10TH INTERNATIONAL TALL BUILDING FIRE SAFETY CONFERENCE

“The good , the bad & the unintended consequences”

Progress since 2024 & 2025

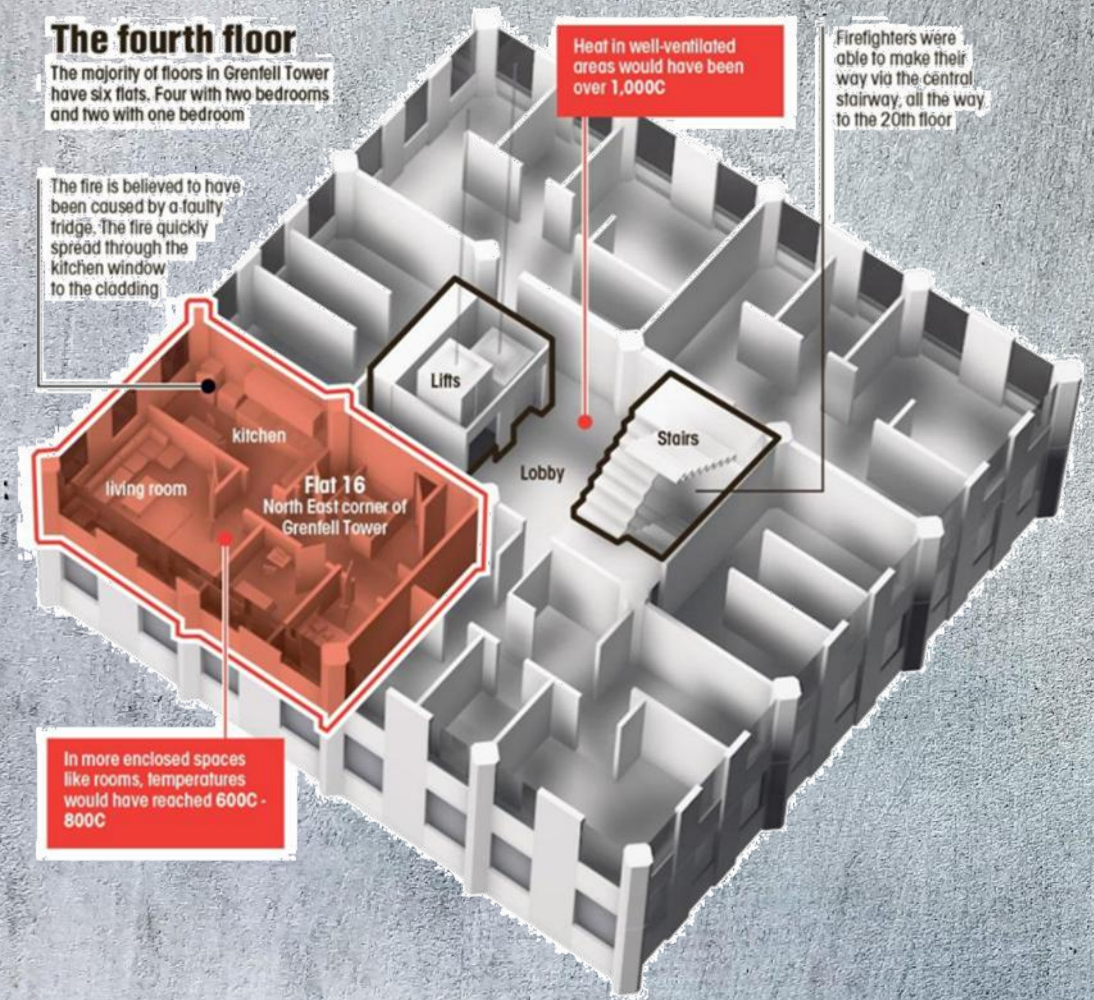
Paul Bussey RIBA, FIFireE, IMaPS, FIIRSM, FASFP

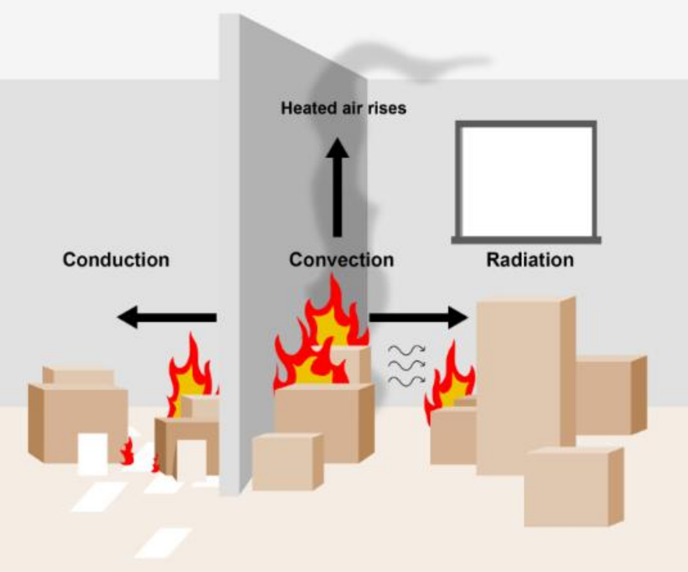
Andrew Gausden- Ex-SeniorFire Officer

Steve Attrill – Novenco

Brad Crisp- Sertus

Understanding the fire spread process





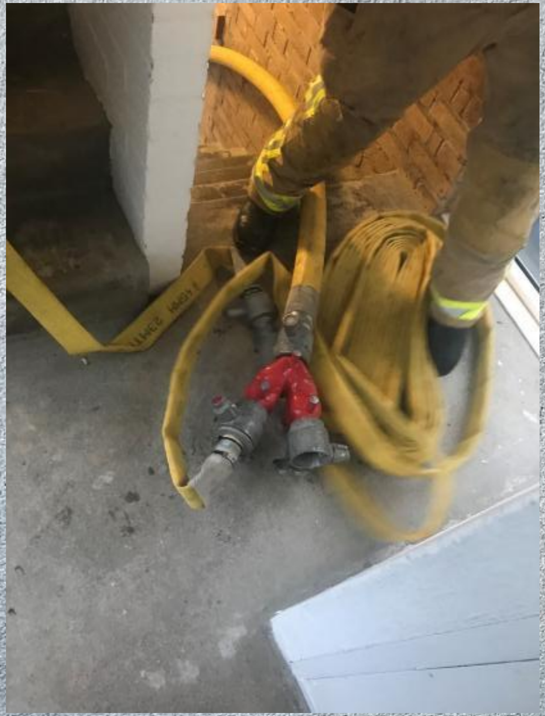
Passive Fire Safety Engineers/ ASFP
CPA- Construction Products Association
CPPI- Code for Construction Product Information- Ethical information.

A firefighting practice drill in a 10 storey social housing block

A team of firemen in a bridgehead location (internal at Grenfell)

Protected Lobbies

A firefighting hose roll on the 900mm wide stair ready to be charged



Twin breaching risers

The fully charged hose ready to be taken up the stair to fire floor

2 stairs – Sept 2026

Stairwell protection teams in high-rise fires

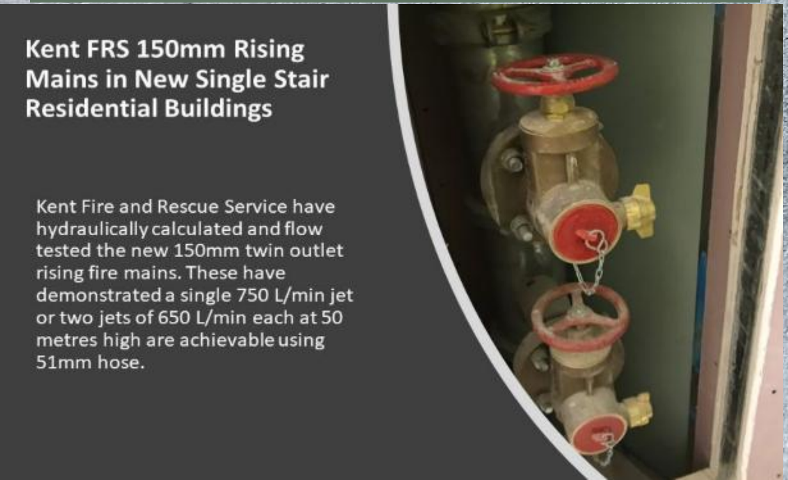
In the UK - s3.3 ADB-1 2019: (in part)

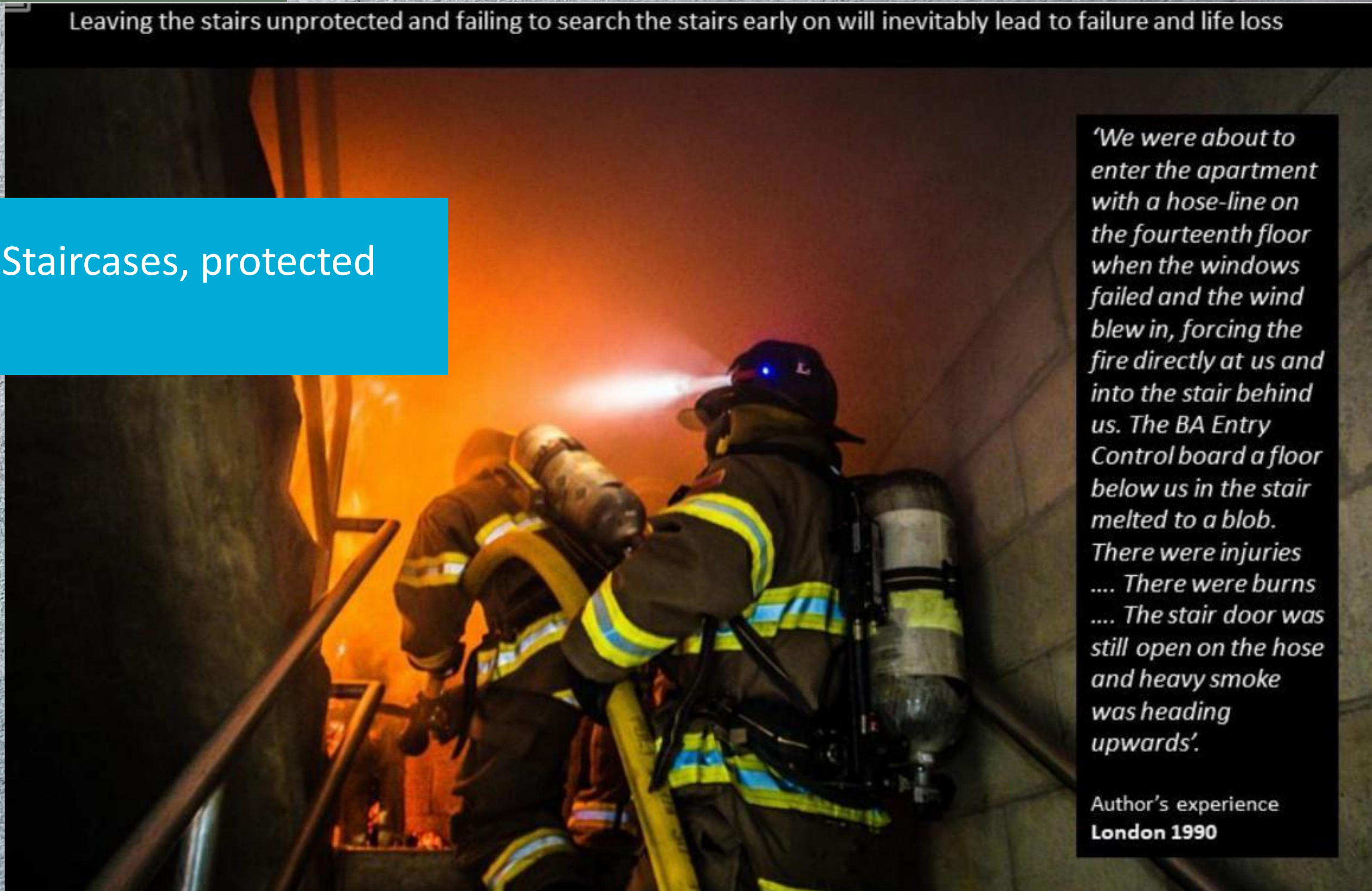
‘Sufficient protection to common means of escape is necessary to allow occupants to escape should they choose to do so or are instructed/aided to by the fire service. A higher standard of protection is therefore needed to ensure common escape routes remain available for a longer period than is provided in other buildings.’

Avoid hoses on the stairs as trip hazard & doors propped

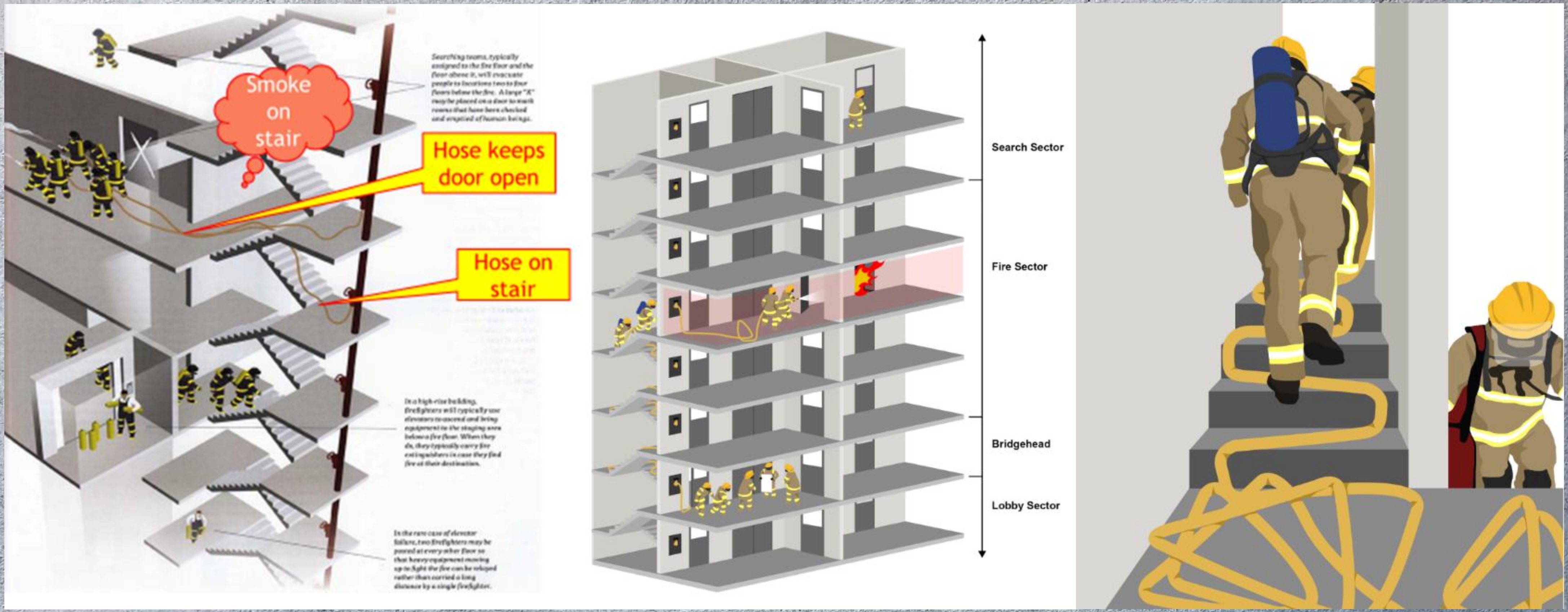
Twin breaching outlets , 2nd Staircases, protected lobbies.

Twin breaching dry riser in protected lobby not stair



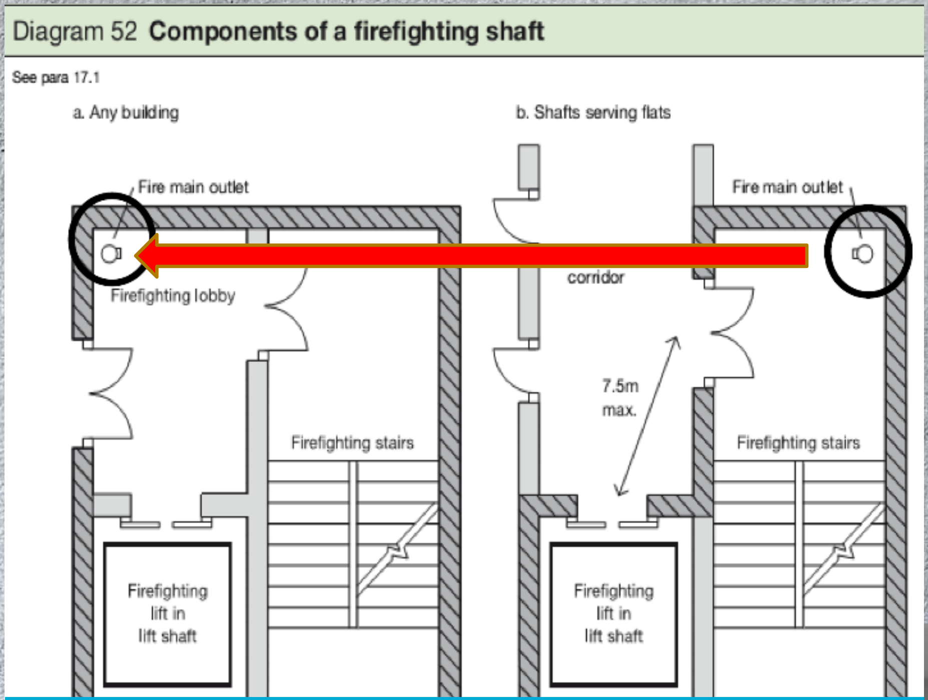


Understanding actual fire fighting activities whilst designing

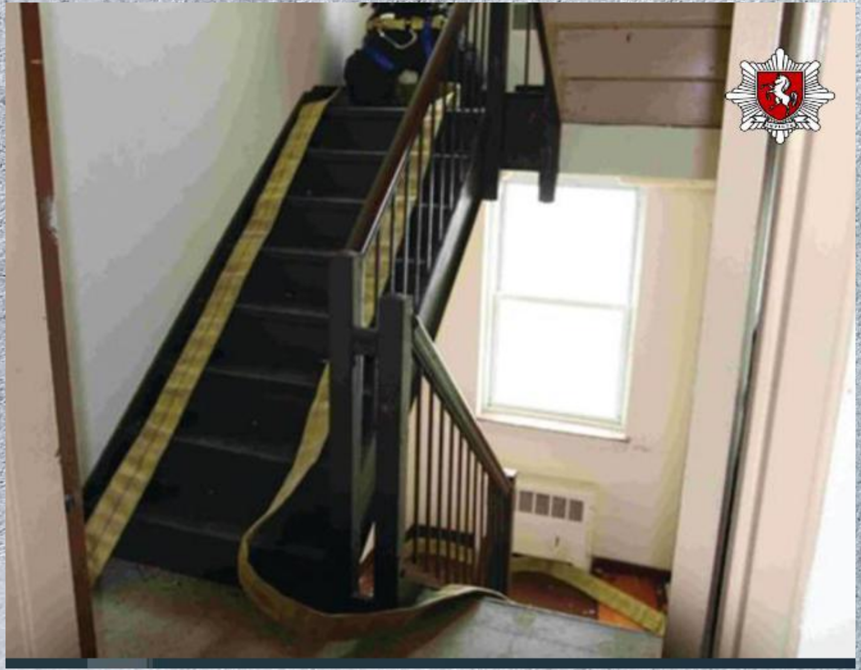


Hoses on Stairs are a serious risk for escapees descending in single stair remediation projects

Twin breaching dry riser in protected lobby NOT stair



Avoid hoses on the stairs as trip hazard & doors propped



Evacuation whilst firefighting ongoing!

Fire-Fighting kit to carry-up

This is not compatible with an Evacuation Strategy in one Stair!

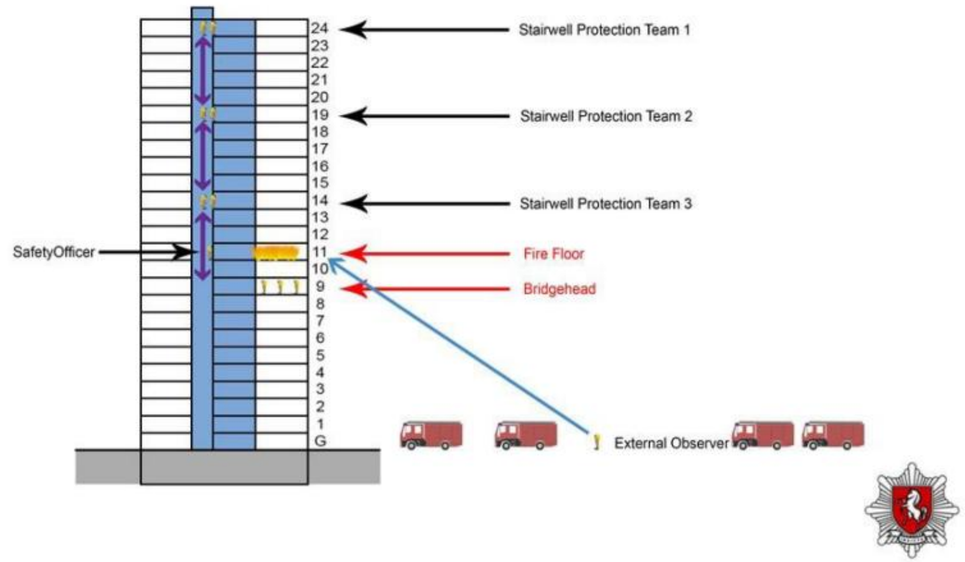
Kent FRS stairwell protection strategy

Roles of 'Stairway Protection Teams'

- **Patrol** stairwells continuously from top-to-bottom to ensure that egress routes are safe and free of obstructions; monitor gas levels
- **Search** floors, stairwells, hallways, and lifts for building occupants who may be trapped or are entering an untenable environment
- **Report** information about conditions at each floor to the incident commander.
- Ensure the stairs are **clear of smoke**
- **Deploy to FSG calls** where required
- **Manage occupant evacuation** where required

Especially where a second staircase is not practicable or available

PVV Positive pressure ventilation by mobile fans suitably deployed with vent to atmosphere openings at the top



Smoke venting & assisted natural stack ventilation

Architects should make it their highest priority to design the pressurization system with its intake at the lowest possible level, ideally at ground or basement low level input.

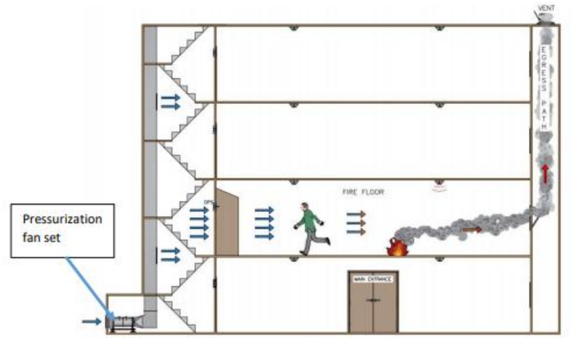
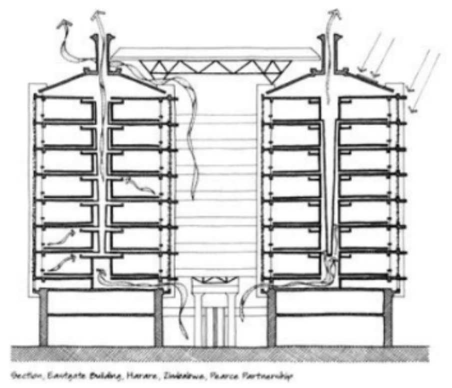
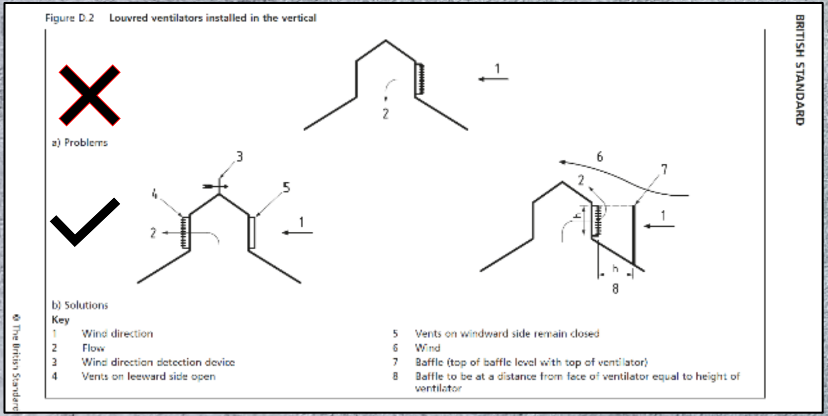


Figure 3 – Simplified diagram with pressurization fan located at ground or basement level



Chimneys / atria with vents at top and bottom
(Image from Sun, Wind, and Light, by G.Z. Brown and Mark DeKay, published by Wiley)



BS 7346-8:2013

BSI Standards Publication

Components for smoke control systems

Part 8: Code of practice for planning, design, installation, commissioning and maintenance

Escapees should move in the opposite direction of the smoke ie. Smoke vents away from Cores

Understanding "vulnerable persons" evacuation

Every Housing Block is effectively a Care Home!

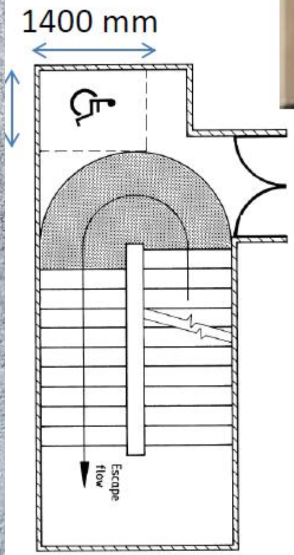
'DOMICILE CARE'

No such thing as "general needs" housing

Stay-Put initially but if ambulant can they proceed to the protected lobby?
Communication is required?
How many in lobby?
Is it a safe place?

Understanding "vulnerable persons" evacuation

Is this an adequate landing refuge?



Can we make further improvements?

Wider stairs, especially where single?

Fire Fighters ascending?

Will vulnerable persons inhibit the escape of others? Is the Stair refuge a safe place?

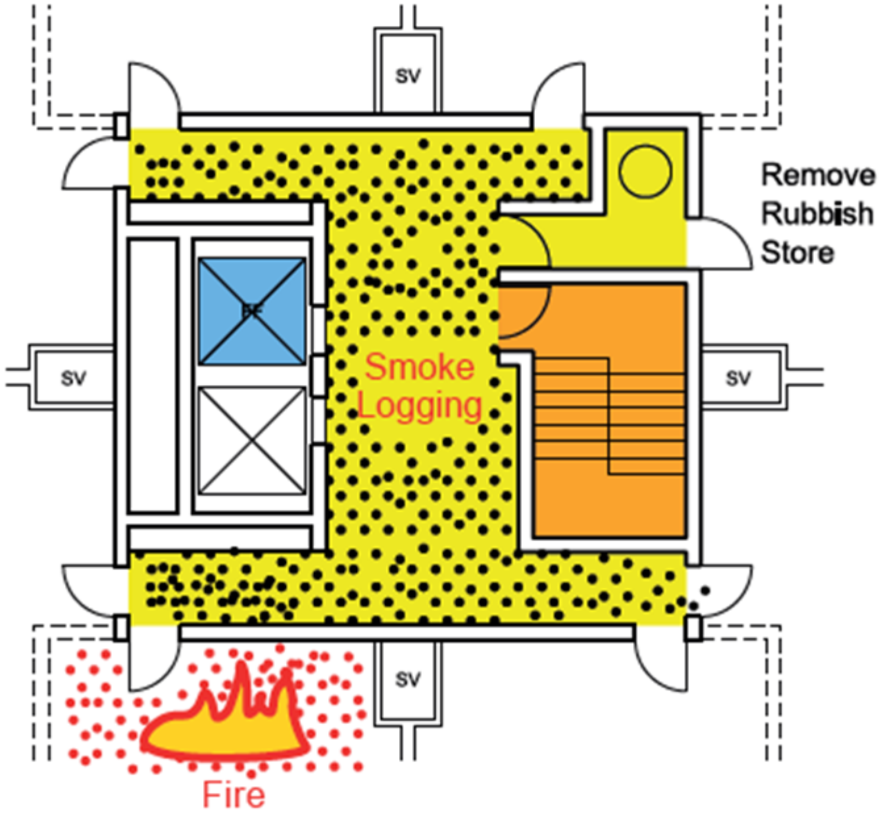
These design criteria need further validation or change

EXISTING HRRBS IN OCCUPATION
Typical Single Staircase & related Legislation

Central Core Block (e.g. Grenfell Tower)

A Current Core (eg Grenfell Tower)

Lobby Access to Dwellings



Existing Grenfell Tower Type

CORE PRINCIPLES

EXISTING HRRBS IN OCCUPATION
Typical Single Staircase & related Legislation

Linear Slab Block (e.g. Lakanal House)

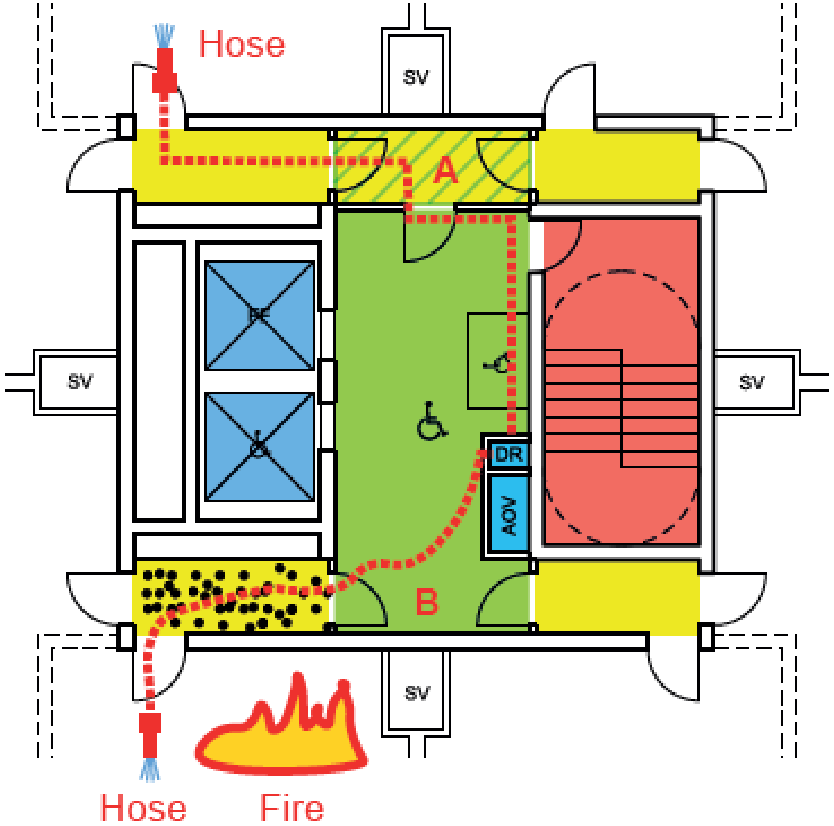
B **Proposed Core** (eg Grenfell Tower)

Enhanced Protected FF Lobby Access Dwellings

Fire Fighting Lobbies:

Option A preferred Refuge secured.

Option B less ideal as the refuge is compromised by an open door.

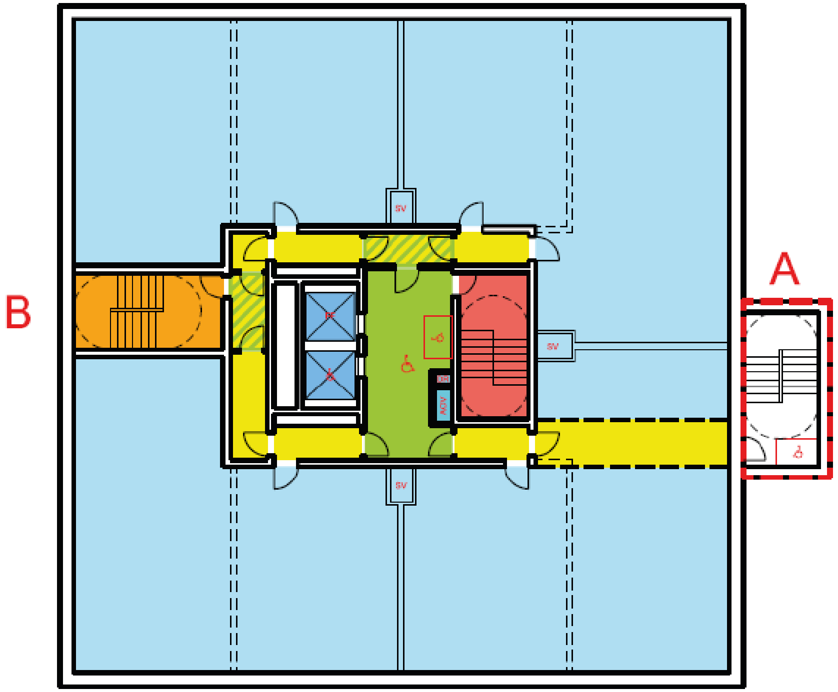


Proposed Improvements to Grenfell Tower Type

NORMATIVE TOWER DESIGN

PROPOSED / FUTURE BUILDINGS
Core 'B'

Alternative 2 Stair Location A or B with alternative Routes available



Proposed Wet Riser
at 30m not 50m

GRENFELL
67m

Additional Layers of Safety

A	Full fire fighting shafts and refuges	✓
B	2nd FF lift (if multiple - disbled P	✓
C	2nd staircase added. Alternative escape route	✓
D	Sprinklers required at 18m/11m	✓
E	Stay put policy only until fails	✓
F	Delayed total evacuation system	✓
G	Intercom to all flats, refuges and lifts	✓
H	Natural smoke ventilation to 2nd stair	✓
J	Fire control room essential	✓
K	100% proven compartmentation and documentation required	✓
L	Fire management / BSM Manager	✓
M	All ACMs etc removed from exterior	✓
N	Travel distances acceptable	✓
O	Min. 1200mm staircase	✓

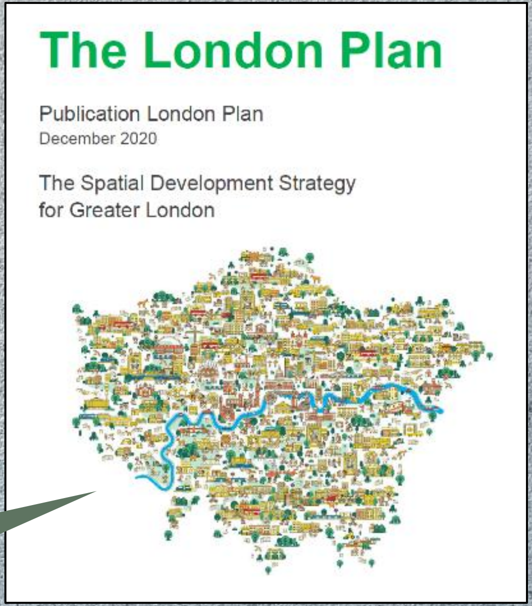
3.5.2 Inclusive design is indivisible from good design

Policy D5 Inclusive design
A Boroughs, in preparing their Development Plans, should support the creation of inclusive neighbourhoods by embedding inclusive design

4) be able to be entered, used and exited safely, easily and with dignity for all

5) be designed to incorporate safe and dignified emergency evacuation for all building users. In all developments where lifts are installed, as a minimum at least one lift per core (or more subject to capacity assessments) should be a suitably sized fire evacuation lift suitable to be used to evacuate people who require level access from the building.

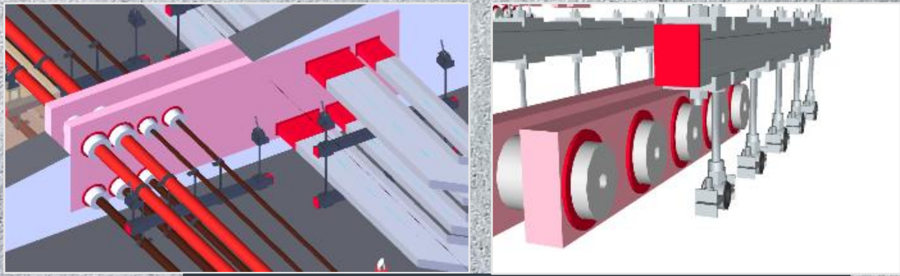
C Design and Access Statements, submitted as part of development proposals, should include an inclusive design statement.



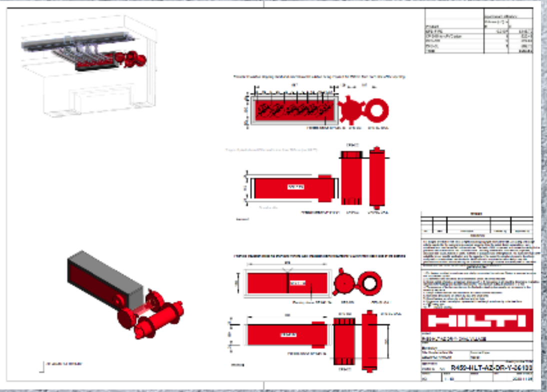
All agreed by the Secretary of State
29 January 2021
What about the ADBs?

The proposed ADB alterations suggest above 18m? 7 Storeys? What about those in lower blocks?

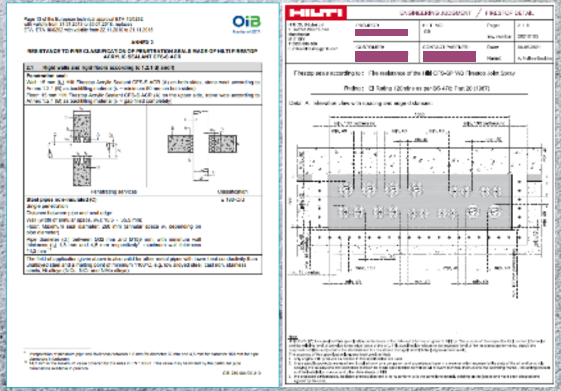
EXAMPLE: BIM design service deliverables & firestopping



BIM Modelling



Shop Drawings



Approvals & Reports

Plan View Drawings

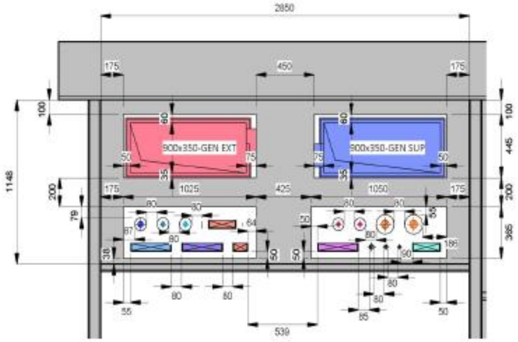
Is it reasonable to provide all this as Gateway 2 application? Staged Applications & AWR's?

Bill Of Materials

Letterbox	Numbers	Dimensions Height mm	Width mm	Length mm	Volume m3	Total Volume m3
APART-LBOX-01	316	150	300	587	0,026415	[illegible]
COM-DOOR-LBOX-A01	7	150	200	840	0,0252	0,1764
COM-DOOR-LBOX-A02	7	150	300	640	0,0288	0,2016
COM-DOOR-LBOX-B01	6	150	300	870	0,03915	0,2349
COM-DOOR-LBOX-B02-1	6	150	300	1100	0,0495	0,297
COM-DOOR-LBOX-B02-2	3	150	300	840	0,0378	0,1134
COM-DOOR-LBOX-C1	11	150	300	1100	0,0495	0,5445
COM-DOOR-LBOX-C1-2	3	150	300	660	0,0297	0,0891
COM-DOOR-LBOX-C2-1	11	150	300	800	0,036	0,396
COM-DOOR-LBOX-C2-2	3	150	300	660	0,0297	0,0891
COM-DOOR-LBOX-L1	10	150	200	1100	0,033	0,33
RISER-SHAFT-LBOX-A1	7	150	200	610	0,0183	0,1281
RISER-SHAFT-LBOX-A2	7	150	200	545	0,01635	0,11445
RISER-SHAFT-LBOX-A3	7	150	200	440	0,0132	0,0924
RISER-SHAFT-LBOX-B1	6	150	200	450	0,0135	0,081
RISER-SHAFT-LBOX-B3-1	12	150	200	600	0,018	0,216
RISER-SHAFT-LBOX-B3-2	2	150	200	270	0,0081	0,0162
RISER-SHAFT-LBOX-B4	14	150	200	1100	0,033	0,462
RISER-SHAFT-LBOX-C2	7	150	200	430	0,0129	0,0903
RISER-SHAFT-LBOX-C3	7	150	200	290	0,0087	0,0609
RISER-SHAFT-LBOX-L1	9	150	200	595	0,01785	0,16065
RISER-SHAFT-LBOX-F2	9	150	200	440	0,0132	0,1188
RISER-SHAFT-LBOX-L3	9	150	200	625	0,01875	0,16875
Total	479					

Gateway 2- In Principle

Gateway 2 – Approval with Requirements



3 Spatial Coordination

PFKG Passive Fire Knowledge Group

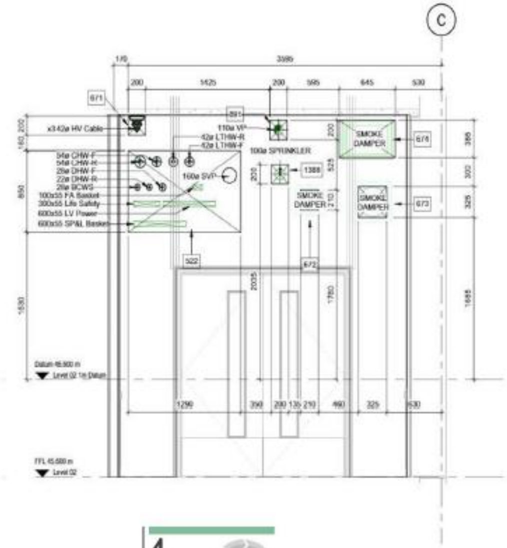
Firestopping Overview

RIBA Stage 2 & Gateway 1

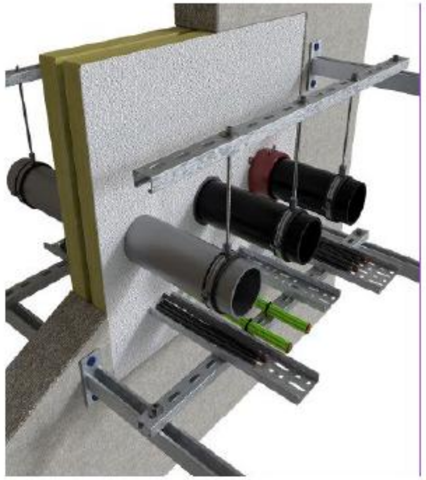
- Denotes 60-minute fire resistance
- Denotes 90-minute fire resistance
- Denotes 120-minute fire resistance

Example fire strategy drawing showing compartmentation layout

RIBA Stage 5 & Gateway 2-3
Construction & recording

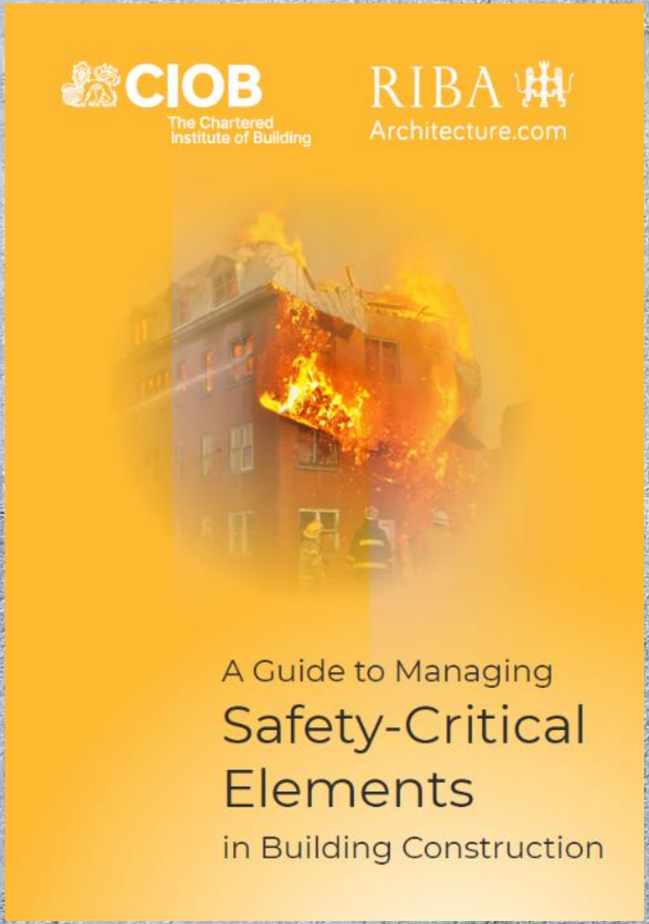


4 Technical Design



Example mixed-service penetration seal solution

Safety Critical Elements - Identify Early , provide full details later.



Appendix E – Consequences of Safety-Critical Element failure.

Figure 1. Incorrectly fixed cavity wall ties and omission of lateral restraint fixings.

Figure 2. Fire stopping / compartmentation omitted.

Figure 3. Inadequate fixings. Picture credit: West Midlands Ambulance Service

Figure 4. Inferior materials. Photo credit: Yankeepapa13/CC BY-SA 4.0

It's not just Fire Safety……….

WHAT HAPPENS NEXT?

PBUSSEY@AHMM.CO.UK

Paul Bussey RIBA, FIFireE, IMaPS, FIIRSM, FASFP

RIBA Academy

PRACTICAL CHALLENGES: SMOKE SYSTEMS

Andrew Gausden

EVACUATION STRATEGY AND THE ROLE OF SMOKE CONTROL

Delayed Evacuation Principles

- Where a fire occurs in a flat, the occupants of that dwelling evacuate, but occupants of all other dwellings can safely remain in their dwellings unless directed to leave by the Fire and Rescue Service or, they are affected by heat or smoke or, ultimately feel unsafe to remain in their individual flat
- A delayed evacuation strategy is highly reliant on smoke control within the common escape routes to maintain tenability limits within acceptable parameters for an extended period

Evacuation Phases

The design of purpose-built flats supports the three phases of the evacuation of residents in the event of fire:

These include:

- Phase 1: The evacuation of the dwelling
- Phase 2: Horizontal escape from the dwelling to a place of relative safety
- Phase 3: Vertical escape from a place of relative safety to a place of ultimate safety

EVOLUTION OF SMOKE CONTROL

Code of Practice 3 Chapter IV Part 1

- 1962 to 1990

Approved Document B Fire Safety

- 1992 to 2006

Approved Document B Fire Safety

- 2006 to date

BS 5588: 1990 Part 1 Code of practice for residential buildings

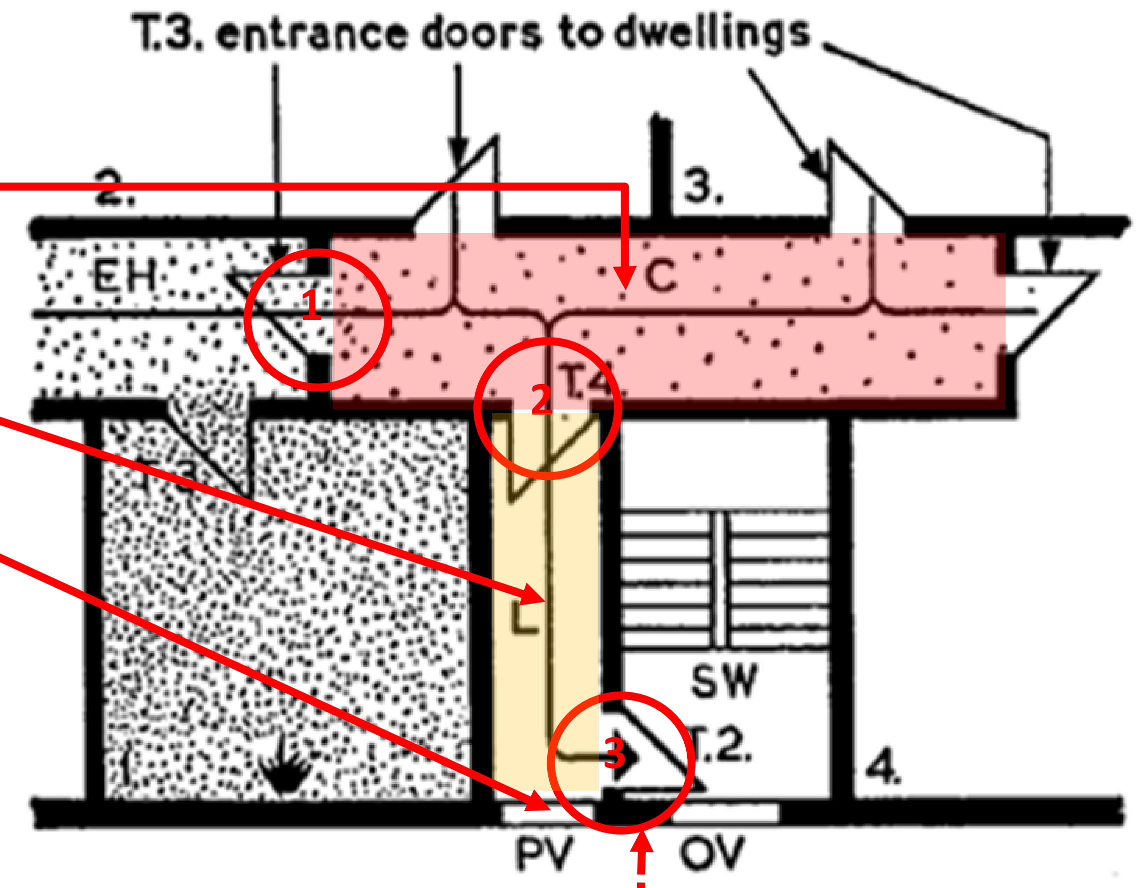
- 1990 to 2011

BS 9991: Fire safety in the design, management and use of residential buildings – Code of practice

EVOLUTION OF SMOKE CONTROL

Code of Practice 3 Chapter IV Part 1

- 1962 to 1990
  - Three-door protection
  - Smoke containment
  - Smoke dispersal*
  - Permanent ventilation
  - Outside wall required

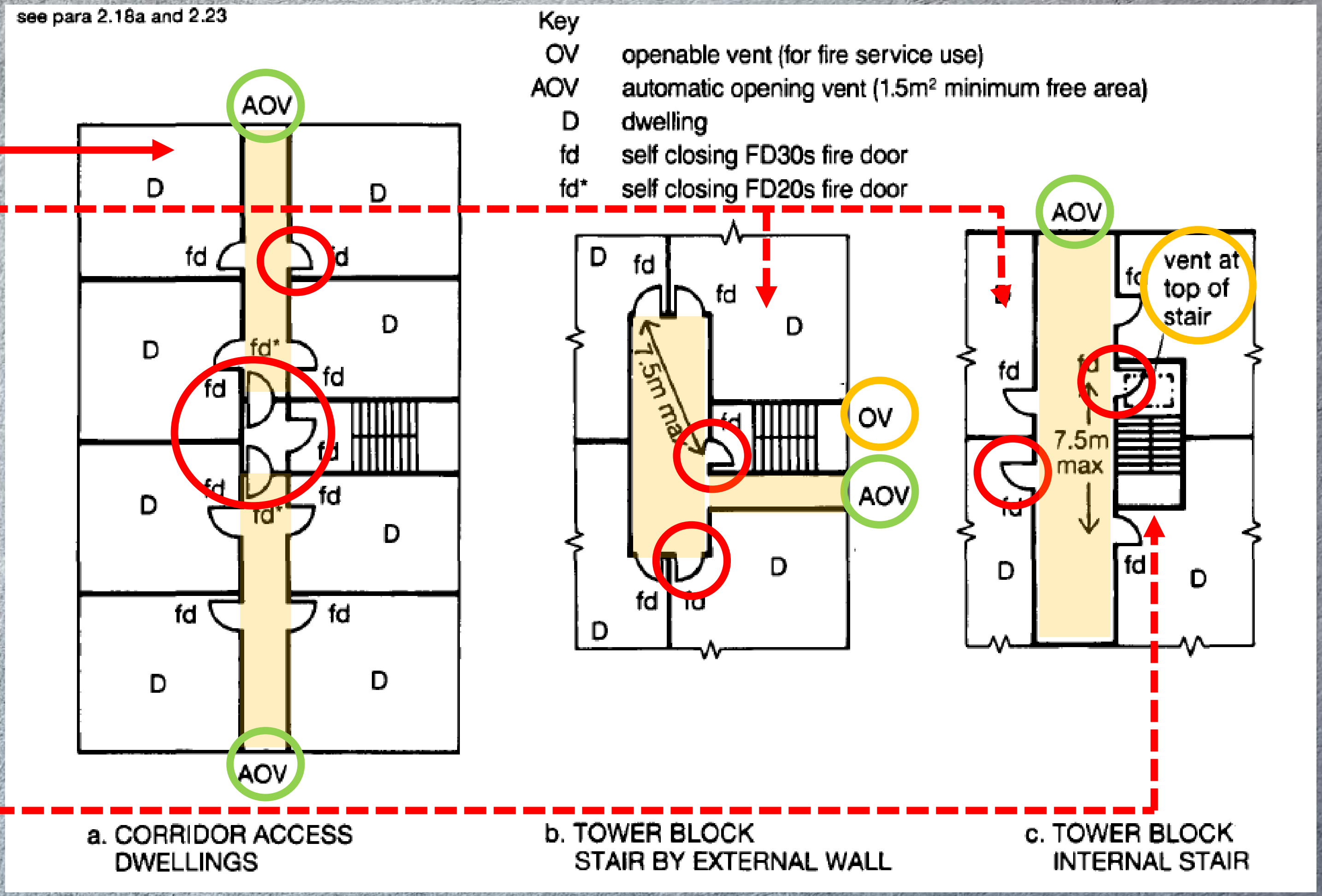


a. Safe

EVOLUTION OF SMOKE CONTROL

Approved Document B

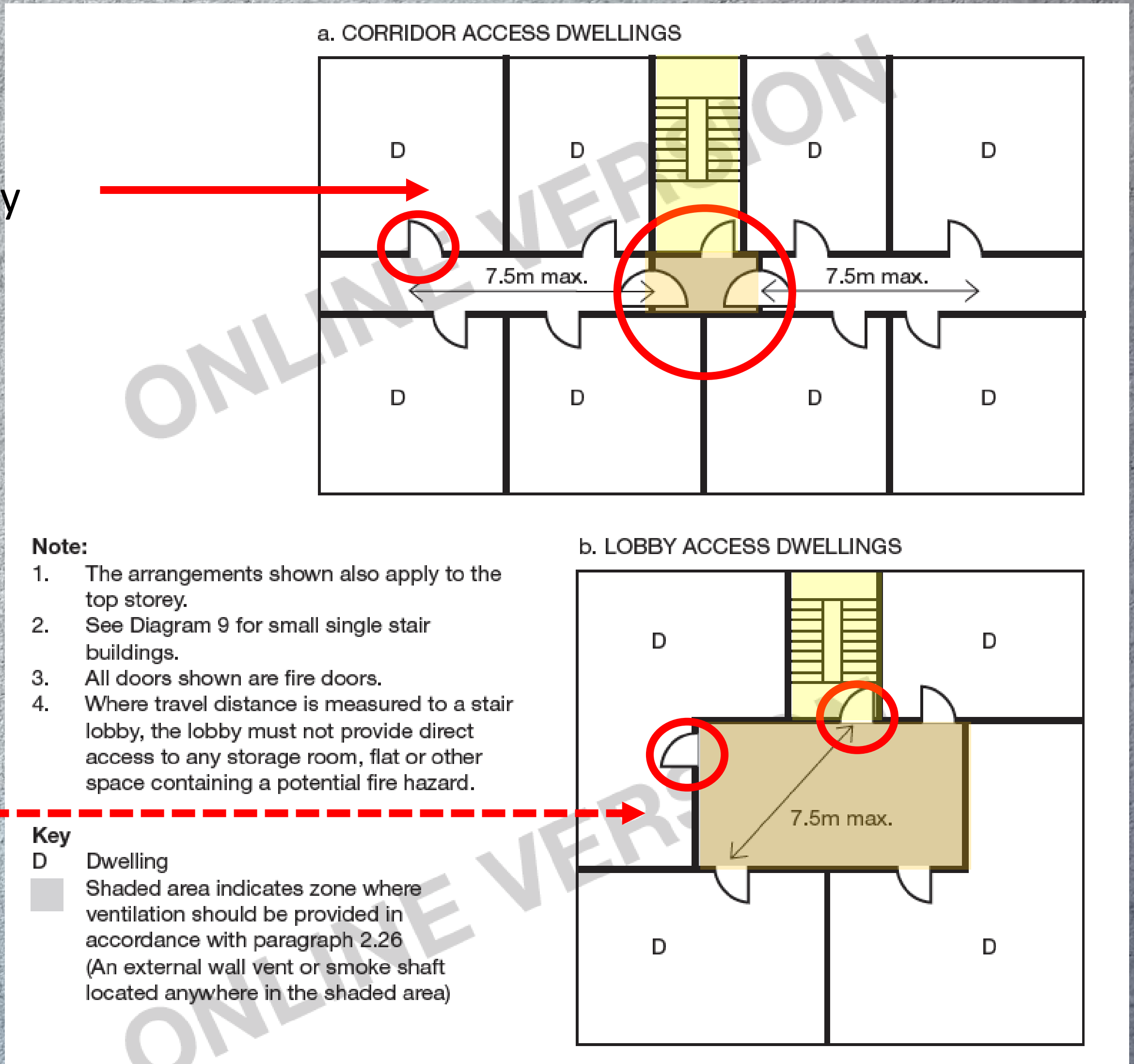
- 1992 to 2006
  - Automatic smoke control
  - Three-door protection & vented corridor
  - Two-door protection, vented lobby & openable stair vent
  - Stair no outside wall



EVOLUTION OF SMOKE CONTROL

Approved Document B Fire Safety Volume 2

- 2006 to date
  - Automatic smoke control, both lobby & stair
  - Three-door protection, corridor & ventilated lobby
  - Two-door protection & ventilated lobby
  - Outside wall or smoke shaft



SMOKE CONTROL SPECIFICATION

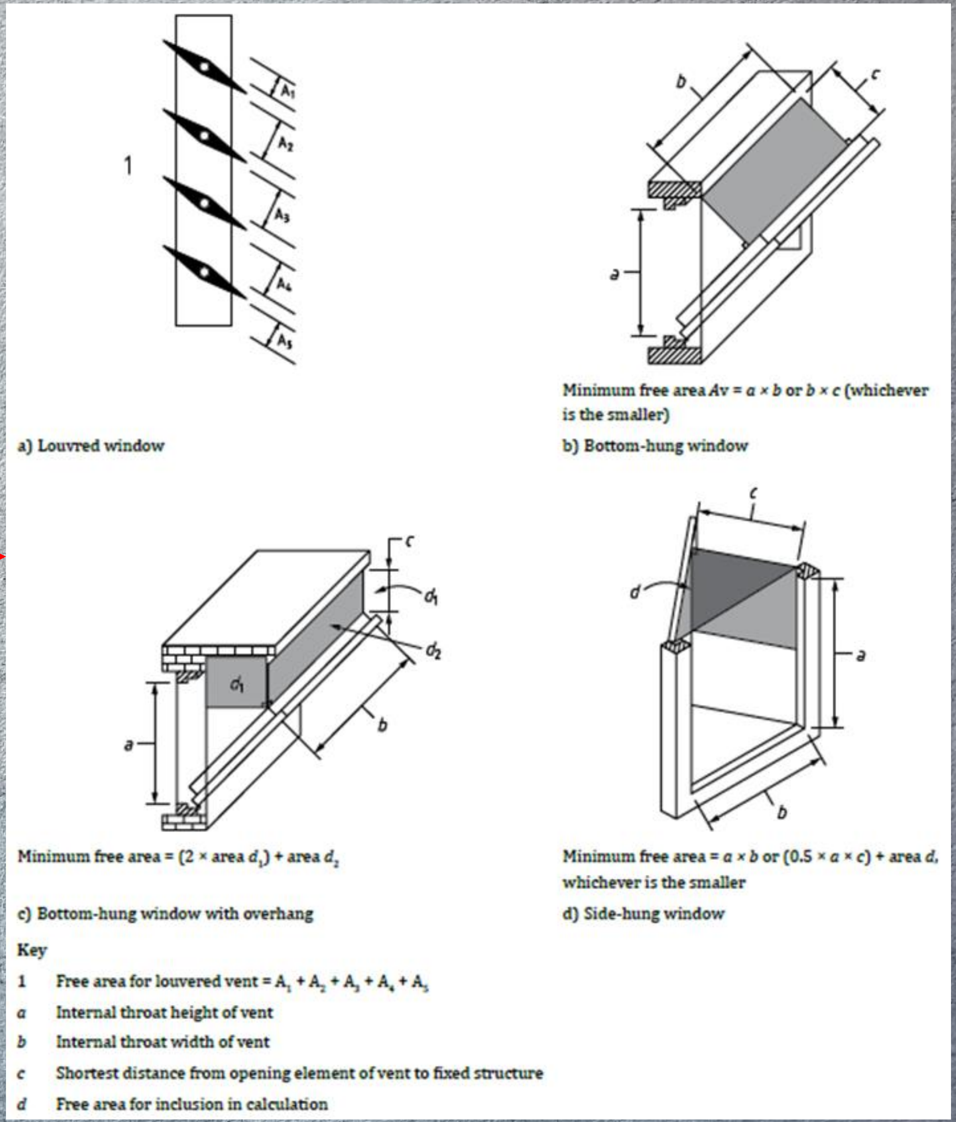
Smoke Ventilators

- **Code of Practice 3 Chapter IV Part 1**
  - Permanent vents: 15 sq/ft (1.4 m^2)

- **Approved Document B**
  - Lobby 1.5 m^2 AOV
  - Stair 1.0 m^2 AOV

- **BS 9991 2024**
  - Lobby 0.9 m^2 AOV
  - Stair 0.7 m^2 AOV
  - Aerodynamic free area

- **General Requirements**
  - Bottom or side hung
  - Sited as high as practicable

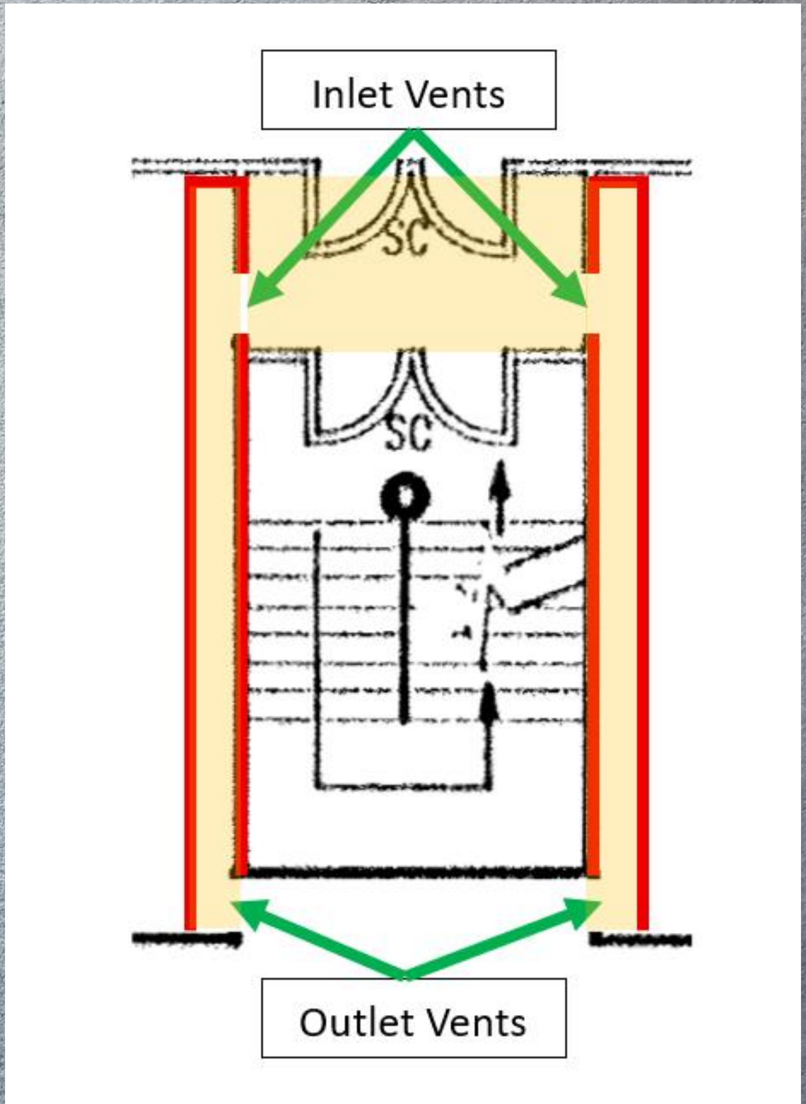


The Actual Reality

SMOKE CONTROL LEGACY BUILDINGS

Smoke Ventilators

- CP 3 Smoke Vents
- 15 sq/ft (1.4 m^2)



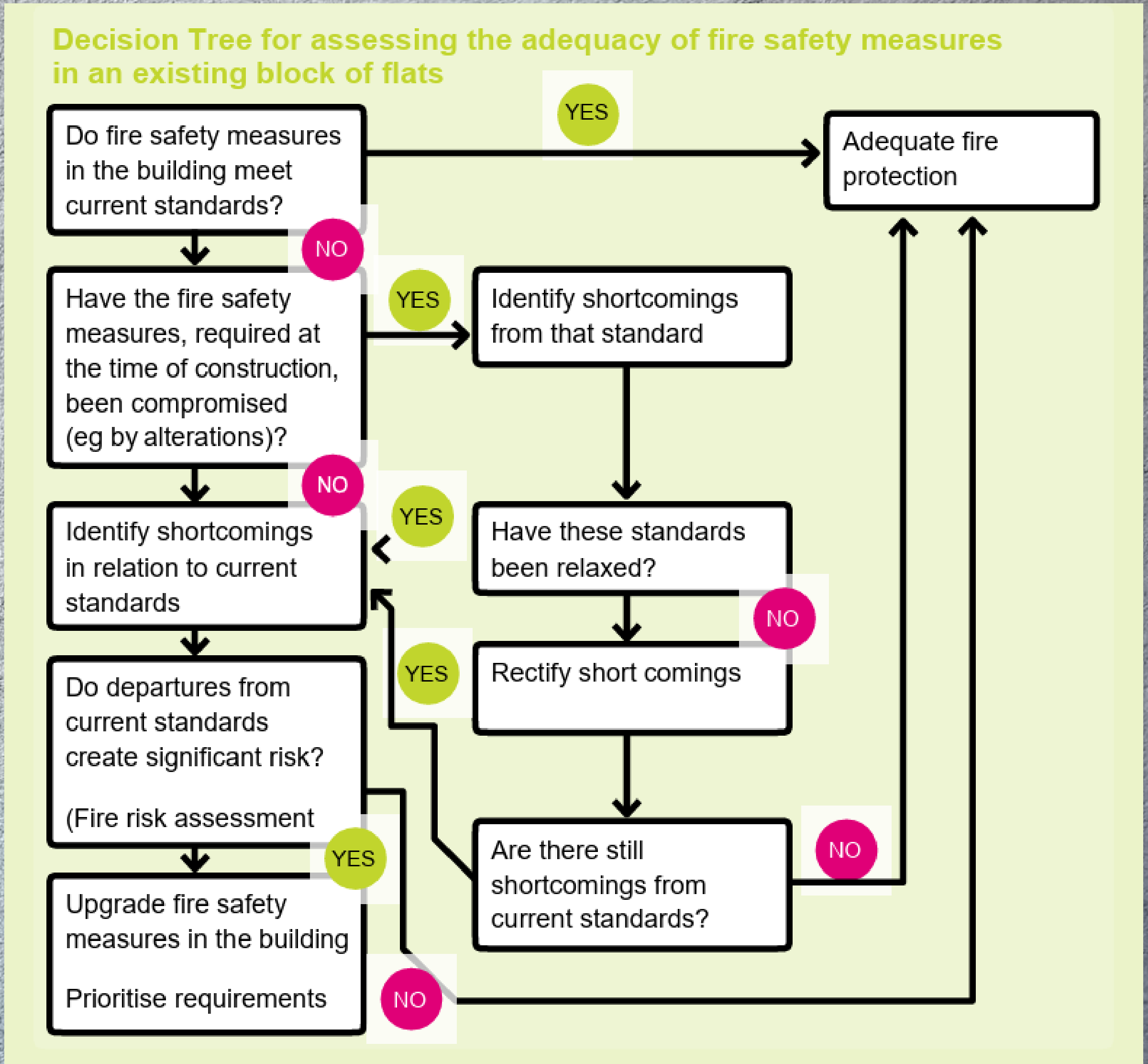
SMOKE CONTROL LEGACY BUILDINGS

Regulatory Reform (Fire Safety Order) 2005

- Purpose-built Flats Guide 2011 to date
  - Framework for carrying out a fire risk assessment to compare the standard of fire safety found in a particular block

Fire Risk Assessment or Fire Strategy

- Can we complete one without the other?




No smoking
Dry
Riser
Inlet

PRACTICAL CHALLENGES: SMOKE SYSTEMS

Thank You

Smoke Ventilation – Intent to Design

Steven Attrill - Product Specialist PDS Systems

Agenda

Smoke ventilation key concepts

Realities of concept into workable solutions

Translating to real building layouts

> **Smoke ventilation key concepts**

Realities of concept into workable solutions

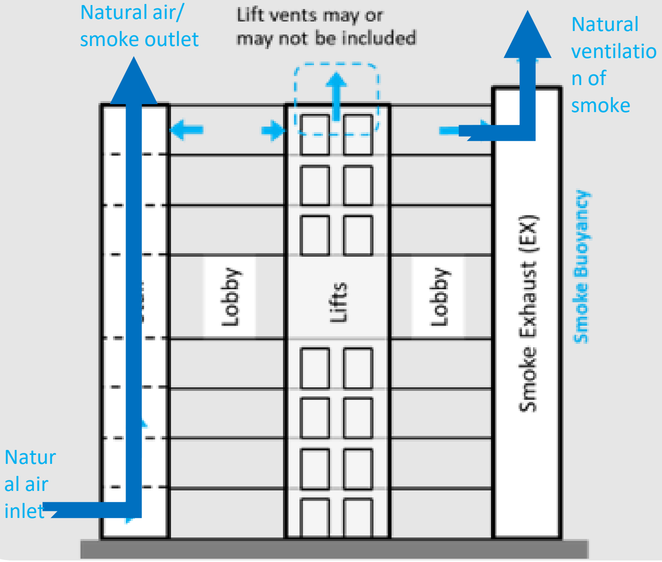
Translating to real building layouts

Smoke ventilation key concepts
- Intent / Basis of Design

1 **Natural System**

Aims to relieve smoke

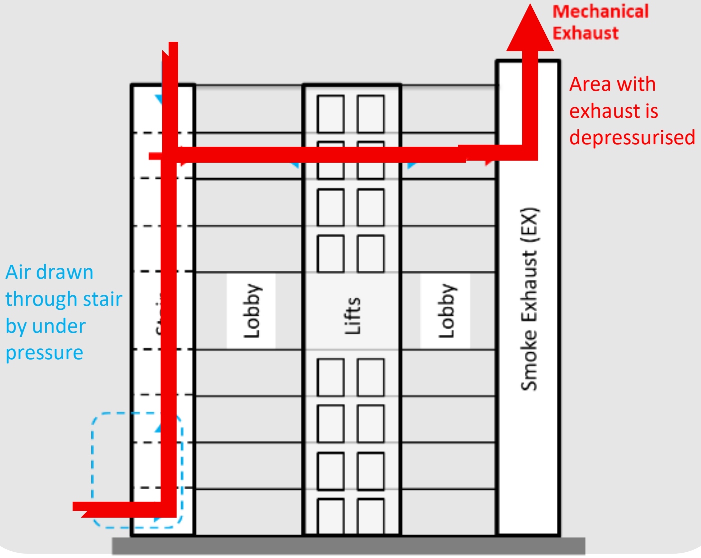
Keep the stair tenable (by encouraging stairwell to purge).



2 **MSVS** **(Mechanical Smoke Ventilation System)**

Aims to remove smoke.

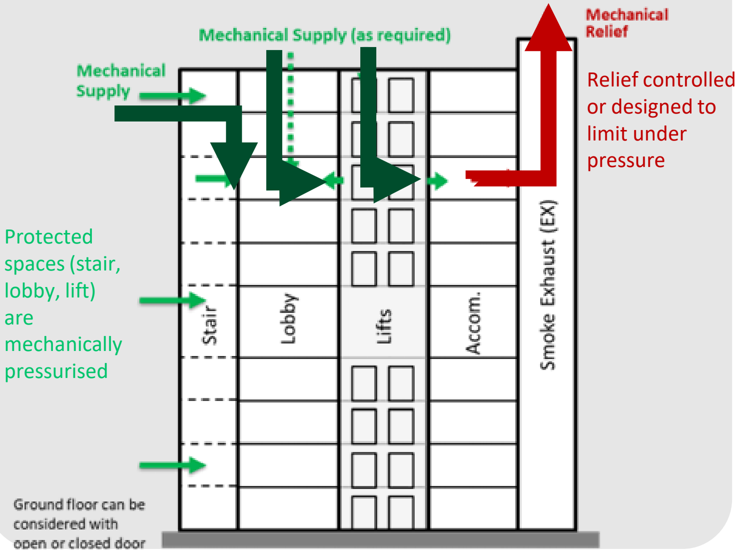
Keep stairs relatively smoke free (by pulling airflow from the stairwell).



3 **PDS** **(Pressure Differential System)**

Aims create protected spaces

which are free of smoke (via passive or active relief).



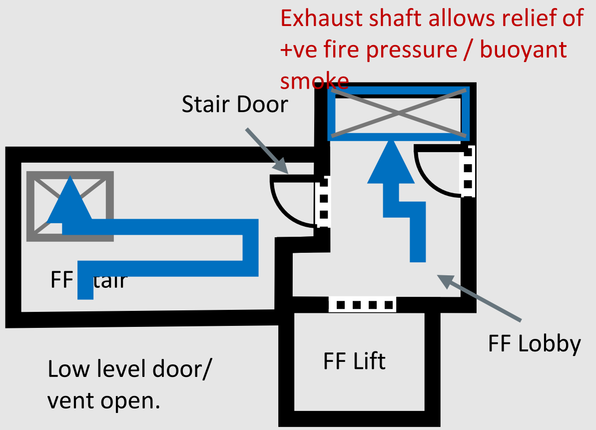
Code compliance does not excuse poor design.

EN12101-6:2022 & EN12101-13:2022 are not harmonised but BS versions are in use.

Smoke ventilation key concepts
- System Function

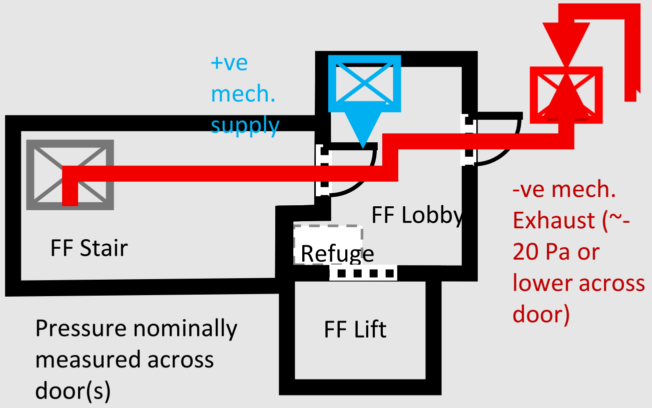
1 Natural System

- Exhaust shaft acts to relieve overpressure from the fire.
- Smoke inadvertently encouraged to move towards the escape route.



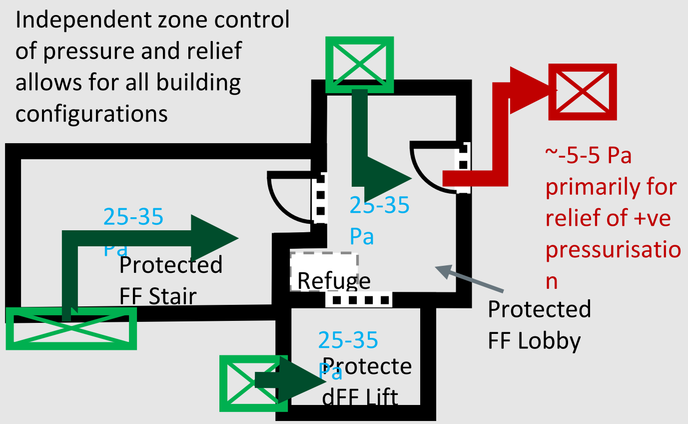
2 MSVS

- Mechanical exhaust nominally depressurises lobbies or corridors.
- Smoke usually pulled towards the escape route.
- Design of supply is key – mechanical preferred for lobby supply.



3 PDS

- Supply pressurises protected spaces.
- Exhaust shaft acts as relief only – aim is to reduce smoke movement.



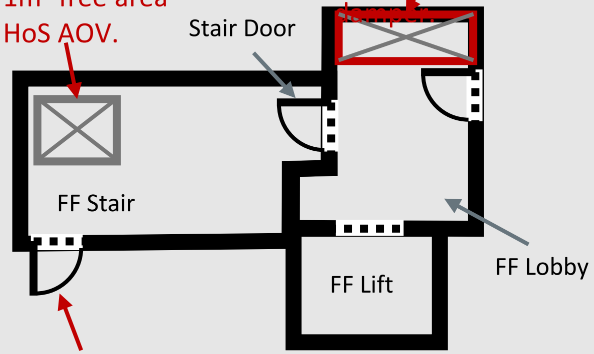
Notes for all systems:

- *Full air routes (inlet through to outlets) and so build quality is a key feature of all smoke control systems,*
- *Natural Systems and MSVSs rely on the stair being ~0 Pa or more, but environmental conditions can impede this.*

Smoke ventilation key concepts
- Conceptual office building <30m in total height

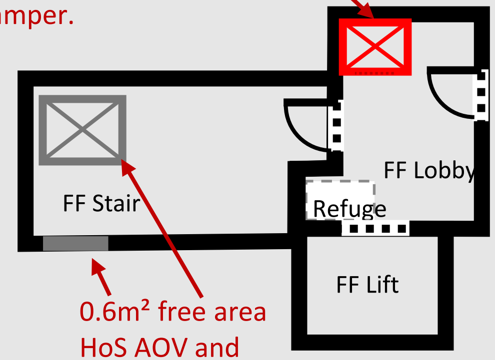
1 Natural System

- Sizing based on code and associated research.



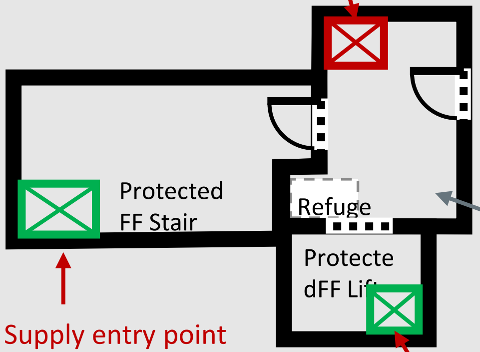
2 MSVS

- Sizing based partly on code but requires CFD – noting that CFD only answers a question and can't design the system.



3 PDS

- Sizing based on code, associated research and analysis.



Notes:

- *Shafts/ duct where air is mechanical (fan) driven should aim to limit flow rates to 8-10m/s, in natural shafts this is limited to 2-3m/s.*
- *Dampers/ inlets should be sized to prevent excess flow around persons/ equipment i.e. <5m/s stair/ lobby supply, <3m/s lift supply and <5-8m/s exhaust.*

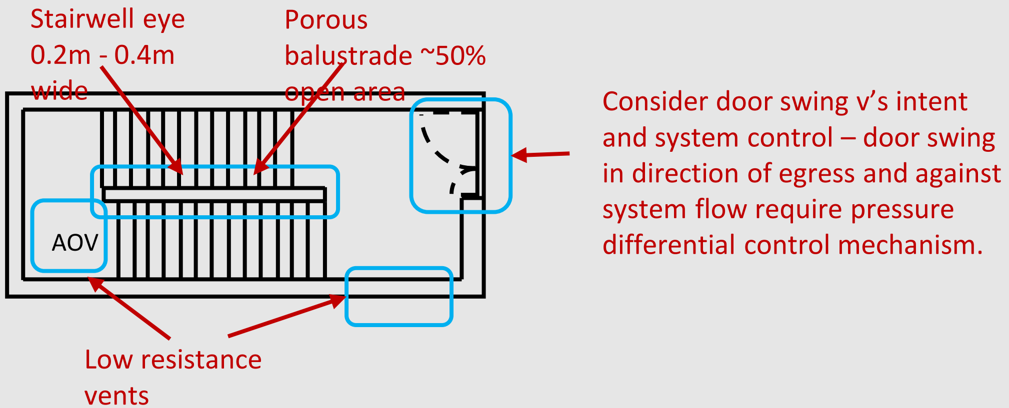
Smoke ventilation key concepts

> **Realities of concept into workable solutions**

Translating to real building layouts

Realities of concept into workable solutions

- Building Geometry
  - Stair design (particularly for Natural systems and MSVSs, but also single inlet PDSs)



For a ~10 storey building equivalent stairwell free areas should be ~2.4m² or higher, including the stair width, eye width, balustrade density and floor to floor heights (~2.8-3.5m).

- Building Effects

Realities of concept into workable solutions

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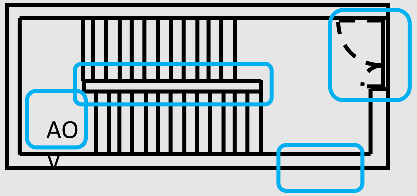
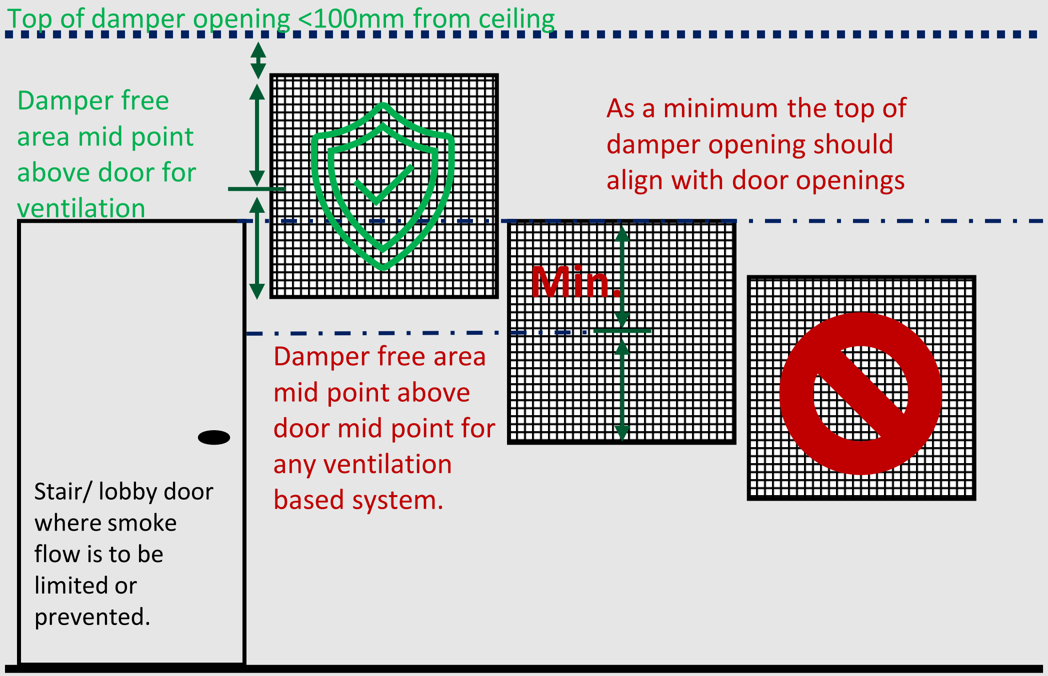


Equivalent free areas ~2.4m² or higher.

  - Lobby design and smoke control damper install



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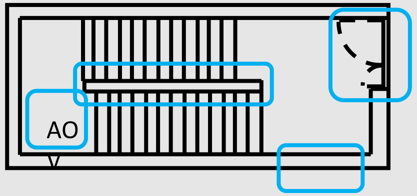

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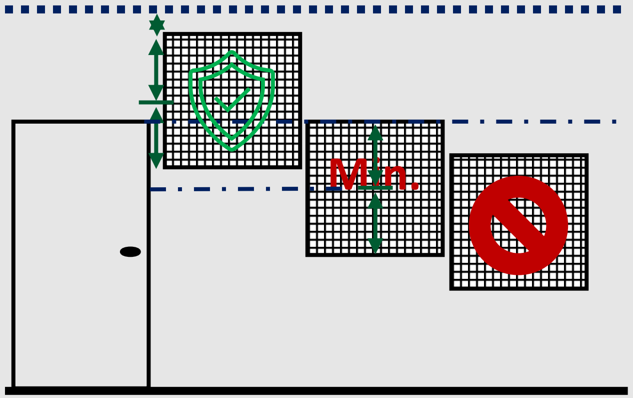

Active area of the dampers should be in the smoke layer for ventilation based systems.

  - Smoke shaft v's duct
    - Concrete & Blockwork are accepted.
    - BS EN 1366-8:2004 smoke extraction ducts are the compliant solution (nominally steel or reinforced gypsum.)

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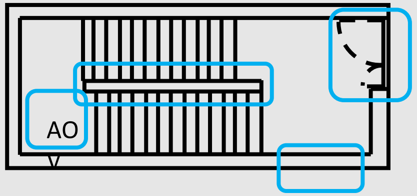

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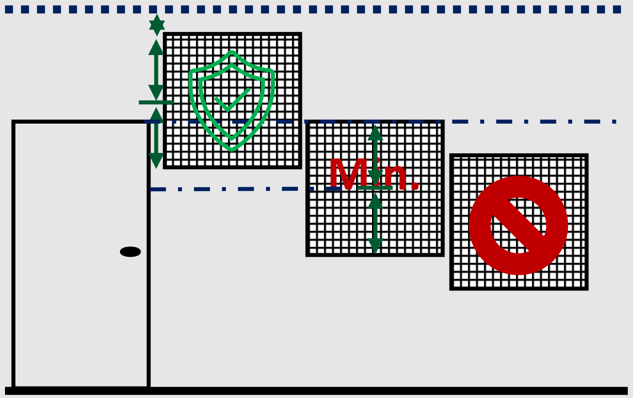

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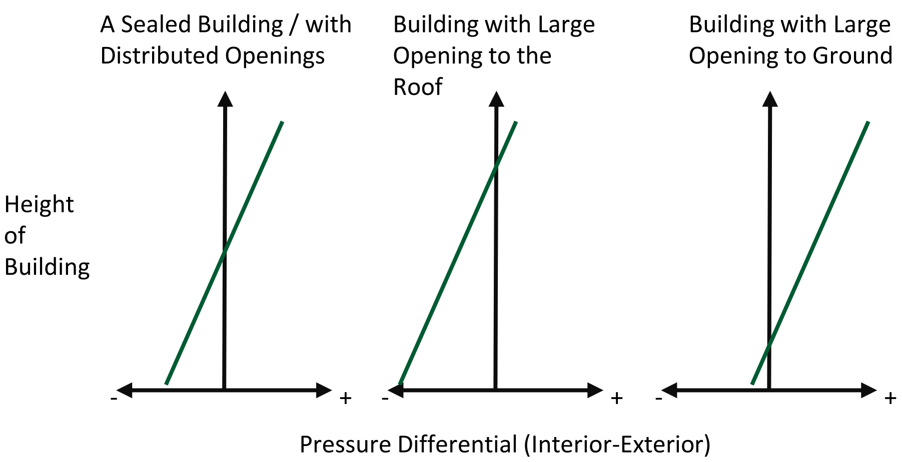
- Building Effects
  - Thermal conditions (Stack effect)

Stack effect is driven by Building Height and Interior-Exterior Temperature Difference

Theoretical Stack Effect Distributions through:



- Stack Effect will be Present in All Vertical Shafts in All Buildings where there is an Internal-External Temperature Difference. Hence, stack effect should be considered in all buildings, but particularly where naturally ventilated shafts are utilised – A combination of options may be required in buildings over 60m in height.
- Detailed Analysis can be Conducted in Support of Physical System Tests – as a guide, a 50m Tall Building with a Temperature Difference of 10-20°C (e.g. Interior = 21°C, Exterior 1-11°C) could Experience a Stack Effect Driving Force of 20-45 Pa

Realities of concept into workable solutions

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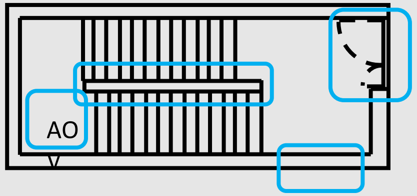

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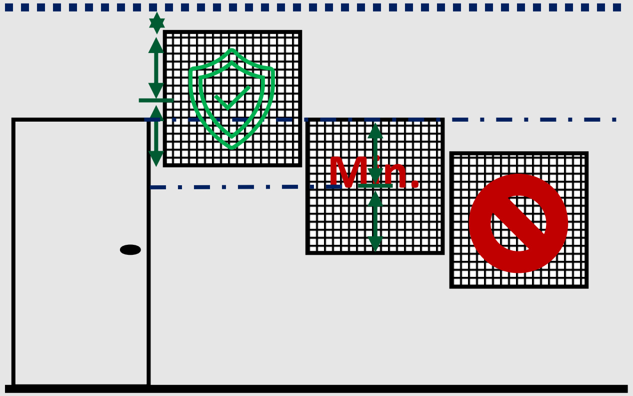

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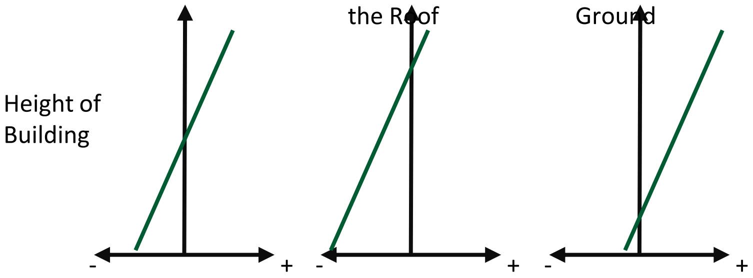
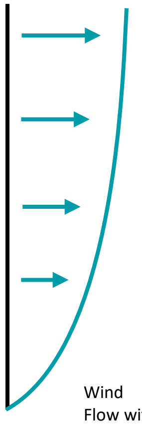
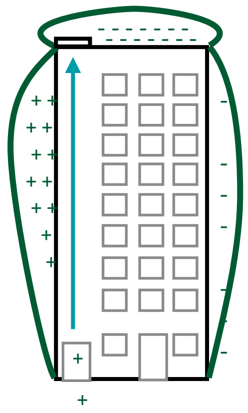
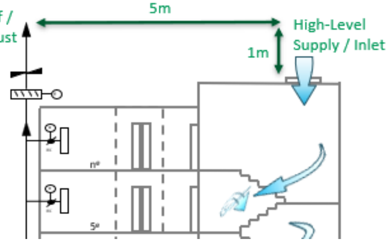


  - Wind conditions (Pressures & Smoke Re-entrainment)

Theoretical Distribution of Wind with Height / Across a Building:







  - Important to Consider Relative Positioning of Openings (Doors/ Vents).
  - Analysis can be Conducted in Support of Physical System Tests.

Realities of concept into workable solutions

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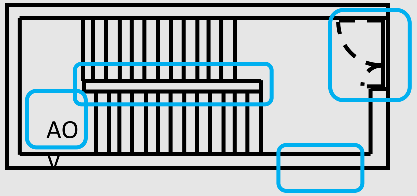

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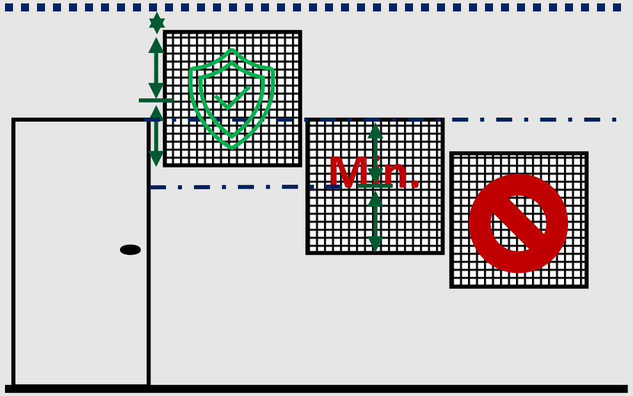

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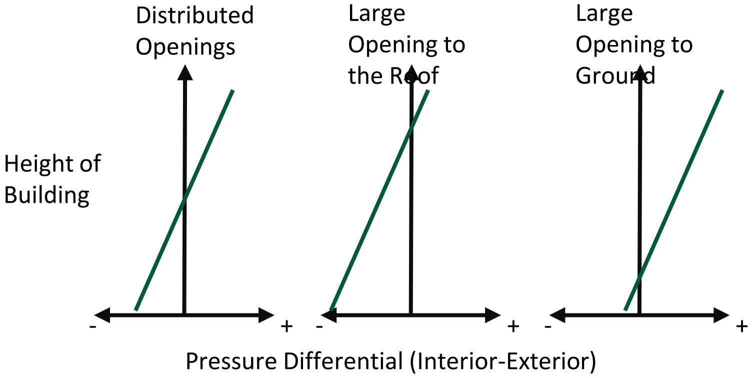

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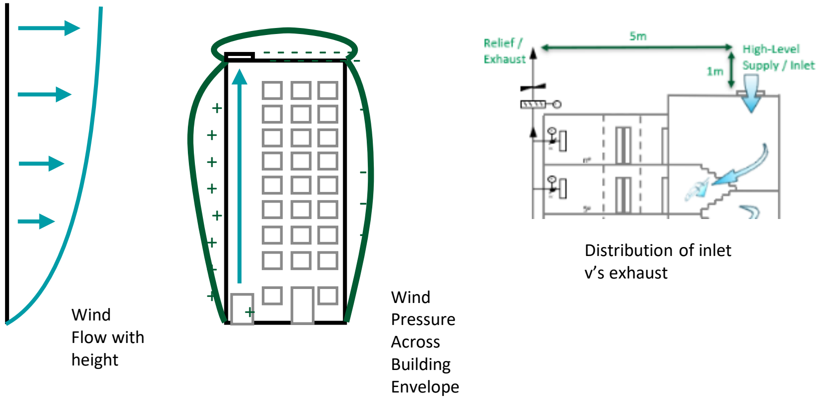


  - People
    - Space limitations/ requirements in stairs and lobbies.
    - Refuge are positioning and conditions.
    - Part M door closer limitations.
    - Firefighter access, including riser access.

Smoke ventilation key concepts

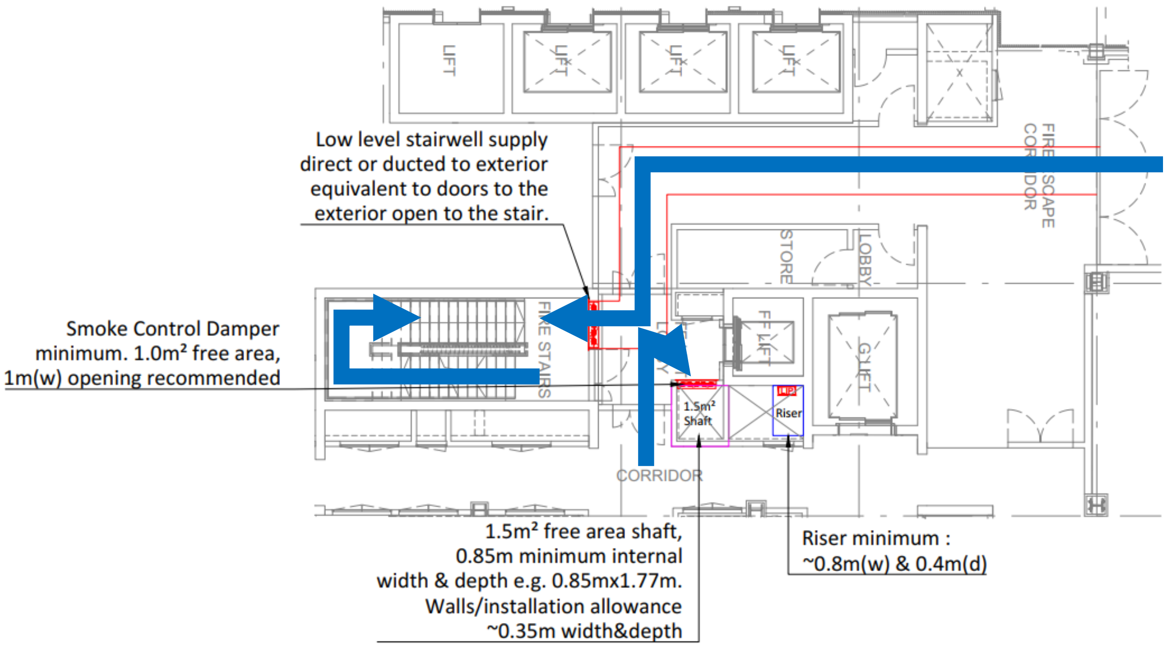
Realities of concept into workable solutions

> **Translating to real building layouts**

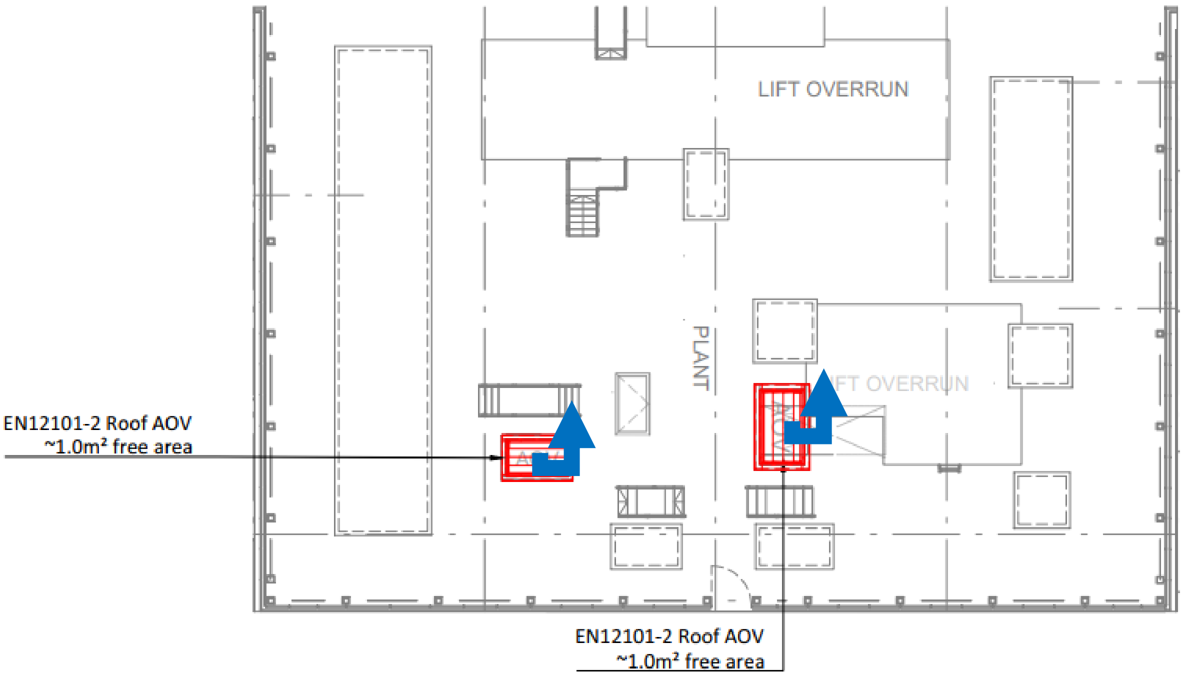
Translating to real building layouts
- Installation drawings for office building <30m in total height

Natural System

Ground Floor - Natural SVS



Roof Level - Natural SVS



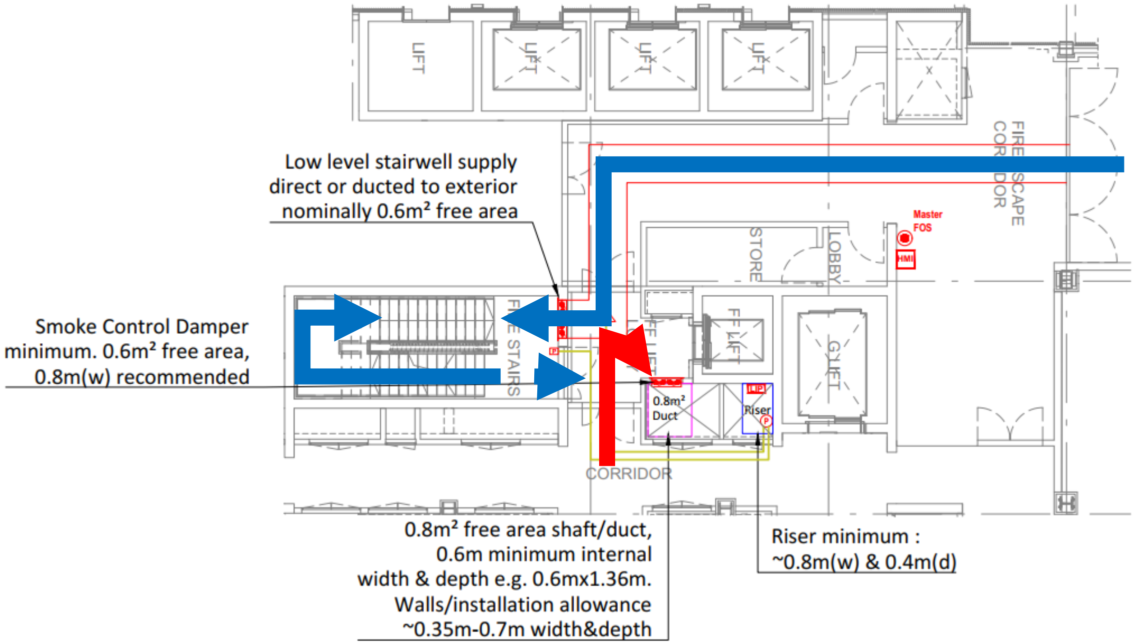
Notes:

- *Although both the stair and exhaust AOVs are expected to exhaust smoke, these are uncontrolled vents and should be positioned to prevent smoke re-entrainment between shafts.*

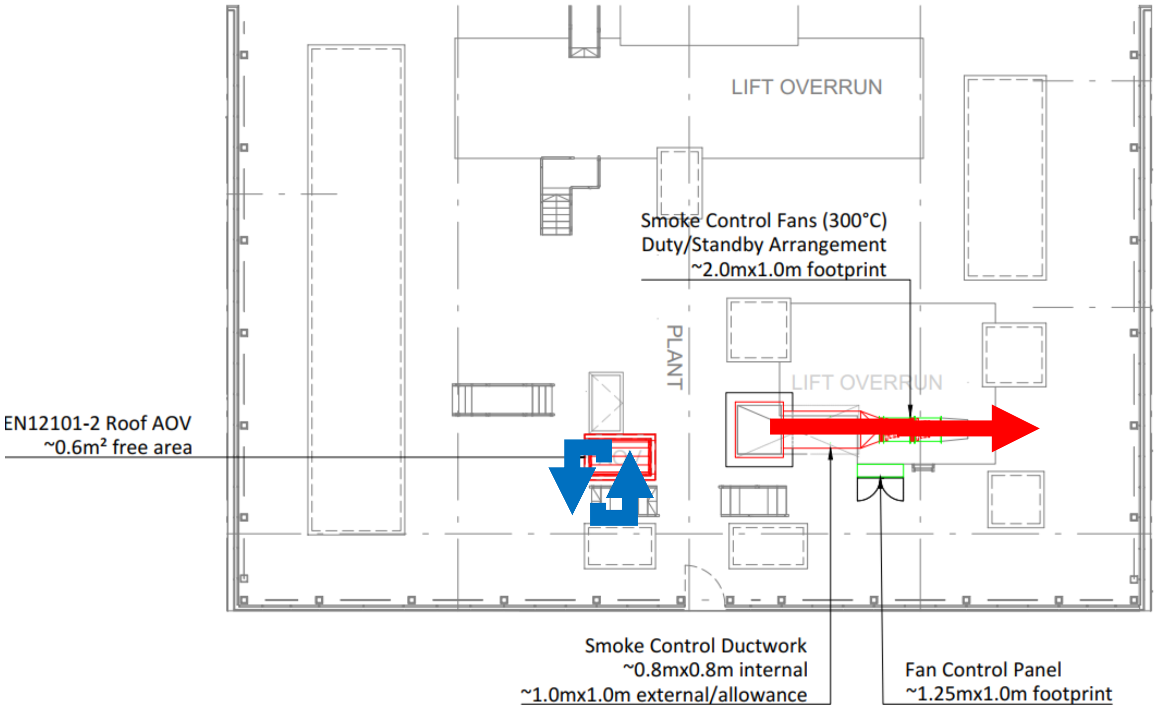
Translating to real building layouts
- Installation drawings for office building <30m in total height

MSVS

Ground Floor - MSVS



Roof Level - MSVS



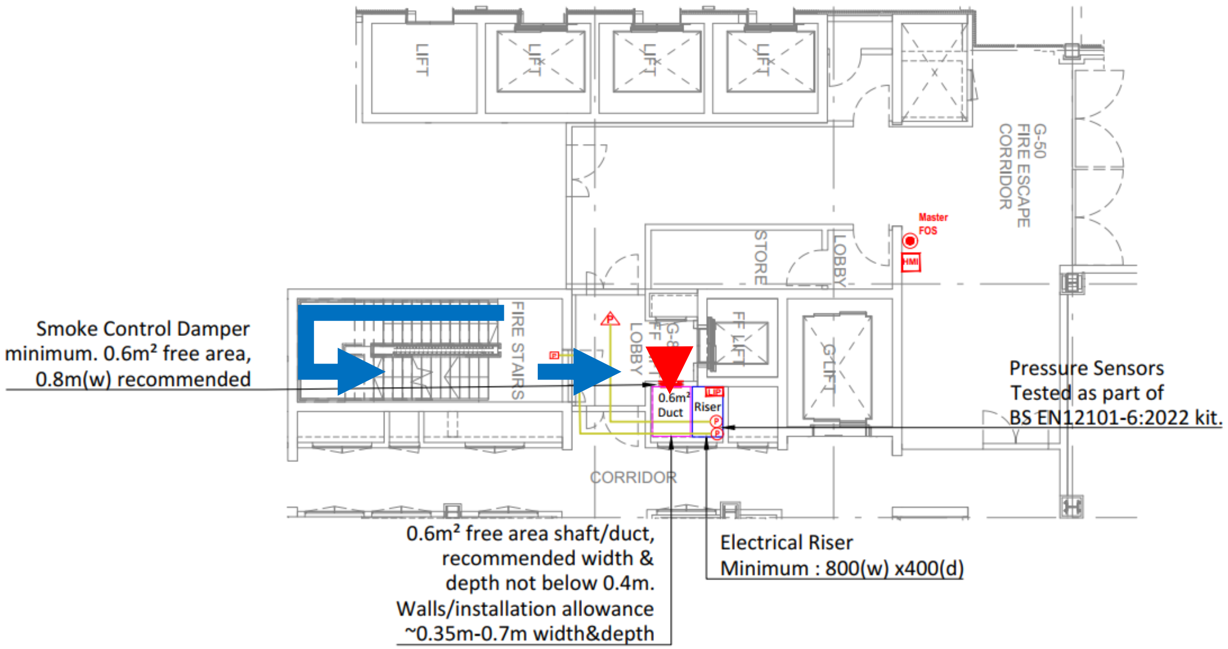
Notes:

- *Positioning of the HoS AOV and exhaust should account for distancing (5m+ horizontal and 1m+ vertical recommended), wind direction and building design.*
- *The intent is for the HoS vent to act as an inlet, however this will be impacted by environmental conditions and have strong negative pressures pulling air from the stair – having a low level inlet helps provide air but does not remove the potential pressure issues.*

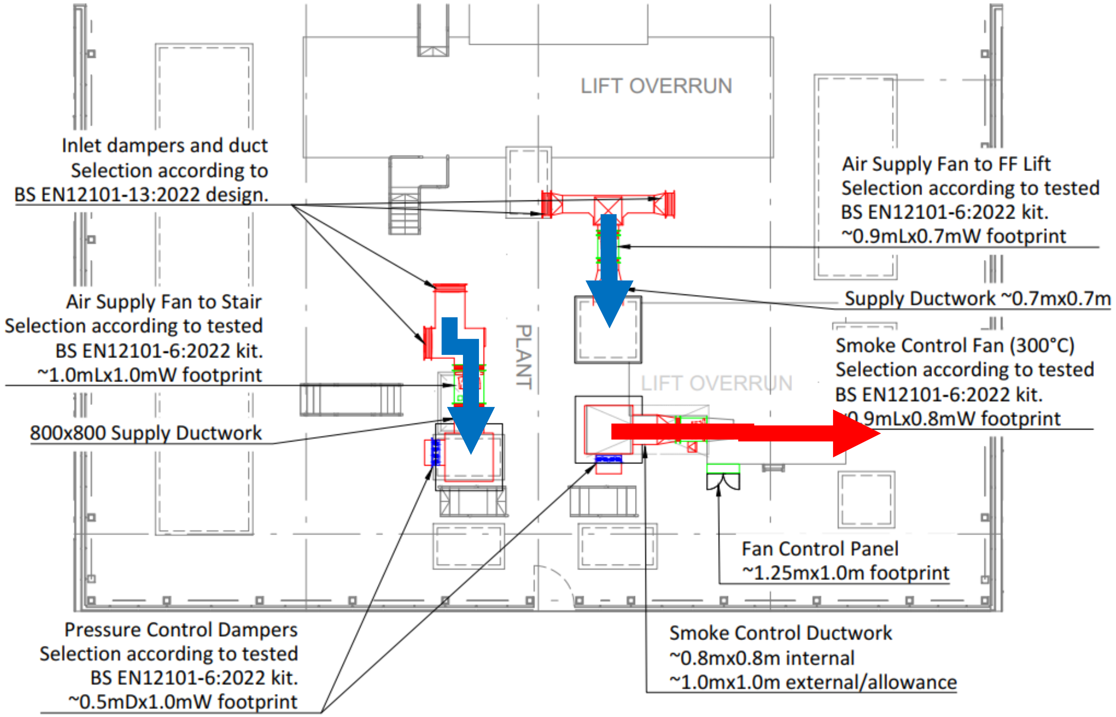
Translating to real building layouts
- Installation drawings for office building <30m in total height

PDS

Ground Floor - PDS



Roof Level - PDS



Notes:

- *Positioning of the supply and relief should account for distancing (5m+ horizontal and 1m+ vertical recommended between supply and relief),*
- *Environmental conditions should be considered for the selection of an appropriate kit e.g. with/ without pressure control hot gas damper.*

Translating to real building layouts

Next Steps

Installation examples for:

- Residential building <**30m,**
- Office and Residential buildings **30-60m**
- Office and Residential buildings **60-100m**
- Buildings **over 100m**? Custom designs based on location?

Collaboration and Coordination with Architecture, Mechanical, Fire, Services.

This needs to be driven from early stages through to final design, installation and commissioning.

From intent to design to installation and commissioning systems must be understood and reviewed

Questions?

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Smoke Control Shafts:

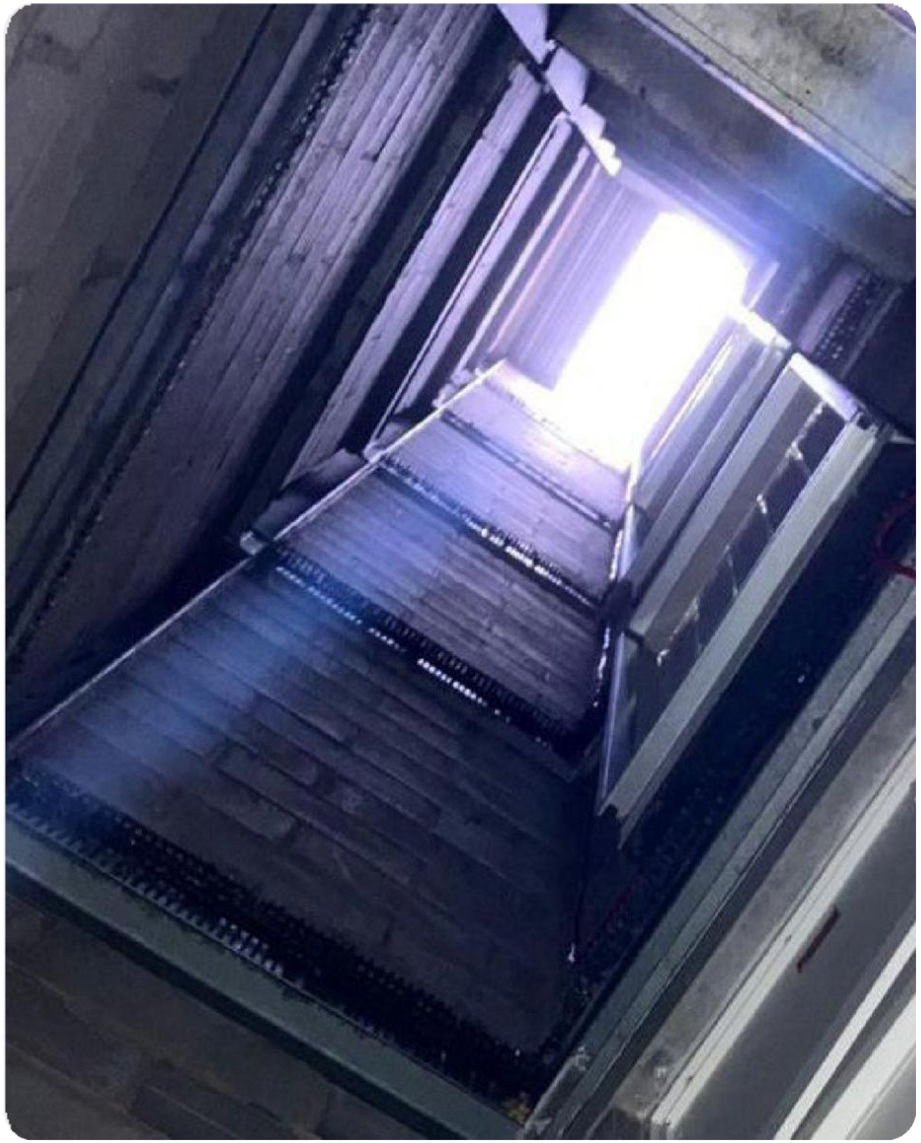
The Hidden Design Risk in Early-Stage Design

Smoke Control Shafts

Why smoke shafts are causing late-stage project risk

- Smoke shaft design is often **deferred** or **assumed**
- Increasing scrutiny (BSA, GW2, documentation)

Result:
late design changes → delays → cost



Greater focus on tested, evidenced solutions

BS 9991:2024

F.5.1 Smoke shafts

F.5.1.1 General

Any smoke shaft that penetrates a fire compartment should have at least the same level of fire compartmentation as that which has been breached.

F.5.1.2 Construction

Smoke control shafts should be constructed from class A1 materials.

NOTE It can be desirable to fully render brick or blockwork shafts, or to line brick, blockwork or flexible wall construction shafts with a DW144 steel duct.

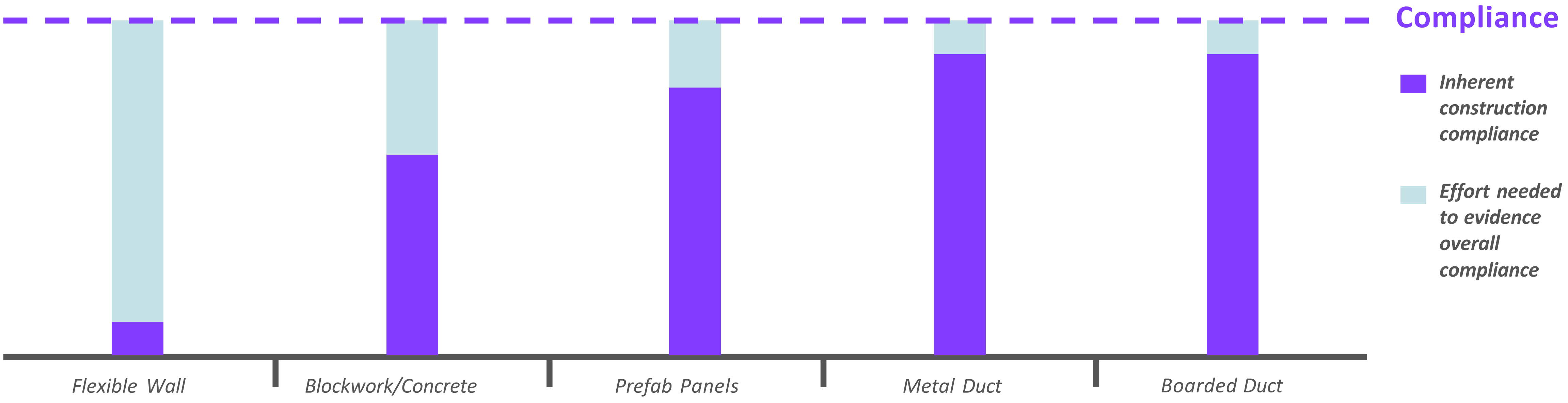
All shafts/ducts should leak not more than 3.8 $m^3/h/m^2$ of the surface area of the shaft/duct at 50 Pa negative pressure, and should be smooth and flush internally.

If smoke control ducting is used as an alternative to a smoke control shaft, it should conform to BS EN 1366-8.

There isn't o

Smoke Control Shafts

Smoke Control Shaft Construction

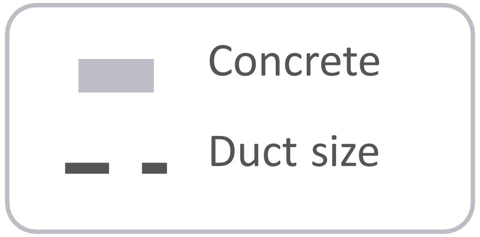


Smoke Control Shafts

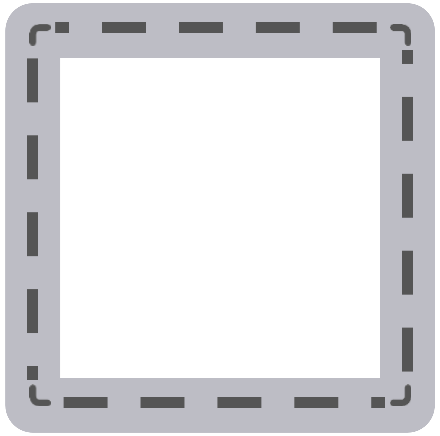
Each option drives different building constraints

Solution	Space impact	Buildability	Programme risk
Concrete	Medium	Excellent	High
Metal duct	High	Complex install	Medium
Prefab panel	Low	Excellent	Low
Boarded duct	Low/mediu m	Complex install	Medium

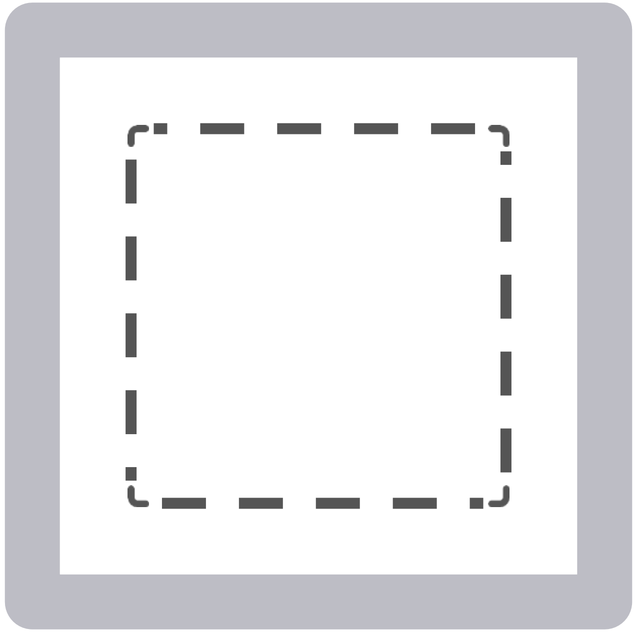
The space problem nobody spots early enough



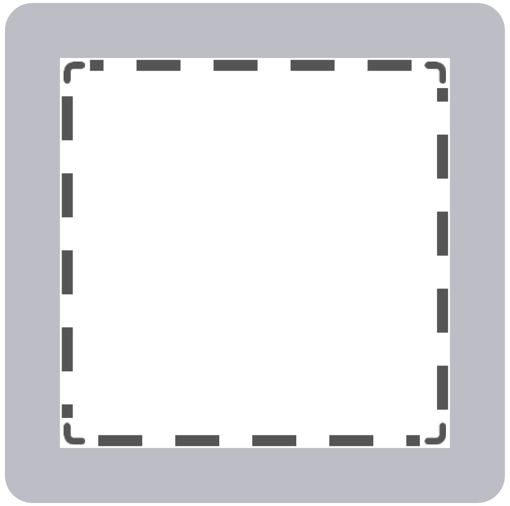
Concrete:



Metal duct:



Boarded duct:



Designing

Blockwork/concrete:

- Hard to achieve tolerances
- Requires sealing / testing

Metal duct:

- New trades required
- Difficult installation

Boarded duct:

- Moisture / H&S risk

Prefab panel:

- Compliance risk

What happens when this isn't considered early?

- Re-design of shaft geometry
- Re-submission at Gateway 2
- Delays to programme
- Clash with:
    - Structure
    - Services
    - Escape strategy

How to eliminate the risk: 3-step approach

Step 1:

Engage early (stage 2/3)

→

Step 2:

Align shaft strategy with full system (not in isolation)

→

Step 3:

Select solution based on risk appetite and constraints

Early engagement vs. late decisions

Implications of late design decisions:

- Redesign required Programme
- delays
- Cost uplift
- Increased compliance risk

Make the shaf

- Different shaft types = different risks
- Space + buildability must be considered together
- Early decisions reduce:
  - Cost
  - Programme risk
  - Compliance uncertainty

Main implication: The smoke control damper specified determines the shaft possibilities.

Thank you.

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Get in touch:

hello@sertus.uk | 01483 269999 | sertus.uk