Trivial	Tolerable	Moderate	Substantial	Intolerable
<ul style="list-style-type: none">• Areas that do not need to be considered	<ul style="list-style-type: none">• Medium risk building on own• E.g. office with no vertical ACP	<ul style="list-style-type: none">• High risk building on own	<ul style="list-style-type: none">• Medium risk building near high risk buildings	<ul style="list-style-type: none">• High risk buildings in close proximity (within cone of influence)

Possible Interventions

- Remove ACP
- Remove ACP vertical connections
- Close off balconies



Possible Interventions:

- Public awareness training for tenants
- Give Way to Emergency Vehicles
- Fast response vehicles in each station
- SMART traffic technologies



City Scale: Risk Ranking with Interventions

Trivial

Tolerable

Moderate

Substantial

Intolerable



City Scale: Risk Ranking with Interventions

Trivial

Tolerable

Moderate

Substantial

Intolerable



Remove ACP

Understanding and Mapping the Financial Risks



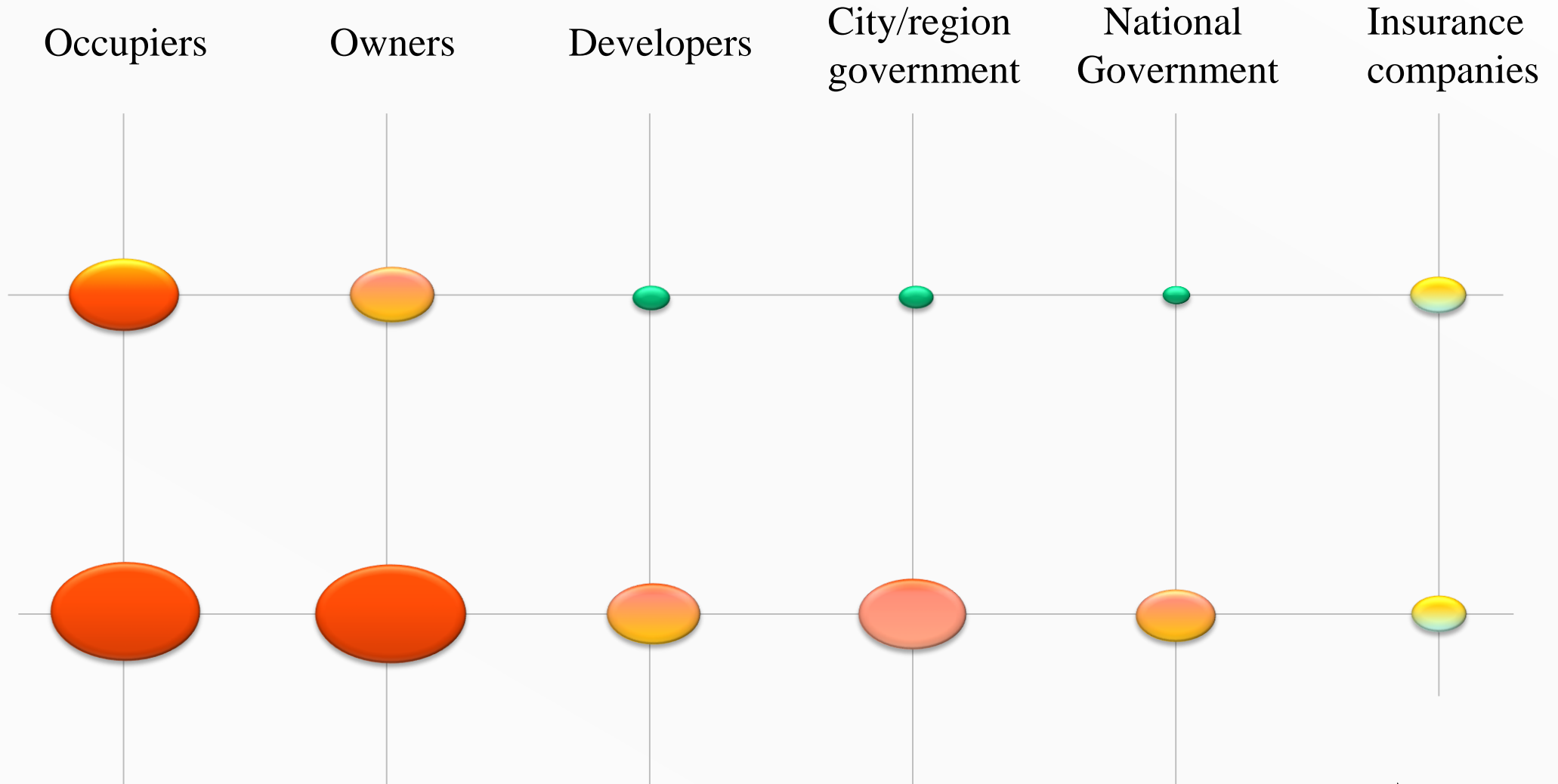
Financial Impact

- Loss or damage to a building affects people, businesses, and government in different ways.
- Financial risks are an important criteria for decision making.
- There are *direct* costs and *indirect* costs that need to be measured.
- How can we capture this in our assessment of the risks?



Financial Consequences

Fire



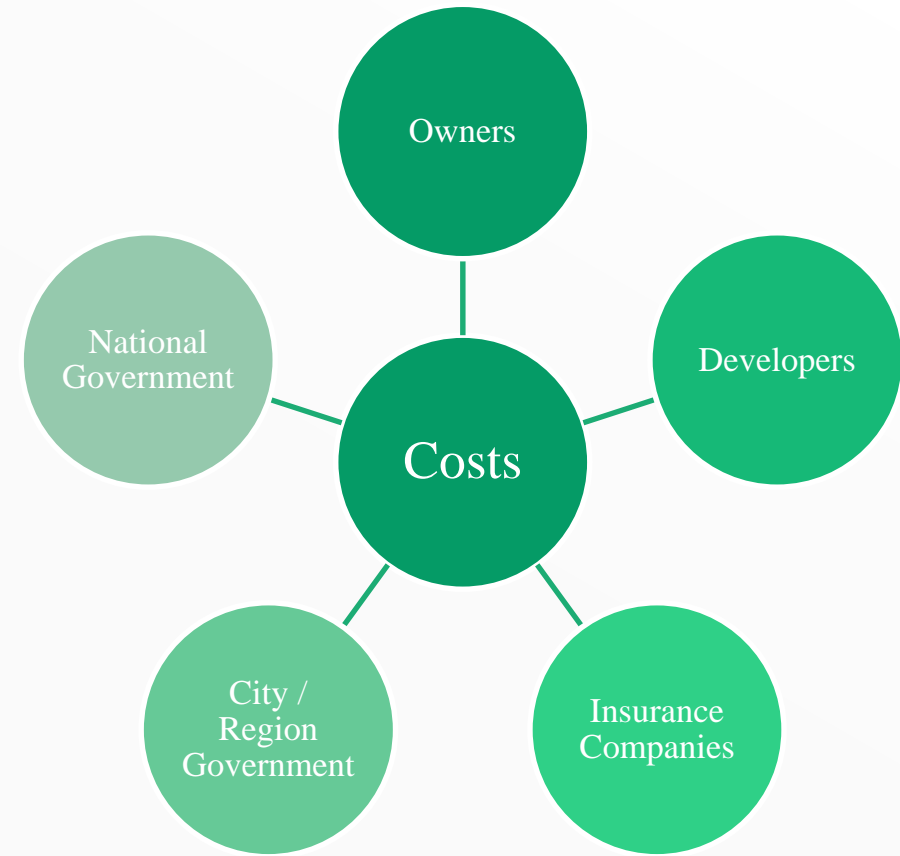
Total costs?



- Total costs may be much larger than the costs to owners and occupiers.
- This will affect choices of technical solutions and priorities for implementing solutions.
- Government decision making will be better informed by analysis of the total costs.



Different building risks present different costs to many different parties.



- How do we decide who should pay, how much, and when?
- What is the most efficient way to ensure that work will proceed quickly?

Examples

- Legislation, regulatory control
- Market led insurance
- Government insurance levy
- Benefits capture and contribution
- Direct government funding

COST BENEFIT



	Occupiers	Owners	Developers	City/region government	National Government	Insurance companies
Legislation, regulatory control	ACP	ACP				
Market led insurance	ACP	ACP				
Government insurance levy	All bldgs	All bldgs				
Benefits capture and contribution						
Direct government funding						

Summary

Different measures will spread costs and benefits across business and government.

A combination of measures will make better alignment between costs and benefits.

The commercial approach will need to be considered at the same time as evaluation of technical solutions.

Analysis of total costs will be needed to inform decisions making.



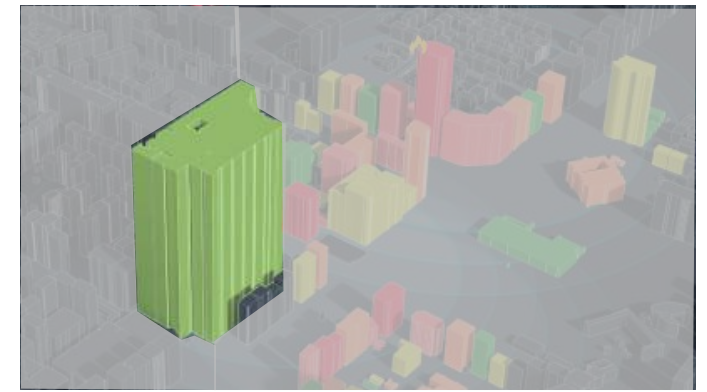
City to Building Scale: Managing Complexity



City/ Region

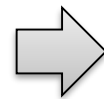


Cluster

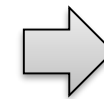


Building

**Portfolio-level:
Abu Dhabi**



**Programme-level:
Downtown area**

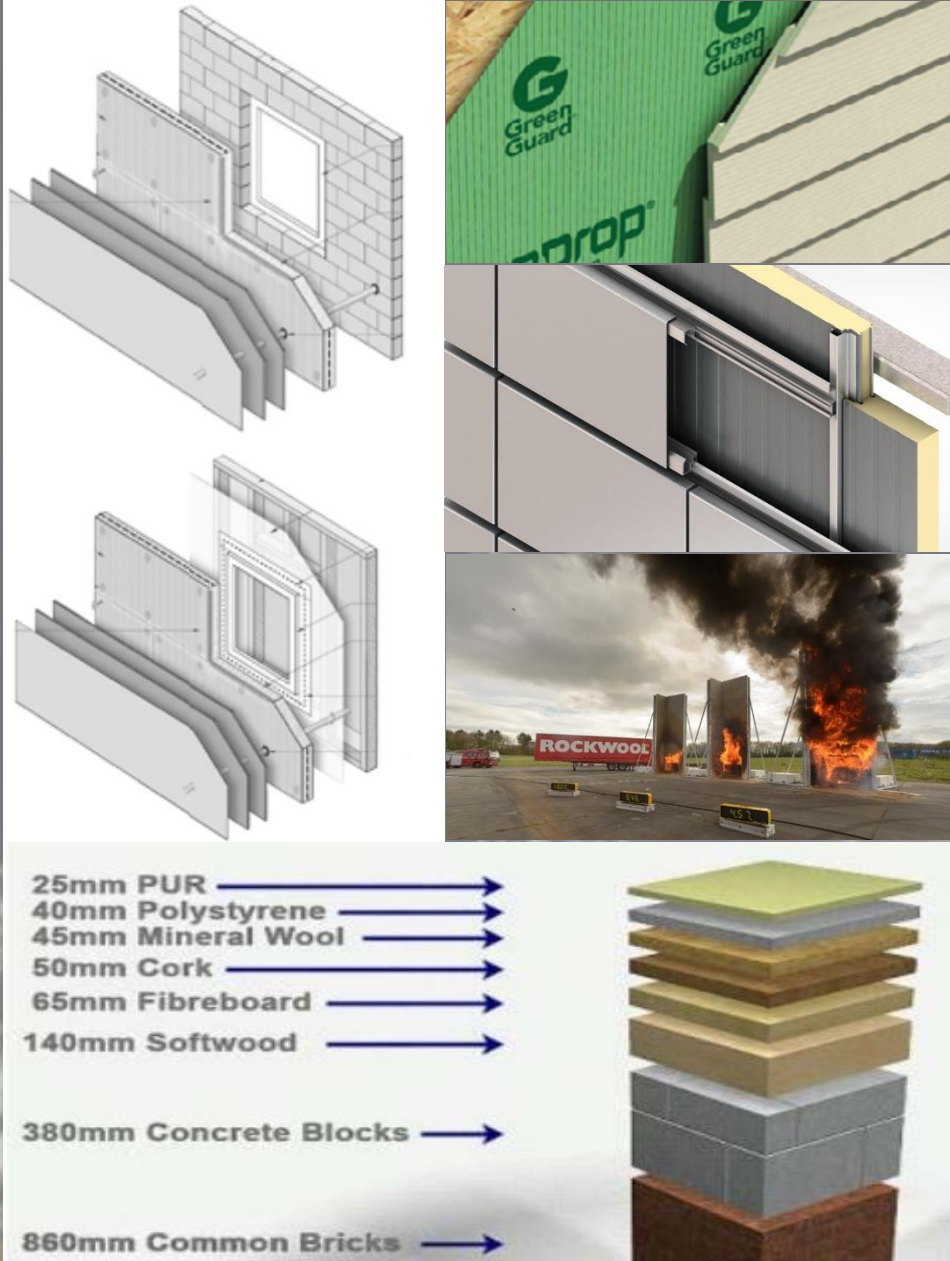


**Project-level:
'Hotel'**

Key Messages



1) Combustible Facades – Global Issue



External fire spread.

B4

The external walls and roof of a building shall be so designed and constructed that they afford adequate resistance to the spread of fire to and from neighbouring buildings.

2) Regulations, codes, standards and enforcement

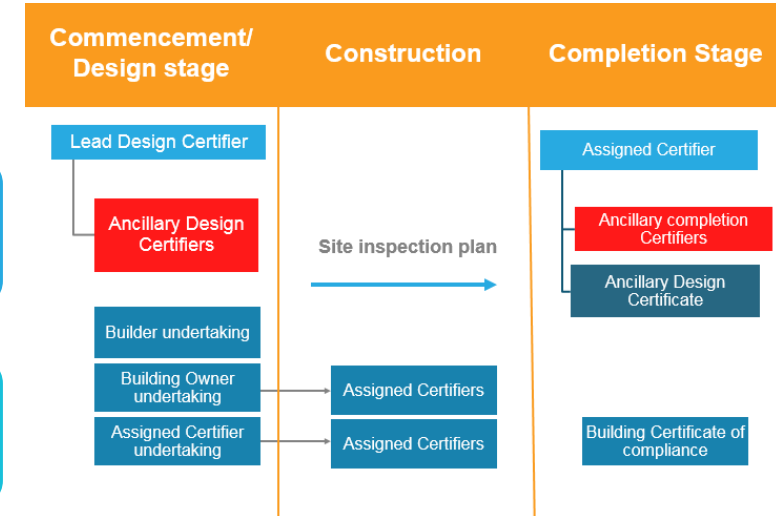
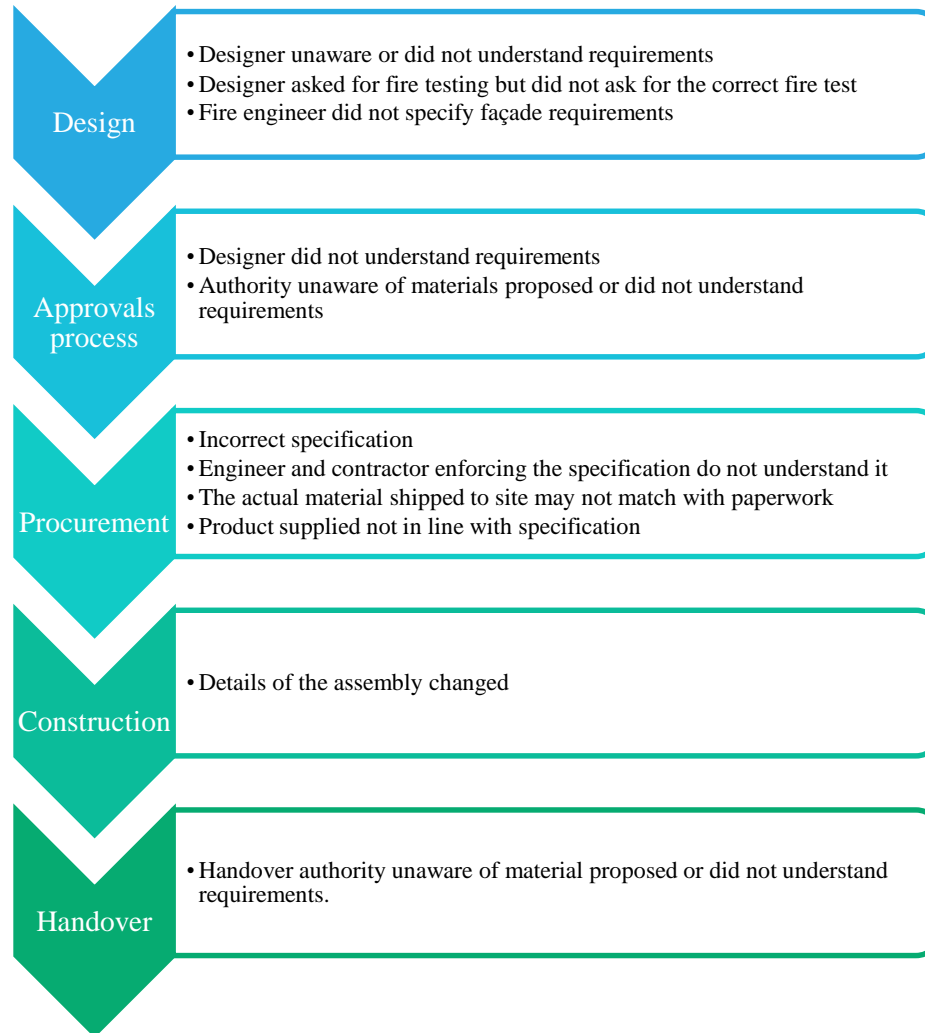


Non-compliant use of External Cladding Products on Buildings

Regulation Impact Statement
for Consultation

August 2016

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Building Regulations 2006

Technical Guidance Document B

Fire Safety

ARUP

3) Risk ranking on city scale, including cost and reputation impact. Develop a range of solutions that are prioritised based on risk ranking



FACTORS

Sleeping

Wind Direction

0°

360°

Proximity Water Supply

X

Age of Building

<5

5-10

10-20

20+

Balconies

Height(m)

<5

5-10

10-20

20+

ALL

Proximity to CD Fire Station

▼ MORE FACTORS

Trivial

Tolerable

Moderate

Substantial

Intolerable

- No cone of influence
- Close proximity to Civil Defence stations
- Good road / hydrant access

- Cone of influence
- Poor access
- Congested areas
- Limited hydrant access

RISKMAP Tool v1.1

ARUP

A photograph of a tall building at night, with a vertical column of fire running up its side. The fire is bright orange and yellow, contrasting sharply with the dark night sky. The building's facade is visible on the left, showing many windows. The fire appears to be coming from a specific section of the building, possibly a staircase or a vertical shaft.

Thank You

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