Stair Pressurisation

‘The Firefighters View’

Paul Grimwood MBE, PhD, FIFireE

Stair Pressurisation

Why did the fire turn right into the corridor?


Technical Perspectives

Understanding pressure differentials in high-rise fires

Paul Grimwood PhD FIFireE takes a look at smoke control design from over the years and how their effects are present today.

In 1910 the New York City Fire Department Chief, Edward Croker, informed the New York State Assembly that the fire department could not successfully combat a fire in a building greater than 7 stories tall. Three months later a fire in the Triangle Shirtwaist Company, which occupied the top three floors of a ten story building in New York City, resulted in the deaths of 146 people. As a result of that fire, many improvements were made to the life safety of buildings. Many of these early developments in fire safety design are now commonly seen throughout our own UK building guidance. However it could be considered that some of our early smoke control objectives may have been misconstrued, resulting in inappropriate and potentially hazardous designs that remain with us today.

Why did the fire turn right instead of left? (pressure differentials)

It is now well understood by our firefighters that both naturally occurring or forced pressure differentials, particularly in a tall building fire, may impact greatly on their safety as well as their ability to function effectively during firefighting and search operations. Natural buoyancy, stack effects, external winds and the configuration of natural or mechanical smoke ventilation systems may all influence levels of fire intensity, firefighter's exposure to sudden temperature changes and smoke travel within common areas. Whilst smoke control systems are primarily intended to protect escaping occupants, it remains critical they are carefully configured and installed in order to also protect the lives of firefighters. Any potential for undesirable impacts on fire development will influence critical command decision making, particularly when prioritising the tactical protection of stairwells over an immediate firefighting intervention, or vice versa.

Using a graphic video of flames entering the corridor from a flat fire I posed the question in a series of command training seminars, '*why did the fire turn right into the corridor and not left*'? The fire officers instantly became aware of the likely pressure differentials existing in the corridor, created by a corridor smoke ventilation shaft located immediately adjacent to the firefighting stair from which they would be advancing. This demonstrated clearly how a negative pressure existing behind their advance could increase temperatures in their approach path to the fire as the fire turned right out of the flat doorway and headed towards the open smoke shaft. It is a known fact in the fire

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It is now well understood by fire engineers in the fire and rescue service, that both naturally occurring or forced pressure differentials, particularly in a tall building fire, may impact greatly on firefighter safety as well as compromising their ability to function effectively during firefighting and search operations.

Whilst smoke control systems are primarily intended to protect escaping occupants, it remains critical they are carefully configured and installed in order to also <u>protect the lives of firefighters</u>.

In the 1940s, the UK regulatory guidance for fire safety designs in tall buildings was going through some detailed major post-war development. There was much collaboration at this time, between UK and US fire safety code development and the experience gained within the high-rise canyons of New York City seemed a logical route to follow.

We can see in UK Post War Building Studies (PWBS) Parts 1-4 (1946-1952) several references to naturally ventilated **‘Fire Towers’** also known in the USA as **‘Smokeproof Towers’.**

POST-WAR BUILDING STUDIES
NO. 29

FIRE GRADING OF BUILDINGS

PART II
FIRE FIGHTING EQUIPMENT

PART III
PERSONAL SAFETY

PART IV
CHIMNEYS AND FLUES

BY A JOINT COMMITTEE
OF THE BUILDING RESEARCH BOARD
OF THE DEPARTMENT
OF SCIENTIFIC & INDUSTRIAL RESEARCH
AND OF THE FIRE OFFICES' COMMITTEE

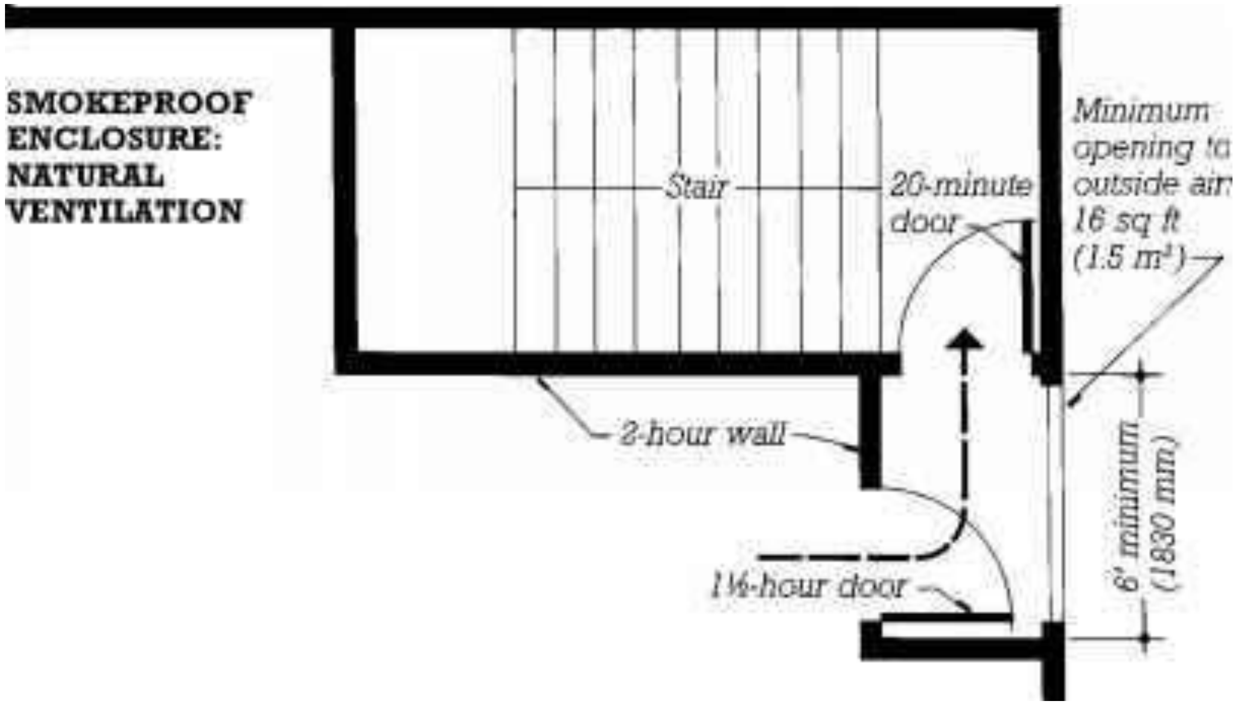
LONDON: 1952
PUBLISHED FOR THE MINISTRY OF WORKS
BY HER MAJESTY'S STATIONERY OFFICE

Access and Facilities for Firefighting (Fire Towers)

"The installation of fire towers in buildings has also to be considered from this standpoint. They form a valuable means of access for firemen. Although fire towers should strictly be considered in this Part of the Report as they are designed essentially for access by firemen, it is more convenient to treat them at the same time as staircases for means of escape"

"The question of the provision of access for firemen by means of fire towers, however, becomes important when buildings appreciably over IOO ft (30m). high are considered. Very few buildings of such heights have been built in this country although they are common in the United States".

Fire Towers
in New York City
(Smokeproof Towers
Elsewhere in USA



Exterior window or naturally vented SMOKE SHAFT

Fire Research Note
No.958

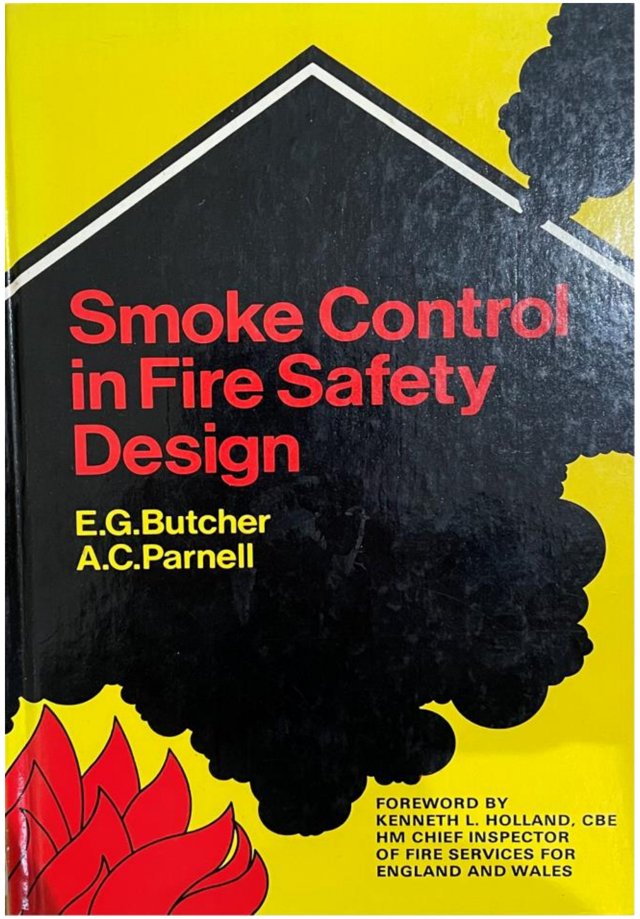
PRESSURISATION OF ESCAPE
ROUTES IN BUILDINGS

P J Hobson and L J Stewart

FIRE
RESEARCH
STATION

1972 – **FRN 958** “Against a background of economic pressure for internal staircases, various ideas for mechanical or natural ventilation as an alternative were tried. This led to natural vent shafts or mechanical extraction from staircases, but these **posed the problem of encouraging smoke movement towards the staircases.**

Consequently, the idea of pressurisation of escape routes was **further evolved**”.

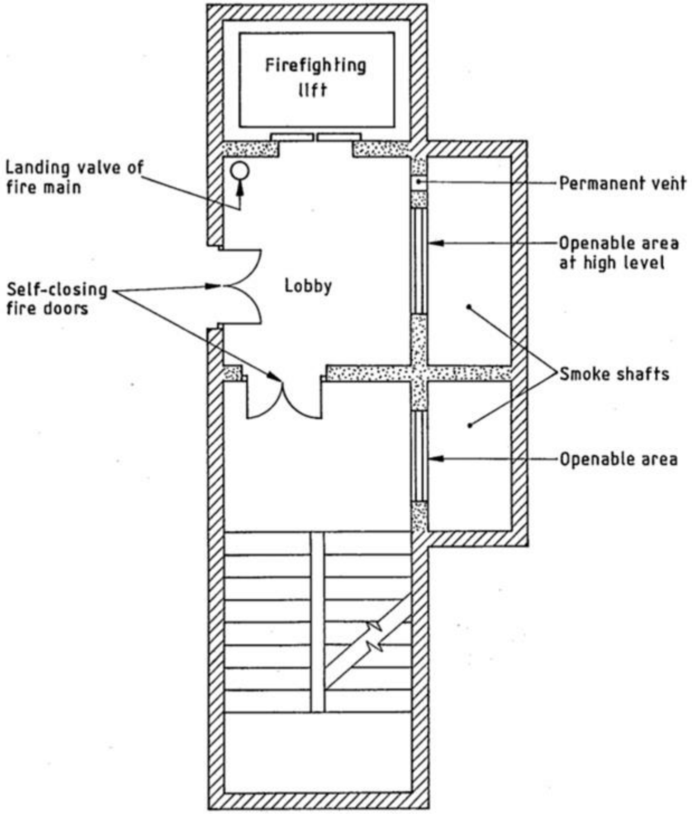


1979 – Brought together the (1964 – 1972) UK live fire test research, and other international research in Australia, Canada, USA, Germany and other parts of Europe.

The general consensus of all the tests were extremely positive, resulting in code development and system design optimisations (BS 5588-4:1978 and BS 5588-5:1986).

Several buildings in London and around the UK followed his approach, until the naturally vented Smoke Shaft designs later became more common in design from 1986 onwards.

Natural U-W Tube Smoke Shafts 1986



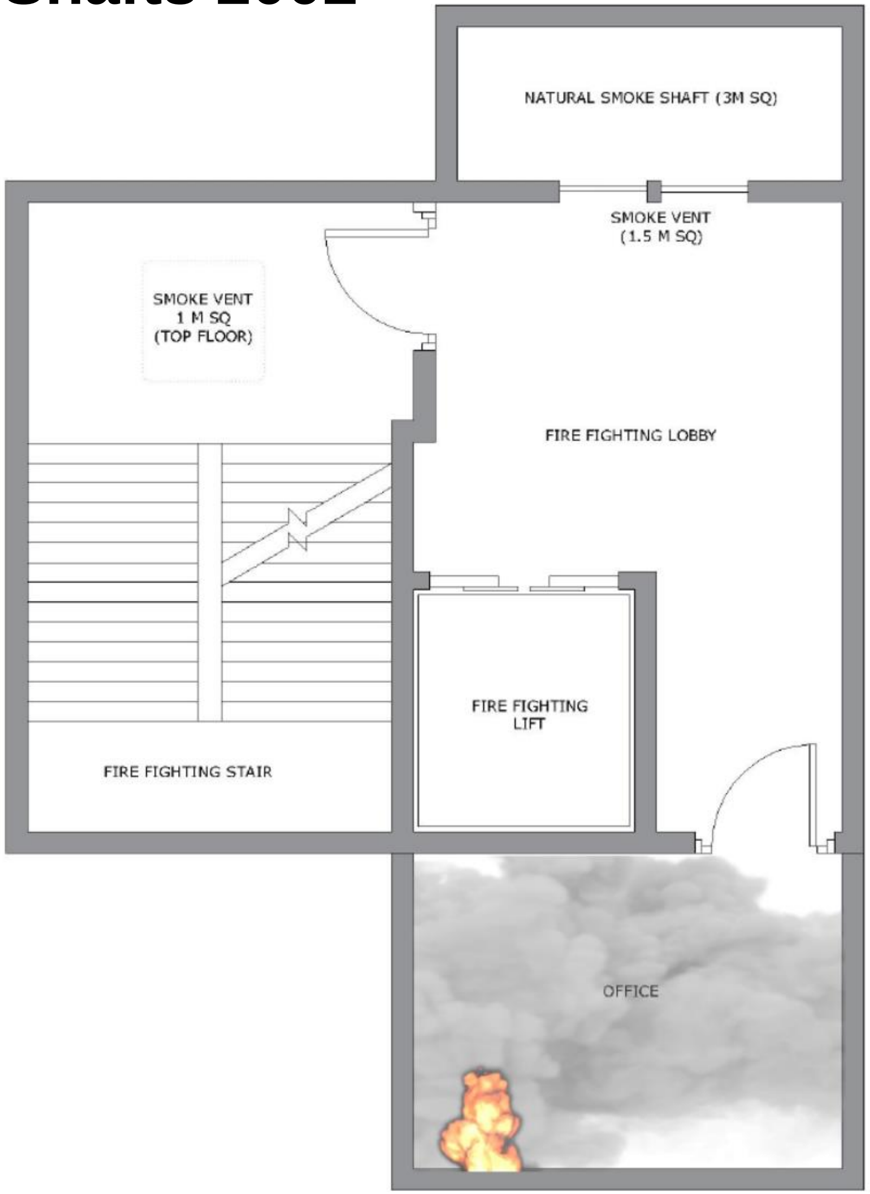
Key

Minimum fire resistance of 2 h from outside the firefighting shaft and 1 h from inside the firefighting shaft

Minimum fire resistance of 1 h from both sides

Figure 3. Smoke control for a typical firefighting stairway, lobby and lift not situated next to an exterior wall

BRE Natural Smoke Shafts 2002



BRE 79204 – 2002 – Smoke Shafts protecting Firefighting Shafts

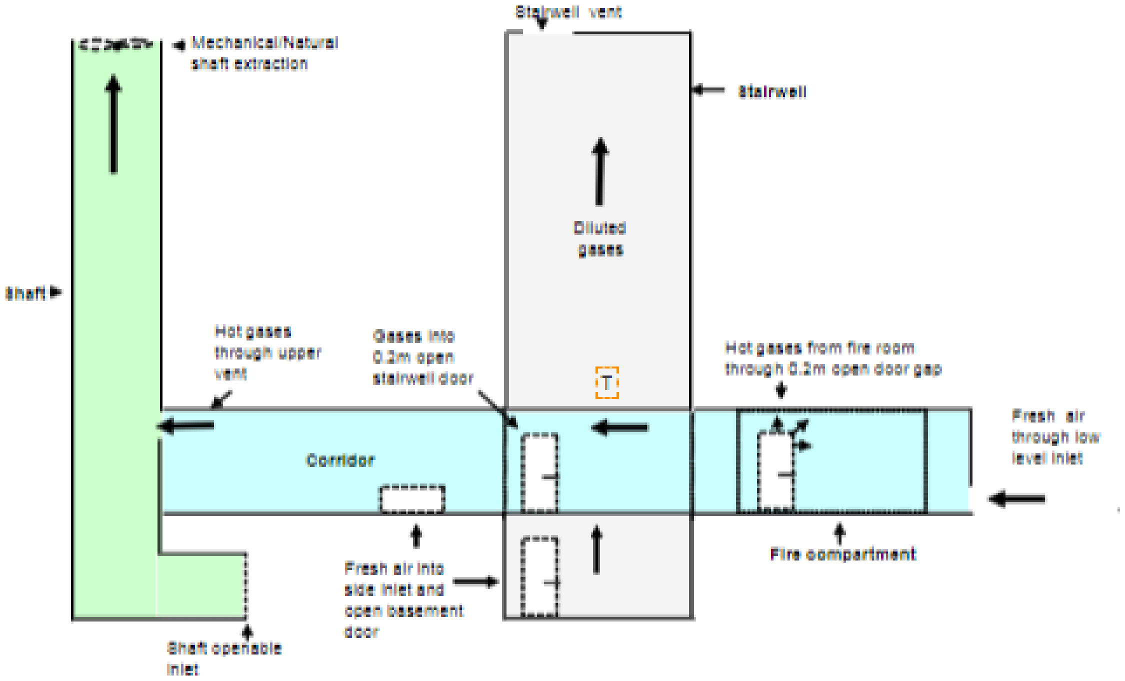
'The performance of naturally ventilated smoke shafts is assessed in terms of how the shafts perform compared to the accepted method of external wall mounted ventilation. This alternative design of smoke shaft [BRE 3m^2] is not a replacement for pressure differential systems. ***Pressure differential systems*** *have specific advantages in providing a* ***higher standard of protection*** *in specific buildings, particularly those operating a means of escape strategy based on phased evacuation.*

They can also provide a ***greater level of protection to the fire-fighting lobby*** *itself than any of the natural ventilation systems discussed herein'.*

BRE BD 2410 – 2005 – Smoke Ventilation of Common Access areas to Flats & Marionettes

- *The **pressurizing of stairs** and/or the **depressurizing of lobby corridors** for means of escape purpose – **2.5 MW Fires***

- *The provision of smoke-rated doors, and two escape stairs with limited travel distances, as a **preferred option,** were seen as important*



The introduction of Mechanical Smoke Ventilation Systems (MSVS) in 2006 came in the form of the **0.6m²** ‘COLT SHAFT’(*top right*) using CFD to demonstrate equivalence to the BRE shaft (*bottom right*).

The pressures in the lobby/corridor were negative, directing smoke and occasionally high heat levels towards the extract shafts.

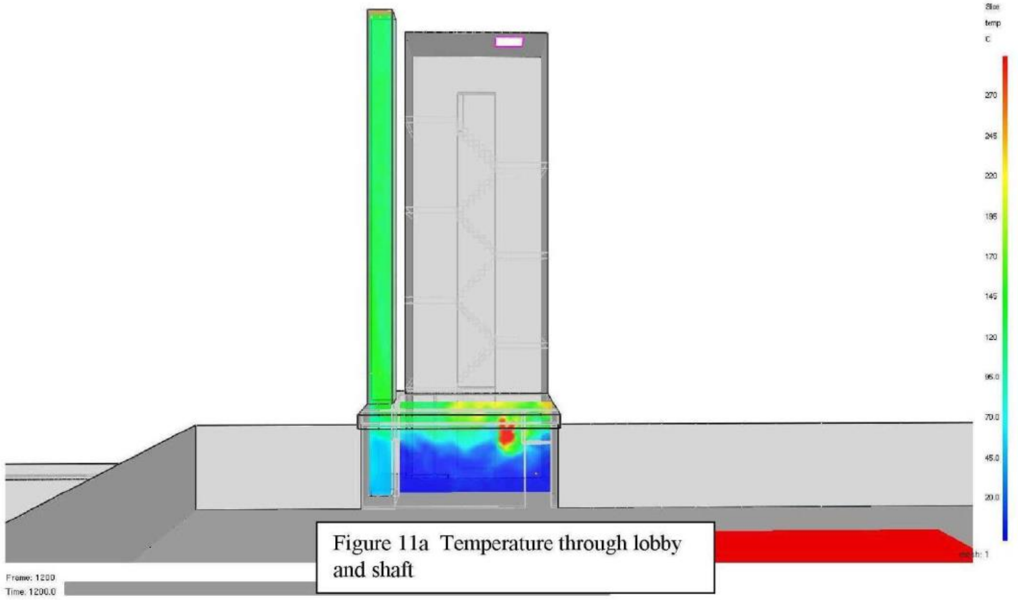


Figure 11a Temperature through lobby and shaft

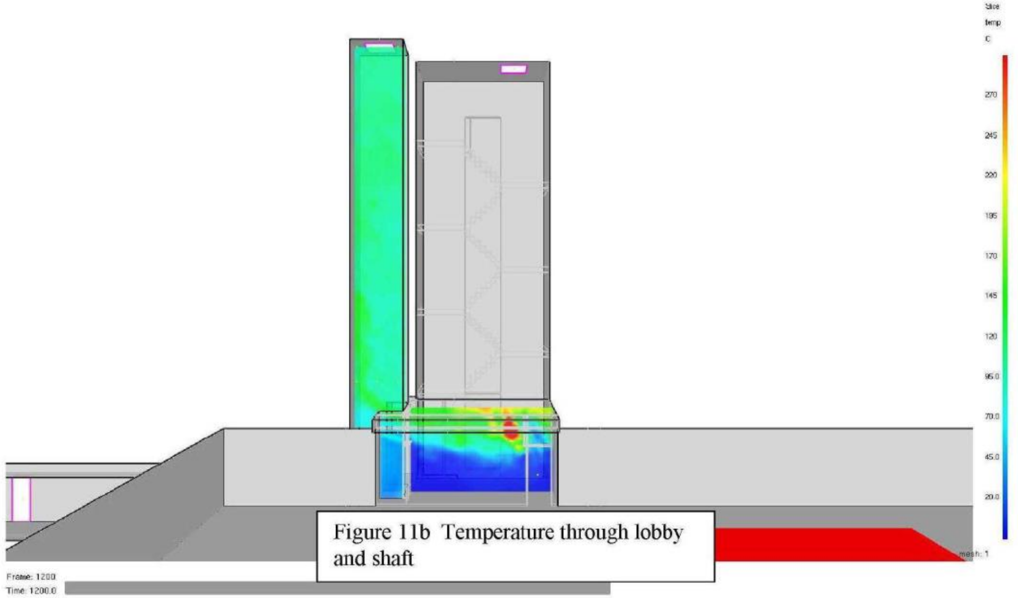


Figure 11b Temperature through lobby and shaft

FOCUS Personal protection

Control risks

Paul Grimwood raises concerns over the use of mechanical extract smoke control systems for common corridors in residential buildings

IN DESIGNING a building, the incorporation of a smoke control system may serve to enhance life safety or assist firefighting access, while also protecting structural components and building contents. However, where design principles fail to follow established technical guidance, there is potential for such systems to actually serve to create hazards for firefighters and escaping occupants.

There may be clear commercial benefits to be gained in utilising smoke control measures that are used as compensatory features in trading for extended travel distances and single stairways in residential buildings. However, Kent Fire and Rescue Service has recently established a policy that serves to rigorously challenge the introduction of such fire engineered solutions without clear proof of concept, where firefighters and possibly relevant persons may be at an increased level of risk.

Building control officers as well as approved inspectors may wish to become aware of the associated technical aspects involved. There is no doubt that this stance may be seen by some as controversial and some reasoned debate is likely to follow. Nevertheless, this should be encouraged and welcomed.

Smoke control objectives

The primary objectives of smoke control systems are to:

- maintain smoke-free and tenable conditions within protected escape routes
- assist firefighting operations by maintaining tenable conditions for firefighters
- delay or prevent the onset of flashover and further fire development
- reduce thermal damage to structural components
- reduce smoke damage to the building and its contents

The various smoke control concepts rely upon natural or forced air movements, as follows:

- natural cross-flow ventilation
- natural buoyancy of hot smoke
- natural pressure differentials created by the difference in temperatures existing between the inside and outside of buildings
- mechanically created pressure differentials using powerful air movement fans to pressurise protected escape routes or depressurise fire-involved areas adjacent to escape routes
- mechanical smoke flushing systems that use fans to force air into protected routes, in order to dilute smoke before flushing it out via smoke shafts or exterior wall outlets

A report[1] from BRE in 2002 proposed a design of smoke shaft used to naturally ventilate stair lobbies with the primary objective of protecting escape stairs. The design concepts were limited to research that used real fire tests on small-scale models, validated by computational fluid dynamics (CFD) simulation based on a 2.5MW ventilated compartment fire.

Later adaptations of this useful research (note BRE report, BD 2410: 2005) saw several fire ventilation designers and commercial fire engineers develop mechanical smoke extract systems using smaller-dimensioned smoke shafts to save on expensive floor space. However, this adaptation may cause many problems for firefighters and, at this time, there has been no research as to how such systems may function where under-ventilated fire conditions occur within a flat or compartment. Furthermore, the evacuation time for occupants may be compromised in several ways, depending on specific design features.

In order to ensure engineered smoke control systems are fit for purpose, the system designers must first demonstrate that

52 JUNE 2010 www.frmjournal.com

Access design

A recent modelling study has highlighted the risk of fire gases in a corridor igniting as firefighters access a residential apartment. **Paul Grimwood** looks at the implications for smoke ventilation design and fire service tactics

WHEN DESIGNING for automatic fan-assisted ventilation to common areas of multi-storey ...idential buildings, the fire engineer commonly utilise a worst-credible compartment design fire of 2MW ...W, producing well-ventilated ...ver conditions. ...roach may be acceptable ...an evacuation strategy, ...ional requirements are ...established guidance. ...ghting to assist fire... the worst-credible fire scenario upon which to base a design may not be a well-ventilated scenario.

A computer zone modelling study undertaken by Kent Fire and Rescue Service has explored this further by analysing data from 14 design scenarios involving different natural and fan-assisted smoke ventilation systems.

Remote ignitions

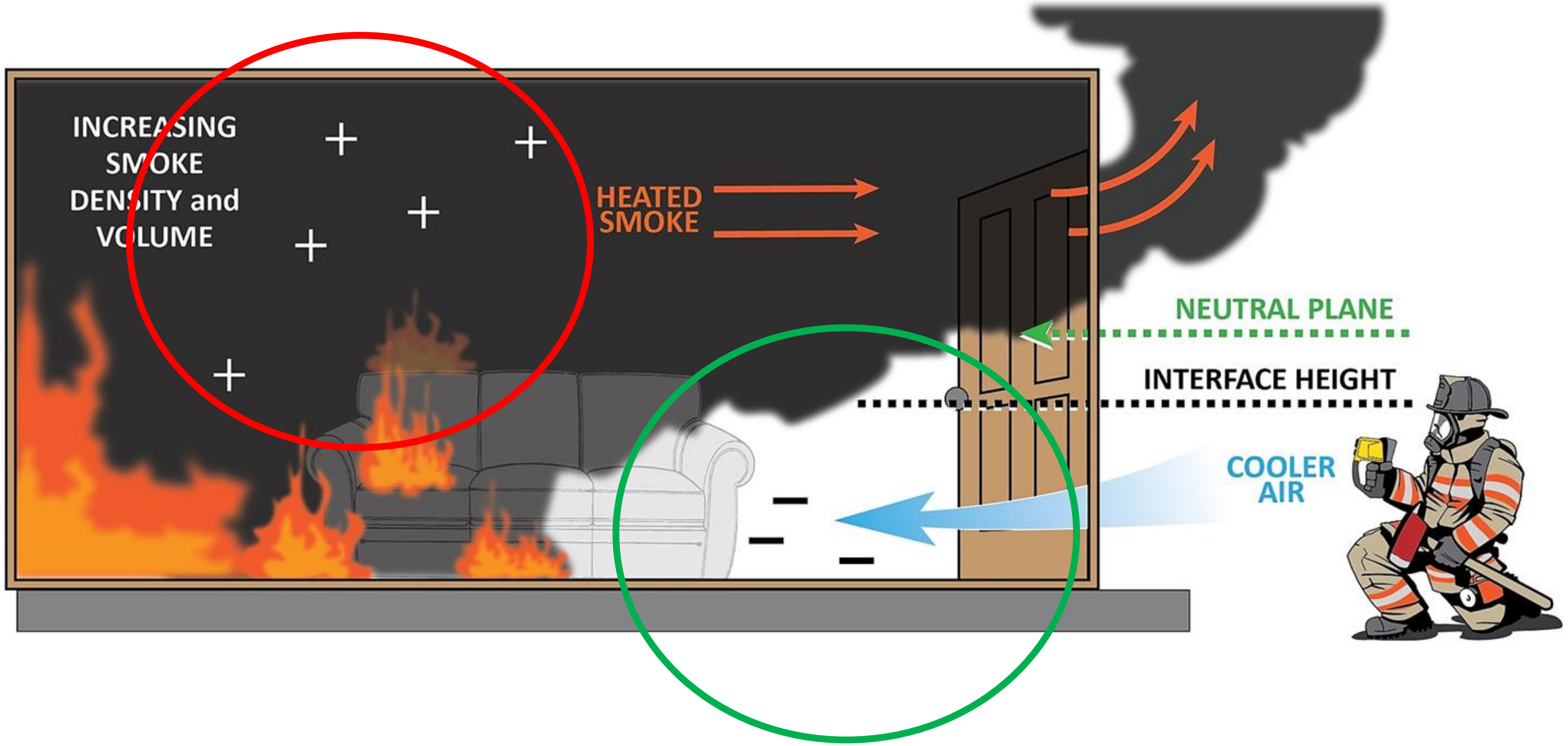
According to data from the Government, post-flashover room fires (<4MW) are confined to the compartment of origin in around 10% of all building fires, whereas post-flashover multi-compartment fires (>5MW) are noted in a further 10% of such incidents.

It has also been observed that, in a smaller number of fires (0.5%), there is some form of abnormal behaviour involving the fire gases that occur beyond or outside the compartment of origin – often referred to by firefighters as 'remote ignitions'. These ignitions of smoke are sometimes related to 'auto-ignition' of combustion products and in other instances may be termed 'backdraughts', 'flash fires' or 'smoke explosions'.

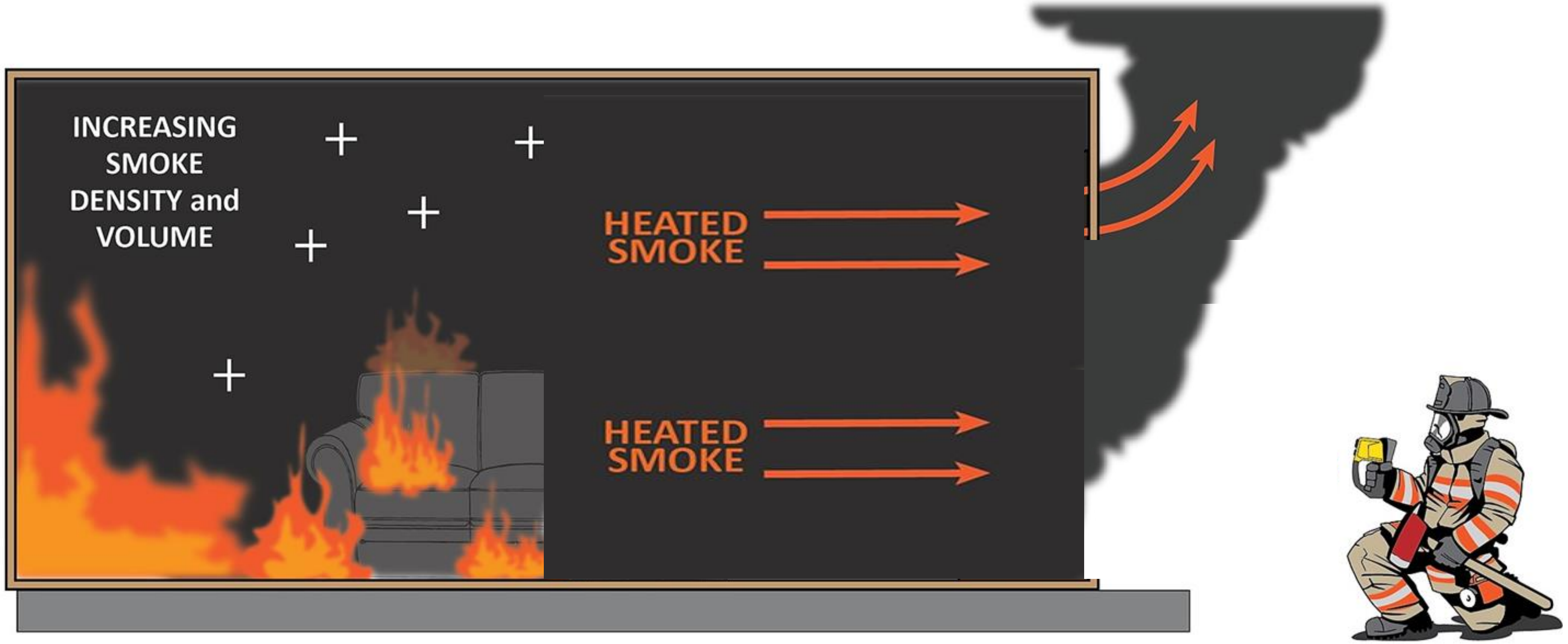
www.frmjournal.com JULY / AUGUST 2011 29

Closed Flat Fire - >1000 Pa

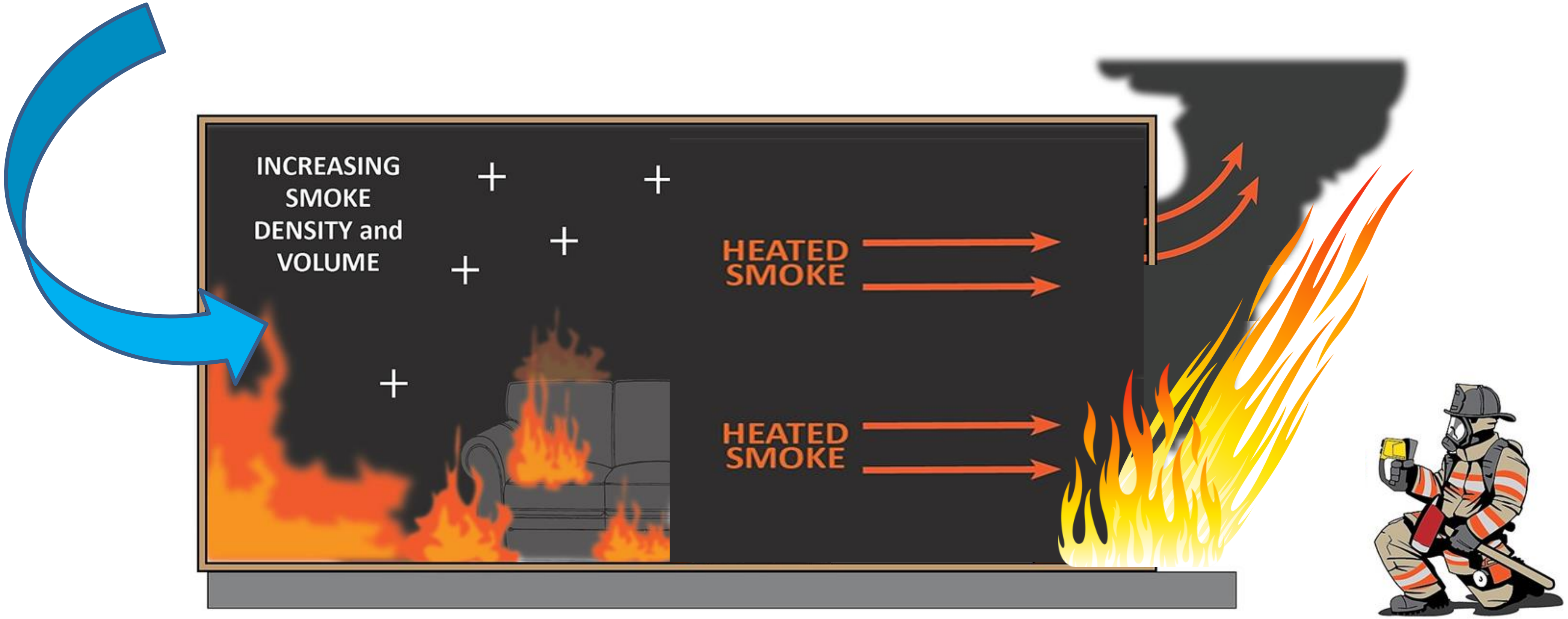
Normal Firefighting Pressures & Air Flows



Corridor Extract System



Corridor Extract System with Window Vent

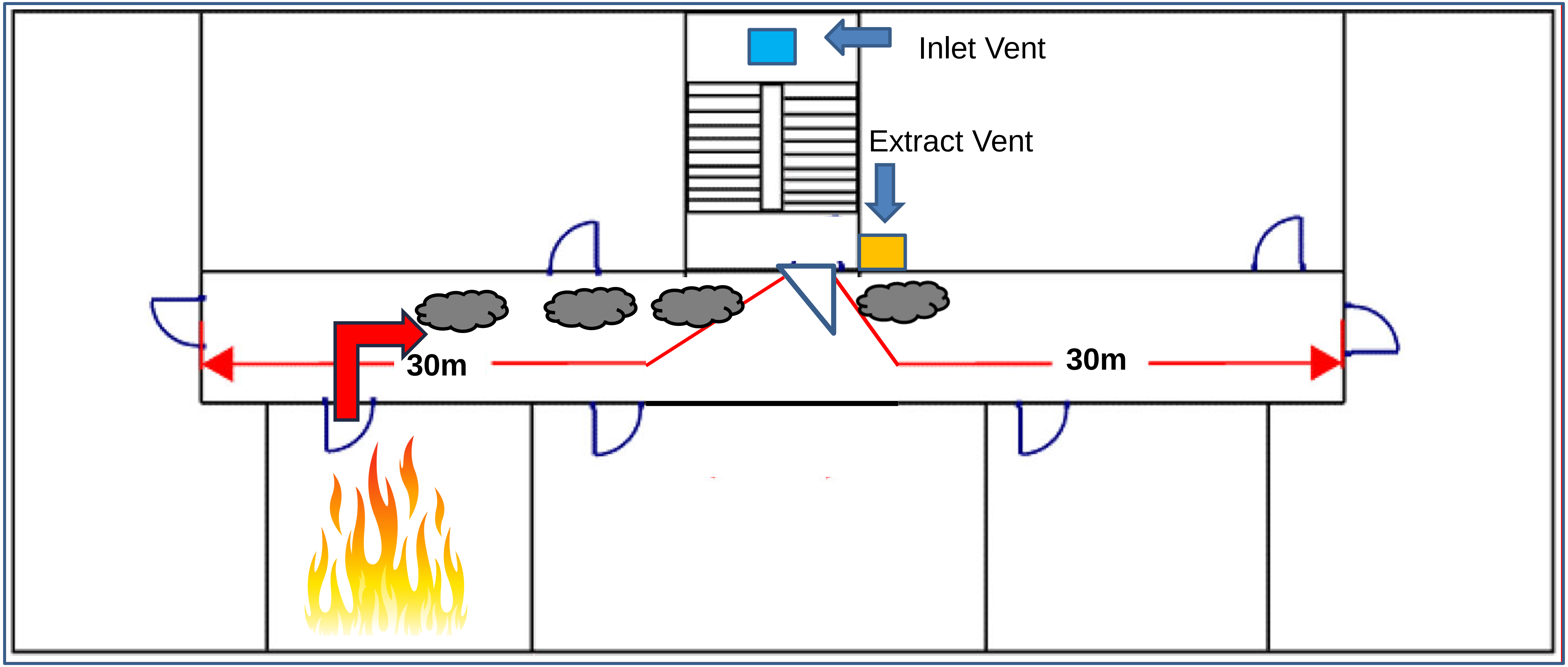


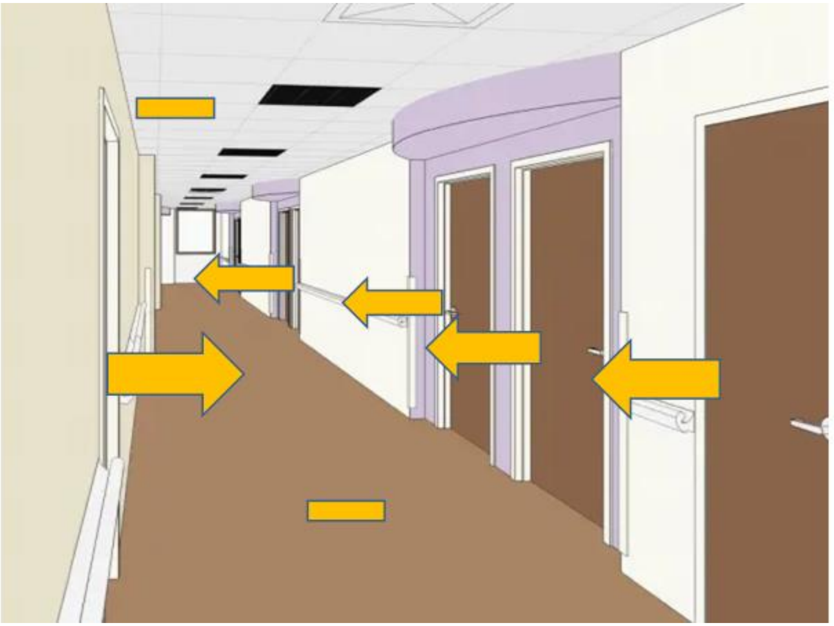
Pressurisation System with Window Vent

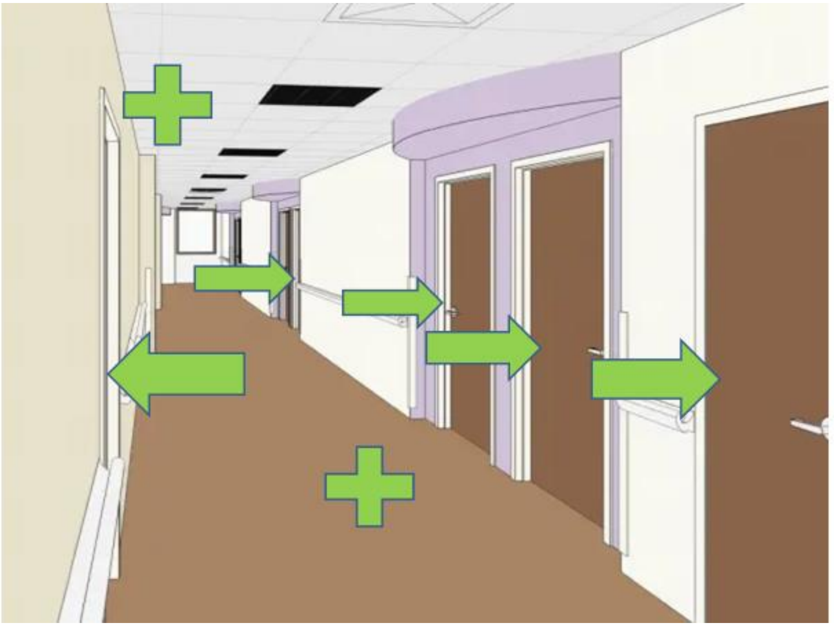

Why did the fire turn
right into the corridor?


08 - 09
10 - 11

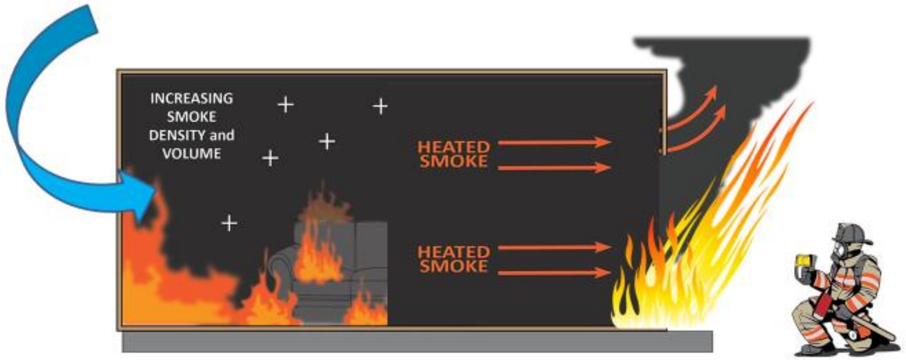
Extended Floor-plate (Flats) to 2006-2015



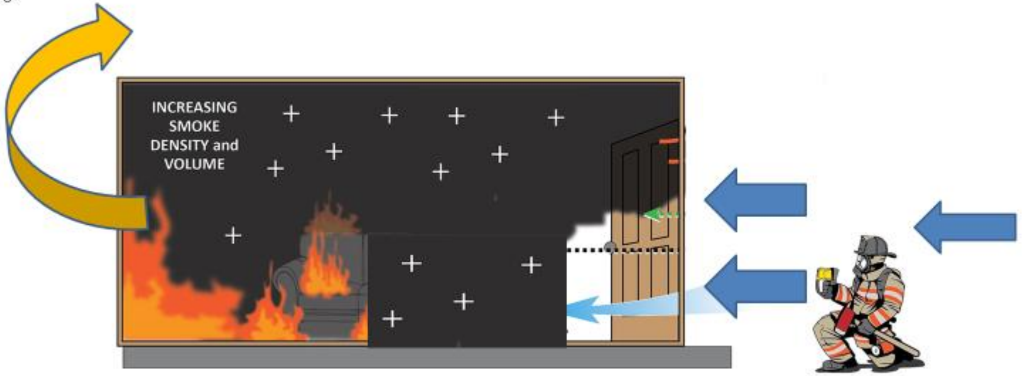




Corridor Extract System with window vent



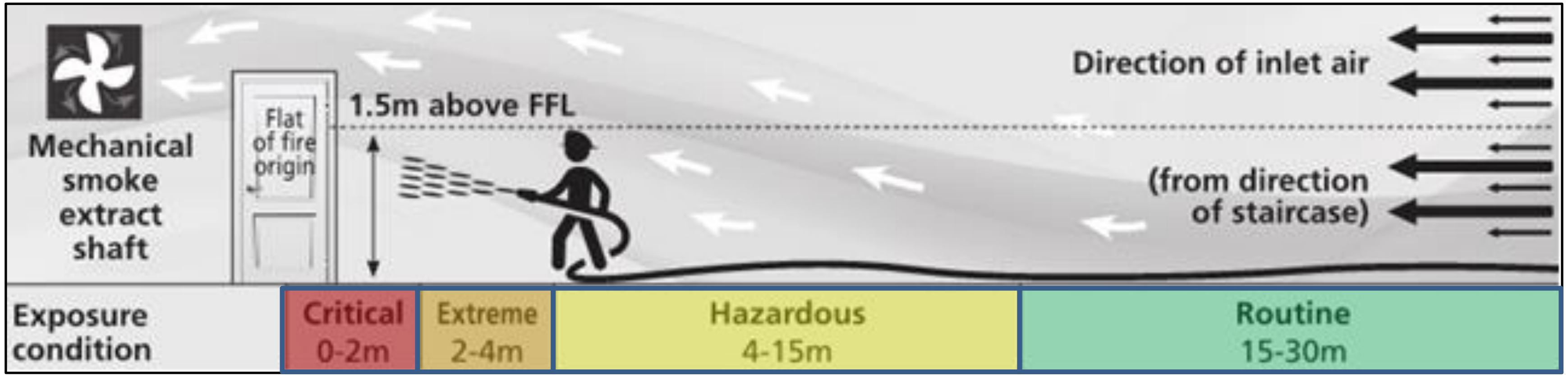
Pressurisation System with Window Vent



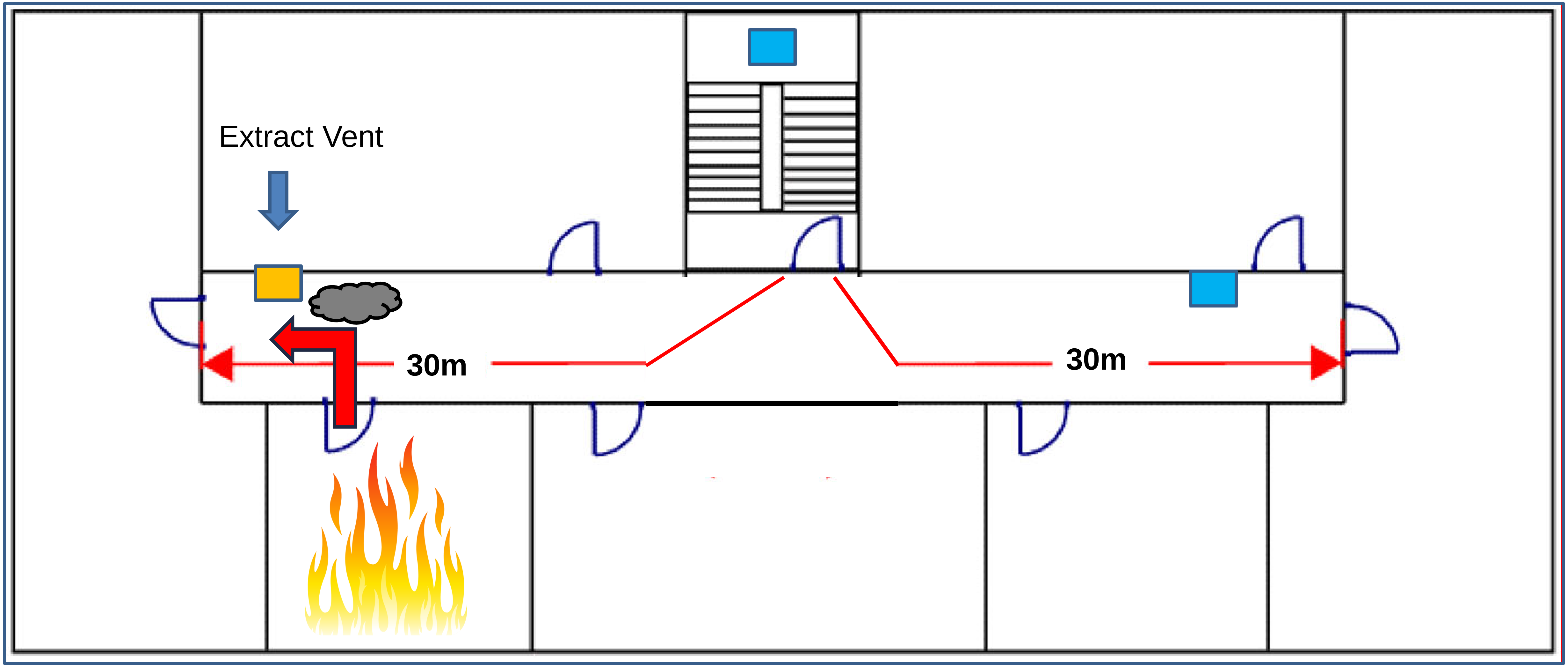
Mechanical Smoke Ventilation Systems (MSVS) (SCA Guidance 2015)

Exposure Condition	Maximum exposure time (minutes)	Maximum air temperature (^{0}C)**	Maximum radiated heat flux (kW/m^2)	Remarks	Recommended distance from apartment door*
Routine	25	100	1	General fire-fighting	15-30m
Hazardous	10	120	3	Short exposure with thermal radiation	4-15m
Extreme	1	160	4 – 4.5	For example, snatch rescue scenario	2-4m
Critical	<1	>235	>10	Considered life threatening	0-2m

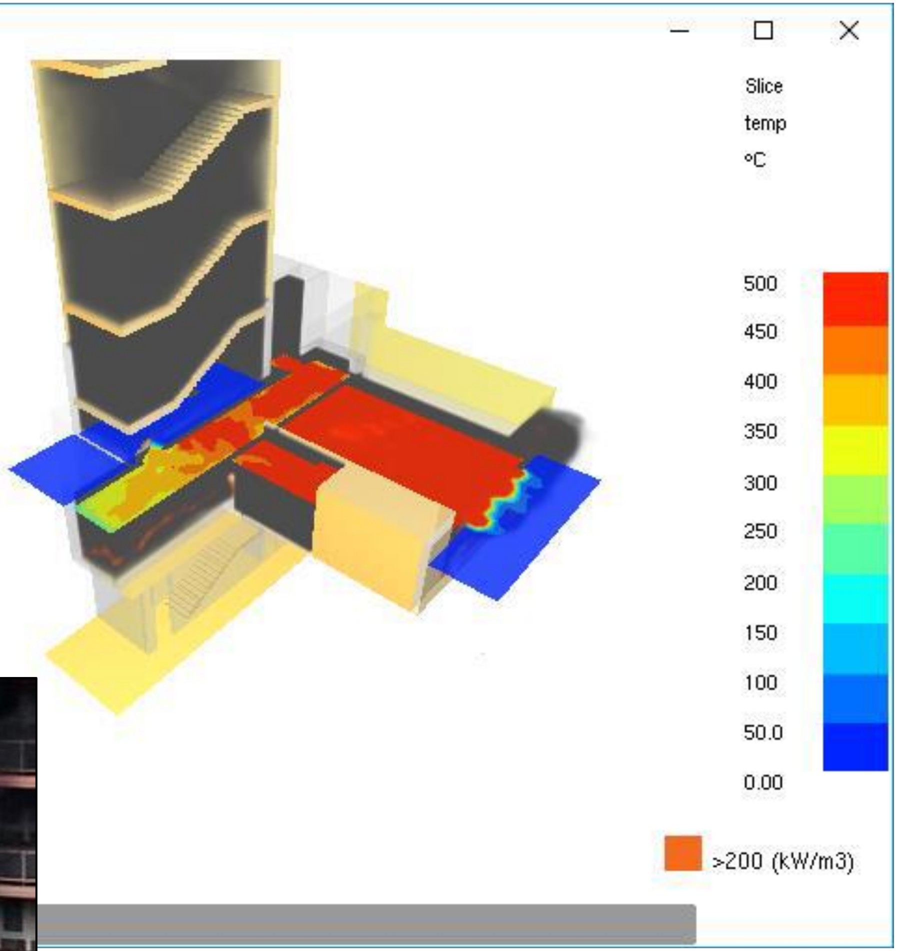
The design guidance produced by the Smoke Control Association in 2015 for extended corridor MSVS took into account the 2011 research and demonstrated how placing the extracting shaft away from the stairs will improve firefighter safety and reduce exposure to unnecessary heat and smoke during firefighting.

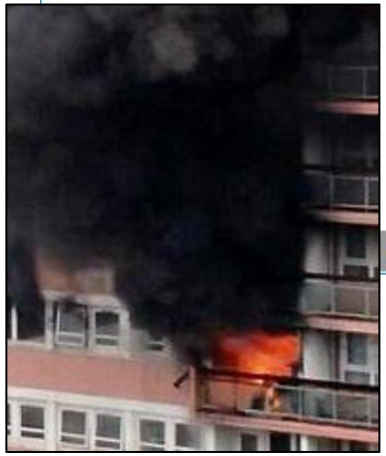


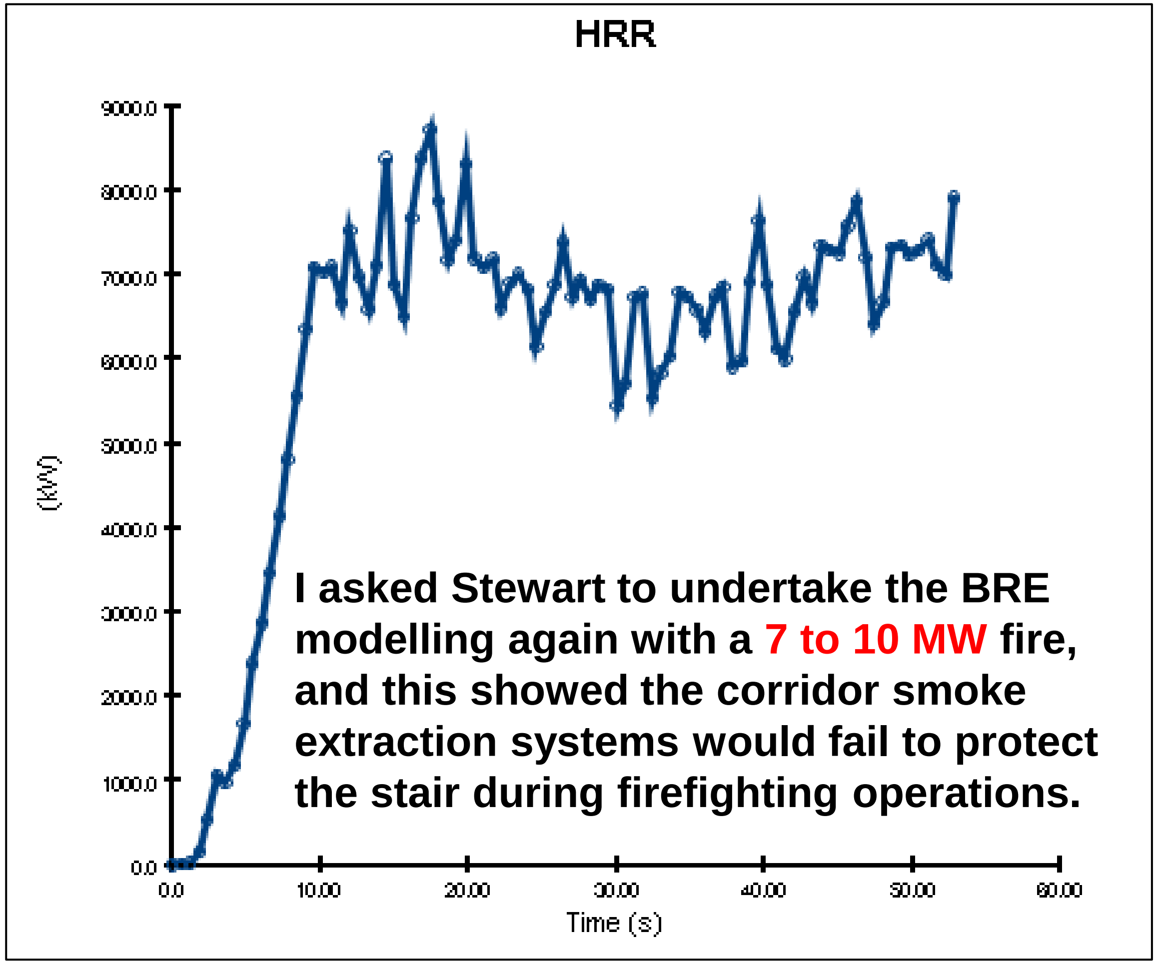
Extended Floor-plate (Flats) to **2015-2023**



Smoke ventilation in common areas of single stair residential buildings







I asked Stewart to undertake the BRE modelling again with a 7 to 10 MW fire, and this showed the corridor smoke extraction systems would fail to protect the stair during firefighting operations.

Stewart Miles – BRE 79204 and BD 2410

Conflicts in Choice of Stair for Firefighting

- Taking hose-lines through stair doors
- Choosing the nearest stair to the fire when a conflict arose between accessing a pre-designed ‘**evacuation**’ stair or a pre-designed ‘**firefighting**’ stair

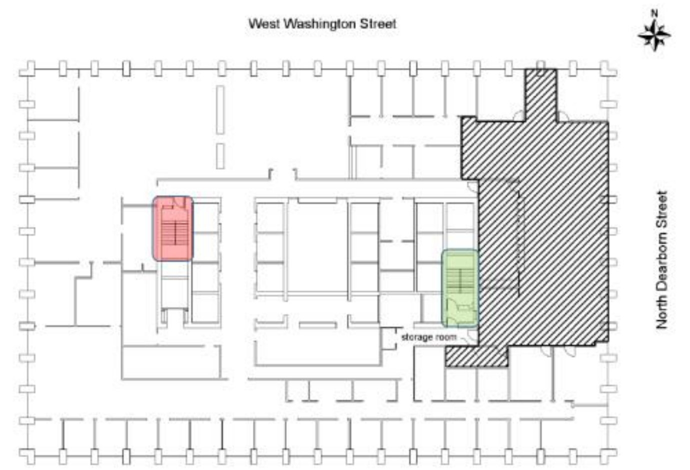
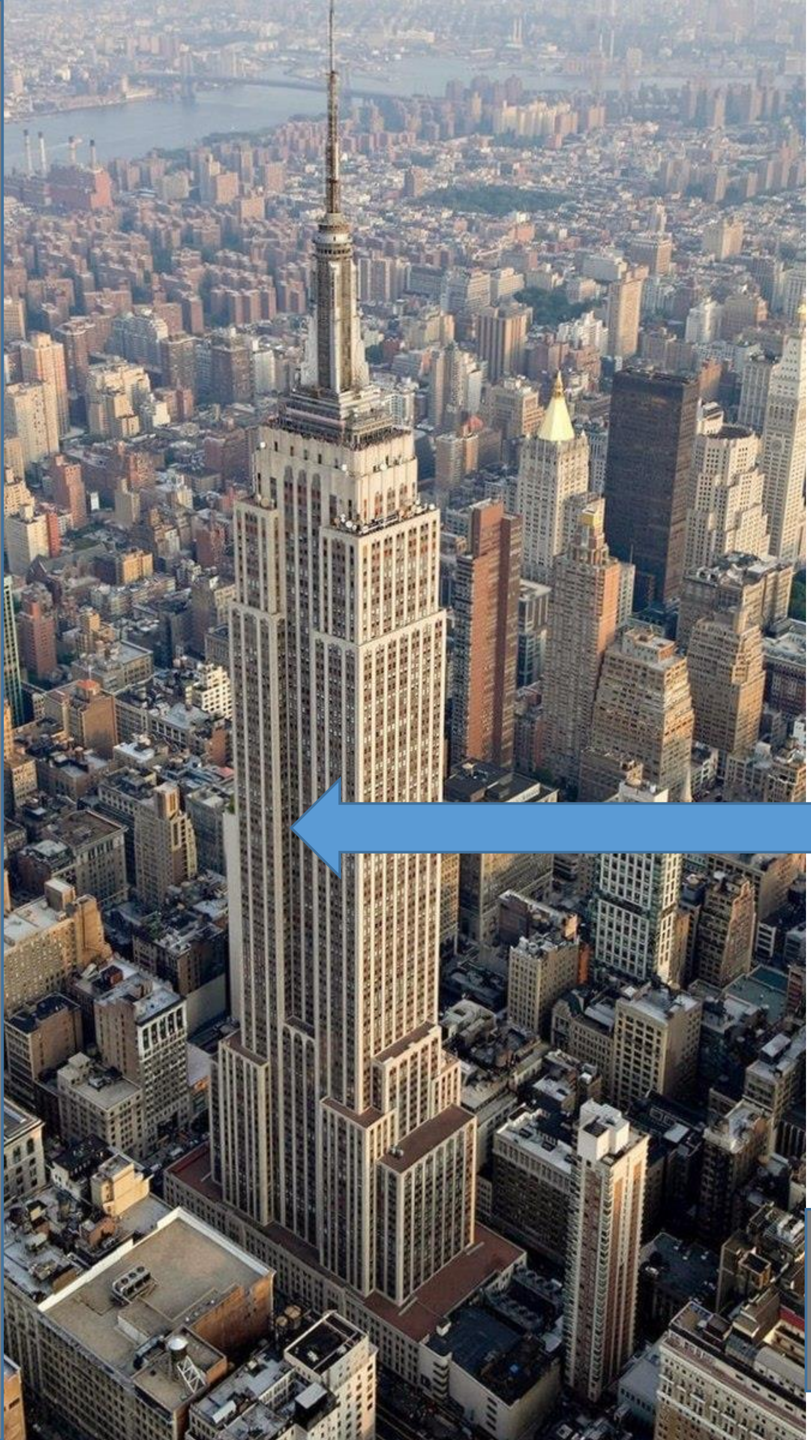
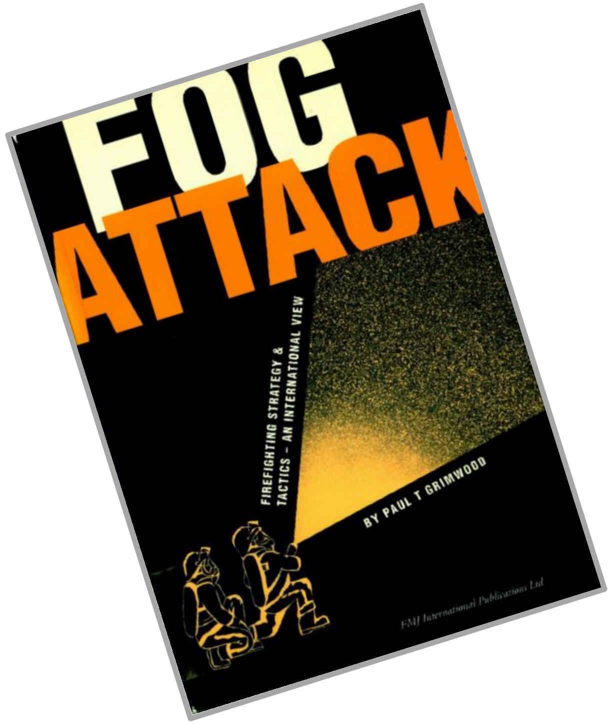


Figure 2. Plan view of 12th floor, showing area of significant fire damage

Pressurised firefighting stair in **RED** and naturally vented smoke tower evacuation stair in **GREEN**

EMPIRE STATE BUILDING FIRE JULY 1990 51st FLOOR





1. **Trapped large numbers above the fire floor as taking hose through the evacuation stair door caused the stair to fill with smoke**

2. **Caused a negative pressure to ‘draw’ fire and heat in the direction of firefighters**

EMPIRE STATE BUILDING FIRE JULY 1990 51st FLOOR

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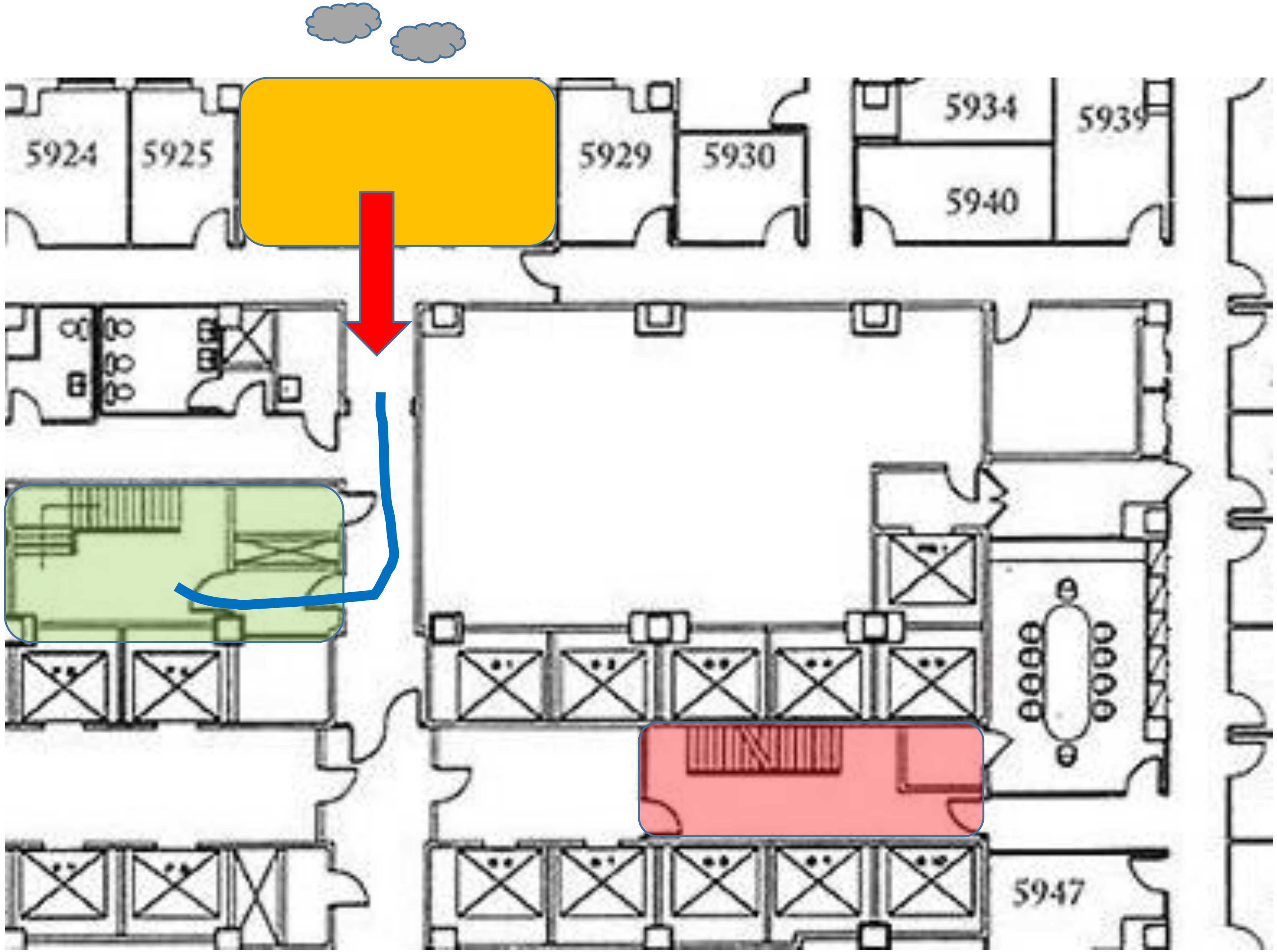

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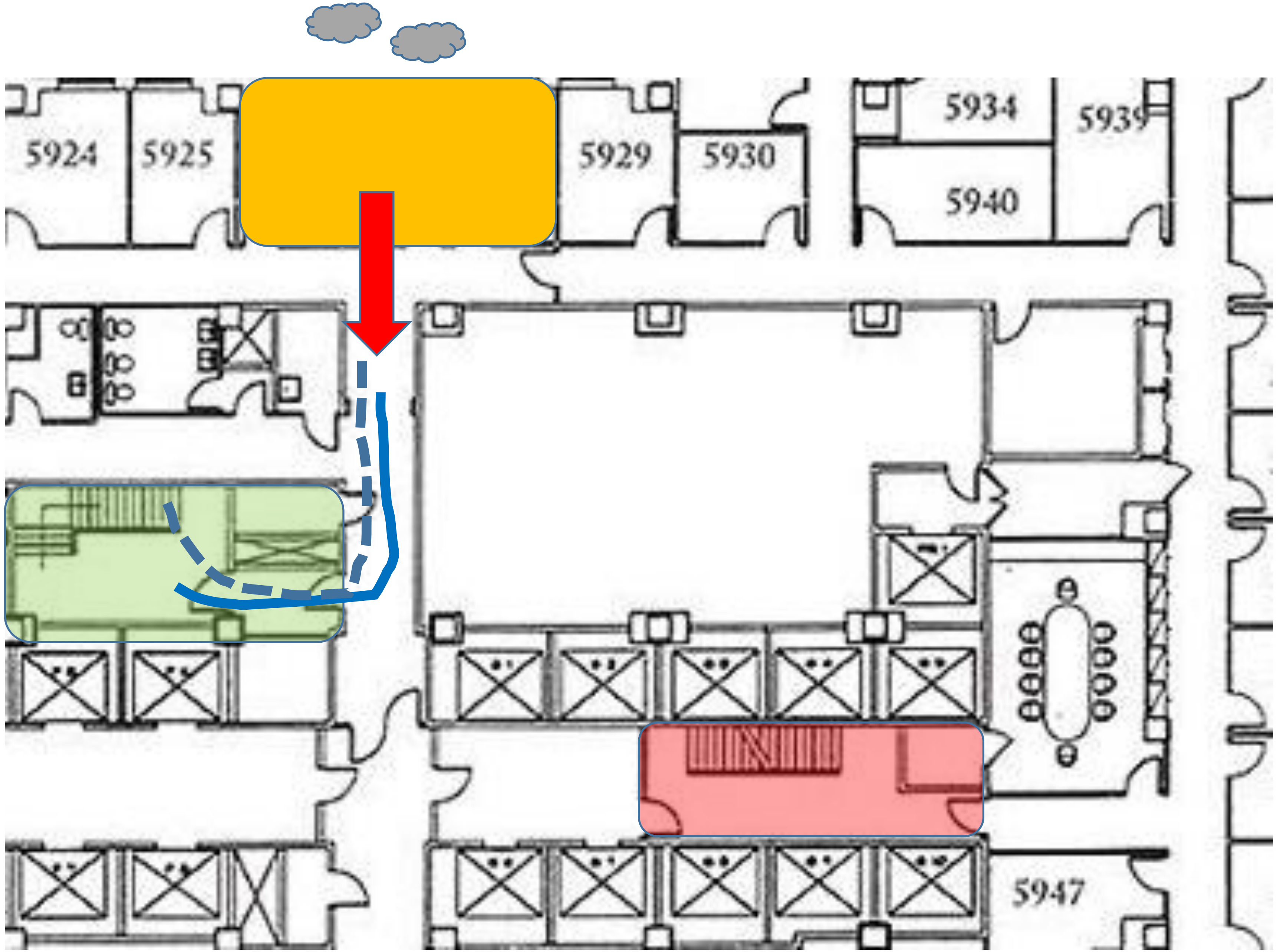

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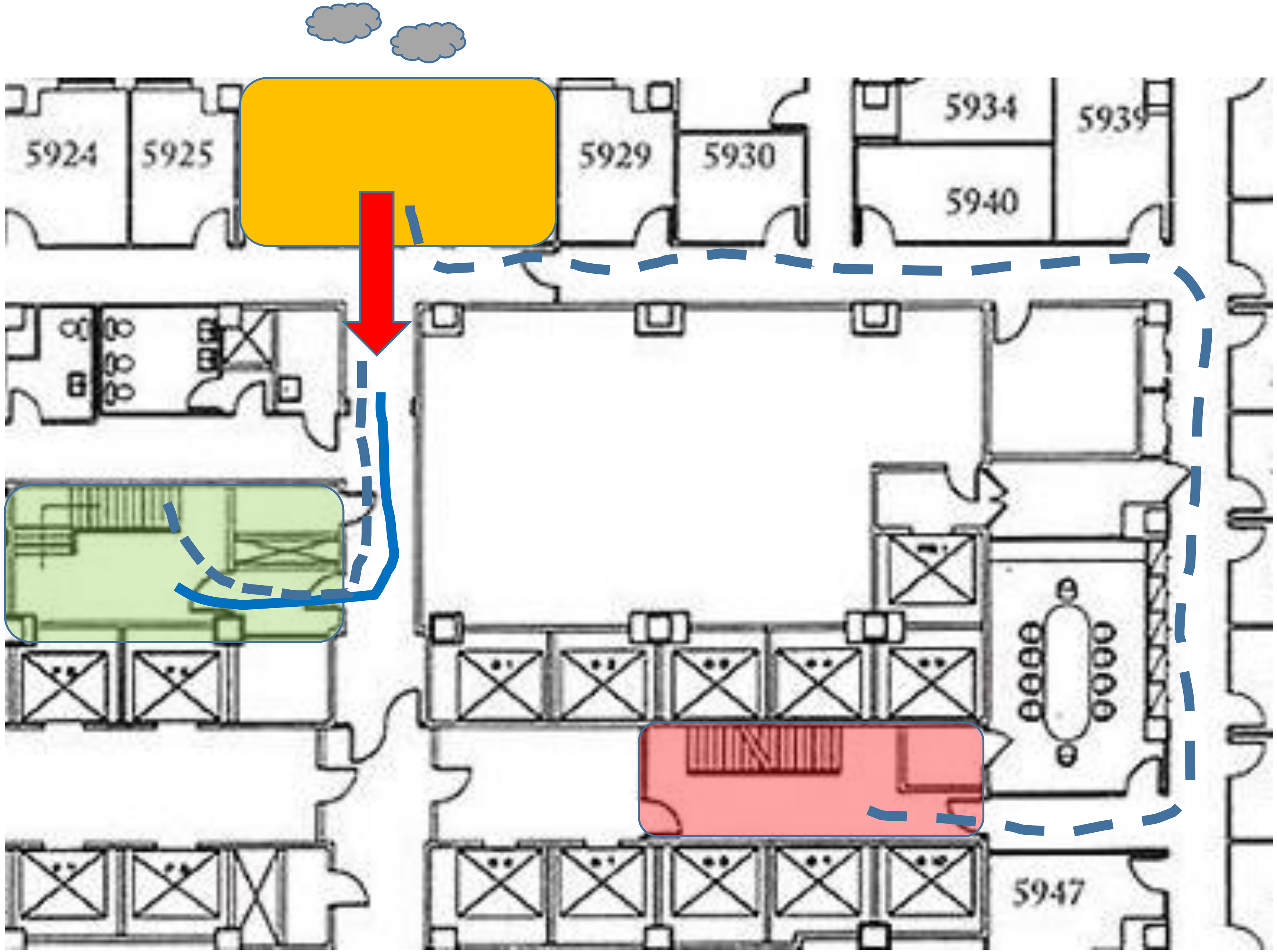


EMPIRE STATE BUILDING FIRE JULY 1990 51st FLOOR

FDNY Firefighting Procedures Vol.1 (Book 5)

Following the Empire State Building fire in 1990, the hazard created by negative pressure differentials existing in a naturally vented smoke shaft (Fire Tower) was made clear in subsequent revisions of the FDNY High-rise Firefighting procedures.

CAUTION: When using a stairway for smoke removal, an adverse condition could occur on the fire floor, causing heat and flames to be drawn toward the stairway being used. The drawing of heat and smoke toward stairways is especially evident whenever fire towers have been utilized. Due to this experience, fire towers are not recommended for use as fire attack stairs.

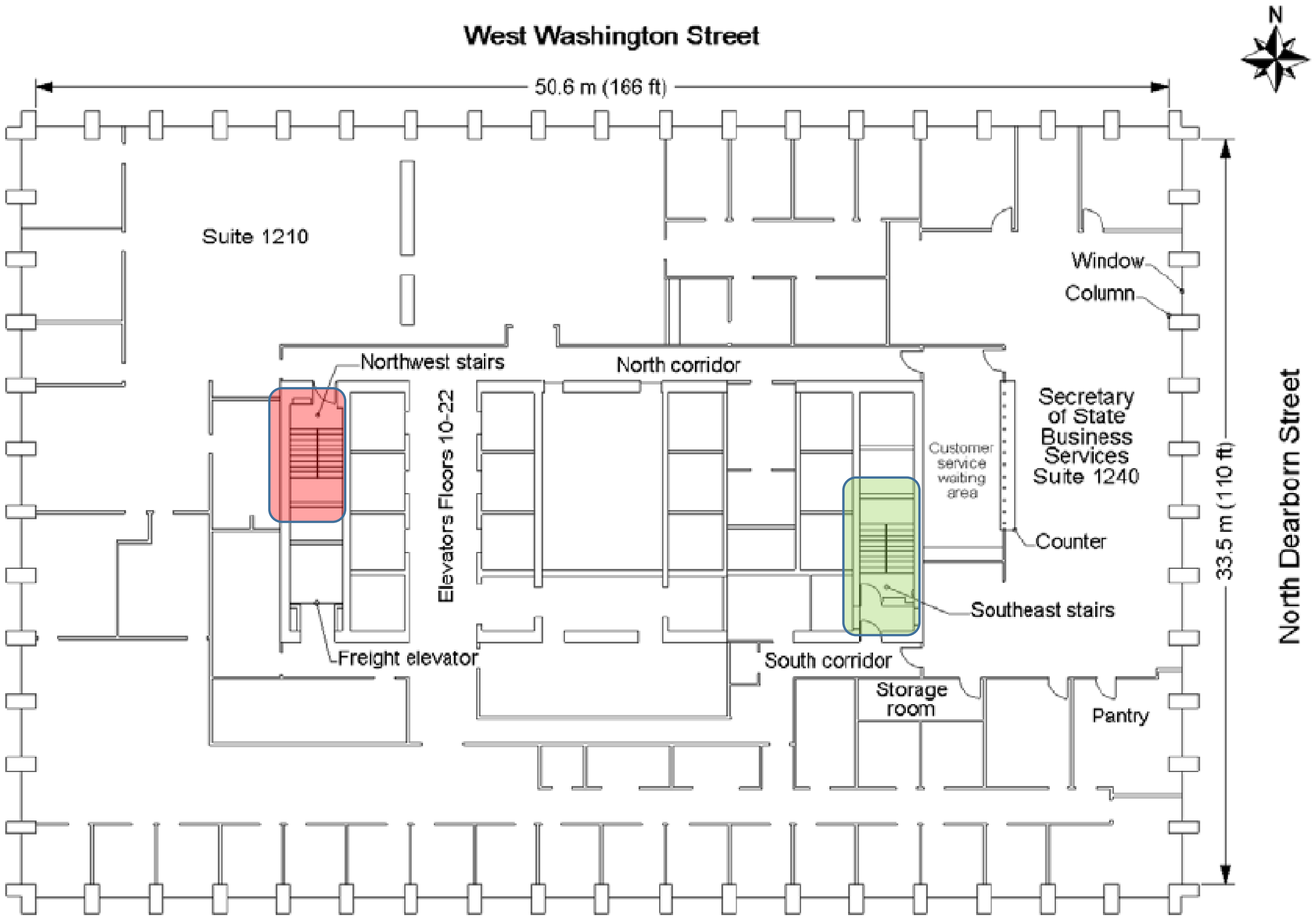
NIST Special Publication SP-1021

Cook County Administration Building Fire, 69 West Washington, Chicago, Illinois, October 17, 2003: Heat Release Rate Experiments and FDS Simulations

D. Madrzykowski
W.D. Walton

NIST National Institute of Standards and Technology • Technology Administration • U.S. Department of Commerce

Cook County Building high-rise Fire Chicago 2003



Pressurised firefighting stair in **RED** and naturally vented smoke tower evacuation stair in **GREEN**

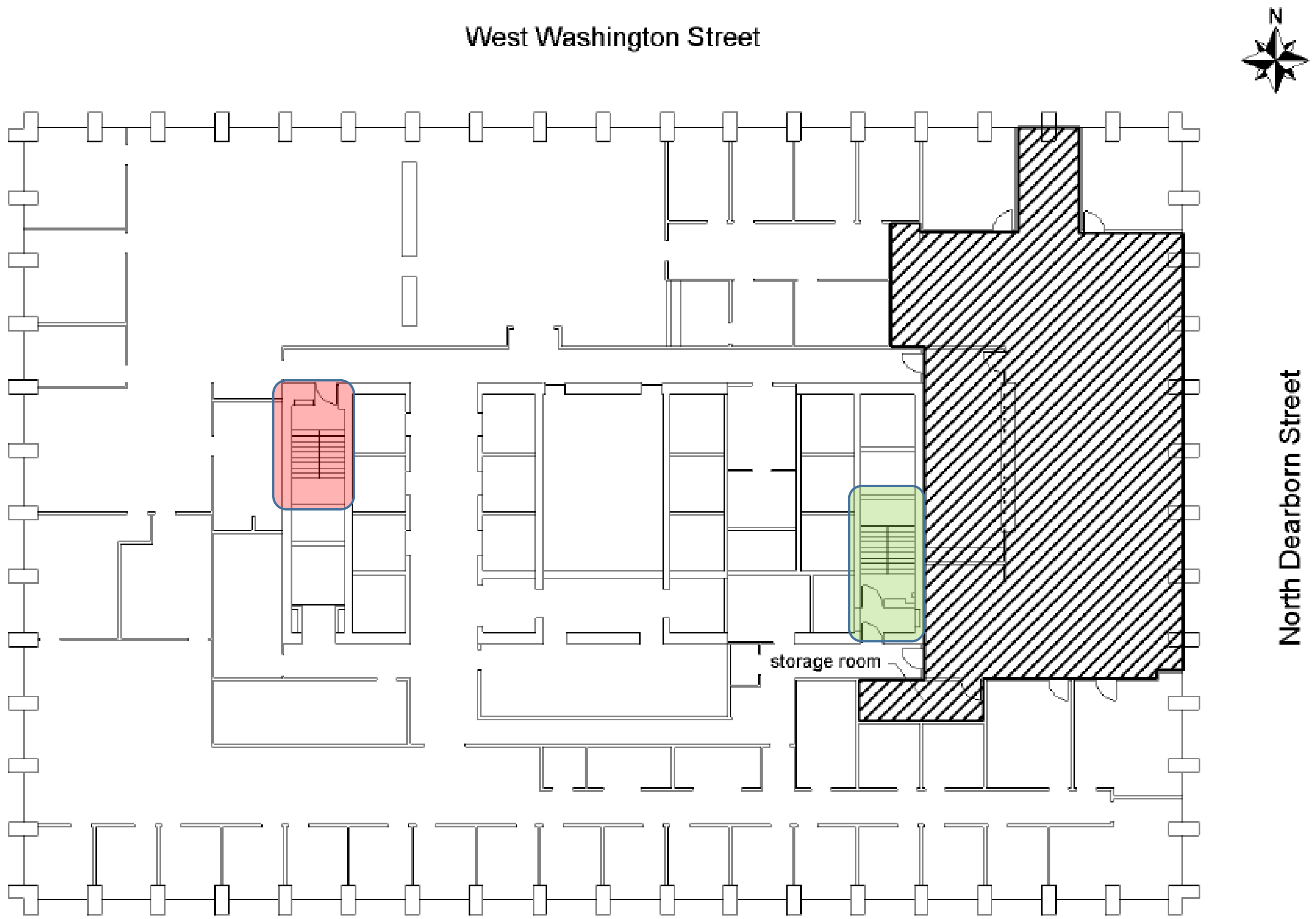


Figure 2. Plan view of 12th floor, showing area of significant fire damage

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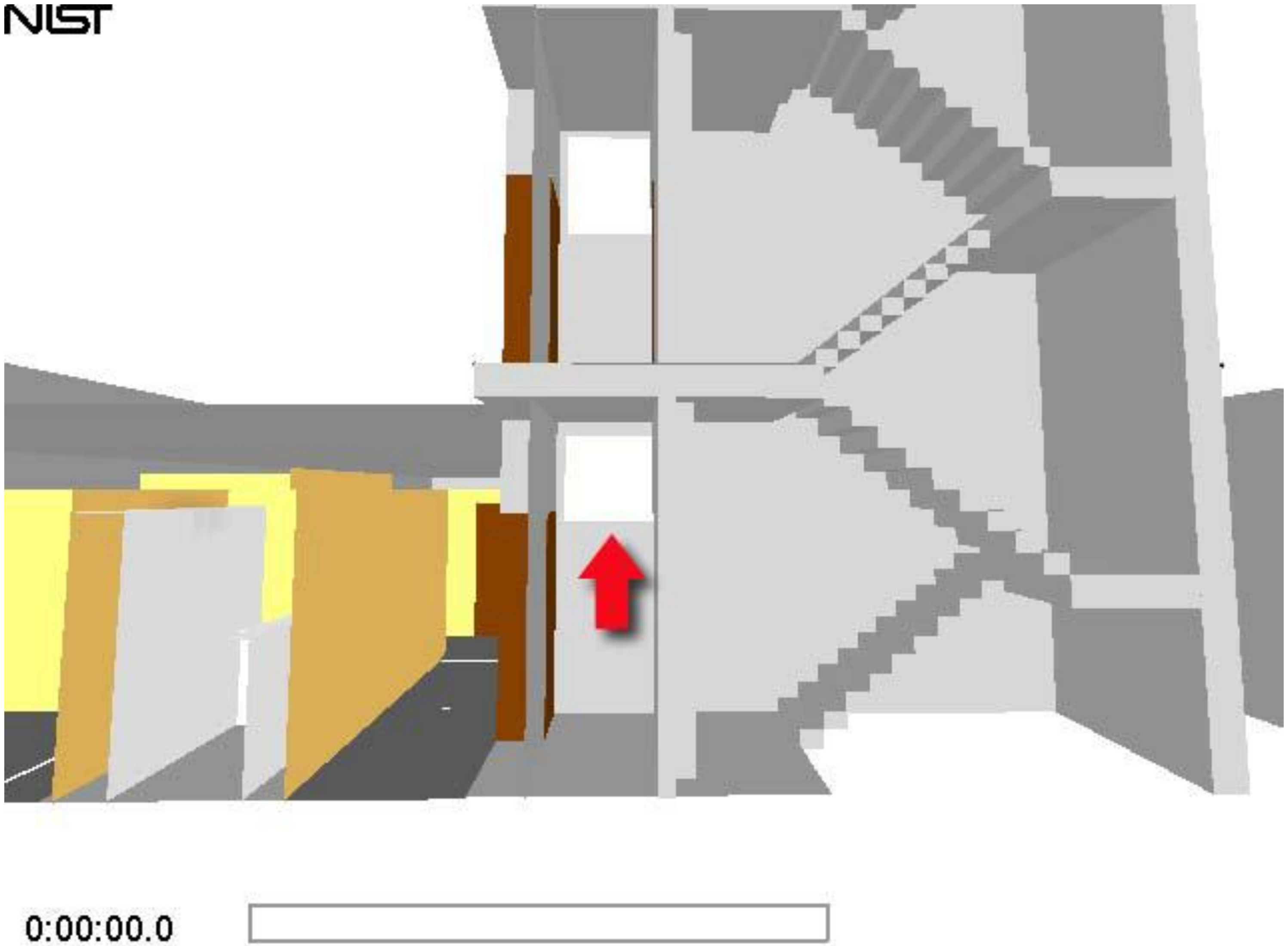
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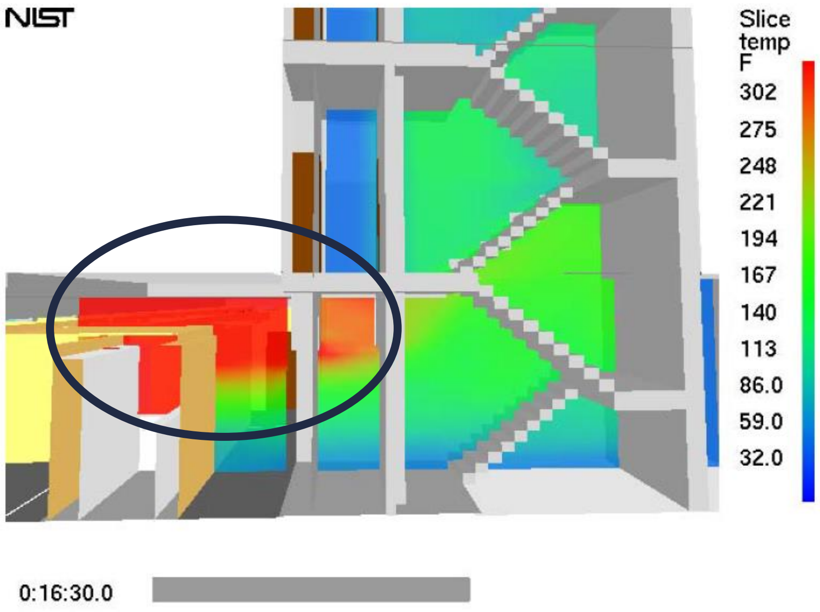


Figure 154. Temperature in southeast stairs at 990 s (16 min 30 s)

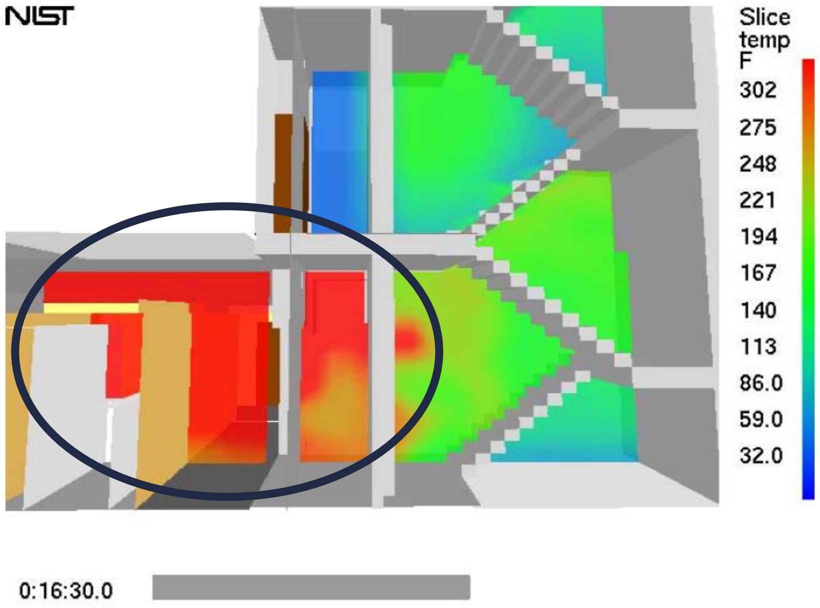
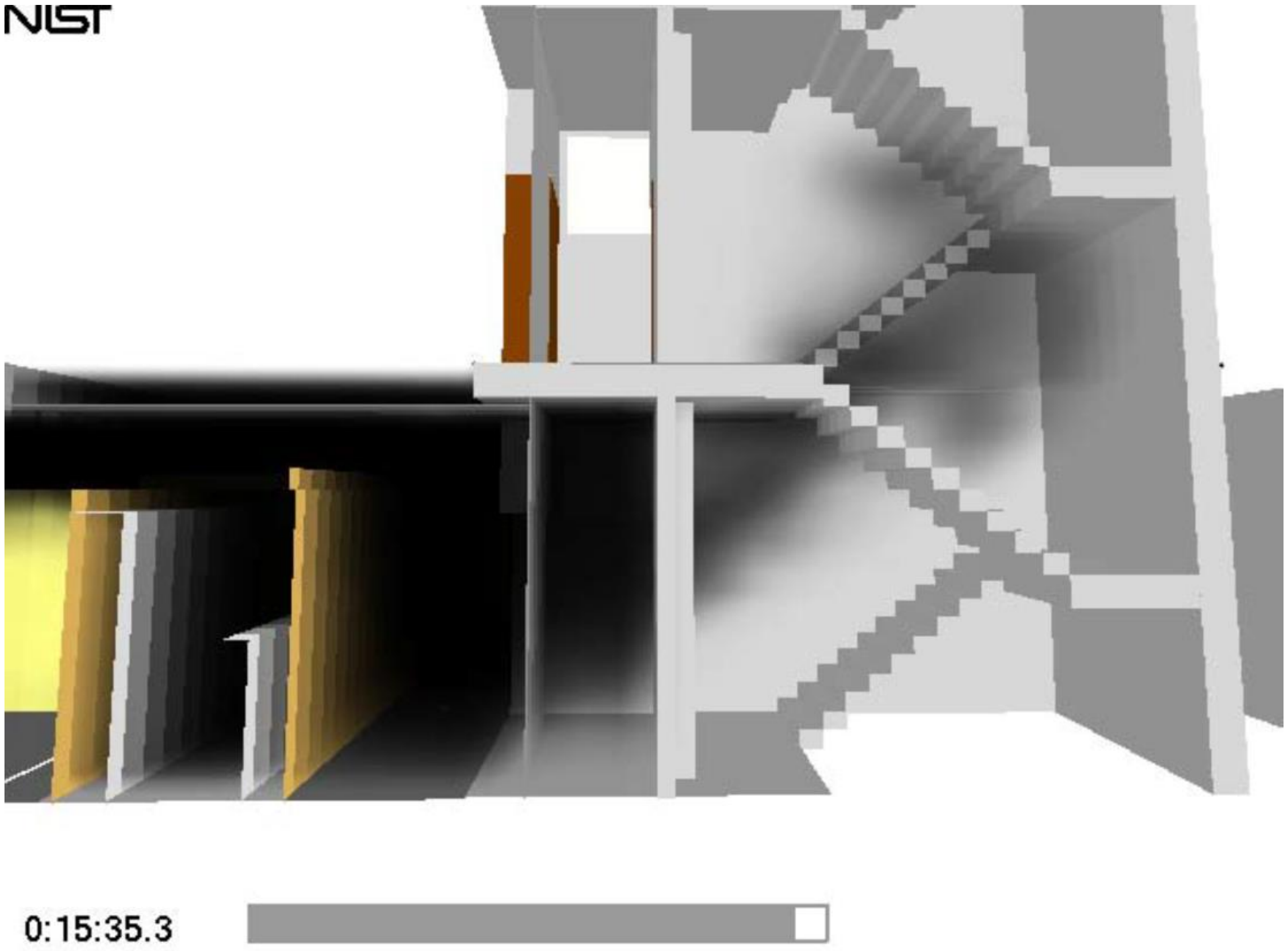


Figure 155. Temperature in southeast stairs at 990 s (16 min 30 s), with smoke shaft

Figure 154 shows a temperature slice through the southeast stairs at 990s **without** a functioning smoke shaft

Figure 155 a temperature slice through the southeast stairs at 990 s **with** a functioning smoke shaft.

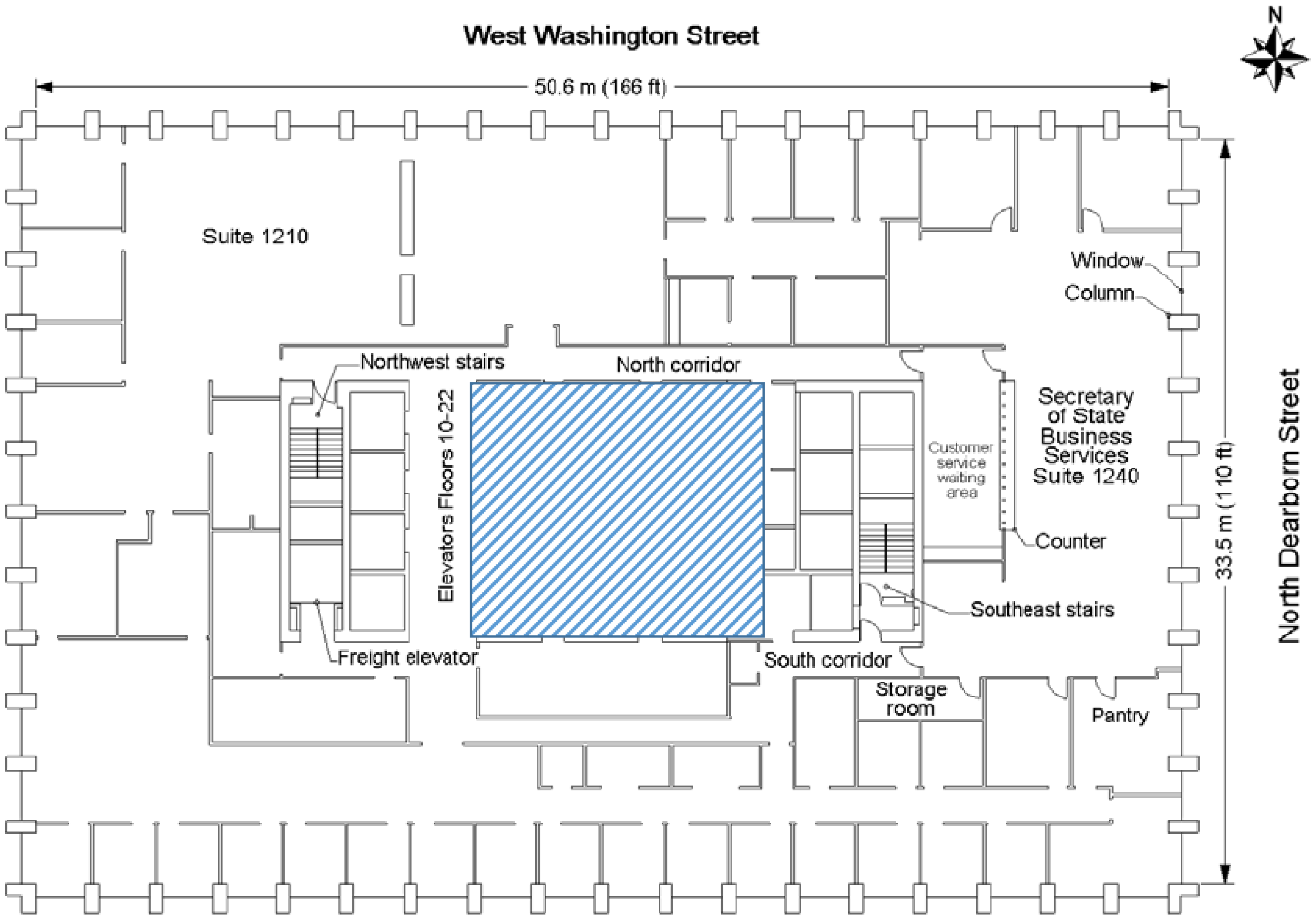
The temperature in the vestibule (lobby) and corridor is higher (floor to ceiling) with the vent open than with it closed.

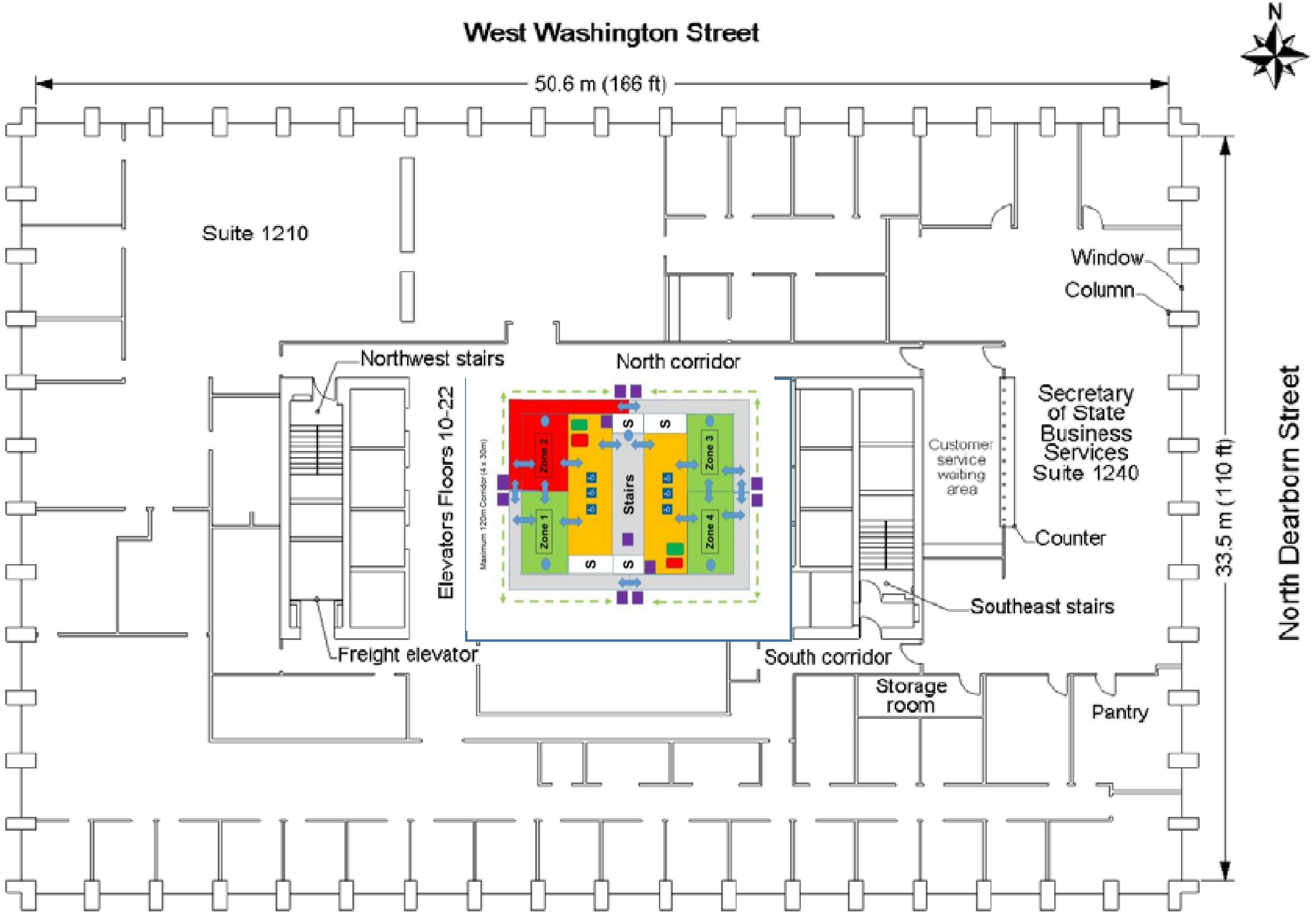


With the vestibule vent open the smoke would have flowed into the smoke shaft and out of the building (flow path), **whilst with an open stair door (for hose) the smoke shaft would have also drawn smoke and fire towards the stairs.**

The Cook County Administration Building is 37 stories tall with one level below grade. The building is constructed with reinforced cast-in-place concrete and has concrete and glass panel exterior walls. More details of the building construction are provided in the modeling section of this report.

Compartmentalization contained the fire damage to a single office suite (Figure 2). Closed solid core doors and 16 mm (0.625 in) gypsum board partition walls limited the fire damage in rooms, on both the north end and south end of Suite 1240. However, the partition walls did not extend above the drop ceiling. The lack of partitions above the drop ceiling allowed for the rapid spread of smoke and fire gases throughout the 12th floor and then throughout the building, through penetrations, HVAC ducts, and open doors. The gross area of the 12th floor is approximately 1695 m^2 (18260 ft^2), based on the overall dimensions of the floor that included the building core. The areas of Suite 1240 that were most heavily damaged by the fire were the open plan office area and the storage room. This area was approximately 243 m^2 (2620 ft^2) or about 14 % of the total floor area.


West Washington Street
N
50.6 m (166 ft)
Suite 1210
Northwest stairs
North corridor
Elevators Floors 10-22
Freight elevator
South corridor
Storage room
Pantry
Window
Column
Secretary of State Business Services Suite 1240
Customer service waiting area
Counter
Southeast stairs
33.5 m (110 ft)
North Dearborn Street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50.6 m (166 ft)
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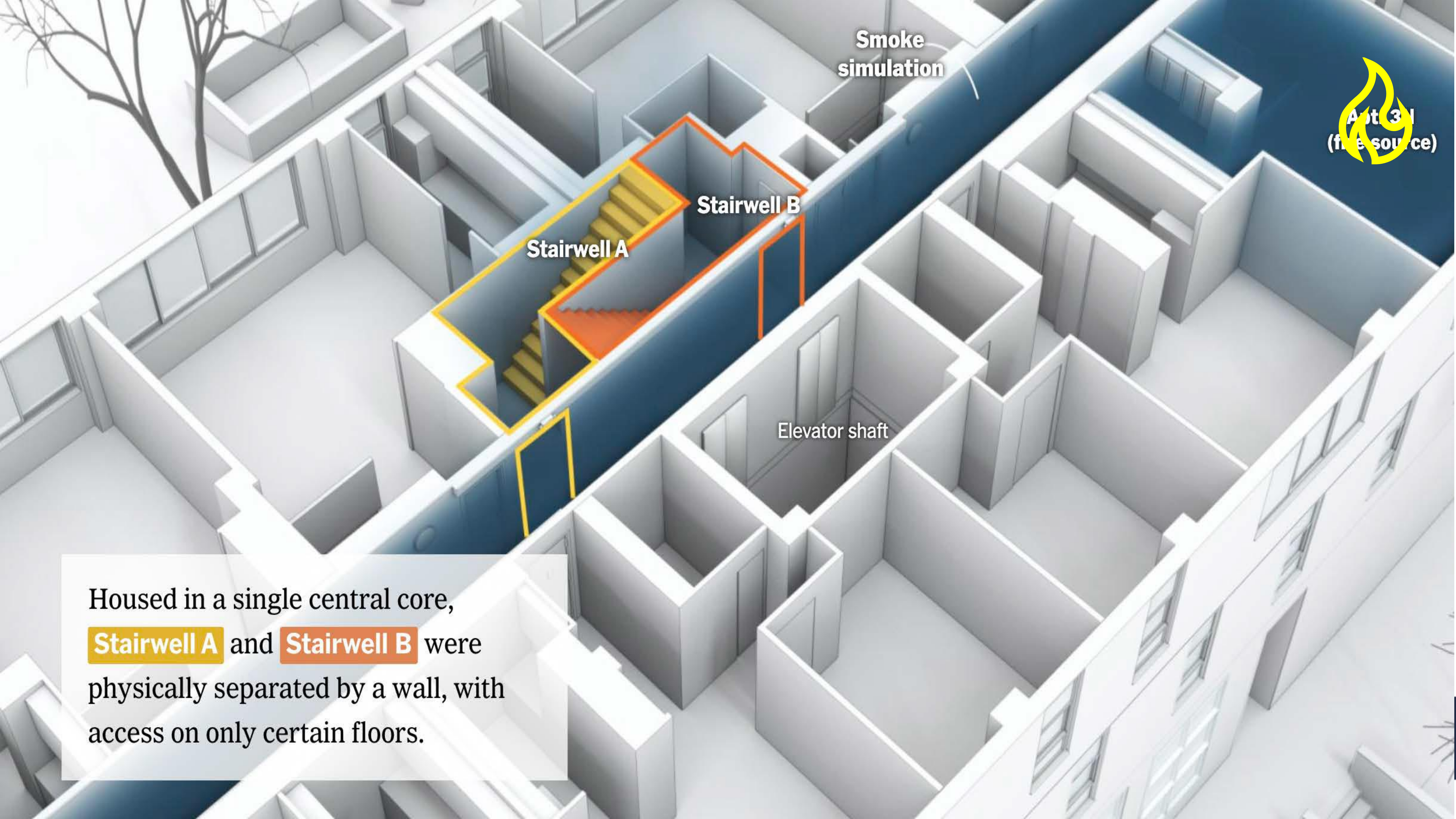
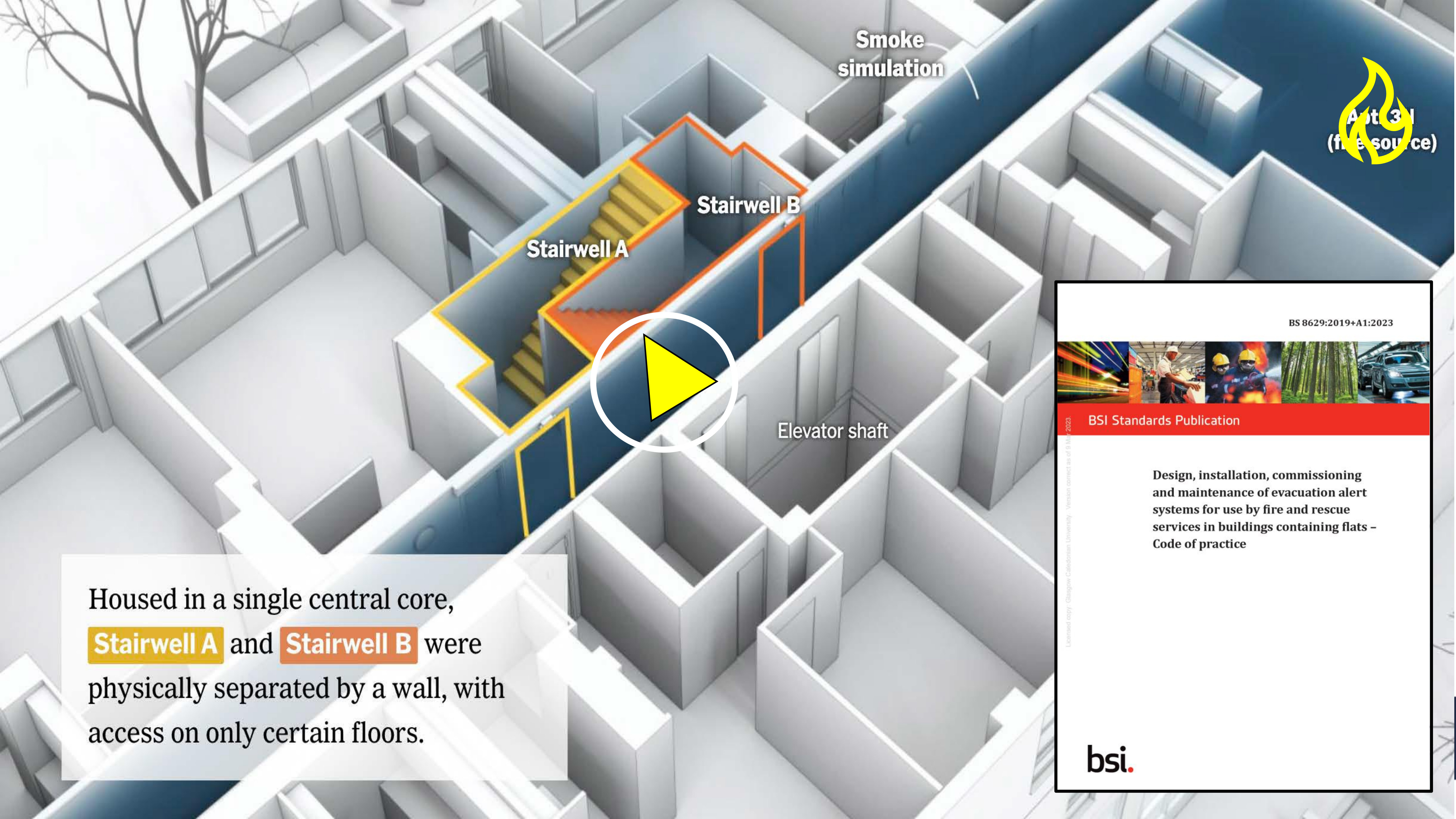
Suite 1210
Window
Column
Northwest stairs
North corridor
Elevators Floors 10-22
Stairs
Zone 1
Zone 2
Zone 3
Zone 4
Secretary of State Business Services Suite 1240
Customer service waiting area
Counter
Southeast stairs
Freight elevator
South corridor
Storage room
Pantry
33.5 m (110 ft)
North Dearborn Street

On the morning of Jan. 9, 2022, shortly before 1100 hours, the FDNY responded to what would become one of the worst fires in New York City's history.

- **17 fatalities including 8 children**
- **9 of the fatalities were located in stairwells**
- **All died of smoke inhalation**
- **60 Victims rescued**
- **30 persons removed in cardiac arrest**
- **Stairwell doors breached (or failed) on fire floor (3rd) and 15th levels.**



Housed in a single central core, Stairwell A and Stairwell B were physically separated by a wall, with access on only certain floors.


Smoke simulation
Stairwell B
Stairwell A
Elevator shaft
Housed in a single central core, Stairwell A and Stairwell B were physically separated by a wall, with access on only certain floors.
BS 8629:2019+A1:2023
BSI Standards Publication
Design, installation, commissioning and maintenance of evacuation alert systems for use by fire and rescue services in buildings containing flats – Code of practice
bsi.

BS EN 12101-13 2022

Part 13 – Pressure Differential Systems

National Foreword

“This standard is **not** intended for corridor/lobby extract or Mechanical Smoke Ventilation Systems (MSVS). These systems generally create a lower pressure in **protected spaces**, such as lobbies and corridors and are outside of the scope of this standard”.

BS EN 12101-13 2022

Part 13 – Pressure Differential Systems

Table 1 — Design requirements of a PDS

Parameter	Class 1	Class 2
Door opening force	≤ 100 N	
Pressure differential	≥ 30 Pa	
Airflow velocity	≥ 1 m/s	≥ 2 m/s
Initiation time	≤ 60 s	
Operation time	≤ 120 s	
Response time	≤ 5 s	

Class 2 systems additionally if required by AHJs

Building Type	Ceiling Height	Design Pressure Difference
Sprinklered	Any	12.5 Pa
Non-sprinklered	2.7 m	25 Pa
Non-sprinklered	4.6 m	35 Pa
Non-sprinklered	6.4 m	45 Pa

Table 1 — Design requirements of a PDS

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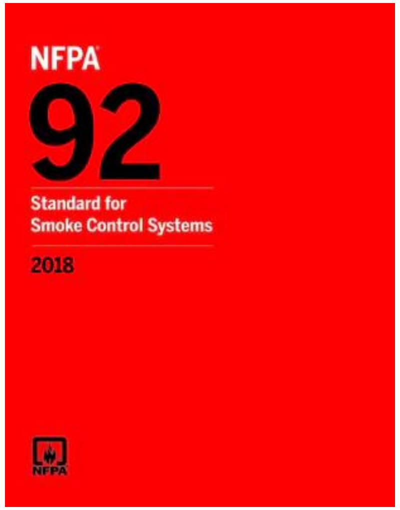
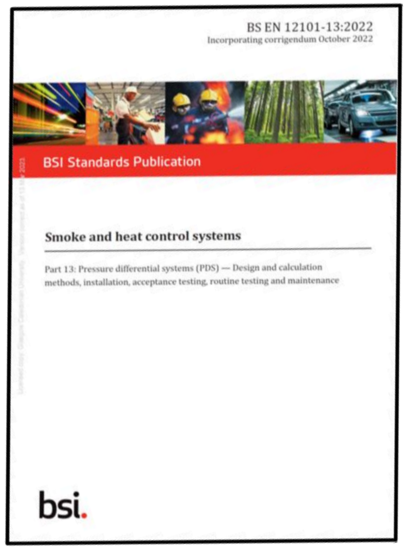




- Protecting a stair, or adjoining corridor, from *typical* fire smoke infiltration requires positive airflows between **0.75 m/s and 2 m/s**.

- Protecting a stair, or adjoining corridor, from **pressurized smoke or flaming combustion** requires even greater pressures and airflows.

- A **12-14 MW** room fire (under research) required **5 m/s** to reverse smoke and flaming combustion back out of the corridor, into and through a window vented fire compartment.

National Institute for Standards and Technology (NIST) USA Report 7213

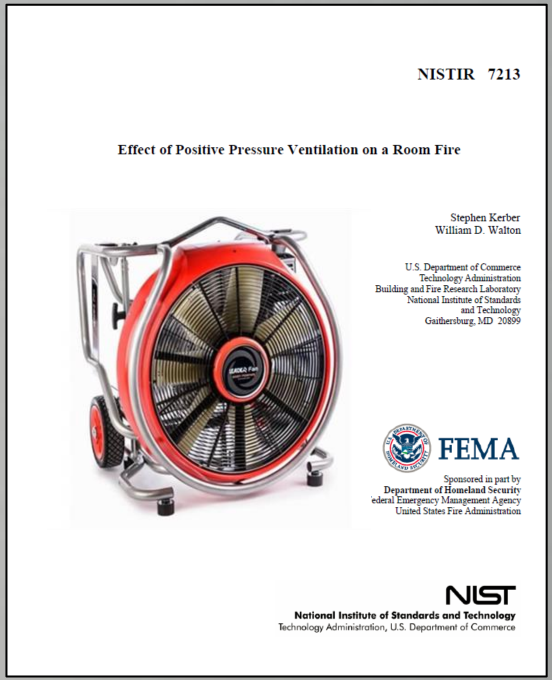
Dr Philip Thomas – Critical Velocity (m/s)

Fire Research Station 1970

MW	m/s	m^3/s
2.4	**4**	**8**
3	4.3	8.7
4	4.8	9.6
5	5.1	10.2
10	5.5	11
12	6.9	13.8
14	7.25	14.5

1970 - The Thomas equation indicates that a velocity of about **4 m/s** is needed to prevent smoke backflow through a 0.9 m wide doorway from a 2.4 MW fire . For a doorway area of 2 m^2, this amounts to about **8 m^3/s**

- **BS 5588-4:1978** (3 - 4 m/s)
- **BS 5588-4:1998** (5 m/s)
- **BS EN 12101-6:2005** (5 m/s)
- BS EN 12101-13:2022 (Removed)


NISTIR 7213

Effect of Positive Pressure Ventilation on a Room Fire

Stephen Kerber
William D. Walton

U.S. Department of Commerce
Technology Administration
Building and Fire Research Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899

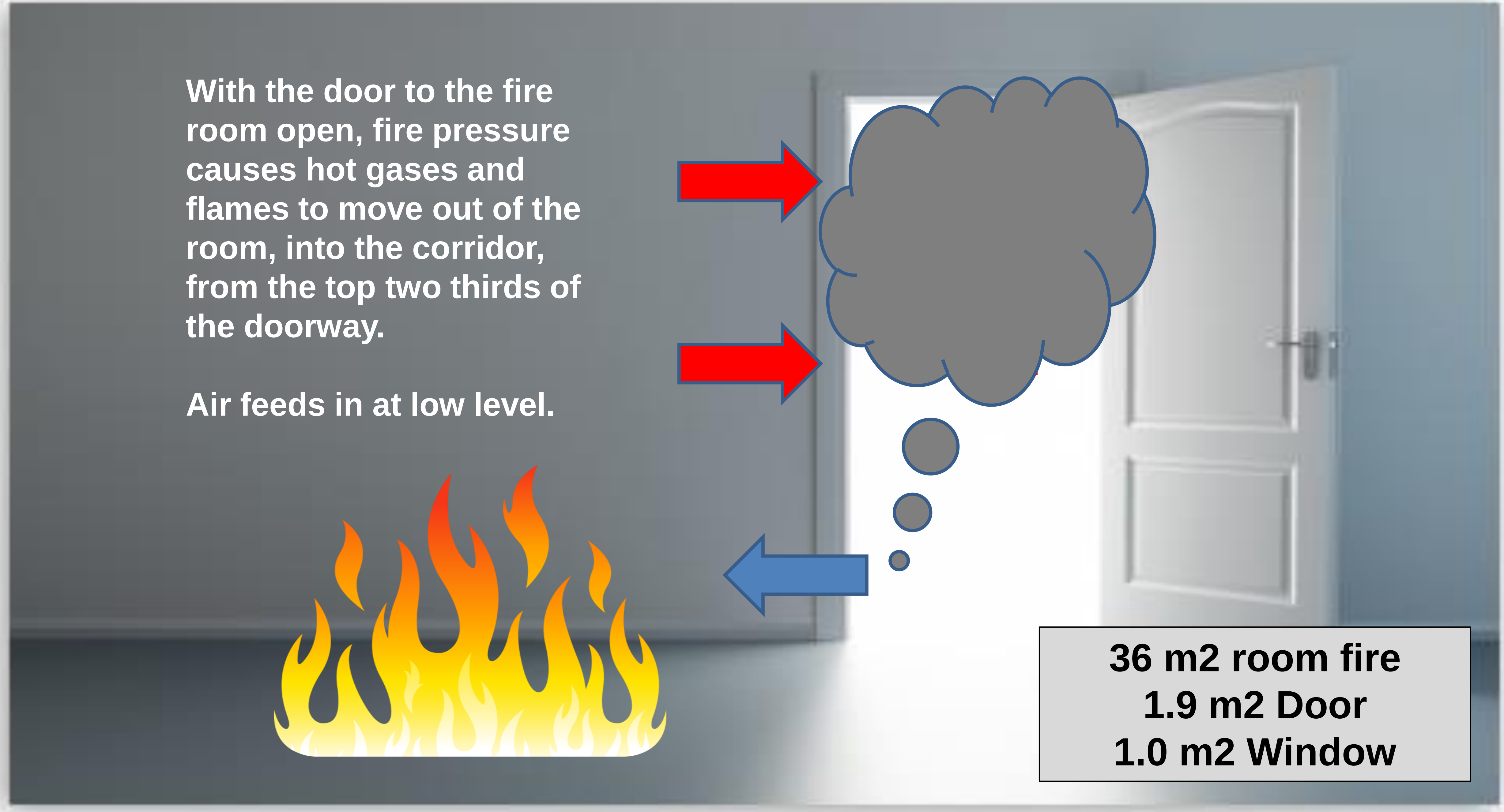
FEMA

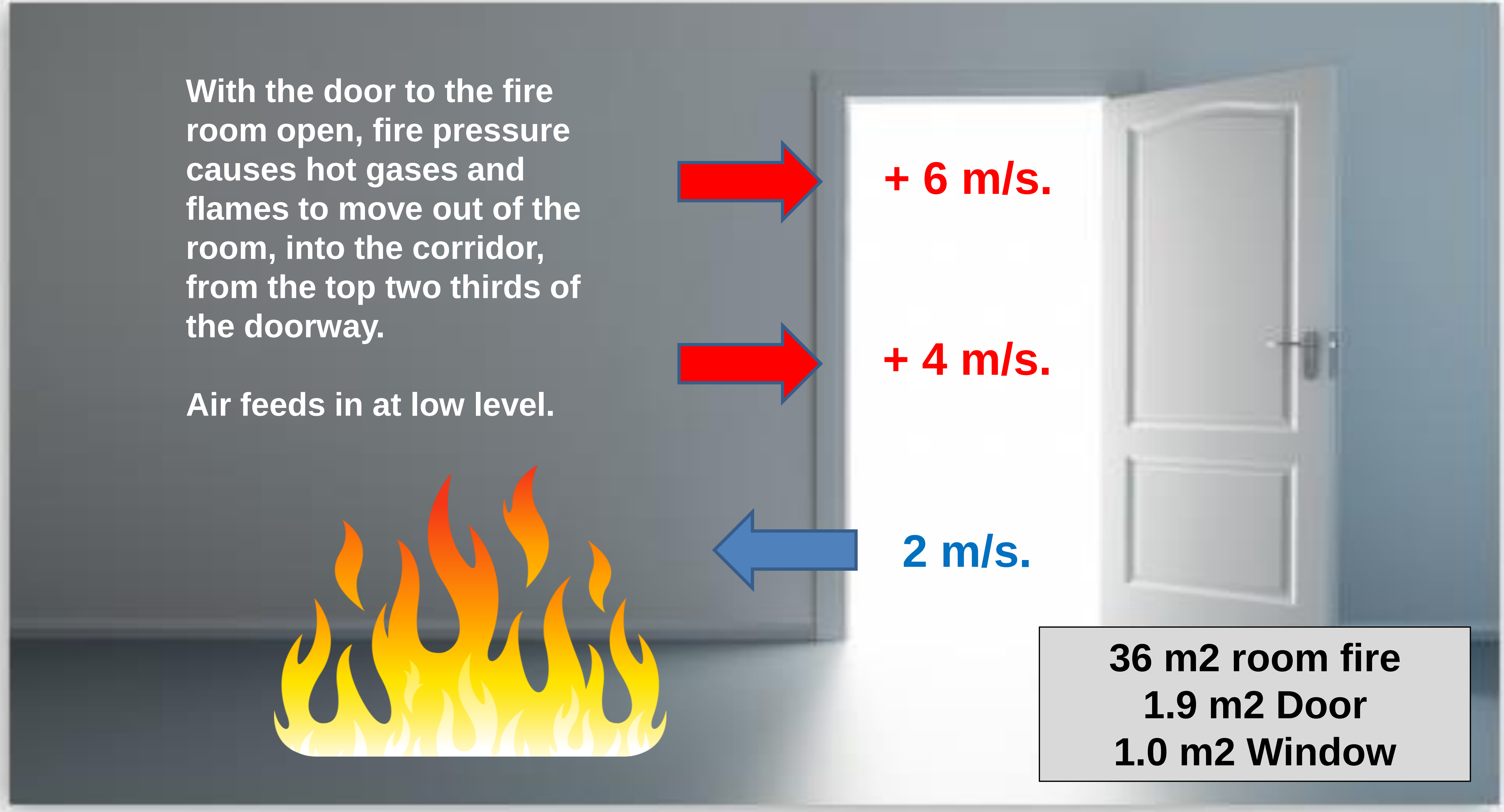
Sponsored in part by
Department of Homeland Security
ederal Emergency Management Agency
United States Fire Administration

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

NIST Report 7213

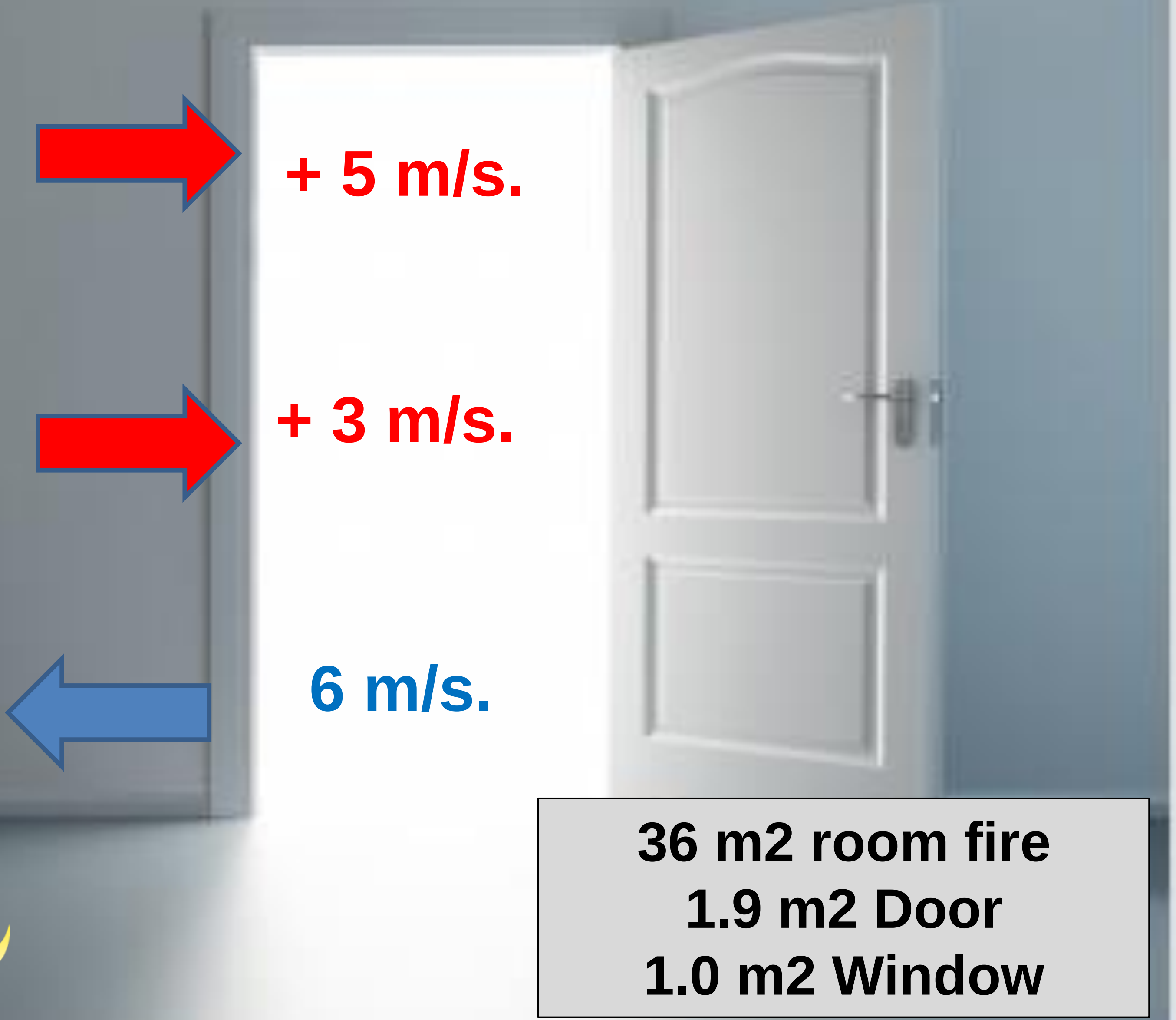
36 m2 room fire
1.9 m2 Door
1.0 m2 Window

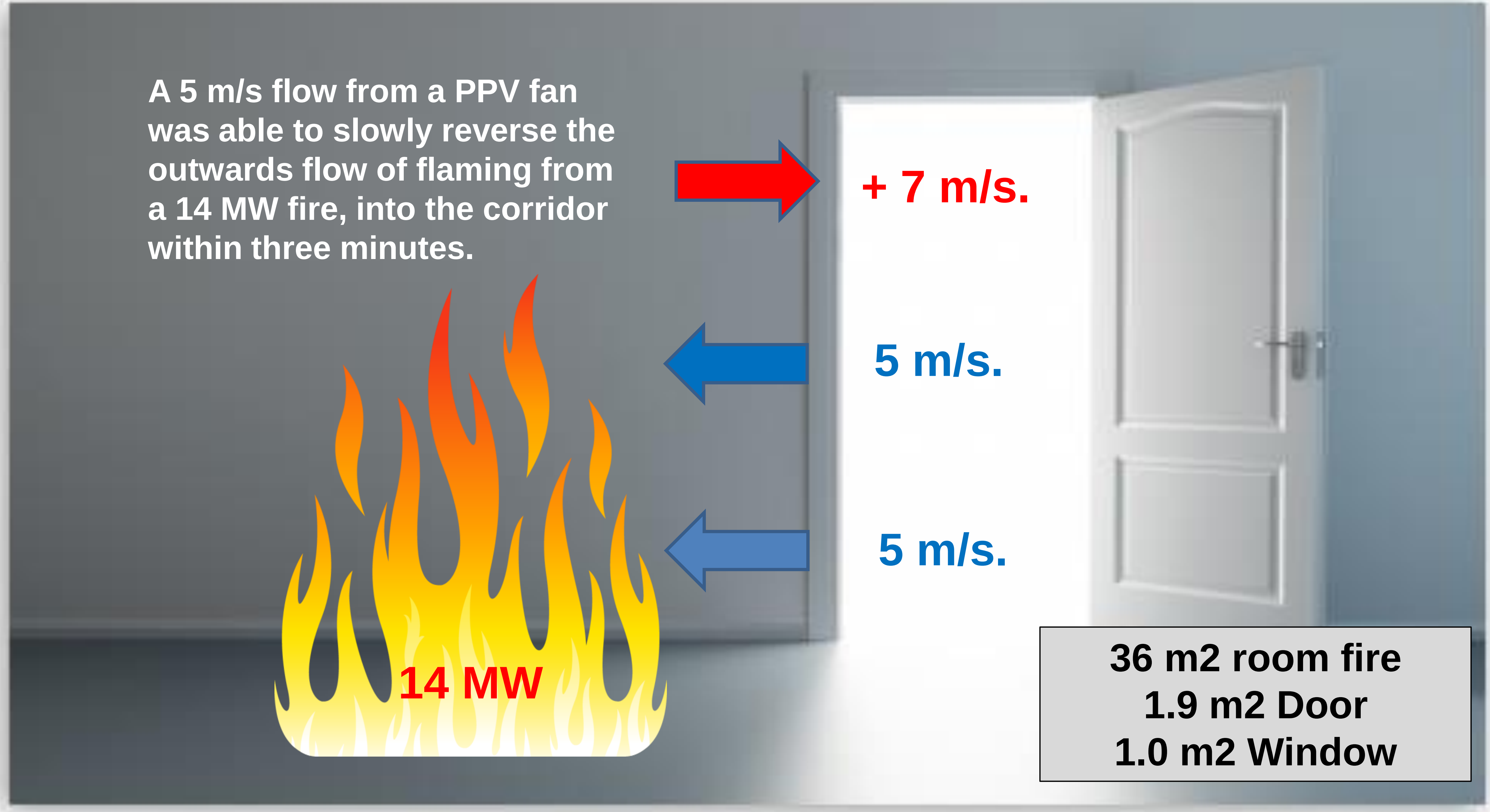

With the door to the fire room open, fire pressure causes hot gases and flames to move out of the room, into the corridor, from the top two thirds of the doorway.
Air feeds in at low level.
36 m2 room fire
1.9 m2 Door
1.0 m2 Window

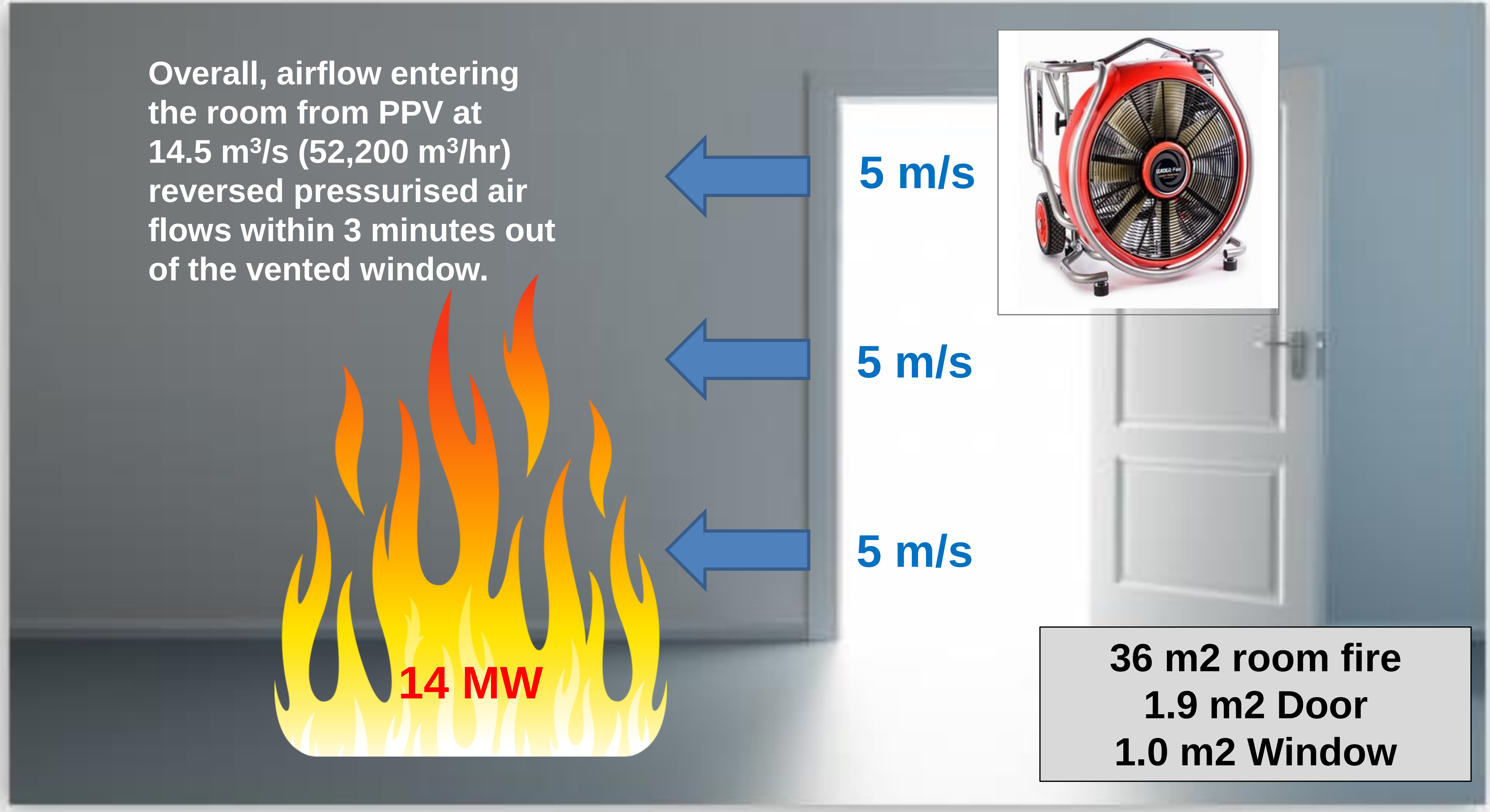

With the door to the fire room open, fire pressure causes hot gases and flames to move out of the room, into the corridor, from the top two thirds of the doorway.
Air feeds in at low level.
+ 6 m/s.
+ 4 m/s.
2 m/s.
36 m2 room fire
1.9 m2 Door
1.0 m2 Window

As the window to the room is vented, the room pressure decreases and flaming into the corridor reduces slightly at first.

As air feeds in below, the fire will again grow without any intervention taking place.




A 5 m/s flow from a PPV fan was able to slowly reverse the outwards flow of flaming from a 14 MW fire, into the corridor within three minutes.
+ 7 m/s.
5 m/s.
5 m/s.
14 MW
36 m2 room fire
1.9 m2 Door
1.0 m2 Window


Overall, airflow entering the room from PPV at 14.5 m³/s (52,200 m³/hr) reversed pressurised air flows within 3 minutes out of the vented window.
5 m/s
5 m/s
5 m/s
14 MW
36 m2 room fire
1.9 m2 Door
1.0 m2 Window

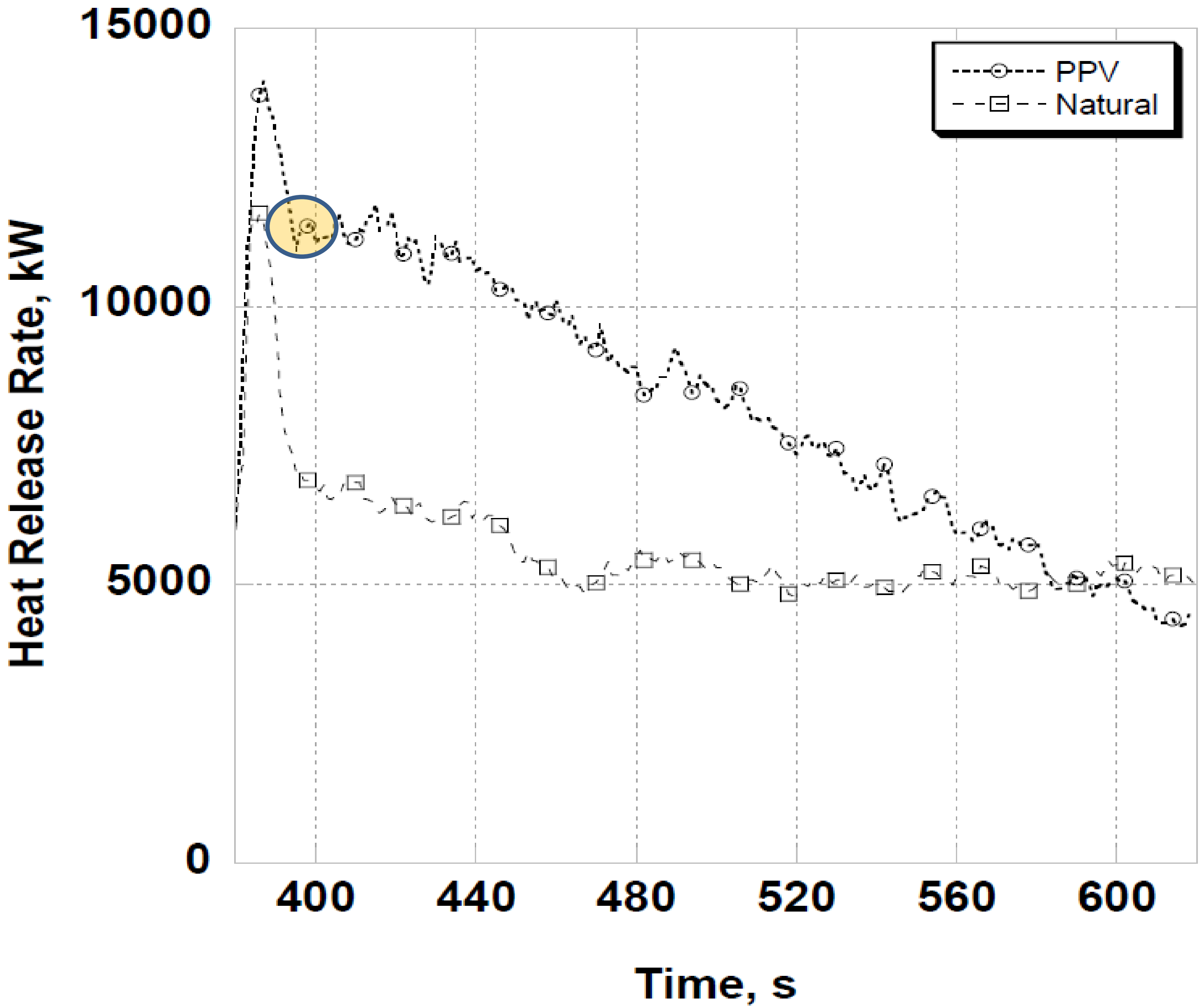


Figure 29 - Heat Release Rate Detail for 200 s Following Peak Output

This experiment (**7G**) served as a good baseline as to how the bedroom fires will behave without the influence of wind. Once the stair was opened and the bulkhead door was opened the bulk flow increased to a range of 1 m/s to 3 m/s (2 mph to 7 mph) out of the fire floor and a range of 2 m/s to 3 m/s (4 mph to 7 mph) out of the top of the stairwell. Once the PPV fan was activated these velocities converged at 0 m/s as the flow from the fan was equalizing the bulk flow from the fire. Once the MVU was activated there were large velocities through the structure and out through the fire apartment open windows. Flow in through the fire apartment door peaked at approximately 8 m/s (18 mph)

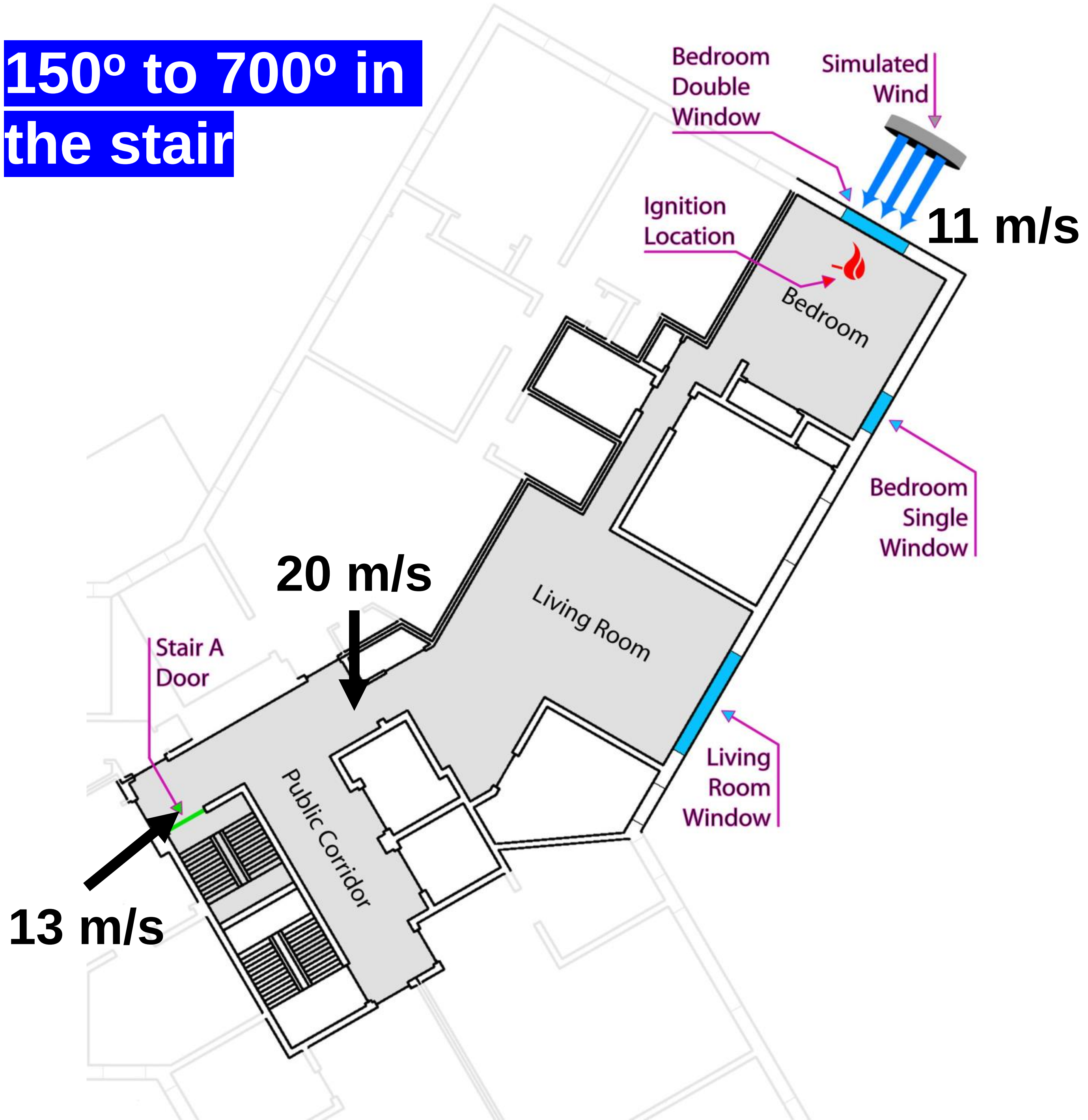
Experiment **7E** – with the influence of an 11 m/s (25 mph) wind - The flows out of the fire apartment were as high as 5 m/s with the stairwell door closed. When the bulkhead door was opened with the fan flow the bulk flow velocity out of the top of the stairwell peaked at 4 m/s. The flow out of the fire apartment with the stairwell opened was approximately 5 m/s and increased to 20 m/s with the bulkhead door opened. The flow into the stairwell was approximately 9 m/s and the flow out of the bulkhead door was 13 m/s with the wind driven flow combined with the PPV fan flow.

The simulated wind velocity of 11 m/s (25 mph) into the bedroom window and out of the open apartment door steadily increased as the fire grew.

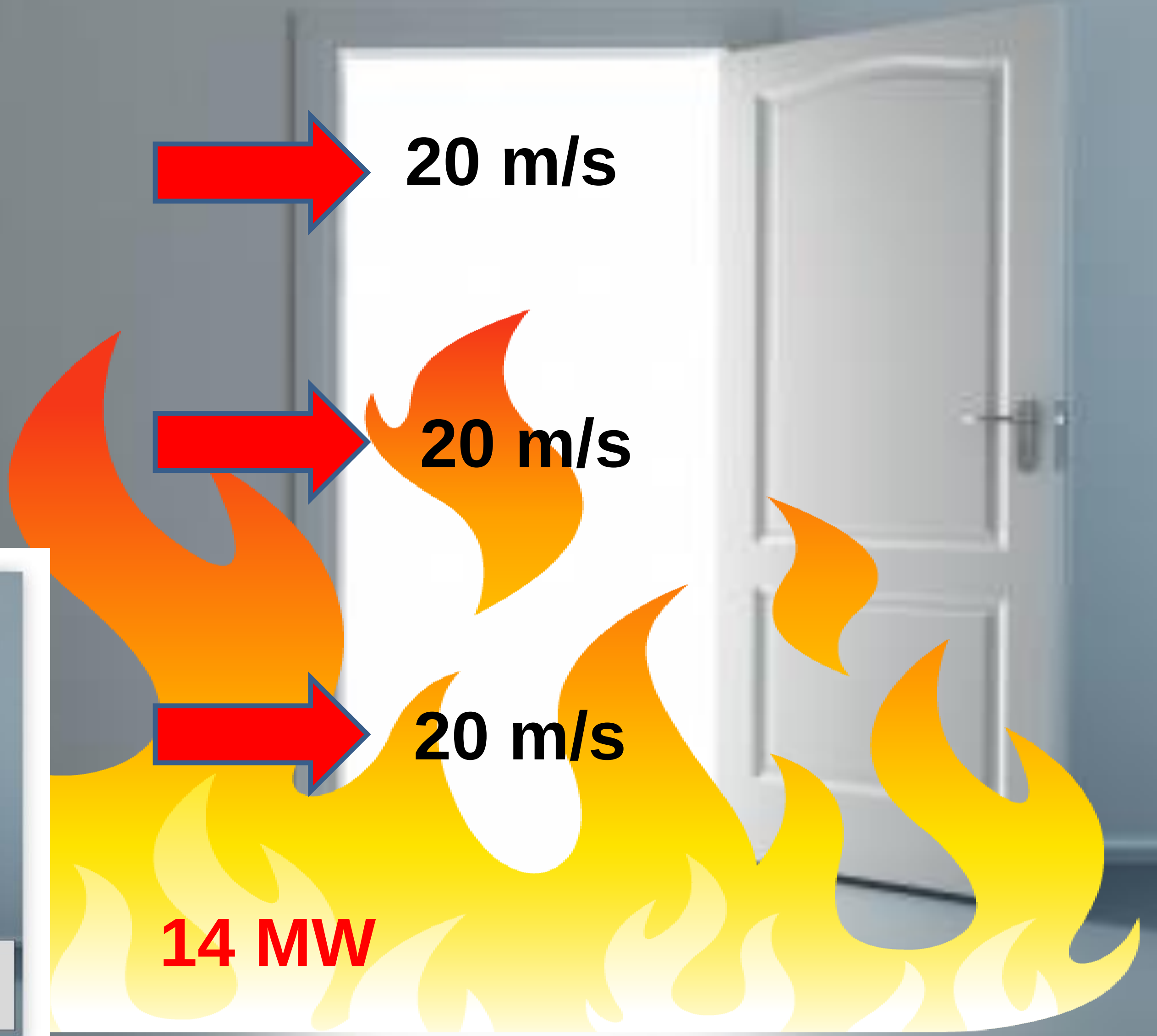
Opening the 7th floor stair door initiated the wind driven condition which had a peak velocity of 20 m/s (45 mph). The velocity into the stairwell and out of the top of the open stairwell door peaked at approximately 13 m/s (29 mph).

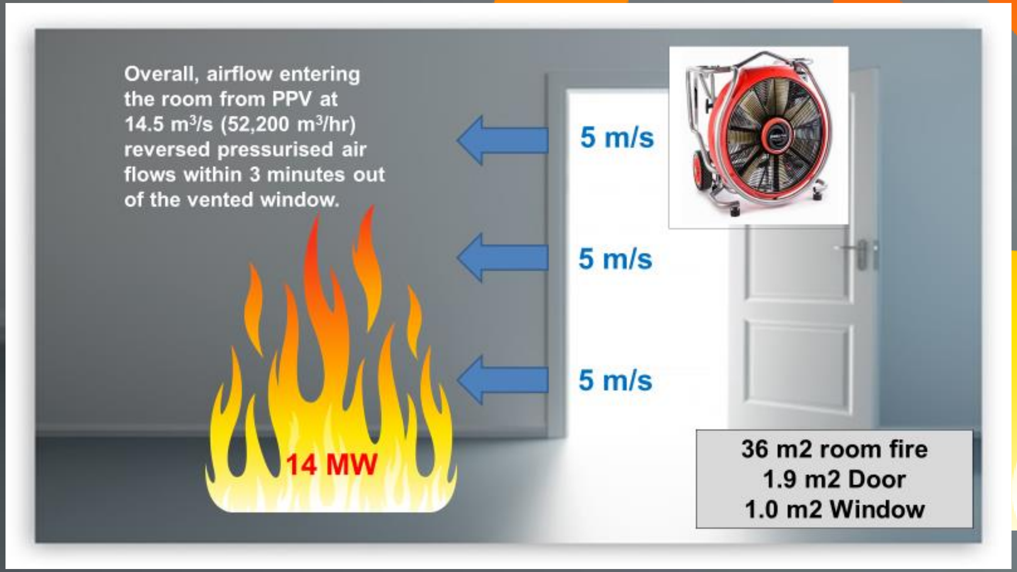
Temperatures in the stairwell were untenable for firefighters.

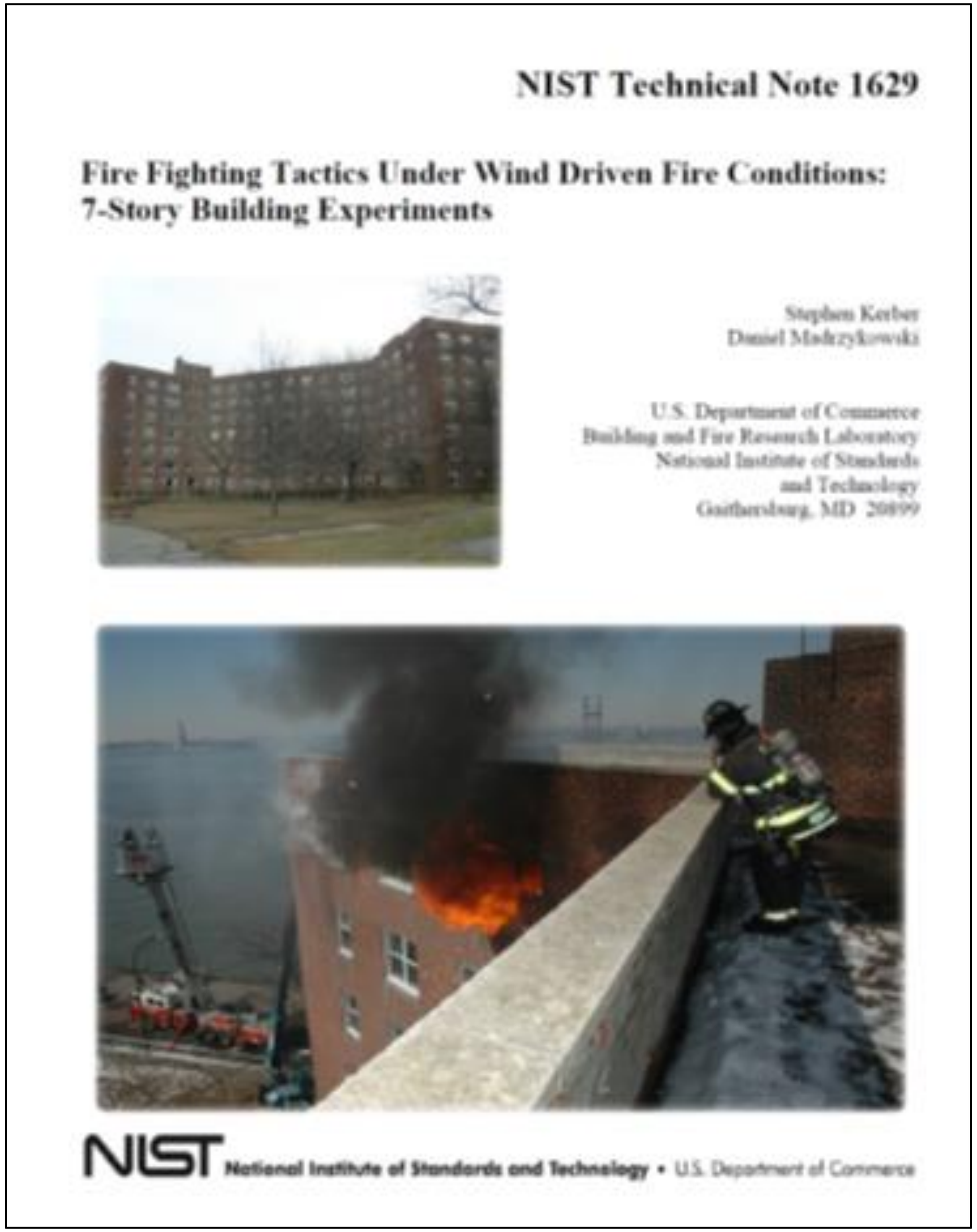
150º to 700º in the stair



An exterior 25 mph wind reverses the flow-path and directs flame, heat and smoke out into the corridor with the high velocity and intensity of a wind-driven fire






NIST Technical Note 1629

Fire Fighting Tactics Under Wind Driven Fire Conditions:
7-Story Building Experiments

Stephen Kerber
Daniel Madrzykowski

U.S. Department of Commerce
Building and Fire Research Laboratory
National Institute of Standards
and Technology
Gaithersburg, MD 20899

NIST National Institute of Standards and Technology • U.S. Department of Commerce

NIST Report 1629 (600 pages) on Wind Driven Fire Tests

The End

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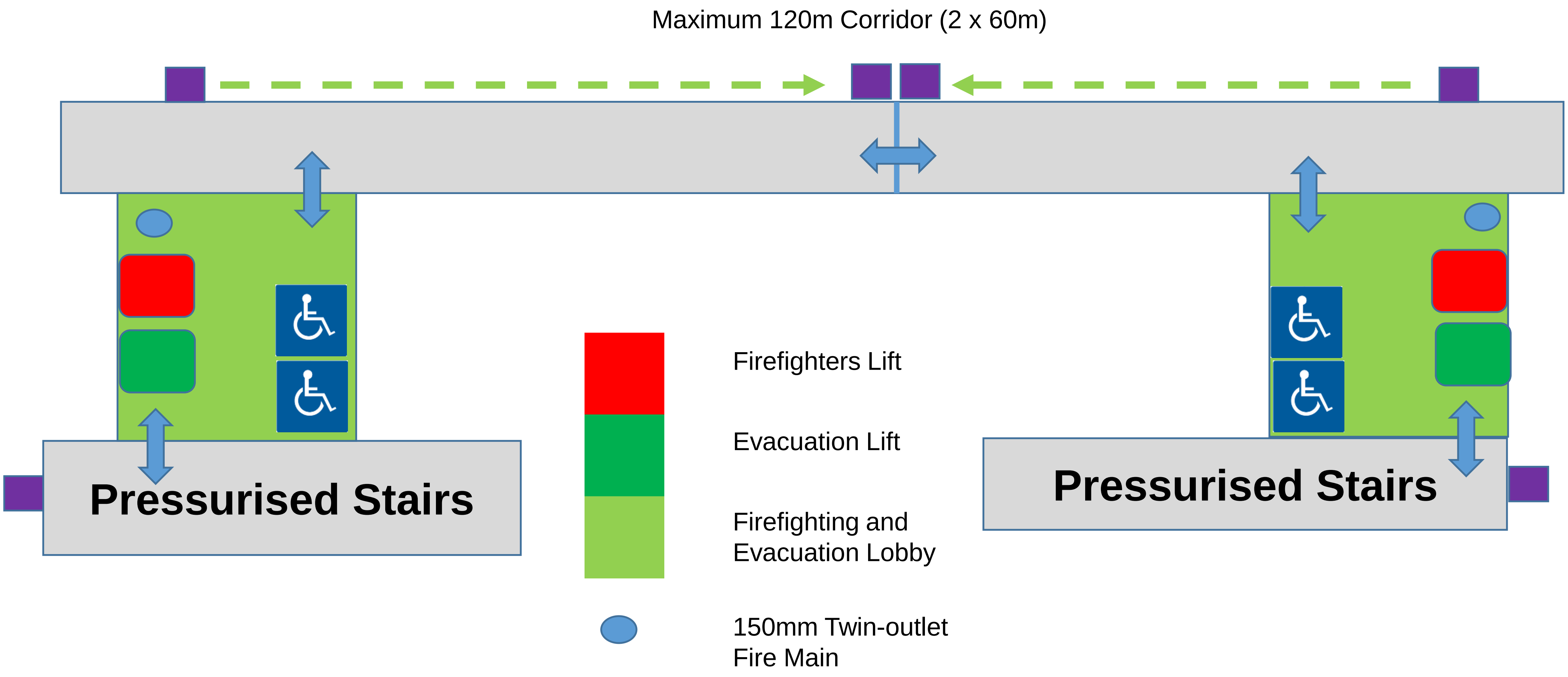
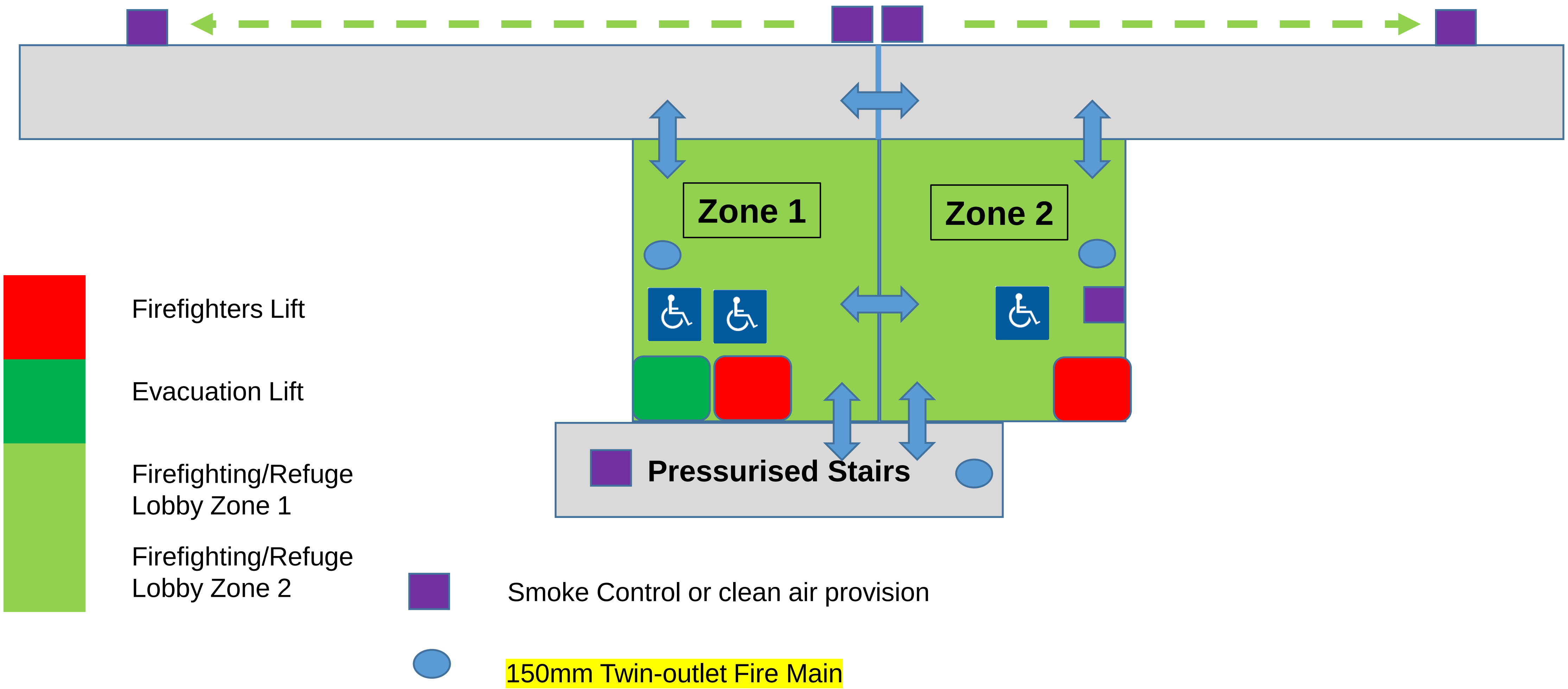
Kent Fire & Rescue Service | together



Maximum 120m Corridor (2 x 60m)
Pressurised Stairs
Pressurised Stairs
Firefighters Lift
Evacuation Lift
Firefighting and Evacuation Lobby
150mm Twin-outlet Fire Main

Maximum 60m Corridor (2 x 30-60m ?)



Maximum 120m Corridor (4 x 30m)

Zones for Firefighting Lobby

Evacuation Lobbies Refuge

Services

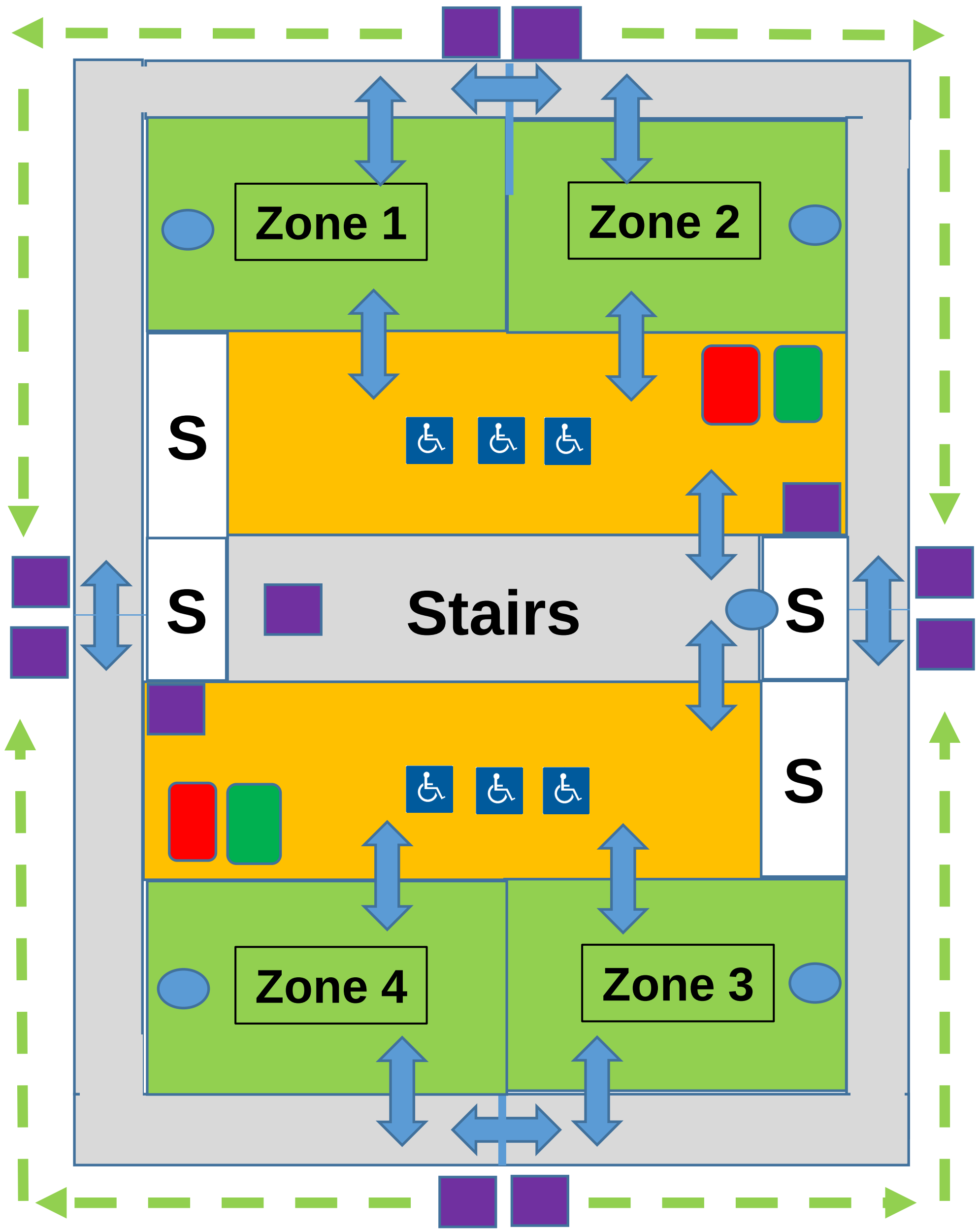
Firefighting Lift

Evacuation Lift

Single Central Stairs for 4 x 30m corridors

Multi- Central Stairs for 4 x 60m corridors

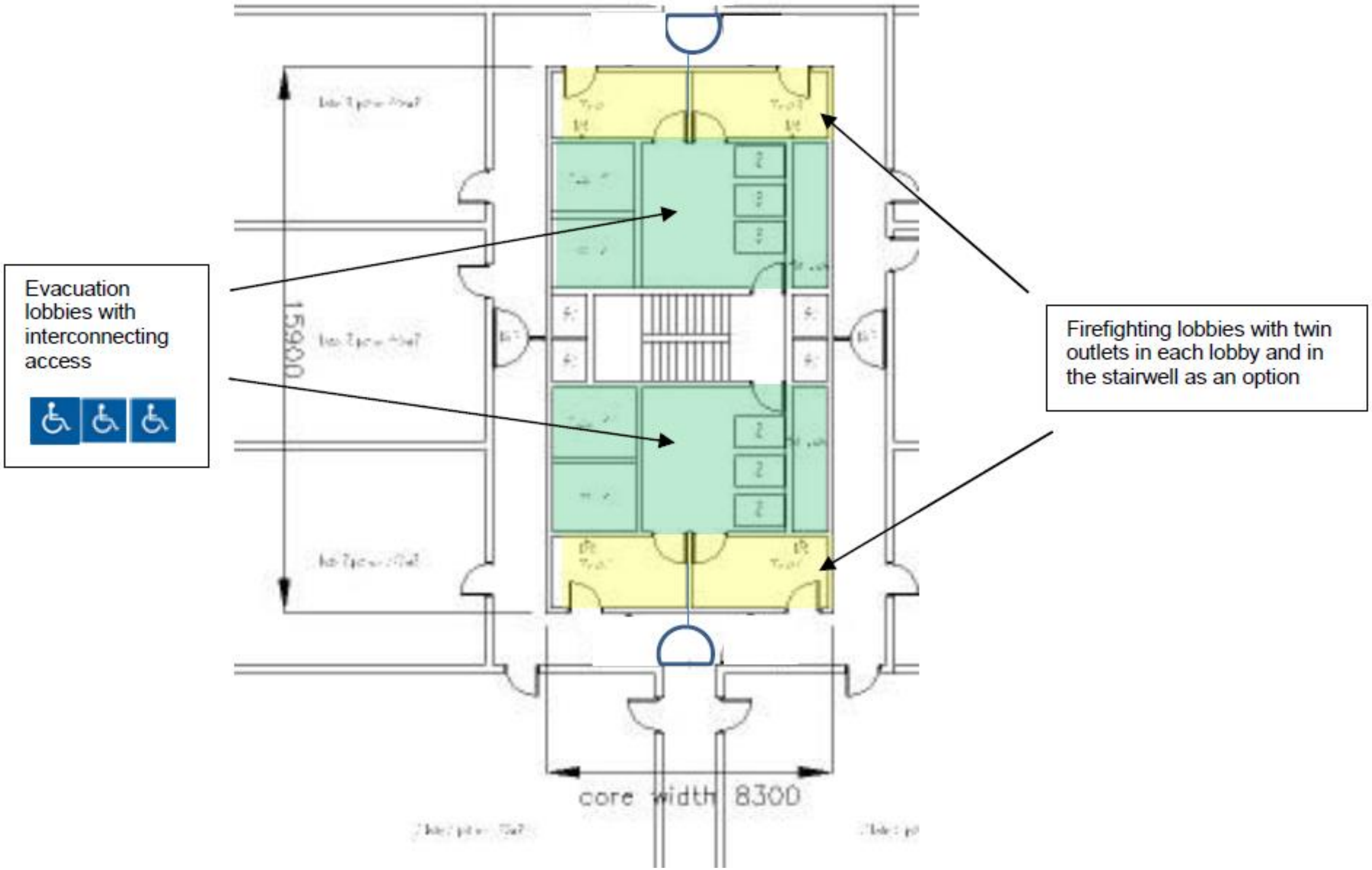
150mm Twin Outlet Rising Fire Main outlets

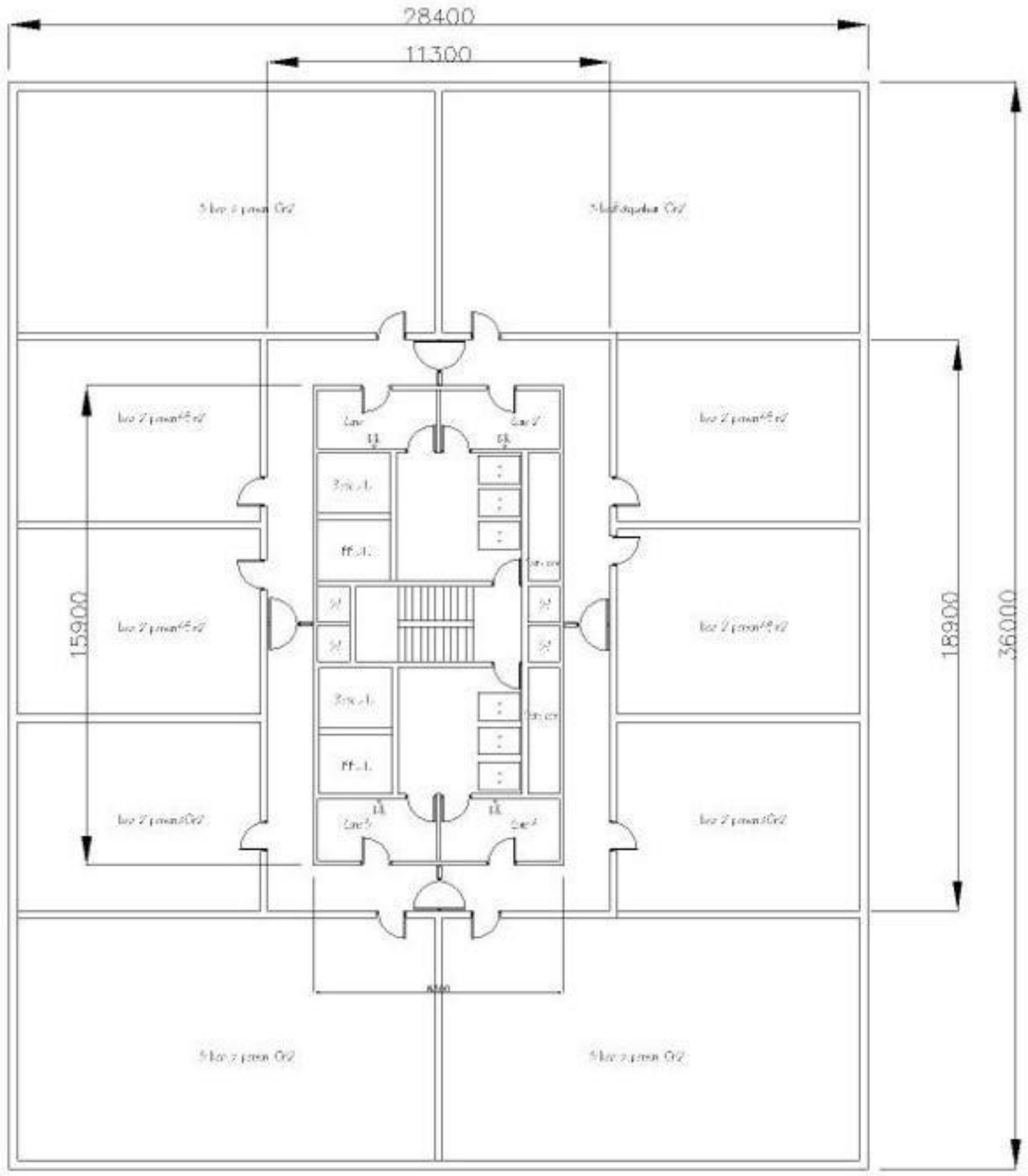


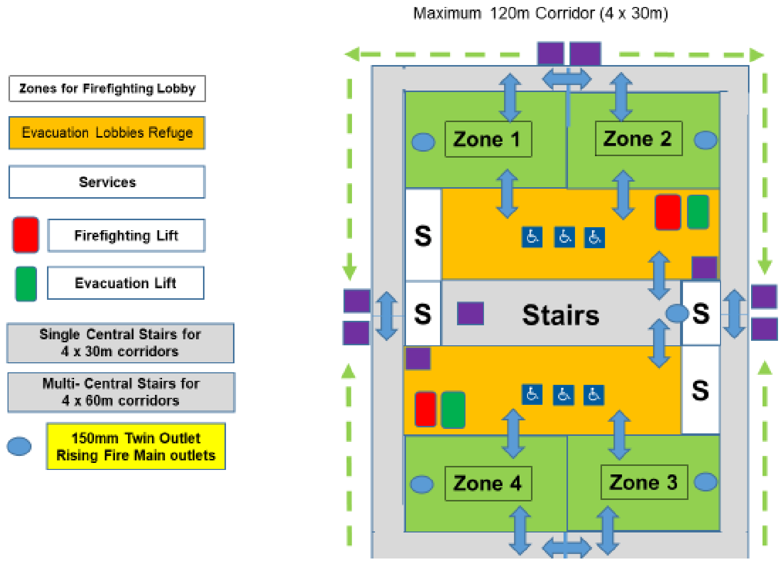
BS 9999:2017 –

Fire-fighting lobbies should have a clear floor area of not less than 5 m2 (6 m2).

The clear floor area should not exceed 20 m2 for lobbies serving up to four lifts, or 5 m2 per lift for lobbies serving more than four lifts. All principal [Evacuation & Refuge] dimensions should be not less than 1.5 m and should not exceed 8 m in lobbies serving up to four lifts, or 2m per lift in lobbies serving more than four lifts.


Evacuation lobbies with interconnecting access
Firefighting lobbies with twin outlets in each lobby and in the stairwell as an option
15900
core width 8300





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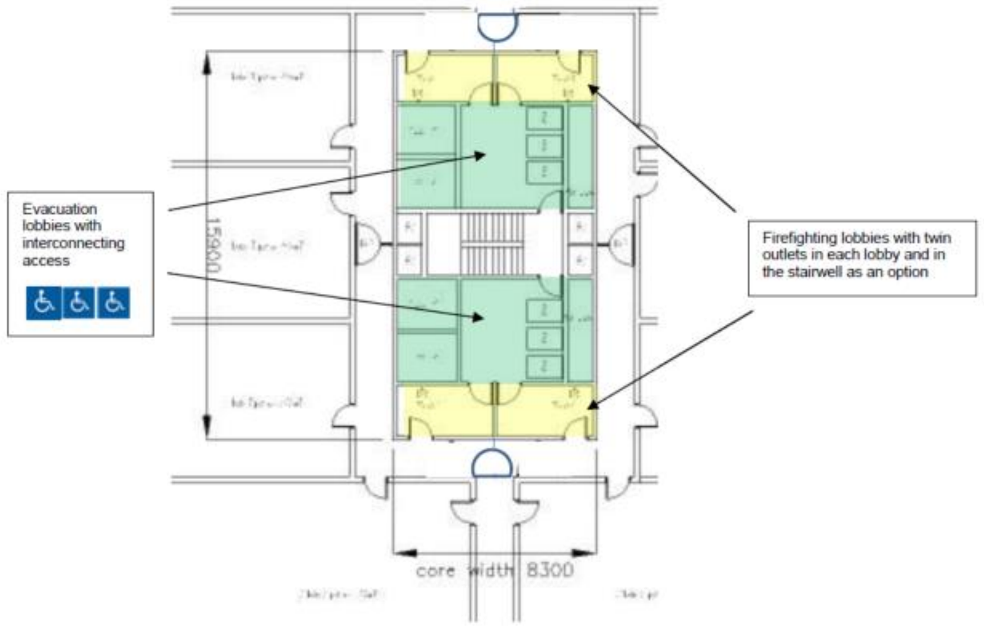
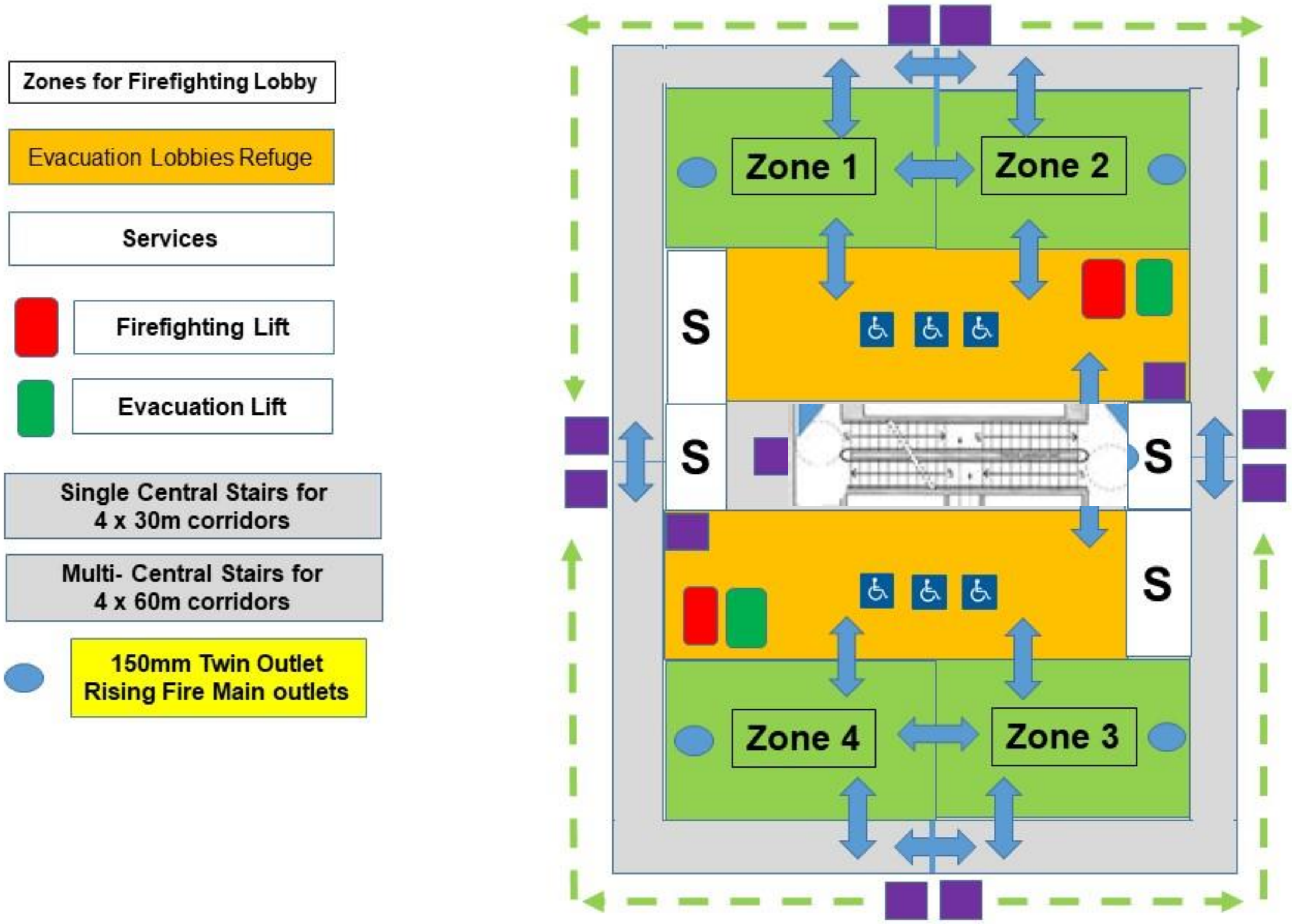


Maximum 120m Corridor (4 x 30m)



BS 9999:2017 –

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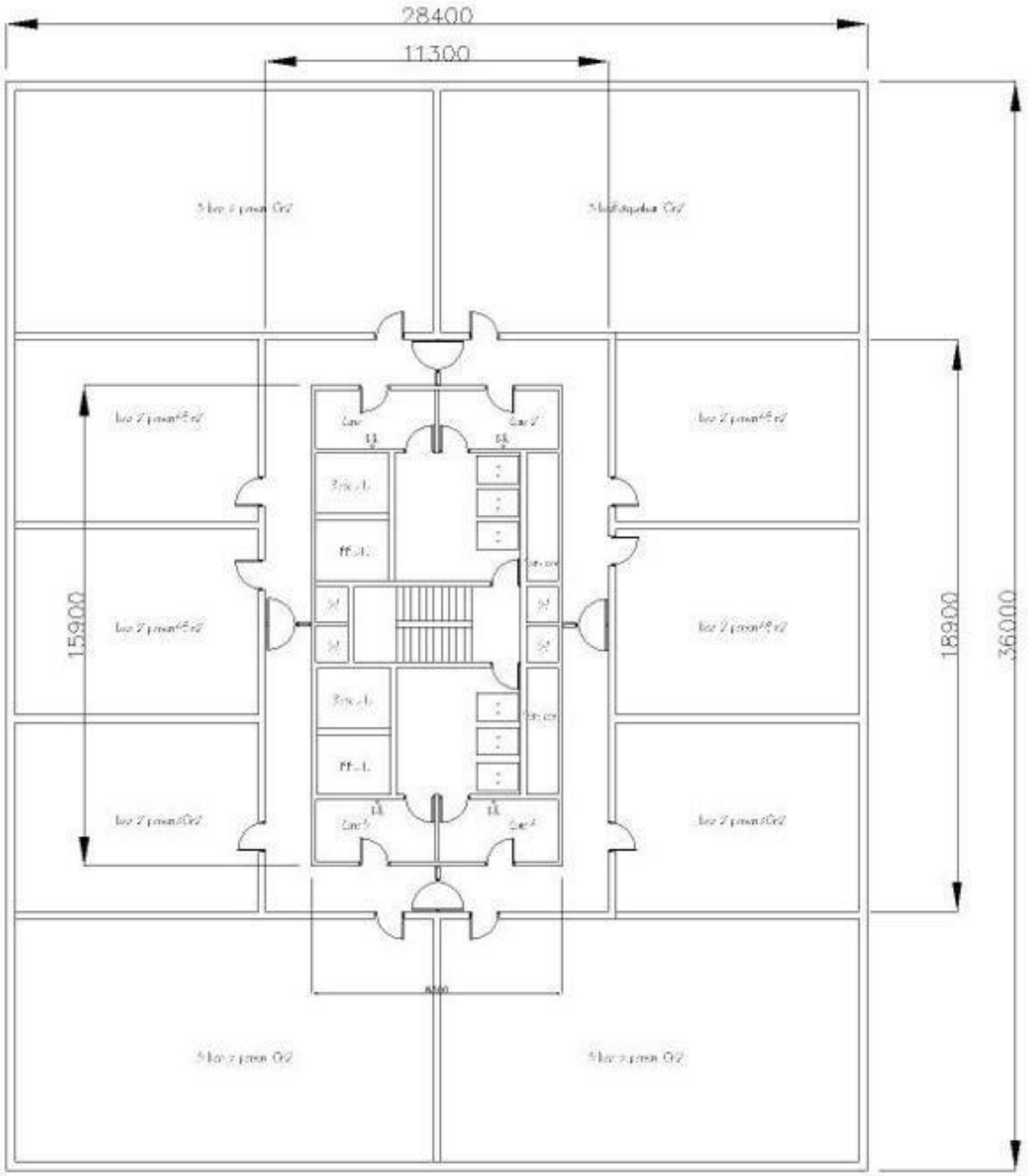
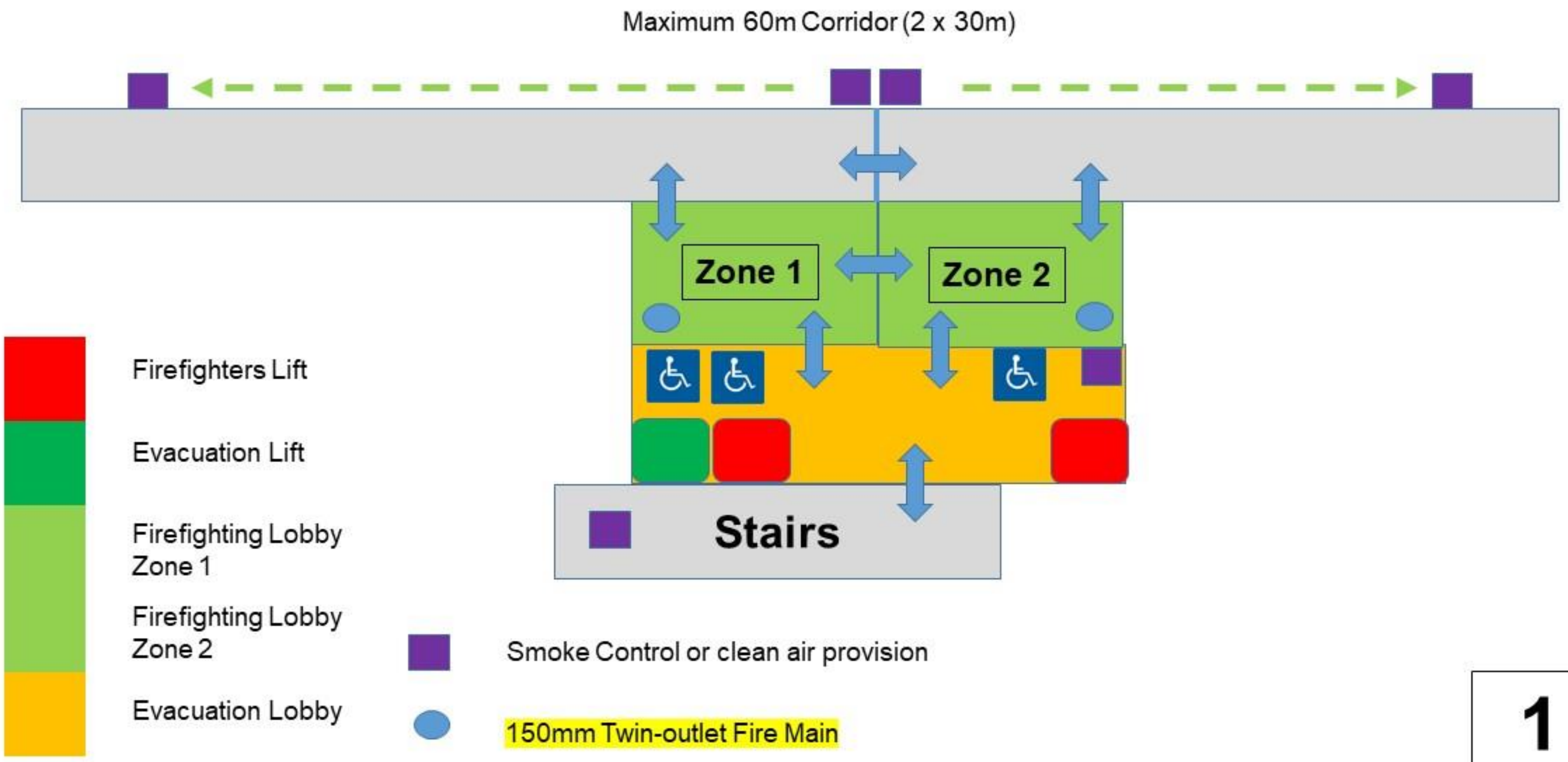
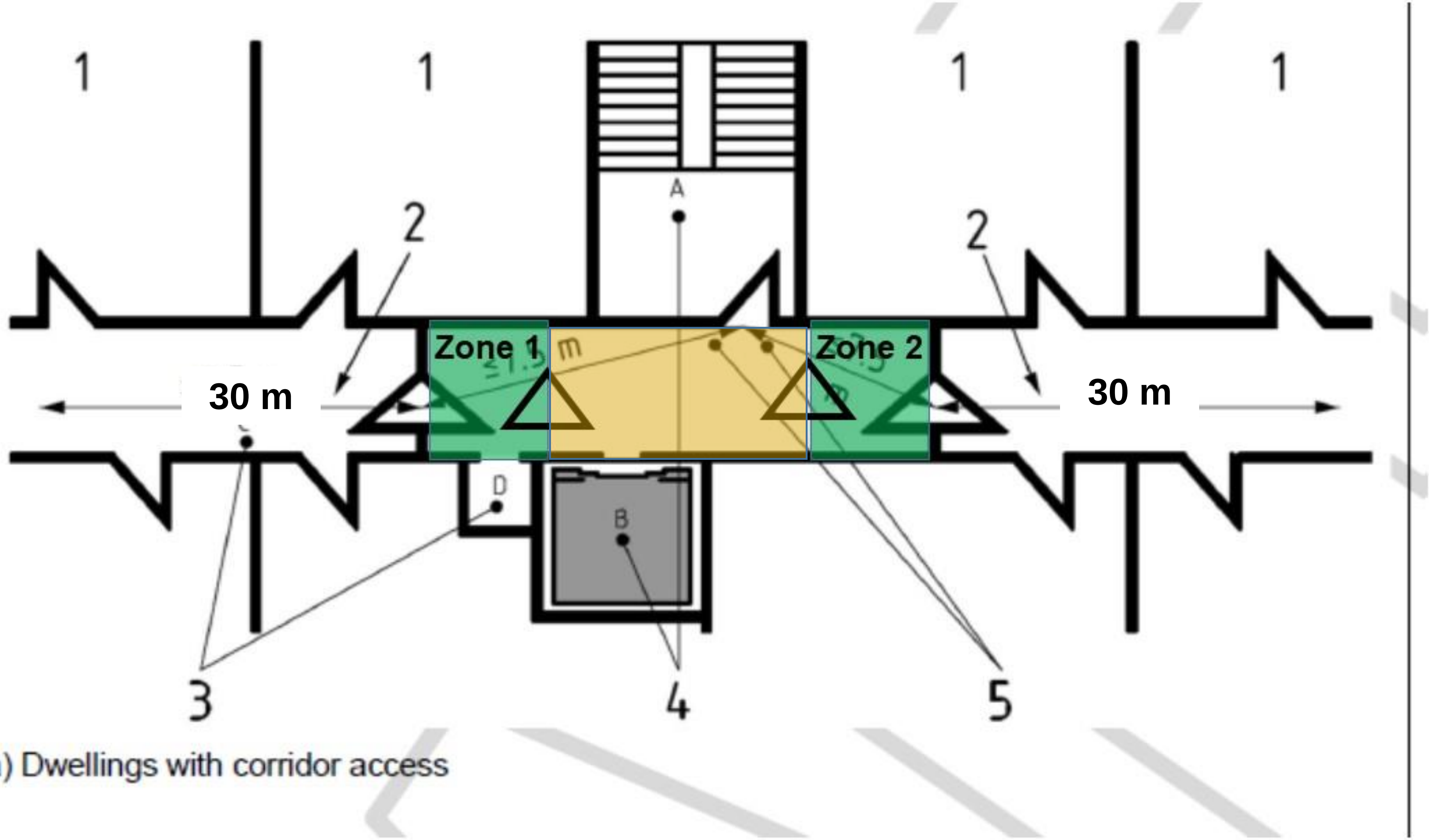
1


28400
11300
15900
18900
36000


Maximum 60m Corridor (2 x 30m)
Zone 1
Zone 2
Stairs
Firefighters Lift
Evacuation Lift
Firefighting Lobby Zone 1
Firefighting Lobby Zone 2
Evacuation Lobby
Smoke Control or clean air provision
150mm Twin-outlet Fire Main

1



a) Dwellings with corridor access