

8TH INTERNATIONAL TALL BUILDING

FIRE SAFETY CONFERENCE
TUESDAY, 3RD DECEMBER 2024

DAY 2

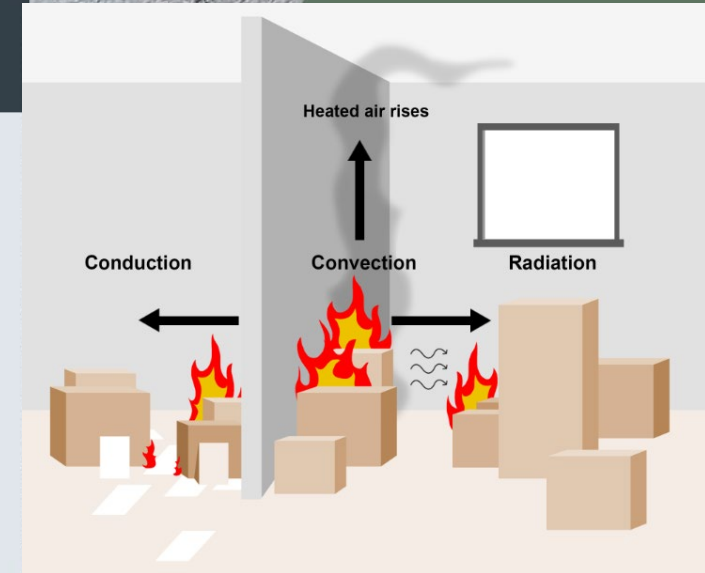
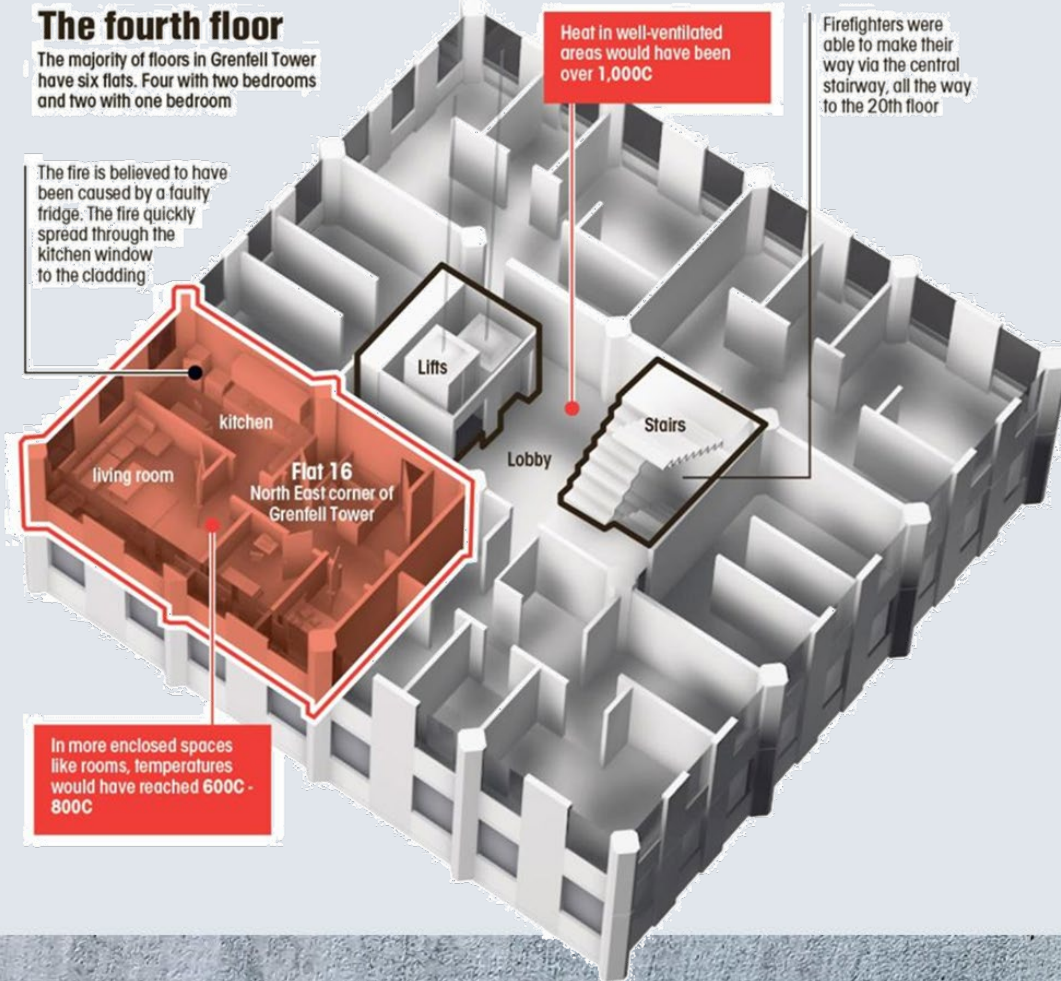
**10:10 KEYNOTE 3 –
PAUL BUSSEY:
ARCHITECTS VIEW OF
TWO STAIR CHALLENGE**

| Paul Bussey RIBA, FIFireE, IMaPS, FIIRSM, FASFP

RIBA Academy



Understanding the fire spread process



European Classifications

R = Resistance to collapse

E = Integrity – resistance to fire penetration

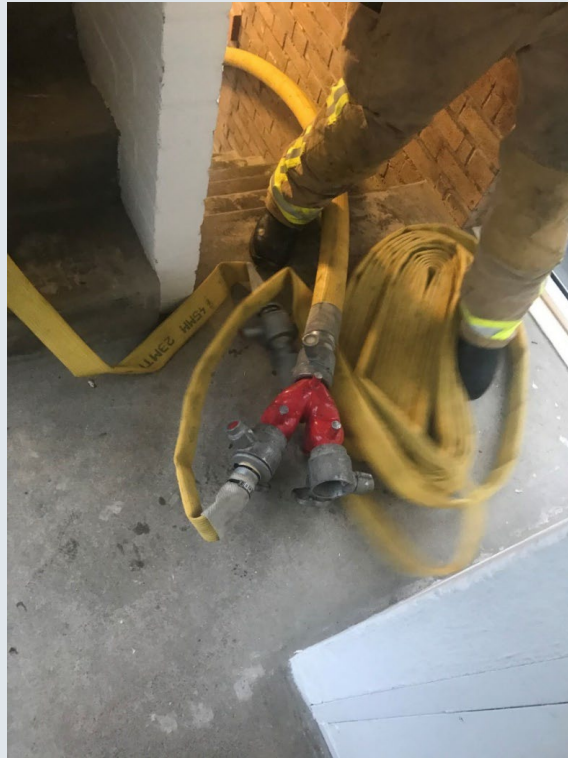
I = Insulation – resistance to transfer of excessive heat

A firefighting practice drill in a 10 storey social housing block

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



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



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



It is impossible to carry out any evacuation whilst fire-fighting is on going in ONE staircase

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

Stairwell Protection Teams R.I.C.E

A Collection of Papers 2020 by Paul Grimwood PhD, FIFireE Kent Fire and Rescue Service



Twin breaching dry riser in protected lobby not stair

Kent FRS 150mm Rising Mains in New Single Stair Residential Buildings

Kent Fire and Rescue Service have hydraulically calculated and flow tested the new 150mm twin outlet rising fire mains. These have demonstrated a single 750 L/min jet or two jets of 650 L/min each at 50 metres high are achievable using 51mm hose.



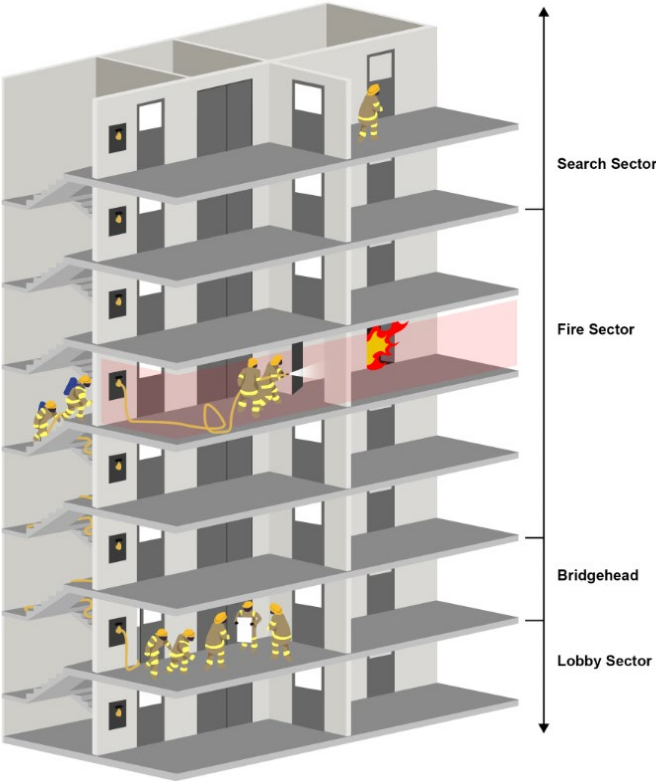
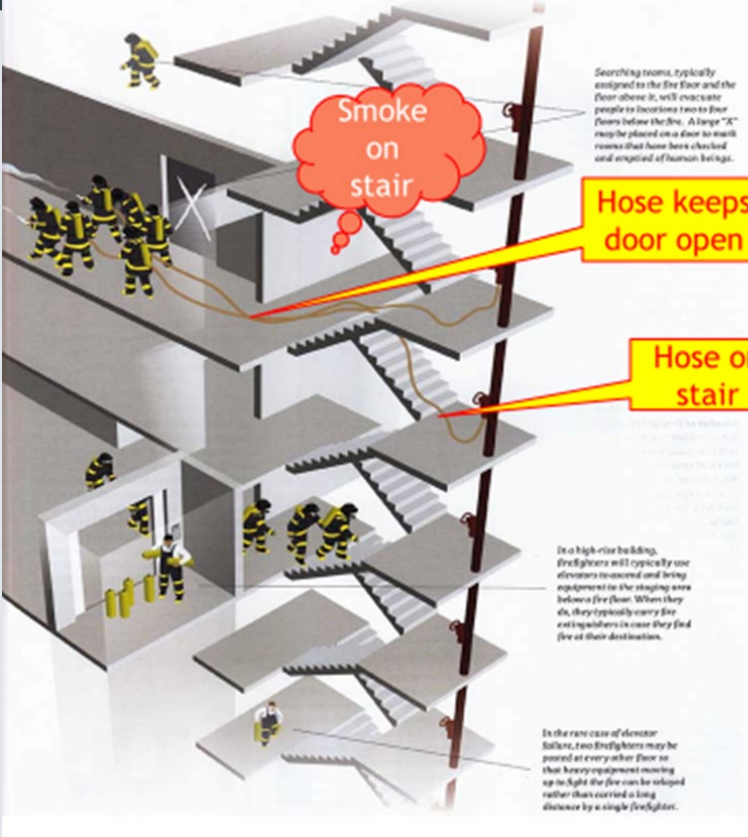
Leaving the stairs unprotected and failing to search the stairs early on will inevitably lead to failure and life loss



'We were about to enter the apartment with a hose-line on the fourteenth floor when the windows failed and the wind blew in, forcing the fire directly at us and into the stair behind us. The BA Entry Control board a floor below us in the stair melted to a blob. There were injuries There were burns The stair door was still open on the hose and heavy smoke was heading upwards.'

Author's experience
London 1990

Understanding actual fire fighting activities whilst designing





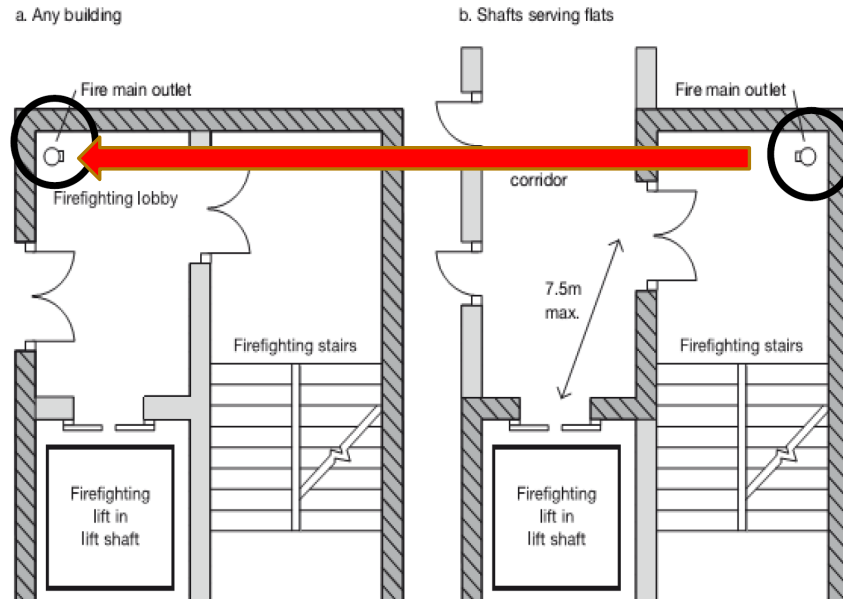
A German fire chief once said that the most important room in a fire building is the stairwell! He is right. Stairwell protection is a critical strategy in a successful firefighting operation, in an occupied building involved in fire.

Avoid hoses on the stairs as trip hazard & doors propped

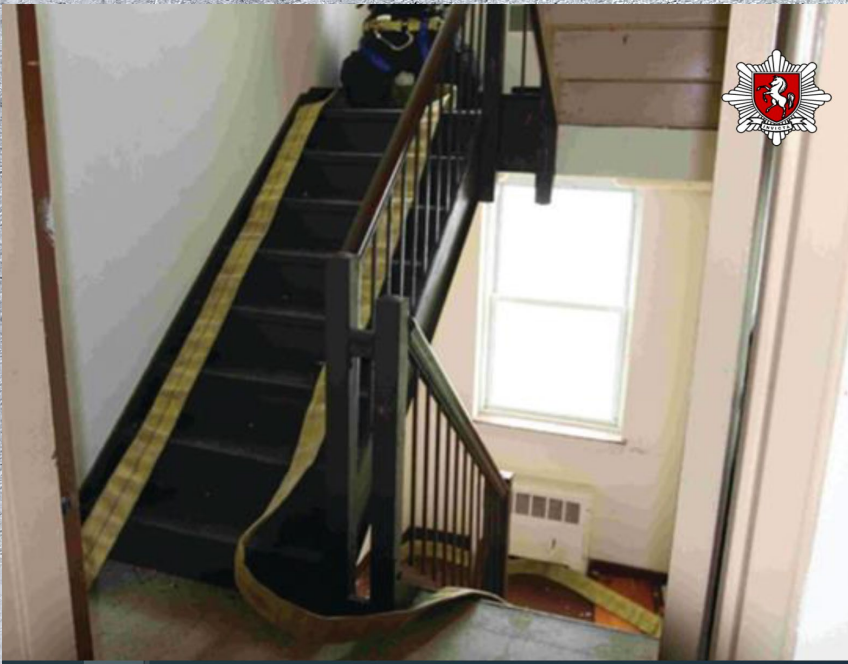
Twin breaching dry riser in protected lobby NOT stair

Diagram 52 Components of a firefighting shaft

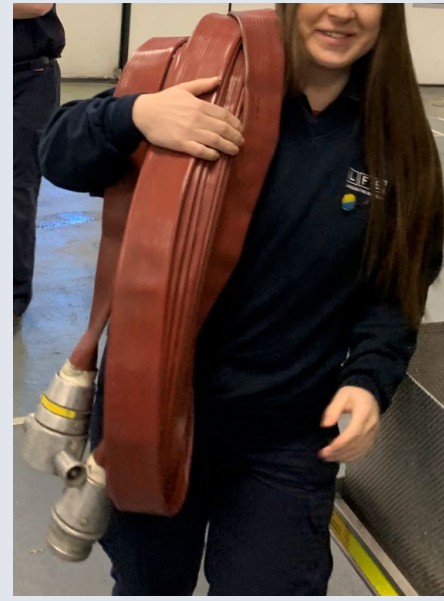
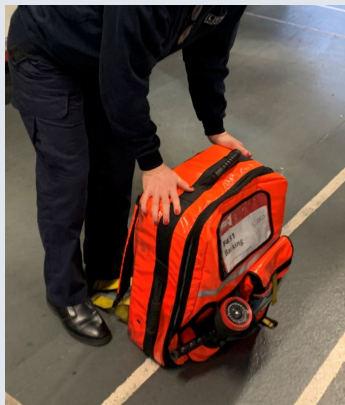
See para 17.1



Evacuation whilst firefighting ongoing!



Fire-Fighting kit to carry-up



Kent FRS stairwell protection strategy

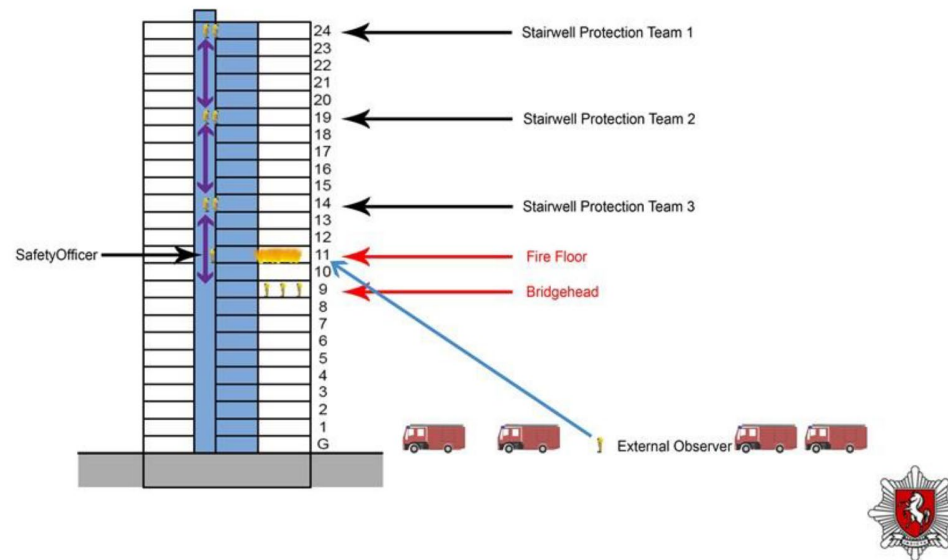
Roles of 'Stairway Protection Teams'

- **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.

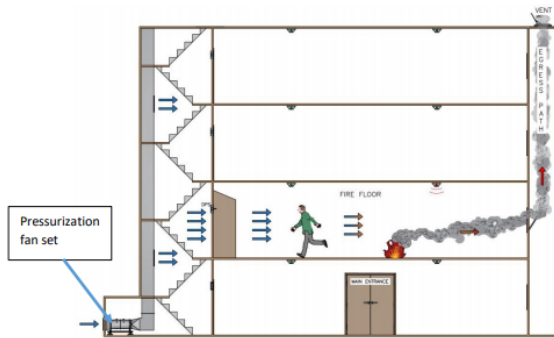
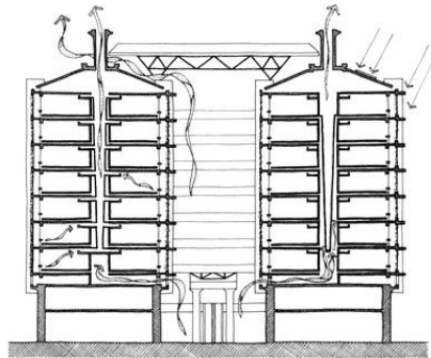


Figure 3 – Simplified diagram with pressurization fan located at ground or basement level

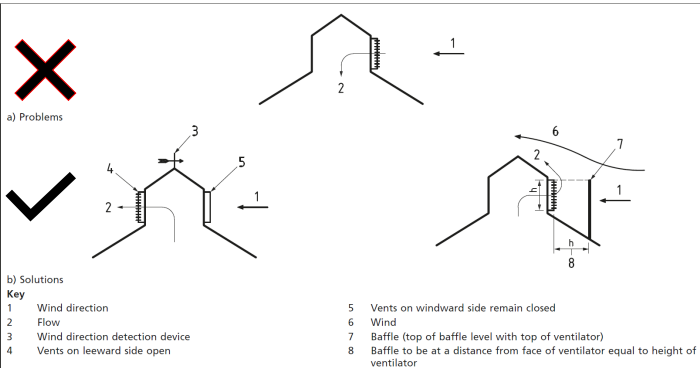


Section, Eastgate Building, Harare, Zimbabwe, Pearce Partnership

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



Figure D.2 Louvred ventilators installed in the vertical



© The British Standards

BRITISH STANDARD

BS 7346-8:2013



BSI Standards Publication

Components for smoke control systems
Part 8: Code of practice for planning, design, installation, commissioning and maintenance

Understanding “vulnerable persons” evacuation



No such thing as “general needs” housing

Every Housing Block is effectively a Care Home!

‘DOMICILE CARE’



Understanding “vulnerable persons” evacuation



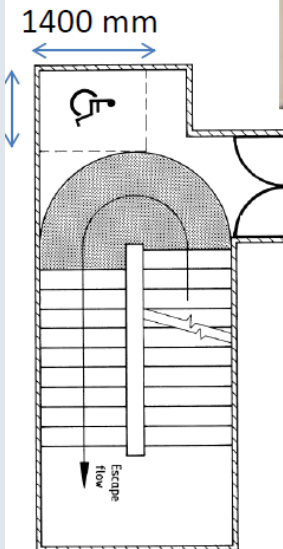
Is this an adequate landing refuge?



Fire Fighters ascending?



Wider stairs, especially where single?



Can we make further improvements?



These design criteria need further validation or change

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?

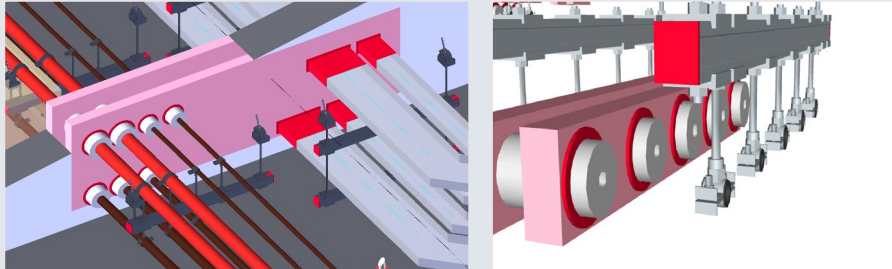
The London Plan

Publication London Plan
December 2020

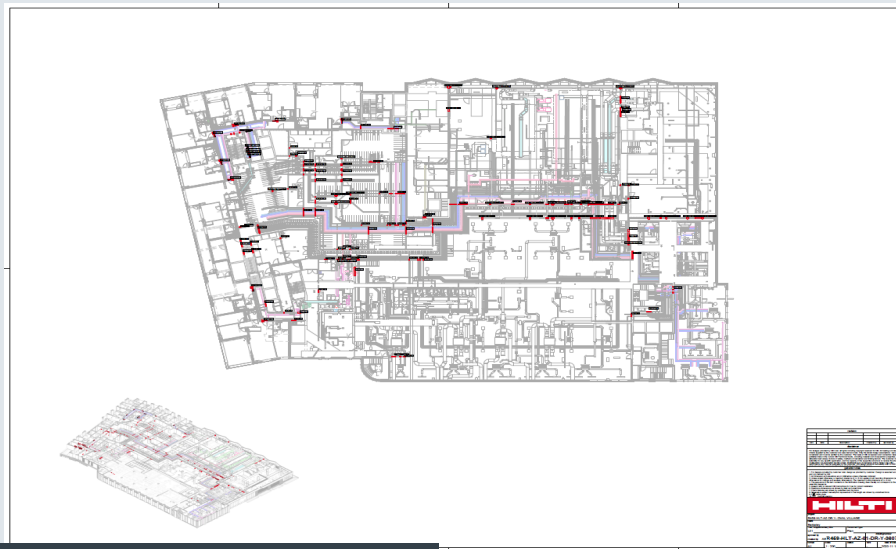
The Spatial Development Strategy
for Greater London



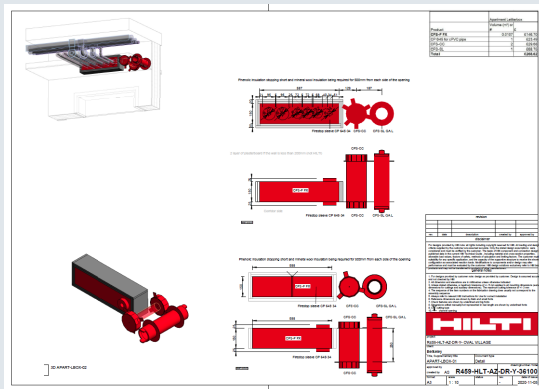
EXAMPLE: BIM design service deliverables & firestopping



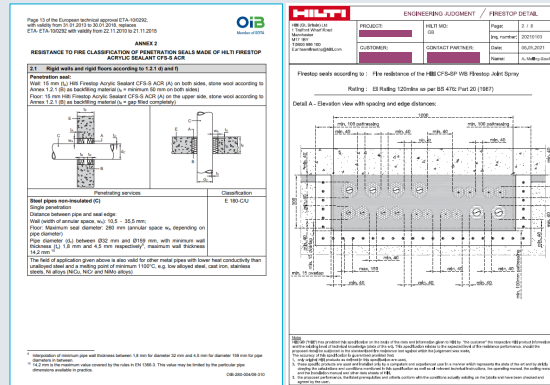
BIM Modelling



Plan View Drawings



Shop Drawings



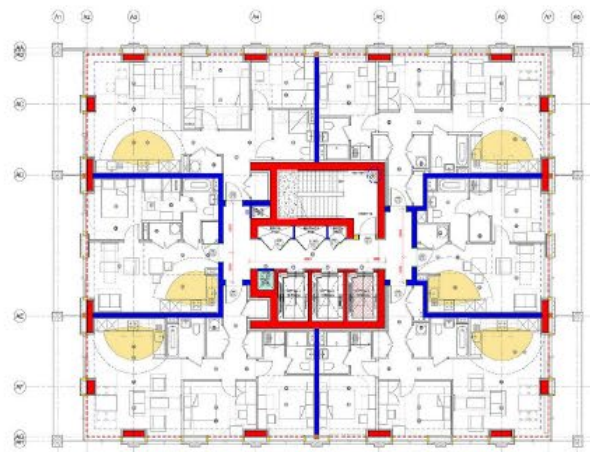
Approvals & Reports

Letterbox	Numbers	Dimensions			Volume m ³	Total Volume m ³
		Height mm	Width mm	Length mm		
APART-LBOX-01	316	150	300	587	0,026415	6,34714
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-B01-1	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-E1	10	150	200	1100	0,033	0,33
RISER-SHAFT-LBOX-A1	7	150	200	610	0,0183	0,1291
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	0,091
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-E1	9	150	200	595	0,01785	0,16065
RISER-SHAFT-LBOX-E2	9	150	200	440	0,0132	0,1188
RISER-SHAFT-LBOX-E3	9	150	200	625	0,01875	0,16875
Total	479					

Bill Of Materials

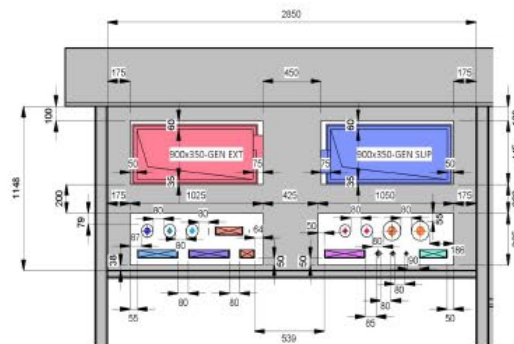
Firestopping Overview

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



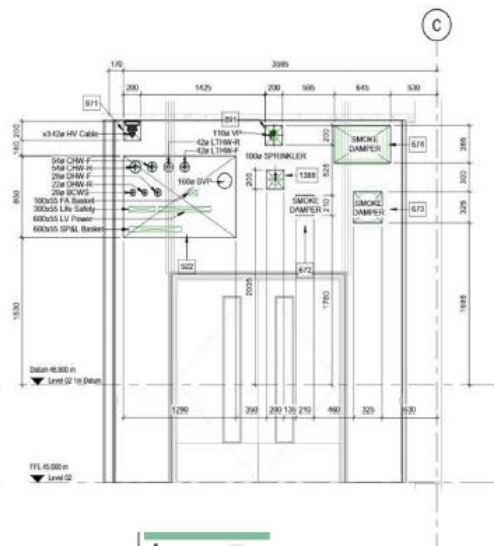
3

Spatial
Coordination



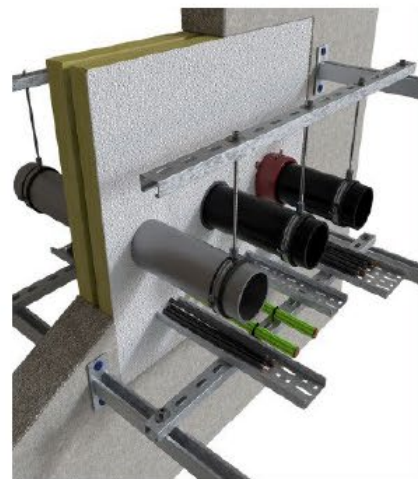
Passive Fire Knowledge Group

RIBA Stage 5 & Gateway 2-3
Construction & recording



4

Technical
Design



Example mixed-service penetration seal solution

Safety Critical Elements

CIOB
The Chartered
Institute of Building

RIBA
Architecture.com

A Guide to Managing
Safety-Critical
Elements
in Building Construction

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.....

RIBA
Architecture.com

EXISTING HRRB'S IN OCCUPATION Typical Single Staircase & Related Legislation CENTRAL CORE BLOCK (eg Grenfell Tower)		CURRENT HRRB'S UNDER DESIGN / CONSTRUCTION Typical Single Staircase		FUTURE HRRB'S TO BE DESIGNED Anti-knock or Under New Future Regulations Typical Single Staircase	
APPROVED DOCUMENT B	APPROVED DOCUMENT B	APPROVED DOCUMENT B	APPROVED DOCUMENT B	APPROVED DOCUMENT B	APPROVED DOCUMENT B
CURRENT Fire Engineering Measures	CURRENT Fire Engineering Measures	CURRENT Fire Engineering Measures	CURRENT Fire Engineering Measures	CURRENT Fire Engineering Measures	CURRENT Fire Engineering Measures
BS9991:2015 Recommendations	BS9991:2015 Recommendations	BS9991:2015 Recommendations	BS9991:2015 Recommendations	BS9991:2015 Recommendations	BS9991:2015 Recommendations
INTERIM Fire Engineering Measures	INTERIM Fire Engineering Measures	INTERIM Fire Engineering Measures	INTERIM Fire Engineering Measures	INTERIM Fire Engineering Measures	INTERIM Fire Engineering Measures
ADDITIONAL BS9991 & BS9992 Recommendations	ADDITIONAL BS9991 & BS9992 Recommendations	ADDITIONAL BS9991 & BS9992 Recommendations	ADDITIONAL BS9991 & BS9992 Recommendations	ADDITIONAL BS9991 & BS9992 Recommendations	ADDITIONAL BS9991 & BS9992 Recommendations
RISK ASSESSED FUTURE Fire Strategy Proposals	RISK ASSESSED FUTURE Fire Strategy Proposals	RISK ASSESSED FUTURE Fire Strategy Proposals	RISK ASSESSED FUTURE Fire Strategy Proposals	RISK ASSESSED FUTURE Fire Strategy Proposals	RISK ASSESSED FUTURE Fire Strategy Proposals
CORE PRINCIPLES	CORE PRINCIPLES	CORE PRINCIPLES	CORE PRINCIPLES	CORE PRINCIPLES	CORE PRINCIPLES
OTHER RELEVANT CRITERIA	OTHER RELEVANT CRITERIA	OTHER RELEVANT CRITERIA	OTHER RELEVANT CRITERIA	OTHER RELEVANT CRITERIA	OTHER RELEVANT CRITERIA
ALL	ALL	ALL	ALL	ALL	ALL

EXISTING HRRB'S IN OCCUPATION Typical Single Staircase & Related Legislation

CENTRAL CORE BLOCK (eg Grenfell Tower) LINEAR SLAB BLOCK (eg Lakeland House)

Fig 6b Dwellings With Lobby Access

1. Maximum travel distance 22m
2. Maximum travel distance 22m
AOV: Automatic opening vent 1.2m² minimum
Fire-resisting construction
Self-closing FD 30S fire door (double leaf)
Self-closing FD 30S fire door
Area requiring a smoke control system

Fig 6a Common Escape Routes in Single Stair Bldgs with Flat above 11m

1. Maximum travel distance 22m
2. Maximum travel distance 22m
AOV: Automatic opening vent 1.2m² minimum
Fire-resisting construction
Self-closing FD 30S fire door (double leaf)
Self-closing FD 30S fire door
Area requiring a smoke control system

Fig 7a Common Escape Routes in Multi Stair Building

1. Maximum travel distance 22m
2. Maximum travel distance 22m
AOV: Automatic opening vent 1.2m² minimum
Fire-resisting construction
Self-closing FD 30S fire door (double leaf)
Self-closing FD 30S fire door
Area requiring a smoke control system

Fig 7b Common Escape Routes in Multi Stair Building

1. Maximum travel distance 22m
2. Maximum travel distance 22m
AOV: Automatic opening vent 1.2m² minimum
Fire-resisting construction
Self-closing FD 30S fire door (double leaf)
Self-closing FD 30S fire door
Area requiring a smoke control system

BS9991:2015 Recommendations

INTERIM Fire Engineering Measures

1 Staircase + Enhanced Core

Fire Engineered

- Communal Alarm
- 100% Compartmentation (proven)
- Stay Put
- Protected Fire Fighting Lobby

1 Staircase + Enhanced Core + Sprinklers + AOV

ADB Compliant with Fire Engineering

- Communal Alarm
- 100% Compartmentation (proven)
- Protected Fire Fighting Lobby

ONLINE VERSION
HM Government

The Building Regulations 2010

Fire safety

B

APPROVED DOCUMENT

Volume 1: Dwellings
Regulation 31: Means of warning and escape
Regulation 32: Internal fire spread (structure)
Regulation 33: Internal fire spread (smoke)
Regulation 34: Internal fire spread (fire spread)
Regulation 35: Access and facilities for the fire service
Regulations 36, 37, 38 and 39

2019 edition incorporating 2020 and 2022 amendments – for use in England

RIBA Core Principles Analysis

Provides

Storyboard of non-compliance:-

- Grenfell & Lakanal, tower and slab block types

Suggested suitable revisions to:-

- Current regulations
- Approved Documents
- British Standards
- Fire Engineering possibilities

Proposals for:-

- Remedial works
- Current design changes
- Future mandatory design criteria

RIBA Recommendations for:-

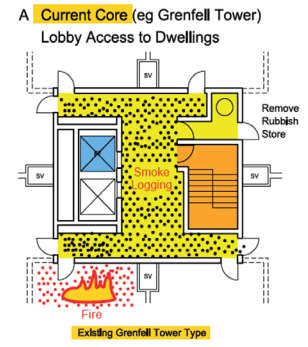
- Hybrid “Rules and Risk Based” regulations to be clarified

APPROVED DOCUMENT B	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations
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CURRENT Fire Engineering	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations
INTERIM Fire Engineering	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations
ADDITIONAL Fire Engineering	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations
RISK ASSESSED FUTURE	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations
CORE PRINCIPLES	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations
OTHER RELEVANT	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations
ALL	EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation	CURRENT HRRBS UNDER DESIGN / CONSTRUCTION	FUTURE HRRBS TO BE DESIGNED Anti-knocking or Under New Future Regulations

CORE PRINCIPLES

EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation

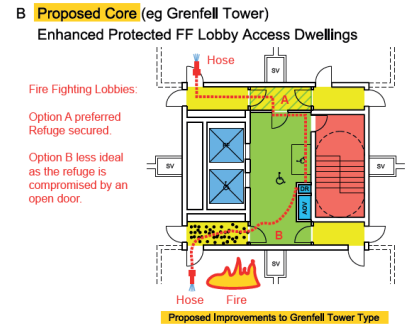
Central Core Block (e.g. Grenfell Tower)



CORE PRINCIPLES

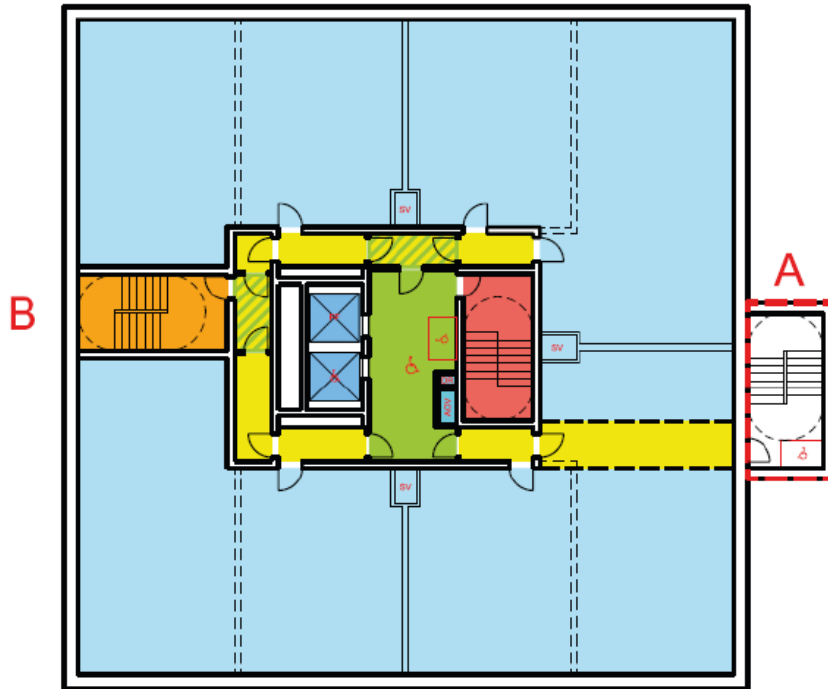
EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation

Linear Slab Block (e.g. Lakanal House)



PROPOSED / FUTURE BUILDINGS Core 'B'

Alternative 2 Stair Location A or B with alternative Routes available



GRENfell
67m



Proposed Wet Riser
at 30m not 50m

Additional Layers of Safety

A	Full fire fighting shafts and refuges	✓
B	2nd FF lift (if multiple - disabled 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	✓

Escape Staircases - Worldwide

Open consultation

Sprinklers in care homes, removal of national classes, and staircases in residential buildings

From: [Department for Levelling Up, Housing and Communities](#)

Published 23 December 2022

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Applies to England

Summary

We are seeking views to inform future updates to Approved Document B

This consultation closes at **11:45pm on 17 March 2023**



30m UK Public Consultation

18m Scotland & NFCC & HRB's

Maximum Allowable Building Height with Single Egress for Residential Occupancies

Note: the drawing assumes a floor to floor height of 3m



Single Staircases Policy Position Statement

- Government should adopt a requirement that new buildings 18 metres or has at least 7 storeys and above in height must have more than one staircase.
- Government should immediately clarify the intended scope of Approved Document B and introduce clear and unambiguous definitions of 'common building situations'.
- Government should immediately publish a clear deadline, and more detailed workplan, for the completion of the full technical review of Approved Document B.
- Government should adopt a requirement that all passenger lifts that are due to be replaced or installed in new or existing tall buildings should be evacuation lifts.
- Government should ensure that comments made by the FRS during building regulations consultations cannot continue to be ignored by those receiving them, by introducing a duty to respond to, any comments made by the FRS and to demonstrate how they have been addressed.
- Government should make it a requirement to retrofit sprinklers in all residential buildings over 18 metres or has at least 7 storeys, that are served by a single staircase.

The 2 Stairs Challenge

Stay Put with Single Stairs

v

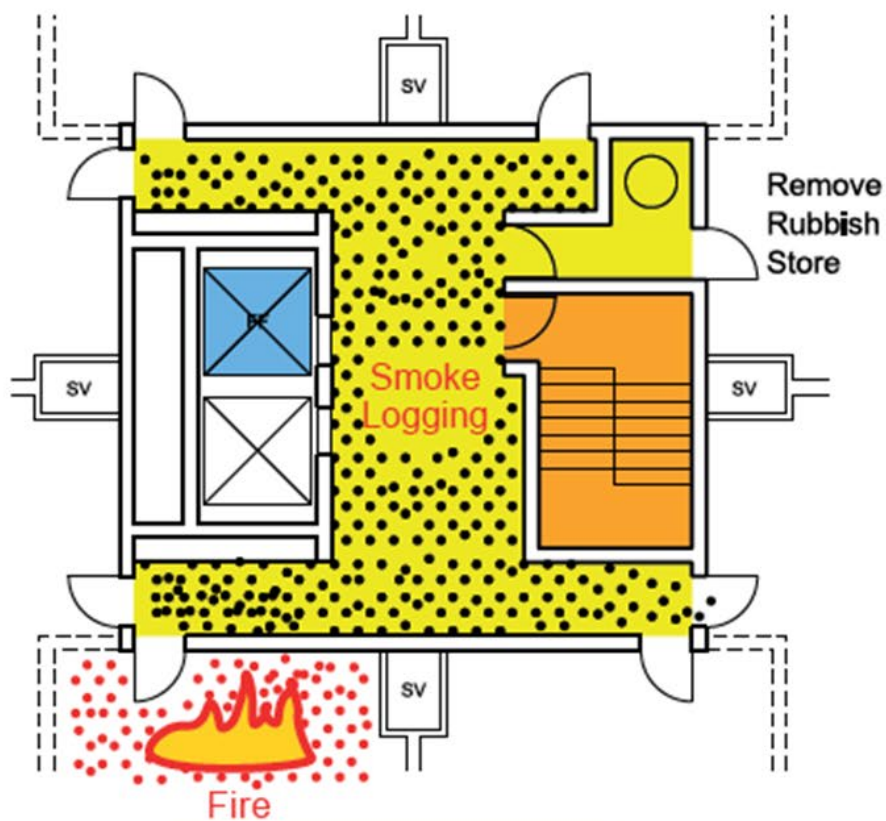
Total Evacuation with 2 Stairs

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

EXISTING HRRBS IN OCCUPATION

Typical Single Staircase & related Legislation

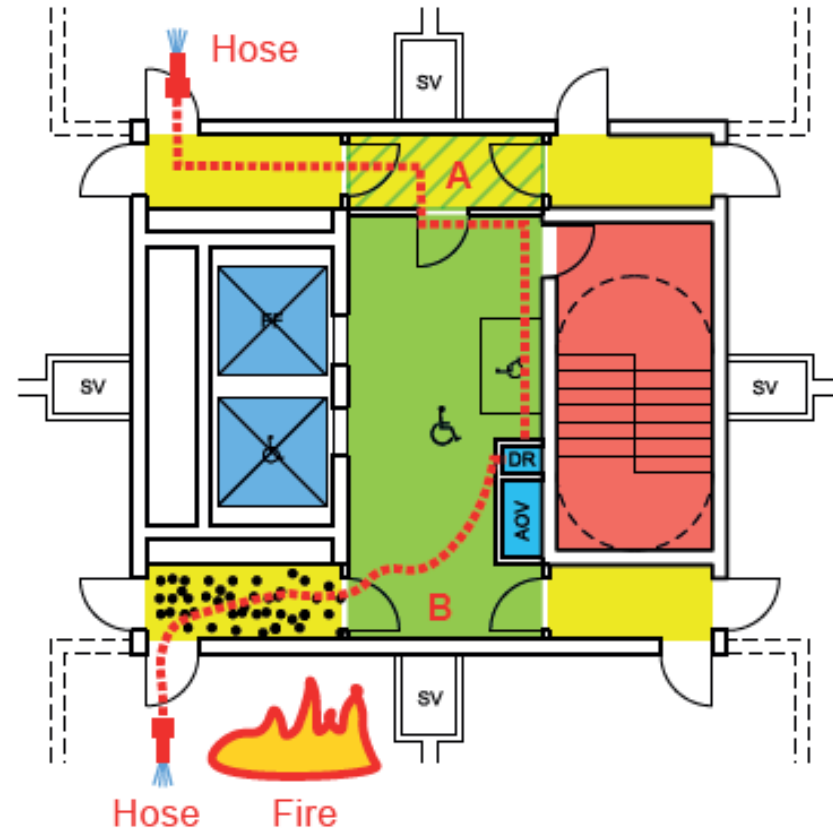
Linear Slab Block (e.g. Lakanal House)

B Proposed Core (eg Grenfell Tower) Enhanced Protected FF Lobby Access Dwellings

Fire Fighting Lobbies:

Option A preferred
Refuge secured.

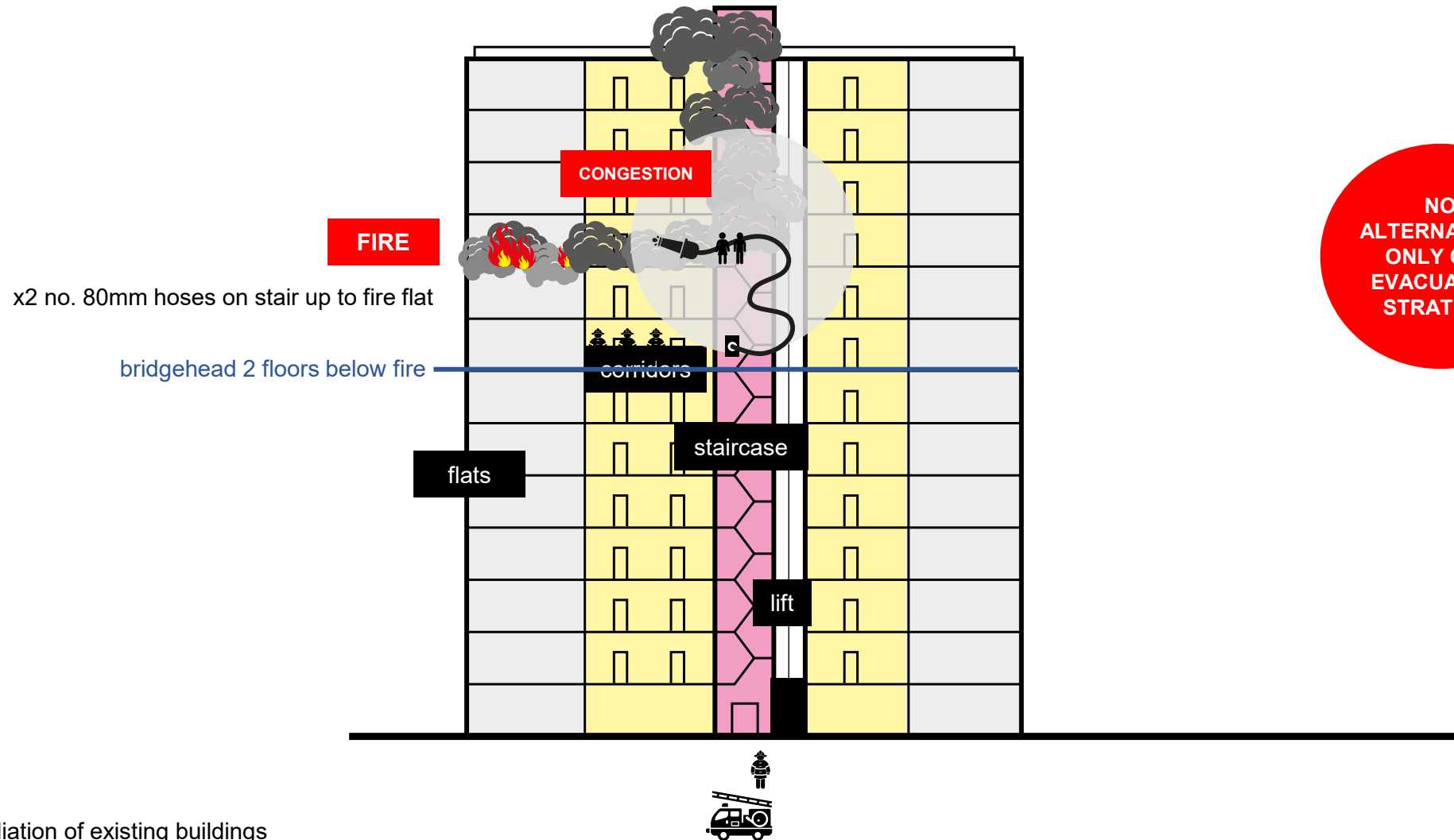
Option B less ideal
as the refuge is
compromised by an
open door.



Proposed Improvements to Grenfell Tower Type

So called 'Adequate' means of escape principles? **FAILED?**

GRENPELL TOWER as June 14th 2017



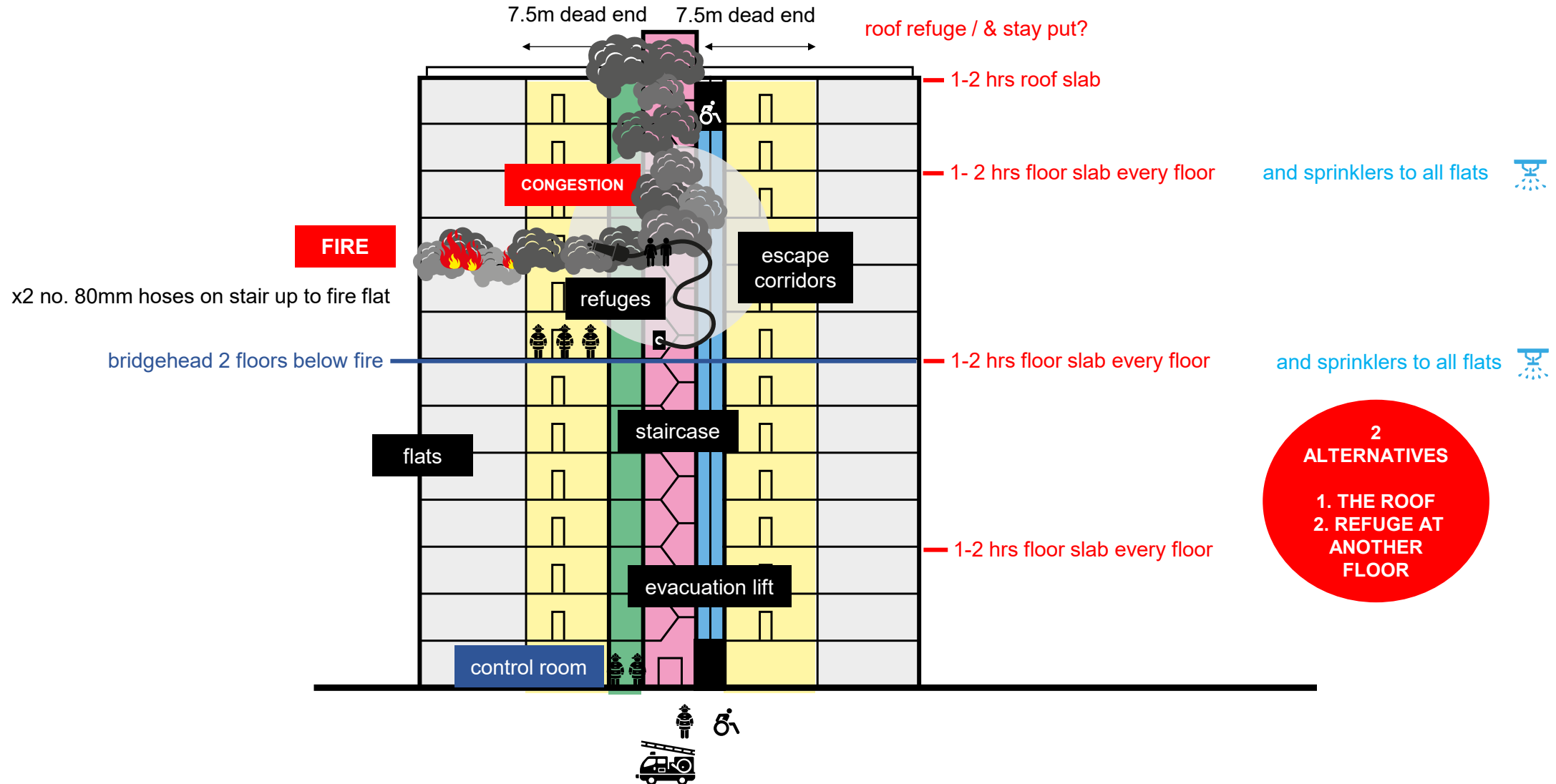
NO
ALTERNATIVES
ONLY ONE
EVACUATION
STRATEGY

Remediation of existing buildings
&/or new build single stair upto 'x'?

'Adequate' means of escape principles?

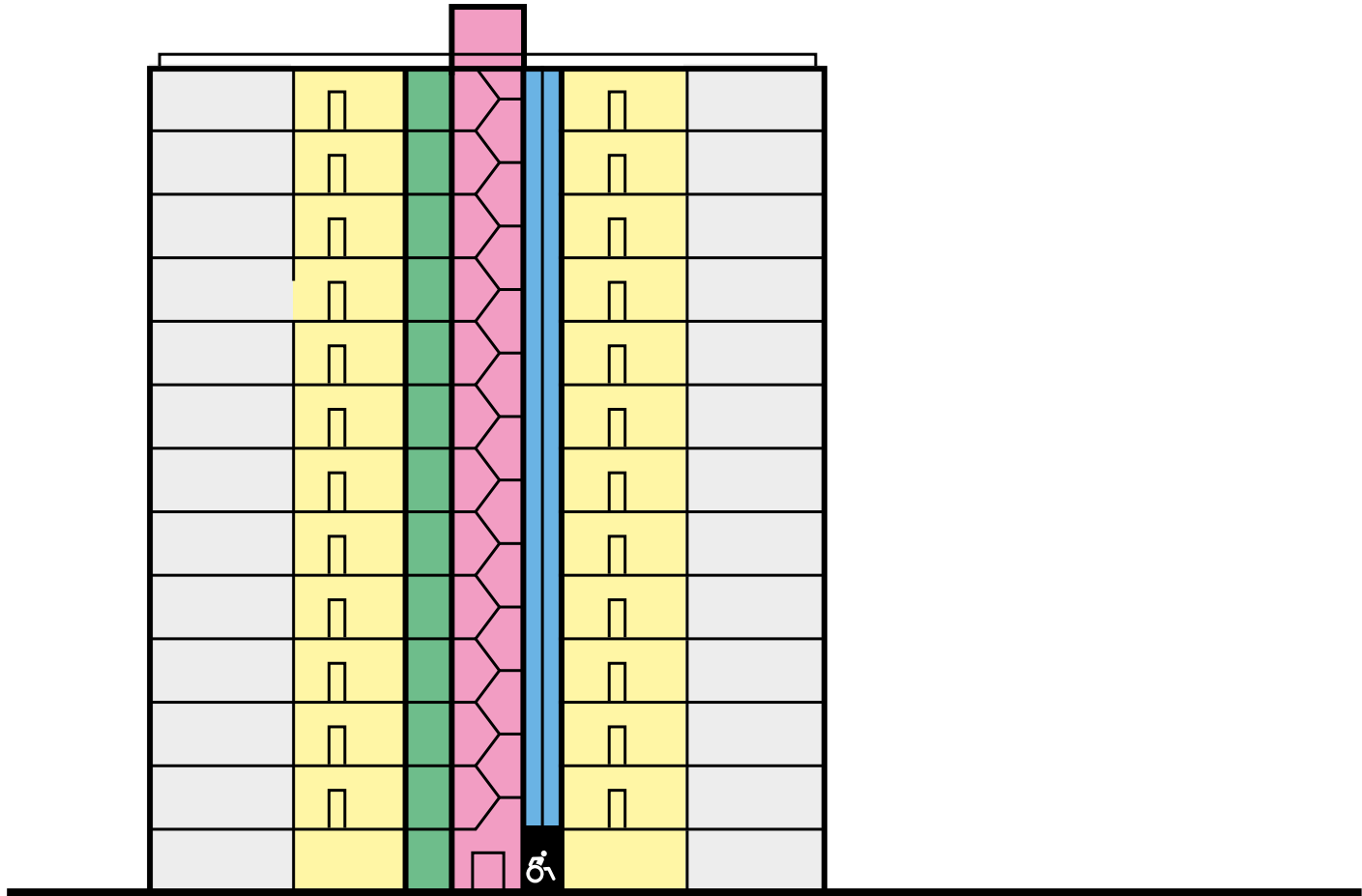
SINGLE STAIRCASE BUILDING

Remediation of existing buildings &/or new build with single stair upto'??' metres.



'Adequate' means of escape principles

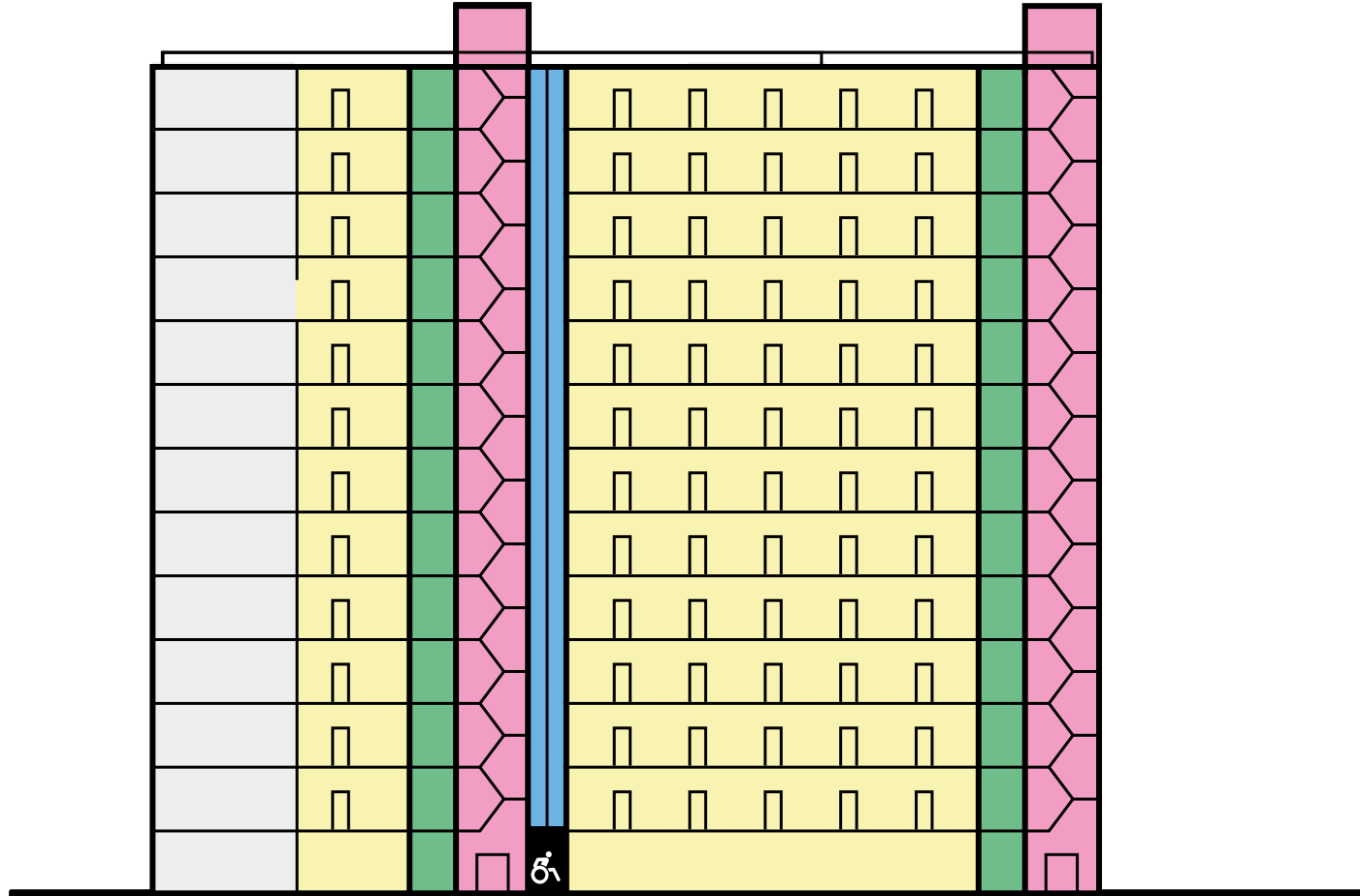
ENHANCED SINGLE STAIRCASE BUILDING



Remediation of existing buildings
&/or new build single stair upto 'x'?

'Adequate' means of escape principles

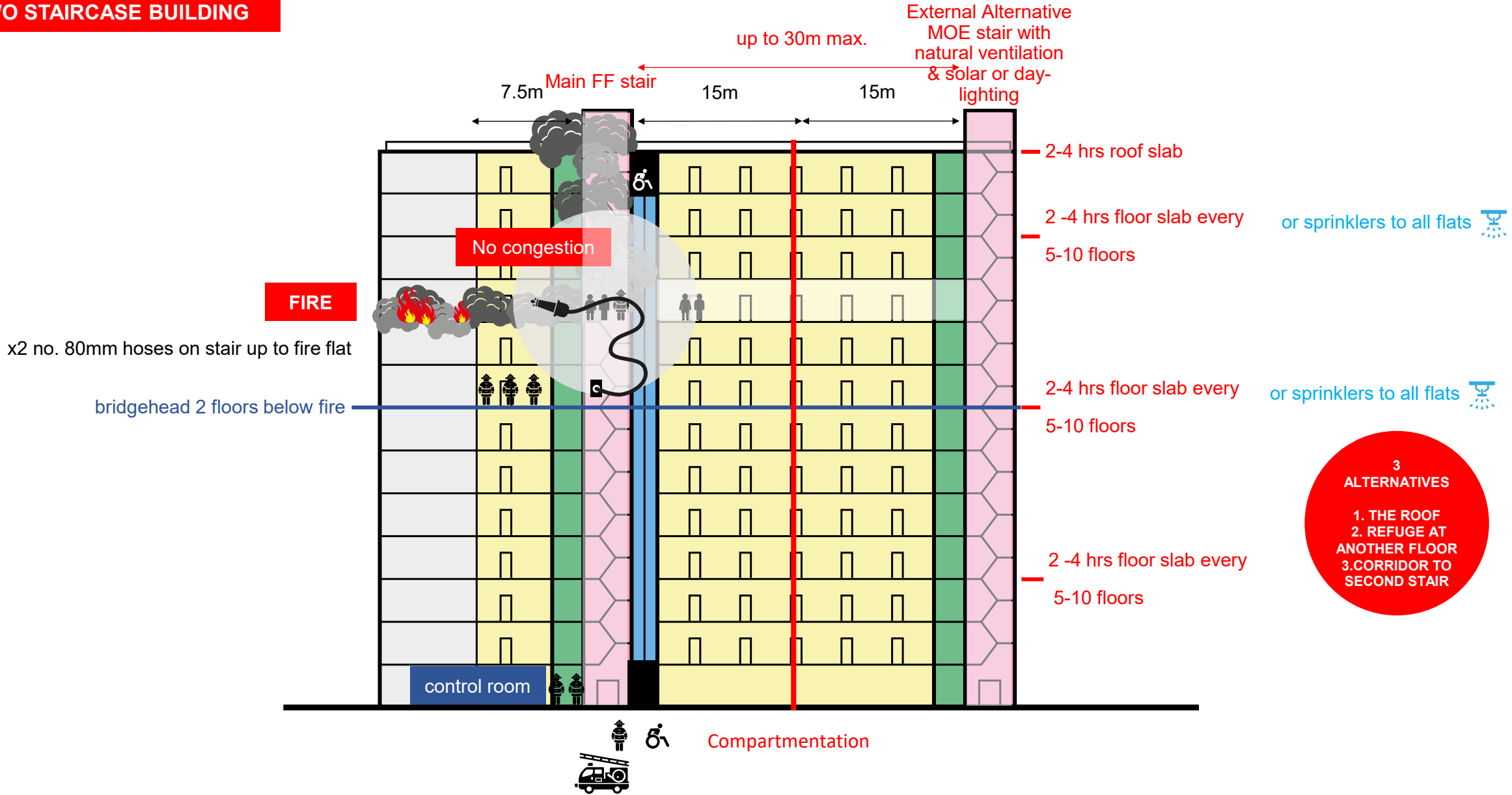
TWO STAIRCASE BUILDING



Remediation of existing buildings
New build for future
New build for future stair upto 'x'?

'Adequate' means of escape principles

TWO STAIRCASE BUILDING



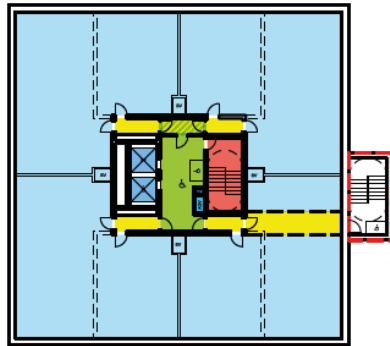
Alternative MOE Options

Additional stairs, OR enhanced core & lifts, and compartmentation.

EXISTING HRRBS IN OCCUPATION Typical Single Staircase & related Legislation

Central Core Block (e.g. Grenfell Tower)

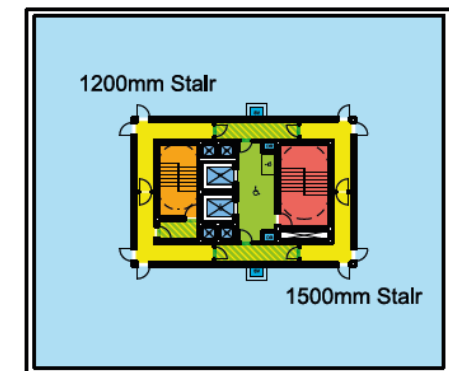
- ② Staircases (not very viable)
- OR Enhanced Core + Sprinklers



As above
+ Sprinklers
and / or Second Staircase
+ Delayed Full Evacuation

FUTURE HRRBS TO BE DESIGNED Anticipating or Under New Future Regulation

- ② Staircases Nett to Gross Areas can be the same or better than single staircase central core due to increased travel distances



No Dead Ends

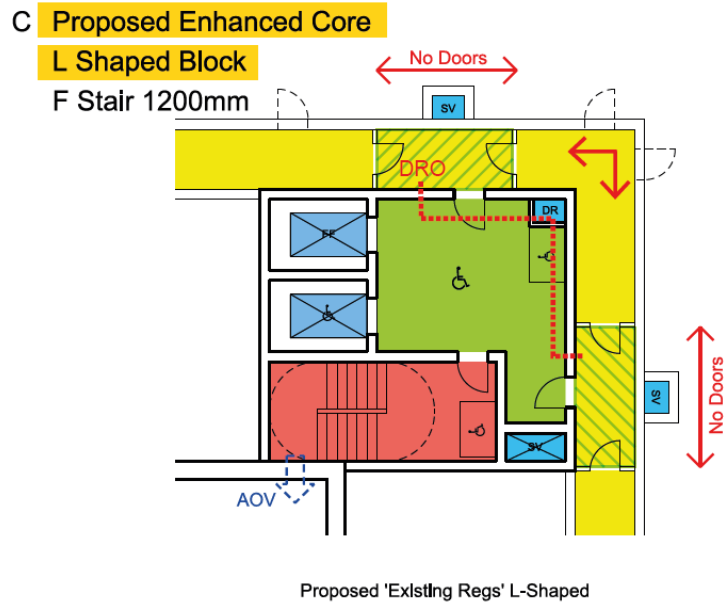
As above
+ Second Staircase
+ Delayed Full Evacuation

Alternative MOE Options

Additional stairs, plus enhanced core & lifts, and compartmentation.

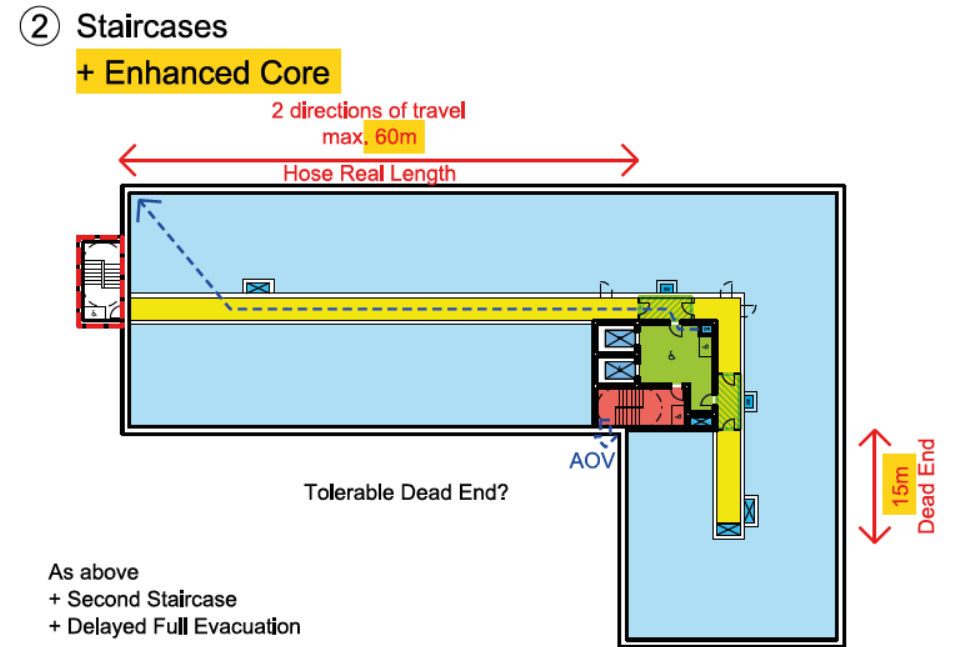
CURRENT HRRBS UNDER DESIGN/ CONSTRUCTION

Typical L Shaped Block



CURRENT HRRBS UNDER DESIGN/ CONSTRUCTION

Typical L Shaped Block



RISK ASSESSED FUTURE
Fire Strategy Proposals

CORE PRINCIPLES

ARCHITECTS VIEW OF TWO STAIR CHALLENGE

WHAT HAPPENS NEXT?

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