

Colt International Ltd

Smoke & environmental ventilation of multi-storey buildings using shafts

CPD Technical Seminar 2020





Certification

of CPD course provision

This is to certify that

Colt International Ltd

has been registered as a CPD Course Provider by
The Chartered Institution of Building Services Engineers (CIBSE)

Accredited from 1 June 2019 to 31 May 2021

Andrew Rowe
CPD Panel Chair
CIBSE

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Building Services Engineers**
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www.cibse.org



Colt have a number of CPD accredited topics including:

- Car park ventilation
- The general principles of smoke control
- Pressurisation
- Smoke shafts
- Overheating common corridors
- Smoke and fire curtains
- Louvre
- Evaporative cooling



A brief history of Colt

Colt International Limited



Founded in

1931

2019 UK turnover

£38.4 million

2019 Group turnover

£180.4 million

Manufacturing facilities in
UK, Holland & Germany



Expertise built on proven experience | www.coltinfo.co.uk

Accreditations and Memberships

Colt International Limited



Accreditations

- Altius Gateway
- CHAS
- Construction Line
- Safe Contractor
- Worksafe Contractor
- RoSPA



Chas Accredited



Constructionline
Part of Capita plc



PPQ still required by clients



**CERTIFICATED INSTALLER OF
ACTIVE FIRE PROTECTION**



Memberships





Smoke Control



Climate Control



Louvre & Shading

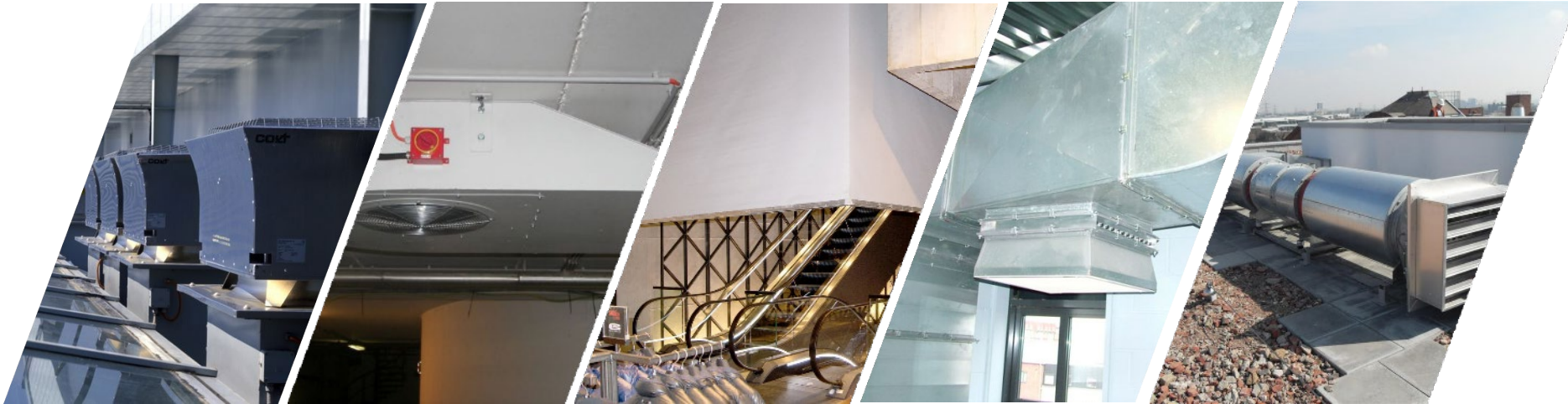


Service





Smoke Control



SHEVS
Smoke and Heat
Exhaust Systems

Car Park
Ventilation

Smoke
Containment

Pressurisation
Systems

Smoke Shaft
Systems





Climate control



Natural
Ventilation

Mechanical
Ventilation /
HVAC

Evaporative
Cooling

Industrial Heating



Performance & Screening Louvre

Colt International Limited



Louvre



Screening

Ventilation &
Rain Defence

Shading

Acoustic





Service



24 hour call out

Nationwide Coverage

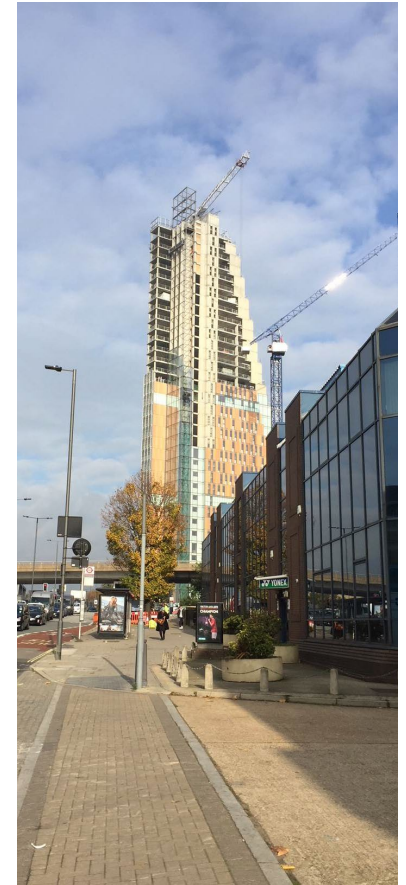
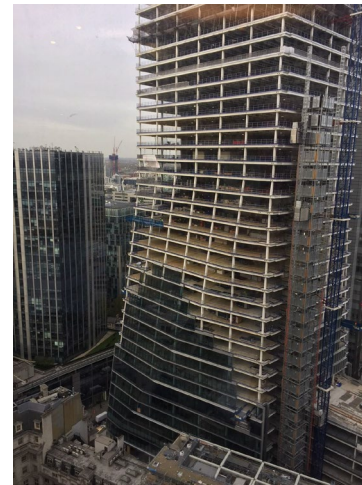
Spare Parts

Surveys



Introduction

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Building Regulations Part B (Fire Safety):

B1 Means of Warning and Escape

Requirement

Means of warning and escape

B1. The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.



Building Regulations Part B (Fire Safety):

B5 Access and Facilities for the Fire and Rescue Service

Requirement

Access and facilities for the fire service

B5. (1) The building shall be designed and constructed so as to provide reasonable facilities to assist firefighters in the protection of life.

(2) Reasonable provision shall be made within the site of the building to enable fire appliances to gain access to the building.



The quest for energy efficiency (ADL and BREAM) has led to very good sealing and insulation in residential buildings and an increase in district heating schemes.

This has unintended consequences for stair lobbies, corridors and entrance halls, which tend to overheat, resulting in unpleasant conditions for residents and possible issues maintaining cold water supply temperatures.



Caspian Wharf, a Berkeley Homes development, uses a district heating system and therefore overheating in the common corridors was a concern for the design team.

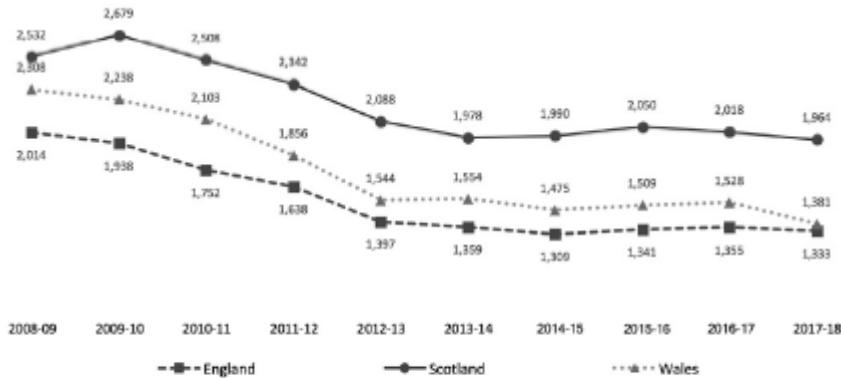
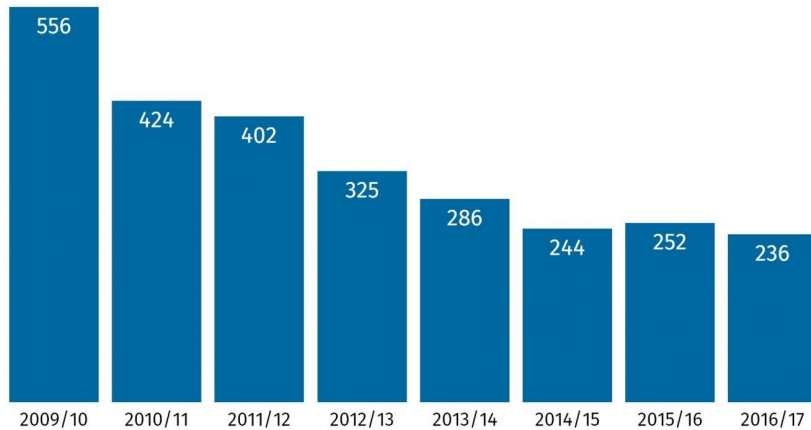


Figure 7: Primary fires per million population, Great Britain, 2008-09 onwards

Fires in high-rise blocks of flats in London



Source: Home Office. High-rise blocks = 10 storeys or more



Fire Statistics - 2017/2018

167k fire attended by Fire and Rescue Services in England – 43% lower than 10 years ago
26k in Scotland

334 fire related deaths – 44% fewer than 36 years ago
44 in Scotland

3,306 non fatal casualties (13% fewer than 5 years ago)
1113 in Scotland

801 Fires in purpose built high rise flats in England

Source: Home Office: Fire & Rescue Statistics: England, year ending March 2018/Fire & Rescue Incident Statistics (Scotland) 2017/2018

November 2017 to January 2018

4 major apartment fires – Manchester, Leeds, Kent & Scotland

2 railway station fires

2 major fires in car parks



Fires in Tall Buildings

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Longer vertical escape time

Sleeping Risk

Psychological impact of smoke

Defend in Place/Stay put

Fire Service Intervention

Single stair buildings

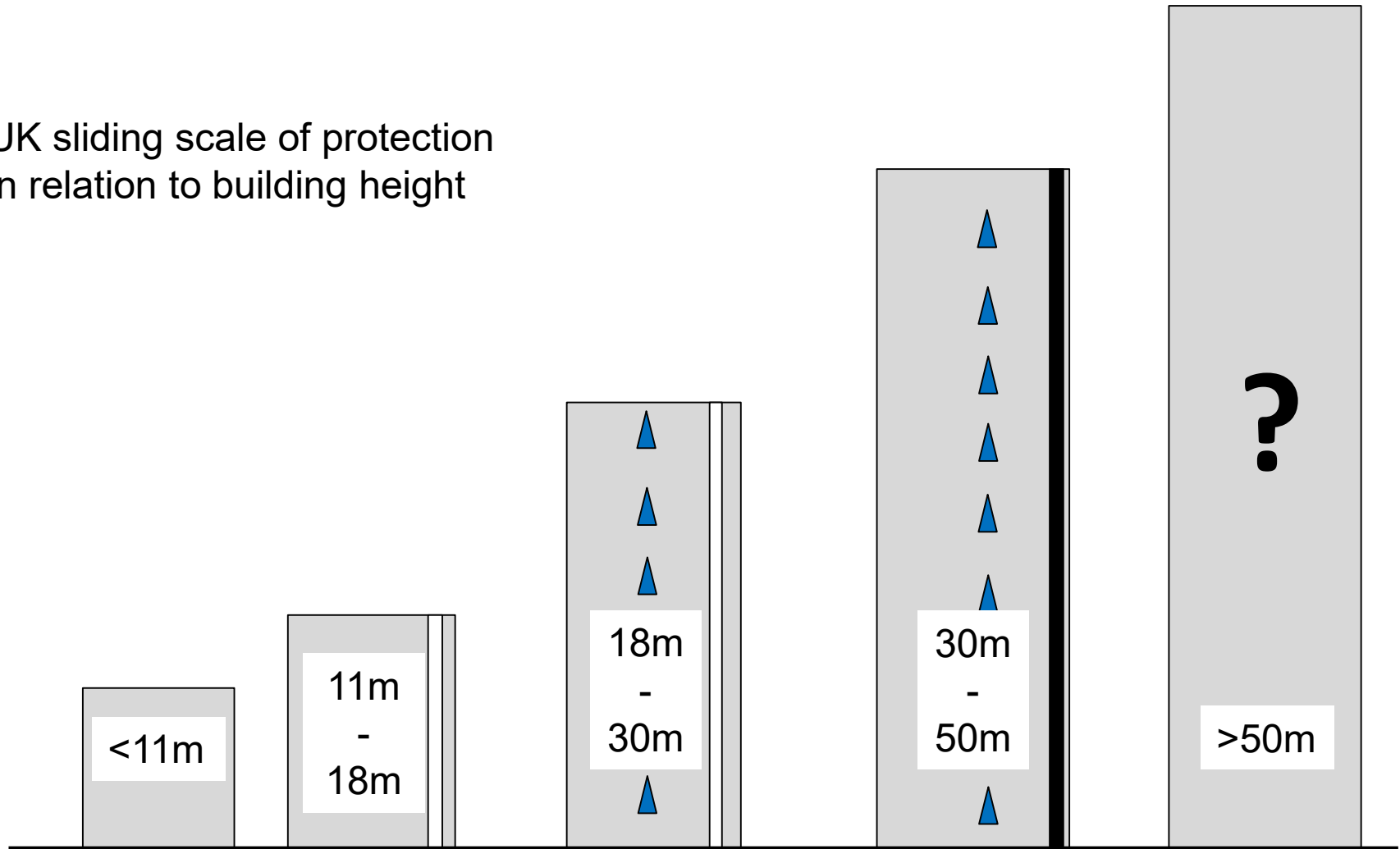


Protection vs height

Smoke & environmental ventilation of multi-storey buildings using shafts 2020

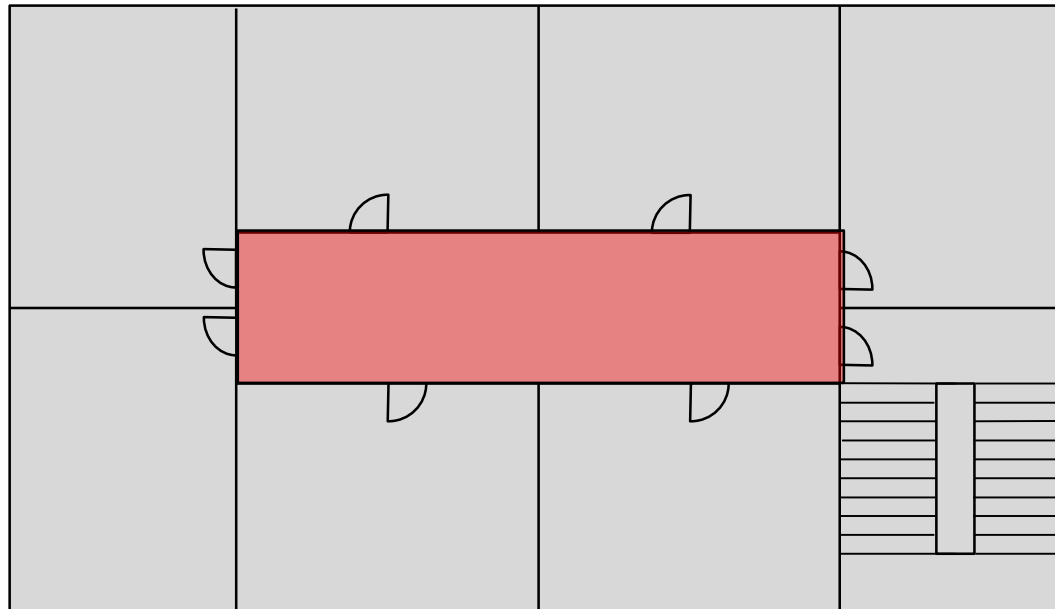


UK sliding scale of protection in relation to building height



Area for ventilation

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Current options for ventilation:

- **Naturally**, using AOVs – up to 30m
- **Naturally**, using shafts/chimneys – 1.5/3.0 m² plan area.
- **Mechanically**, using shafts.
- **Mechanically**, using pressurisation (in accordance with BS EN 12101-6: 2005).



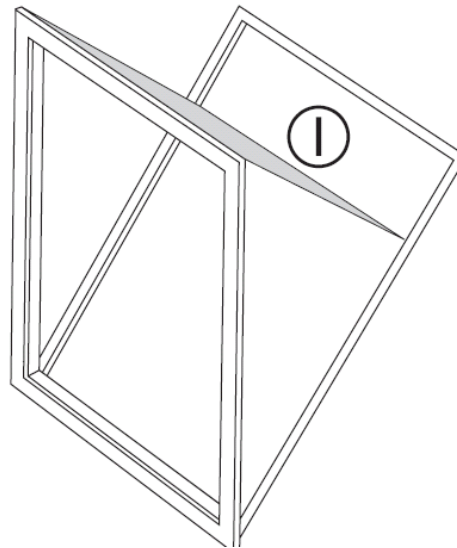
Natural AOVs – Automatic Opening Vents

Lobbies / corridors should be ventilated by an AOV with a free area of at least 1.5m^2

AS PER CURRENT VERSION
OF ADB:

1.5m^2 can only be achieved via
open area at 90° to direction of
airflow, ie area ①.

Total Area = ① only = 1.5m^2



To achieve 1.5m^2 , a 1.5m
wide vent will need to
open over 1m

Site fitting of motors to
windows



Natural AOVs – Automatic Opening Vents

Under the CPR, Smoke ventilators should be CE marked to EN 12101-2, ensuring:

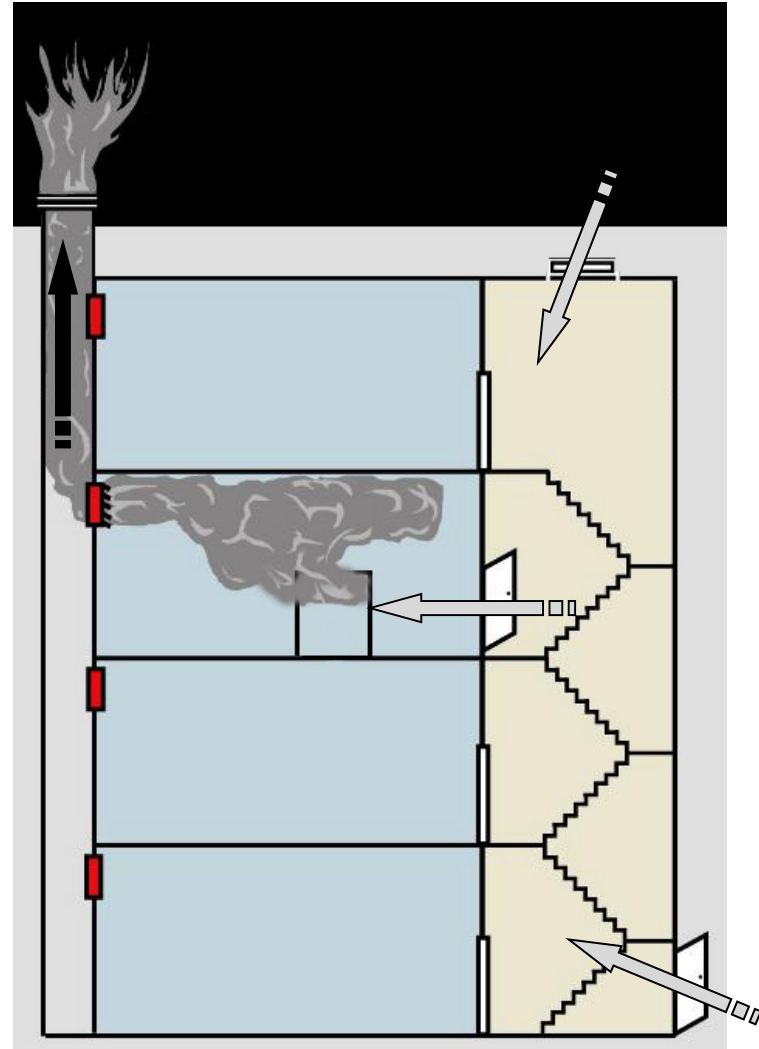
- Compatibility of components
- Reliability
- Robustness
- Resilience to heat
- Opening under wind



Natural Shaft Systems - Residential

Typically:

- 1.5m² shaft
- 1.0m² damper
- 1.0m² stair vent
- Battery back up system
- Fire rated cabling – 24Vdc

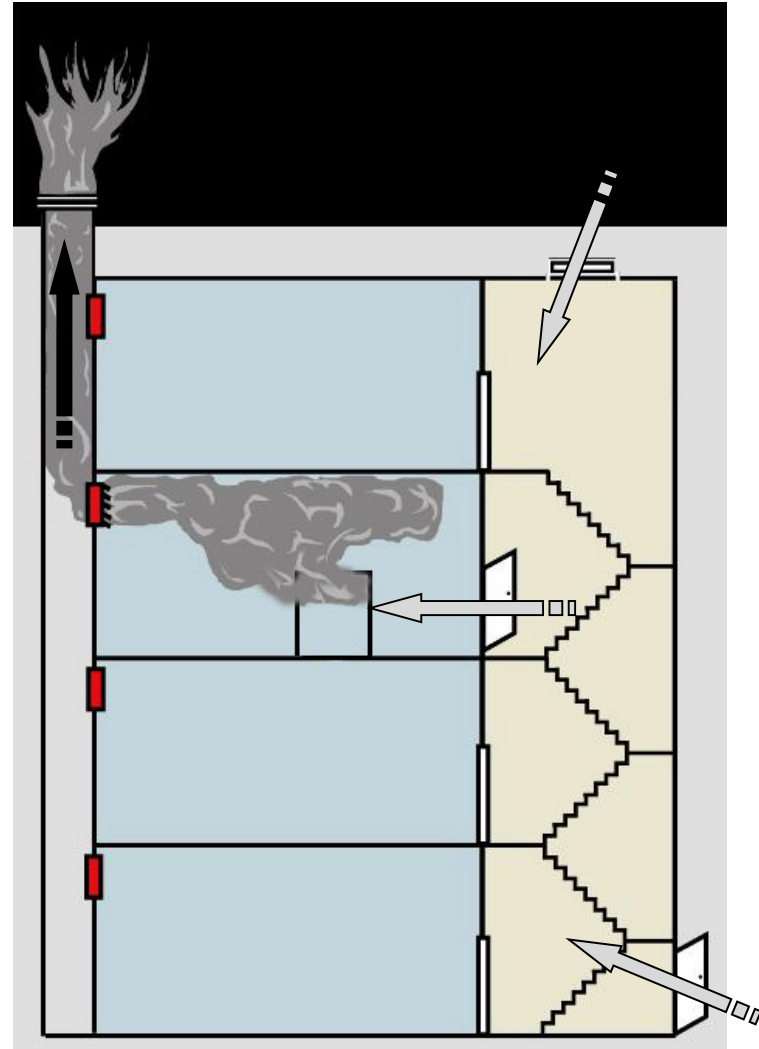


Natural Shaft Systems – Commercial

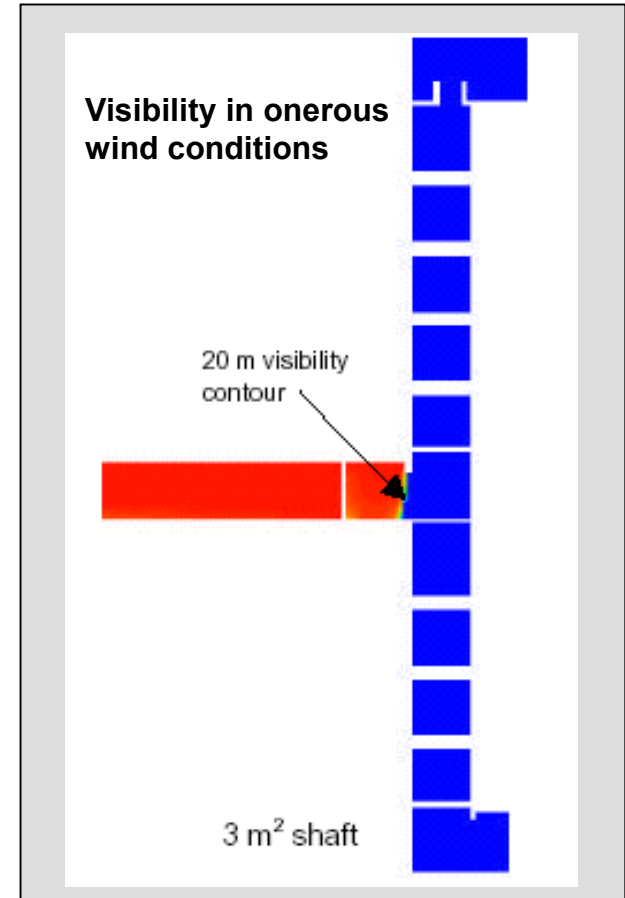
BRE Shaft for fire fighting

Typically:

- 3.0m² shaft
- 1.5m² damper
- 1.0m² stair vent
- Battery back up system
- Fire rated cabling – 24Vdc



BRE Shaft – scale model and CFD Validation



Natural shaft systems - Equipment

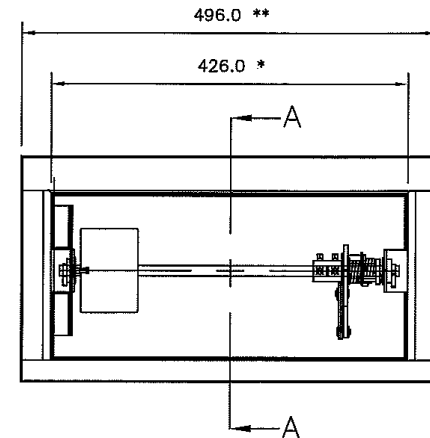
Smoke & environmental ventilation of multi-storey buildings using shafts 2020



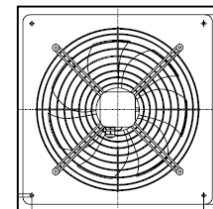
+
Corridor
temperature
sensor



+ Small fire dampers for
environmental use



+
environmental
fan and
ventilator?



+
Ceiling
grilles?



Maglocks?



Natural Shaft Systems - Limitations



Space



Geometry



Thermal



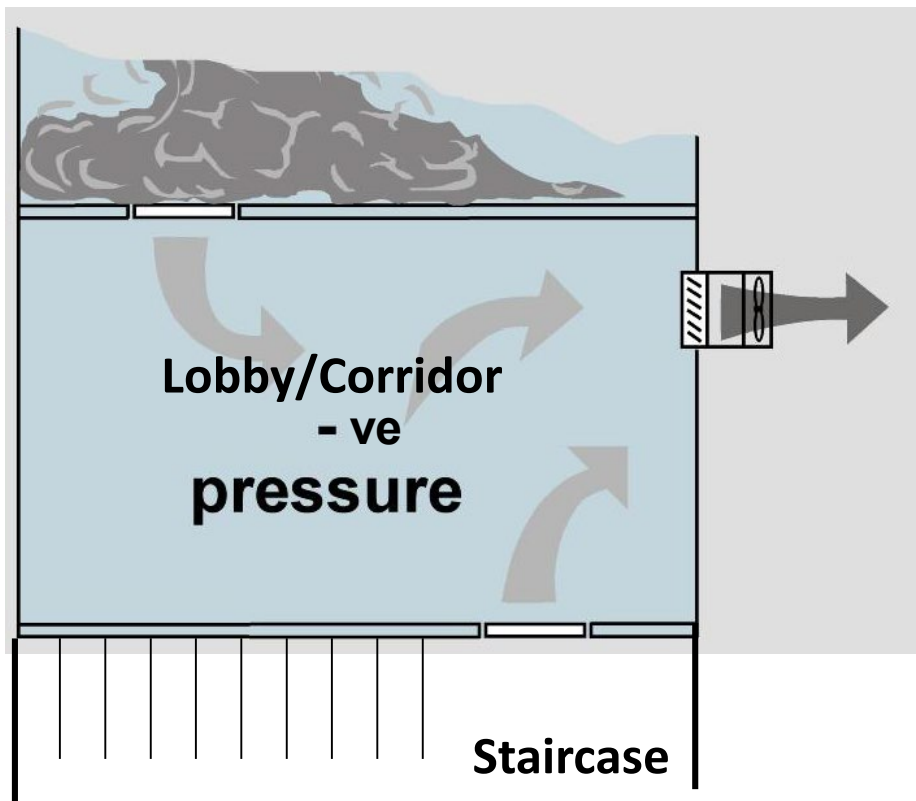
Mechanical Shaft Systems

- Designed to provide equivalent performance to the BRE Natural Shaft
- Requires run and standby motors, standby power and fire rated wiring to provide a resilient system
- Shaft sizes are much smaller, often by as much as 80%.
- Guaranteed rate and direction of ventilation, regardless of relative temperatures and wind direction.
- Can have horizontal sections, bends, fans can be located at top or bottom of shaft.

But, mechanical extract requires a means of preventing over-depressurising the fire fighting lobby.



The major challenge is to avoid excessive depressurisation of the lobby to prevent smoke being drawn in and avoid problems opening doors



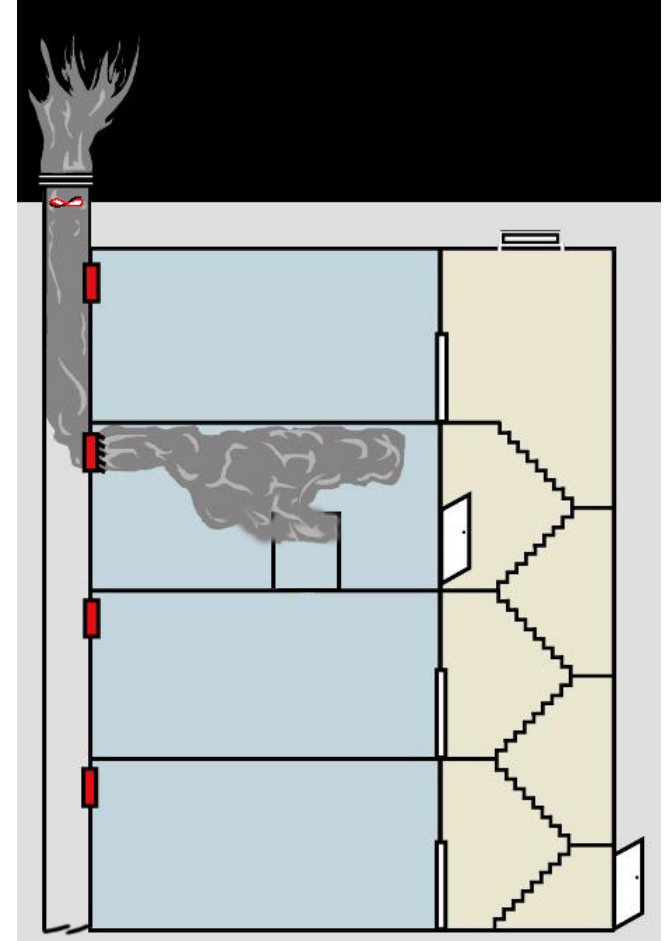
This can be avoided by:

- Low level inlet
- An inlet shaft
- Door to open into lobby
- Grilles in doors
- Variable speed fans

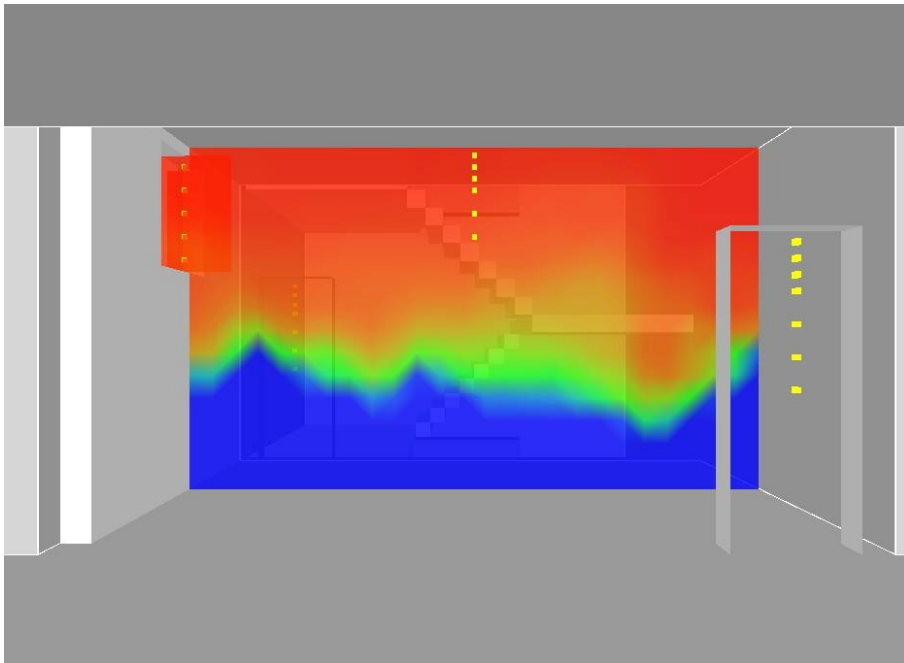
Designed to be at least as good as the BRE smoke shaft and better in adverse wind conditions

The system comprises:

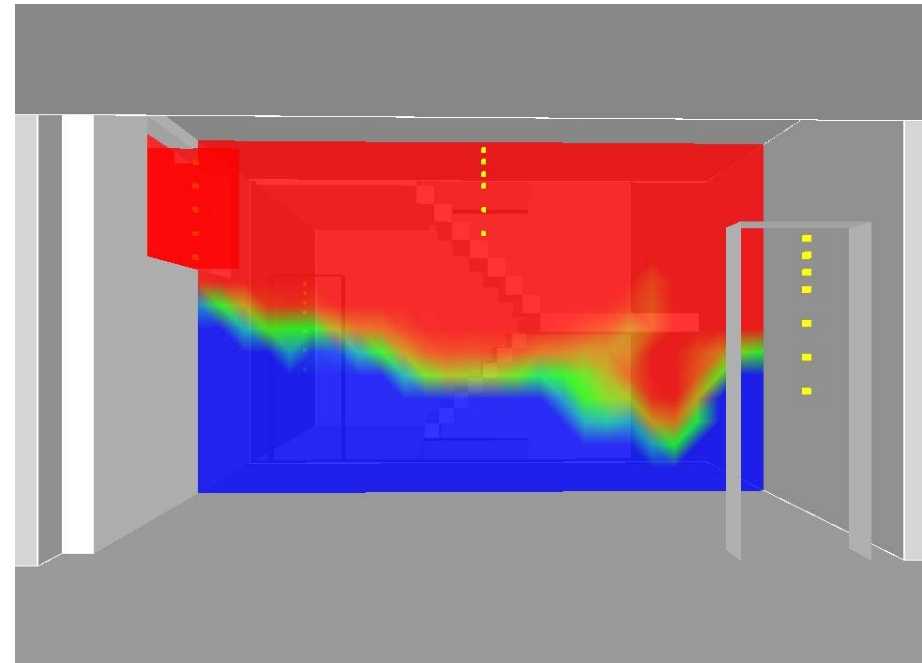
- a small vertical shaft 0.6m^2 instead of 3.0m^2
- a variable speed extract fan set (run and standby)
- a pressure sensor in each lobby
- a small motorised damper to each lobby
- a 1m^2 stairwell ventilator



Mechanical Shaft vs Natural Shaft – Visibility (doors open)



Mechanical shaft

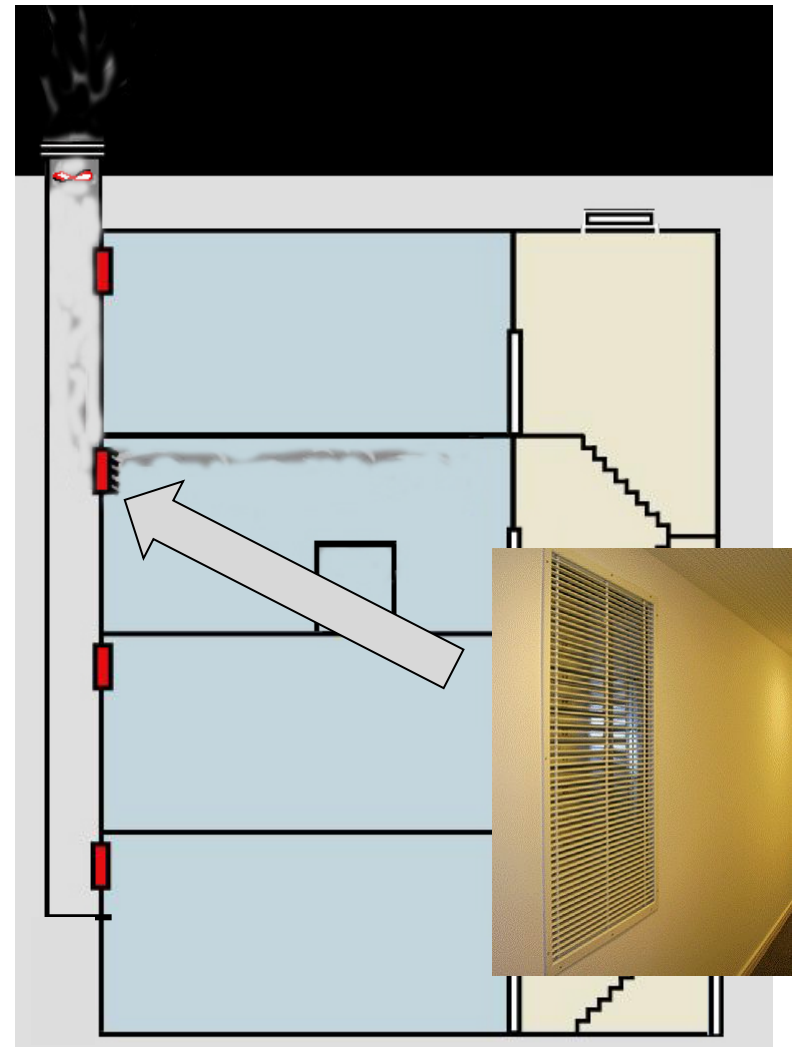
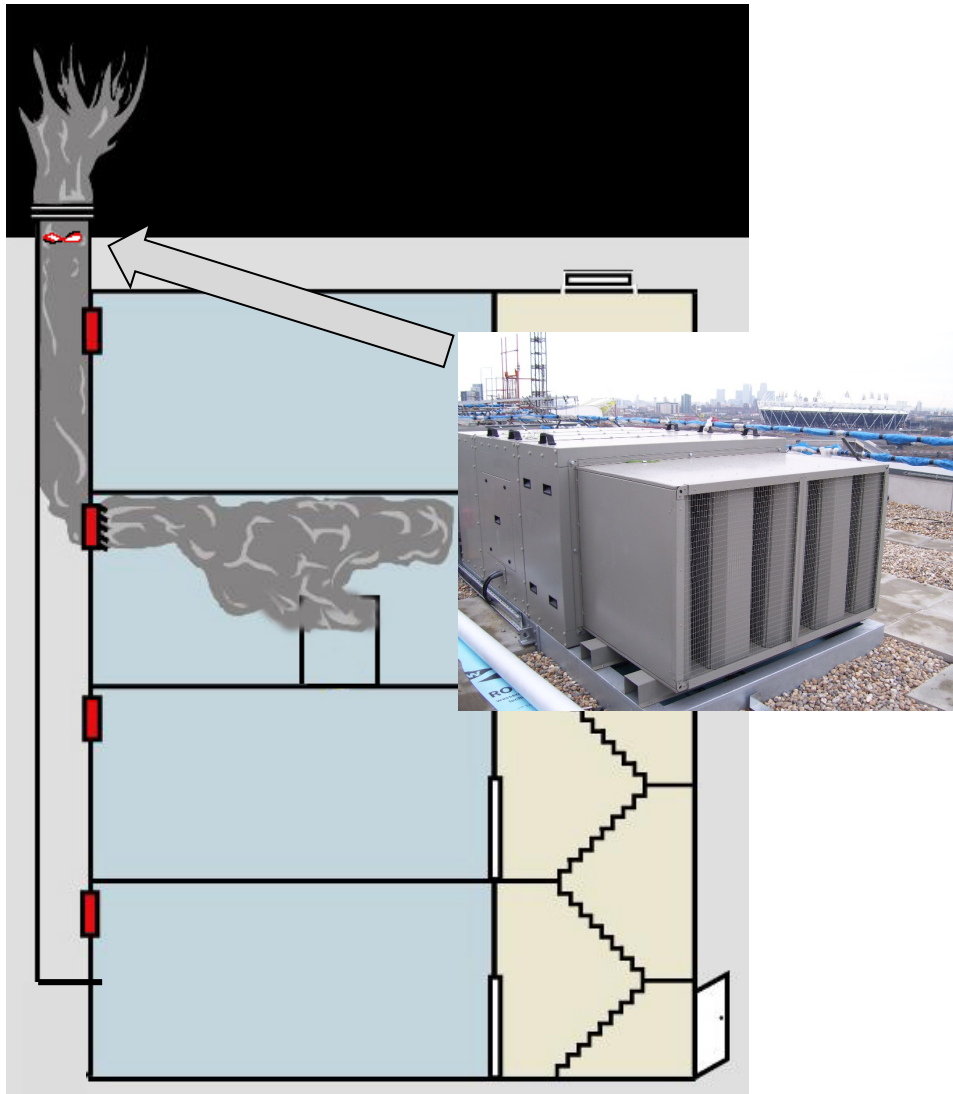


BRE shaft



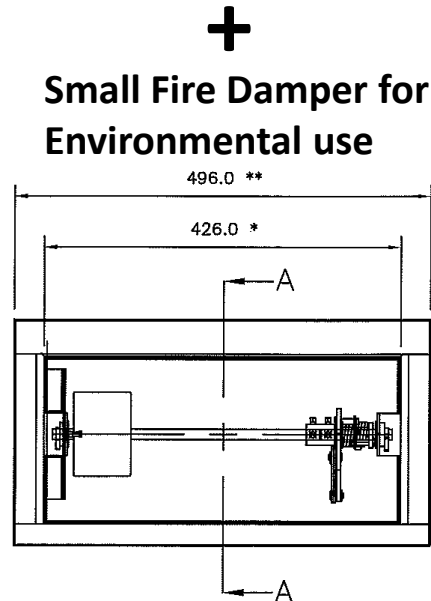
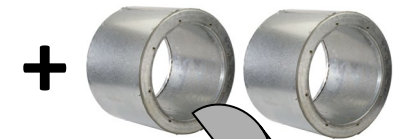
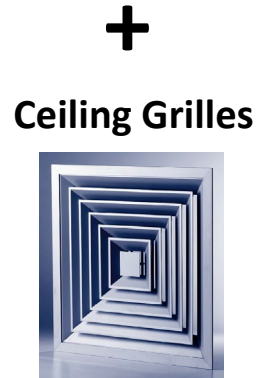
Mechanical Extract

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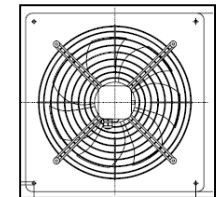


Mechanical shaft systems - Equipment

Smoke & environmental ventilation of multi-storey buildings using shafts 2020

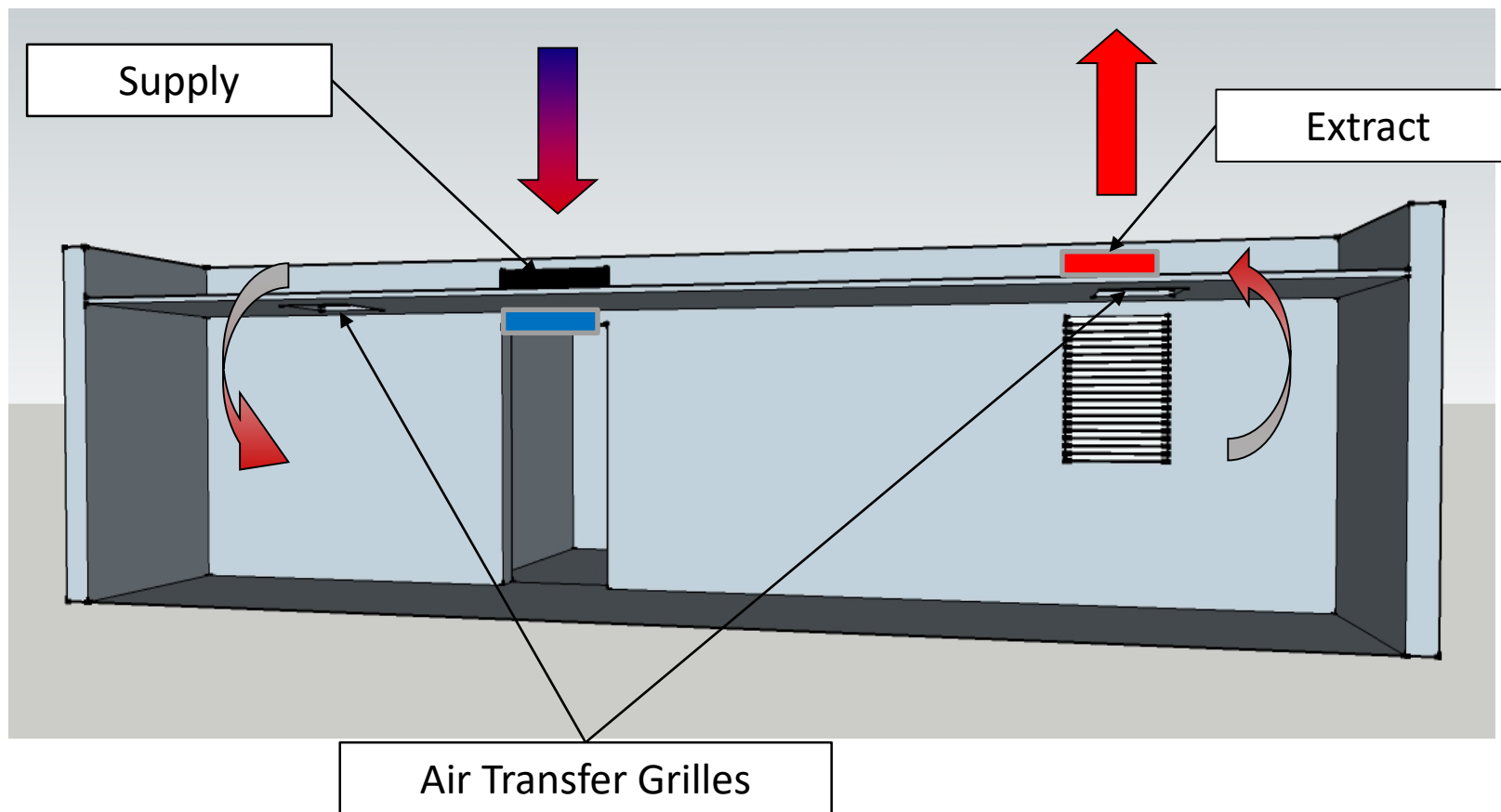


OR add a separate, quieter fan



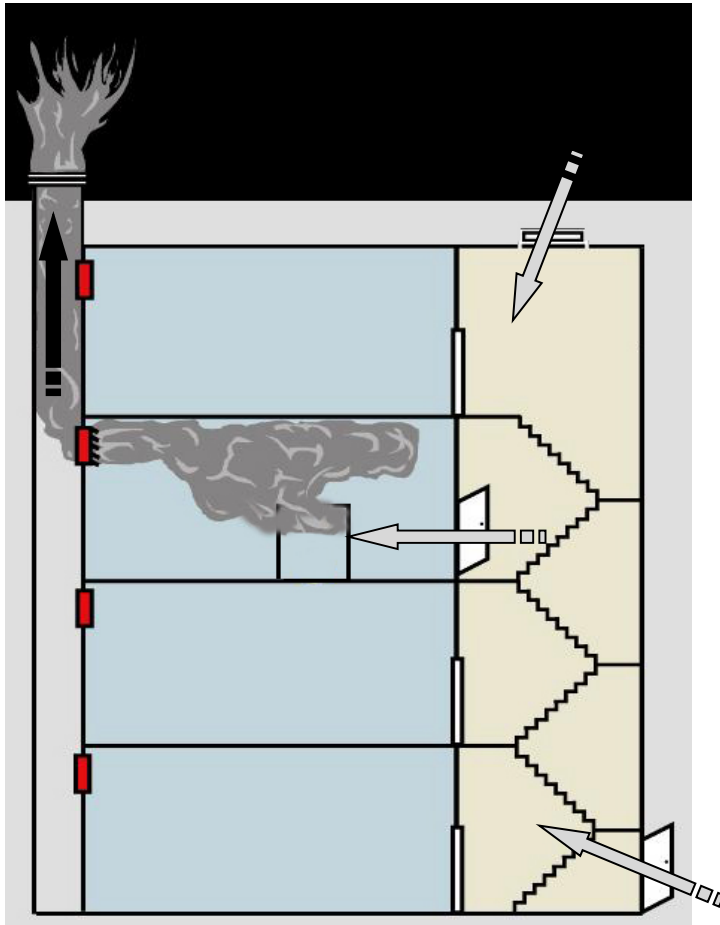
Extended travel distance systems

Ventilation solutions for overheated common corridors in apartment buildings 2018

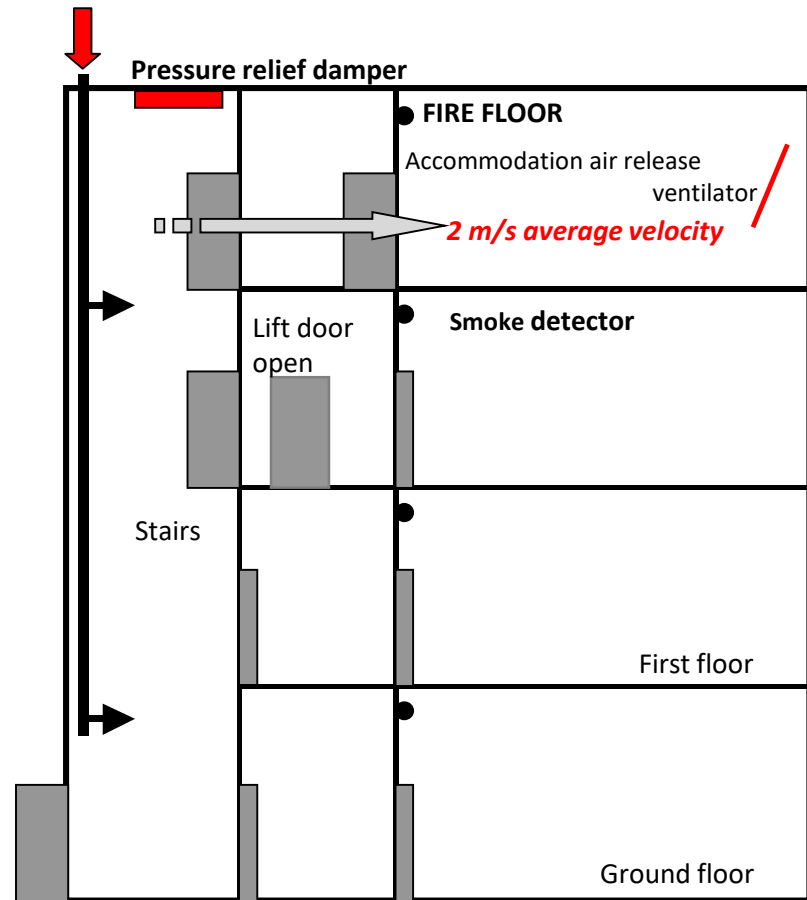


Smoke shafts or pressurisation?

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Shaft System



Pressurisation



Challenges for smoke control design in multi-storey buildings:

- Greater occupant numbers
- Architectural Constraints
- Environmental Effects – Stack/Wind
- Greater resistance paths
- More leakage paths – unavoidable/avoidable
- Inlet sources
- Social Issues
- Construction/Fit out

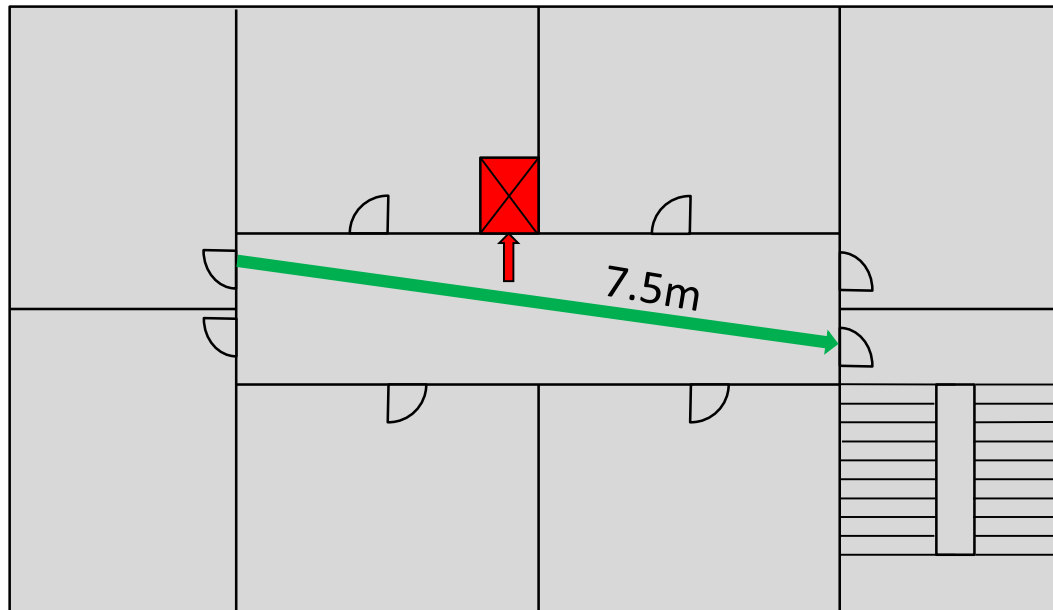


Extended travel distance

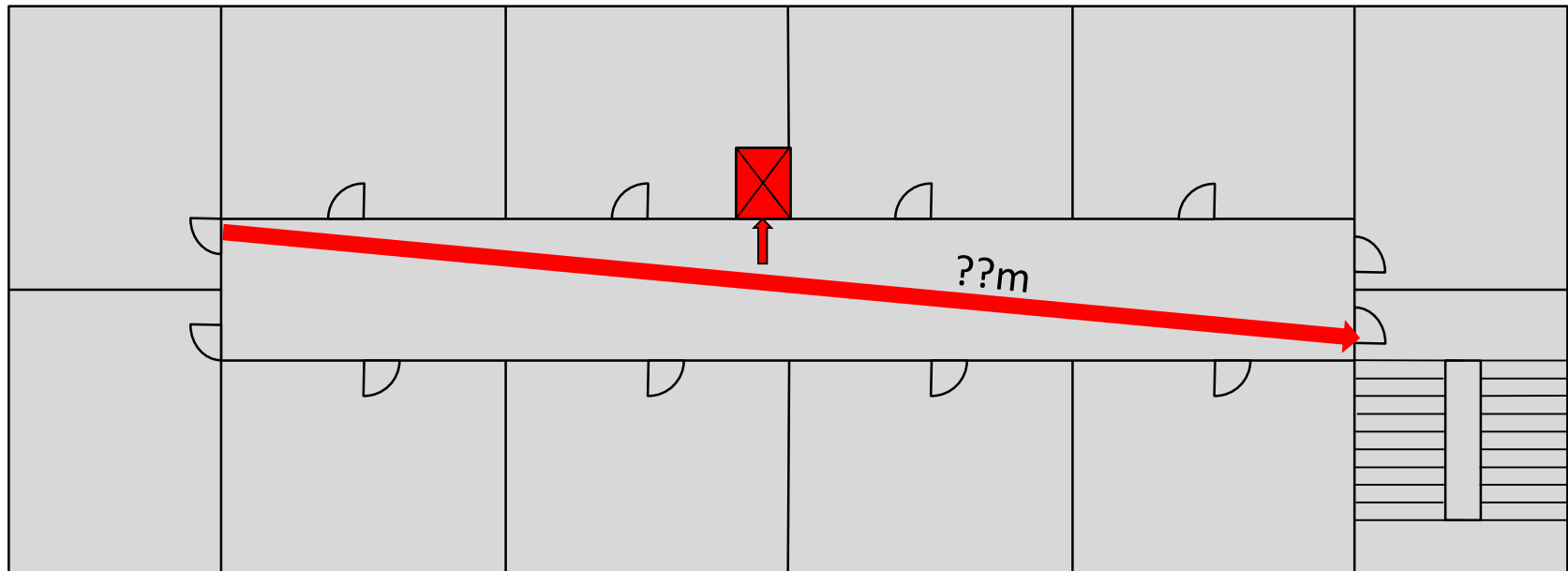
Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Maximum travel distance in single direction = 7.5m (15m if sprinklers are fitted)



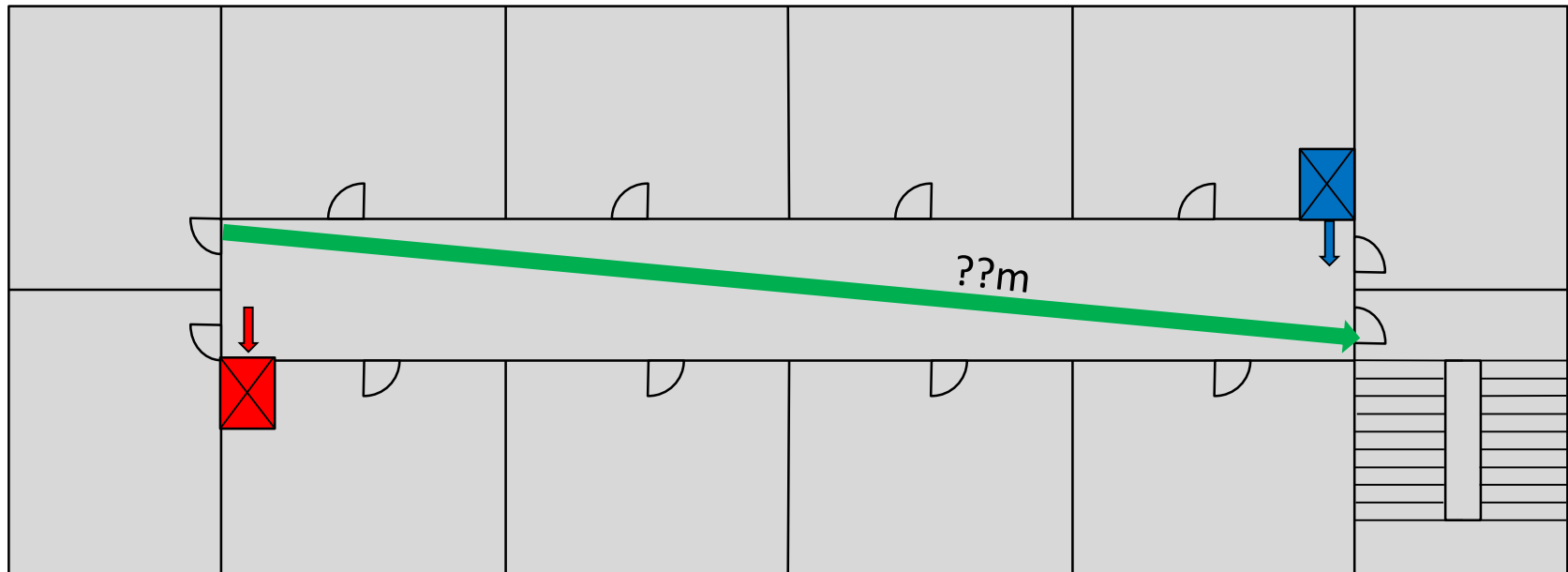
Where the maximum travel distance is greater than 7.5m (15m with sprinklers) special attention is required.



Extended travel distance

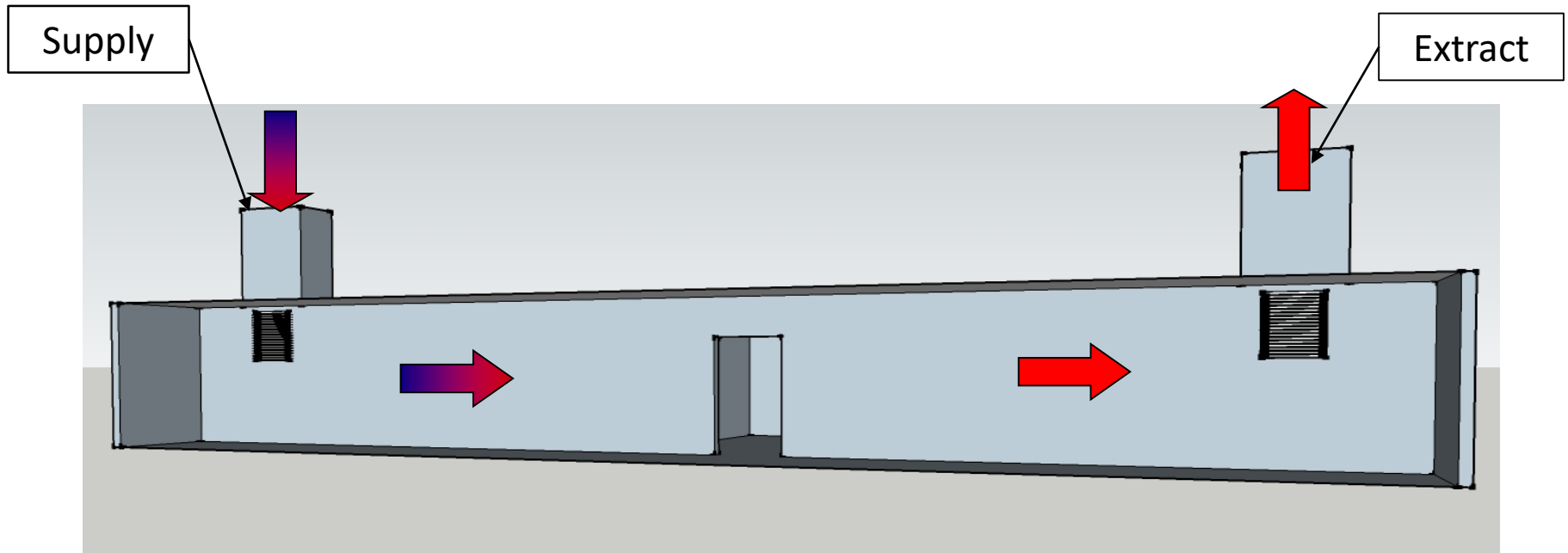
Smoke & environmental ventilation of multi-storey buildings using shafts 2020

By using multiple shafts, the corridors can be extended.



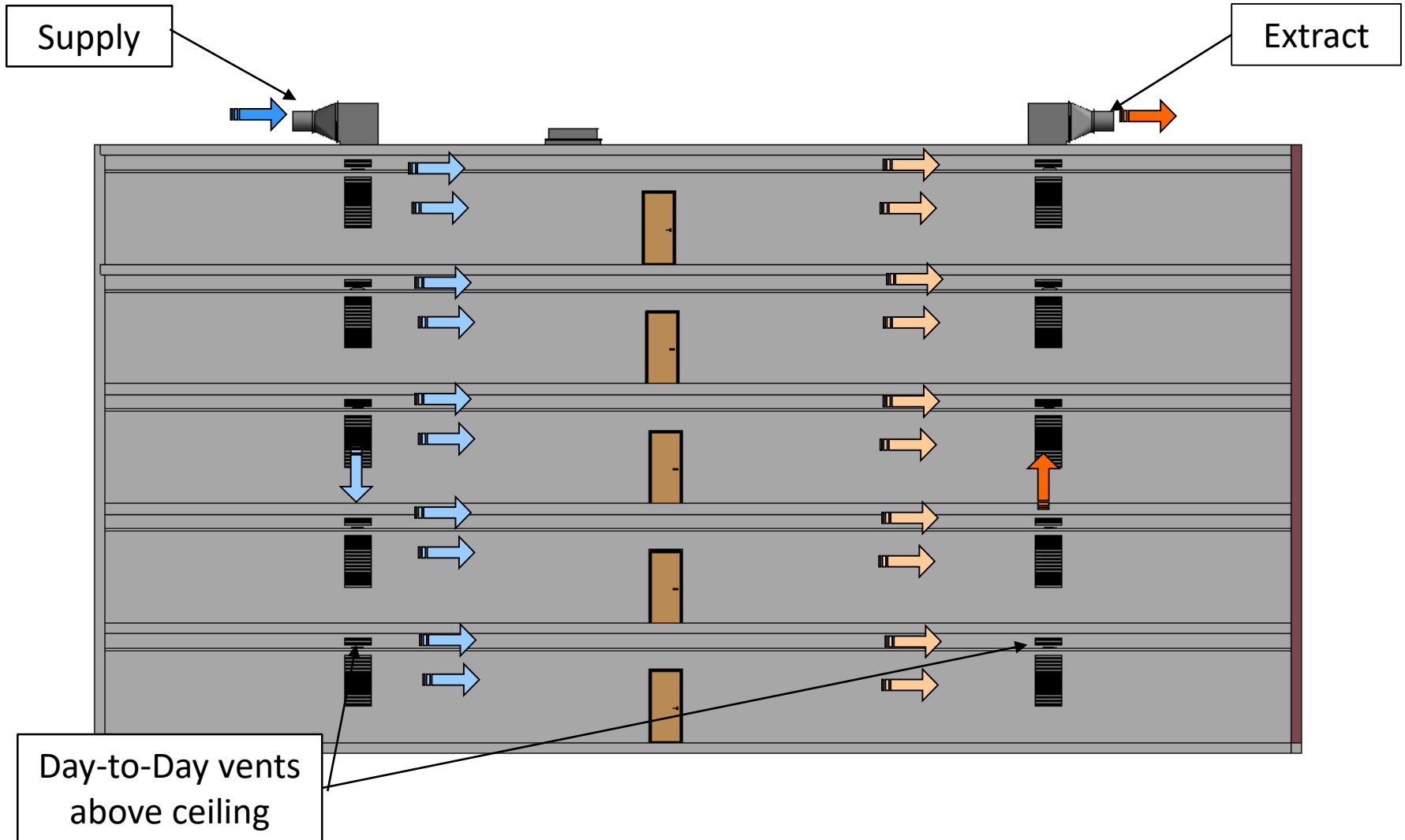
Extended travel distance

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Extended travel distance

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Q: What can you do to avoid heat building up in these common areas?

A: Use the existing smoke control system for day-to-day ventilation.

The simple solution is to use the ventilation equipment which is already providing smoke control to these areas.

Natural or mechanical smoke ventilation systems may be adapted for day-to-day ventilation use.



Q: Will you require additional equipment or modifications?

A: Yes, but the amount varies

If your building has a **multiple shaft smoke control system**, it can readily be configured to provide day-to-day ventilation with minimal additions.

If the building has a **single shaft system**, you will need inlet air. You could provide it from a service riser or the stair using a weathered roof smoke vent and a suitable damper.

You will need to consider fan noise, as noise levels considered acceptable for emergency use will not be acceptable for day-to-day ventilation use.



Extended travel distance systems - Equipment

Smoke & environmental ventilation of multi-storey buildings using shafts 2020

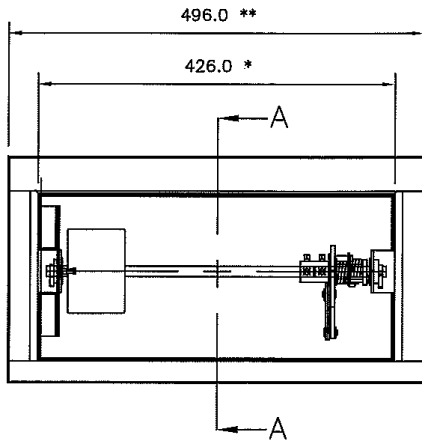


+
Corridor
Temperature
Sensor

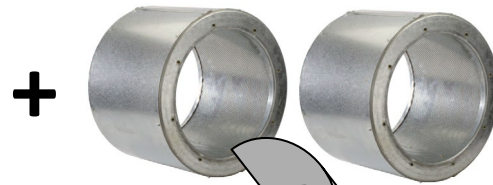


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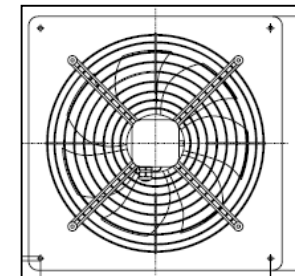
Small Fire Damper for
Environmental use



+ Variable Speed
Drive for
Extract/Supply
Fans



**OR add a
separate,
quieter fan**



Challenges for ventilation design in multi-storey buildings:

- Greater occupant numbers
- Architectural Constraints
- Environmental Effects – Stack/Wind
- Greater resistance paths
- More leakage paths – unavoidable/avoidable
- Inlet sources
- Social Issues
- Build quality
- Strategy
- Reality vs expectation
- Weather defence
- Cost effectiveness
- Noise



Increasing Occupancy Numbers

- People remain in the building longer
- Doors are open for greater periods
- Stairs are occupied for longer, with more people
- Waiting time in lobbies increase

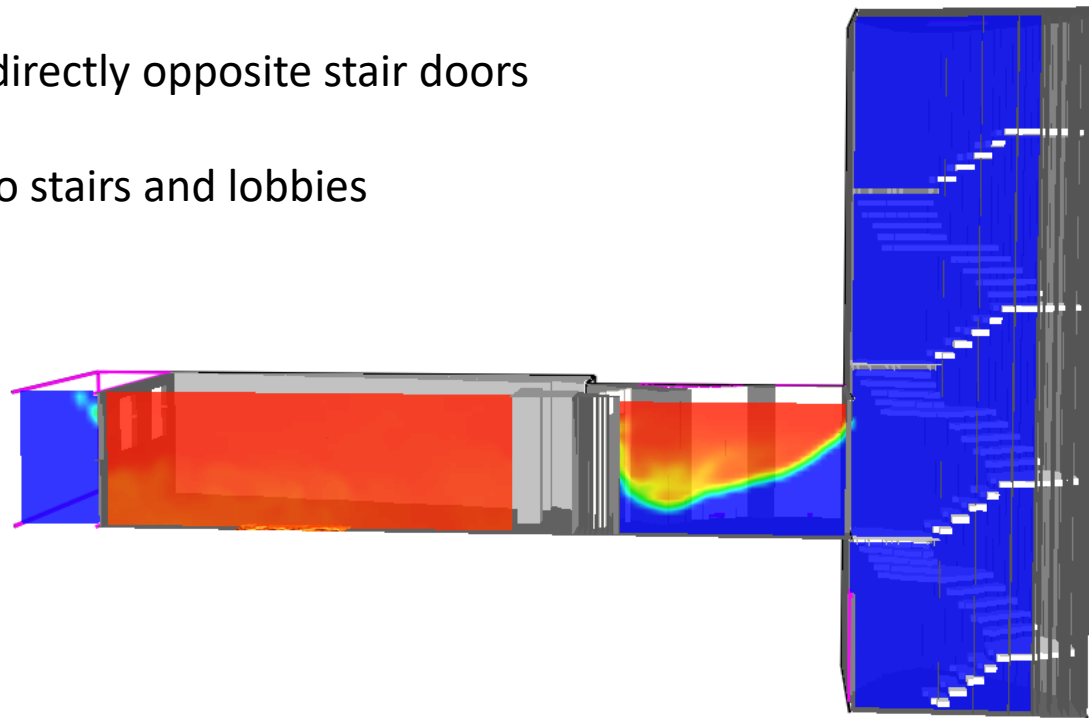
Architectural Constraints:

- Full height doors
- Poorly sized shafts, in wrong locations
- Aesthetic pressure to conceal extract from view – grilles/damper types



Avoid:

- Apartment doors directly opposite stair doors
- Full height doors to stairs and lobbies



Wind and stack effect

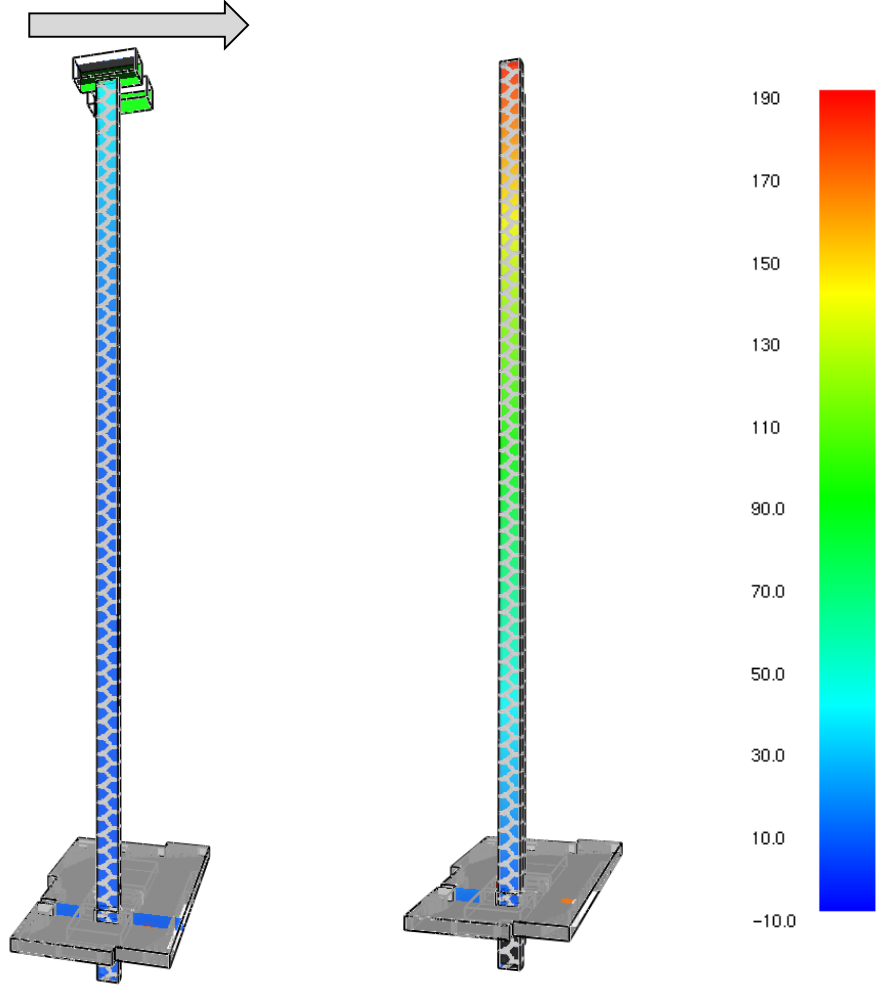
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Stack effect

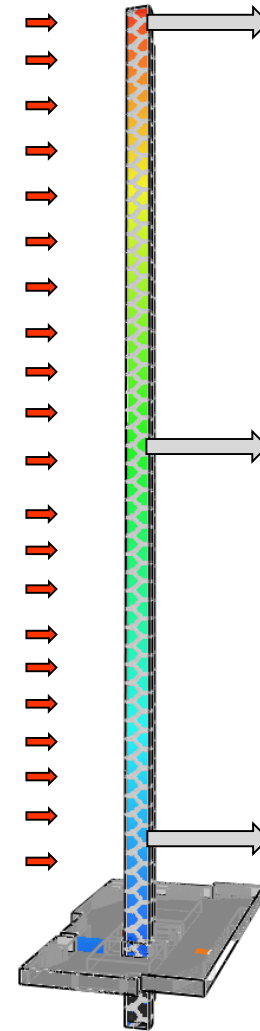


Wind effect



Resistance Paths/Leakage

- Flexibility in the extract plant location will drastically reduce resistance paths
- System should accommodate leakage from multiple levels and locations
 - 10% allowance is not enough



Build quality – avoidable leakage



- Cramming
- Hoarding
- Garden Cities



Social issues

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



- Social Housing
- Physical Capability/Ability
- Wilful damage/neglect

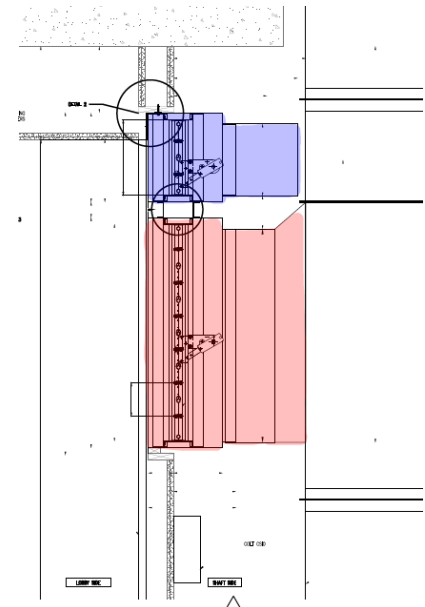
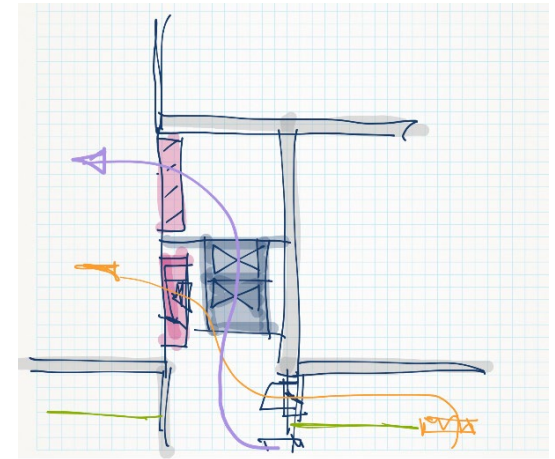


Details to consider – Environmental Strategy

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



- Ventilating all floors simultaneously is most effective against overheating.
- But, this can mean large equipment if there are many floors.
- Rotate groups of floors to be ventilated?
- Inherent balance - ground level supply, roof level extract?
- Does ceiling void need to be ventilated too?
- Are separate day-to-day dampers a cost effective benefit?
- Night cooling?



Details to consider - Fans

Smoke & environmental ventilation of multi-storey buildings using shafts 2020



Basic Smoke Control Installation



Dual purpose systems



Details to consider – Rain defence

Smoke & environmental ventilation of multi-storey buildings using shafts 2020

Dual purpose systems should consider rain entry



Enhance conditions with active cooling provided by an Evaporative Cooling System



A ventilation system based on supplying outside air alone is able to achieve temperatures in the corridor typically 2-5°C above the outside ambient.

With evaporative cooling we are able to reduce supply temperatures below outside ambient, providing active cooling in the corridors.

Shaft

- Fire rated
- Non combustible
- Well sealed –
3.8m³/hr/m² at 50 Pa
- Free from services and obstructions
- Cabling – BS 8519 Control Systems Cat 3

Fans

- Temperature Rated
- F300 minimum (CE Marked EN12101-3)
- Sized to meet required duty + leakage
- VSD/DOL

Smoke Ventilators

- CE Marked - EN 12101-2
- Open and stay open if required
- Known ventilation performance
- Life cycle tested



Commissioning Process:

1. Complete installation
2. Check for conformity to design
3. Electrical installation checks
 - Continuity/Impedance
 - Insulation
 - Resistance
 - Network
4. Electrical Performance Tests (fans):
 - Test incoming voltage to MCC Panel from Primary and secondary supplies
 - Record resistance and current across phases
 - Rotational check – speed and direction where required
6. Cause and Effect Testing
 - Primary / secondary fan switchover
 - Primary / secondary supply switchover – Black Building
7. Test and prove compliance with design
8. Smoke Test - where specifically required



Testing and maintenance

- Smoke control is a life safety system, covered by the **Regulatory Reform Order**. Testing and maintenance is covered by **BS 9999 Annex I**
- Regular testing – weekly
- Three monthly full test
- Annual inspection and maintenance by a competent person



BS 9991
BS 9999



SCA Guide



BS 7346-8



Documentation



- Well designed systems can provide both smoke and day-to-day ventilation.
- Can utilise a number of shared components.
- Vital to carefully consider building type, geometry and expected usage in system or equipment selections.
- Effective maintenance can extend the lifespan of a system.





Smoke and environmental ventilation of multi-storey buildings using shafts

Whitepaper

Your next steps:

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Email us: info@coltgroup.com

Visit our website: www.coltinfo.co.uk



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Whitepaper: Smoke and environmental ventilation of multi-storey buildings using shafts

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blog.coltinfo.co.uk/white-papers





Q&A Session...

COLT

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