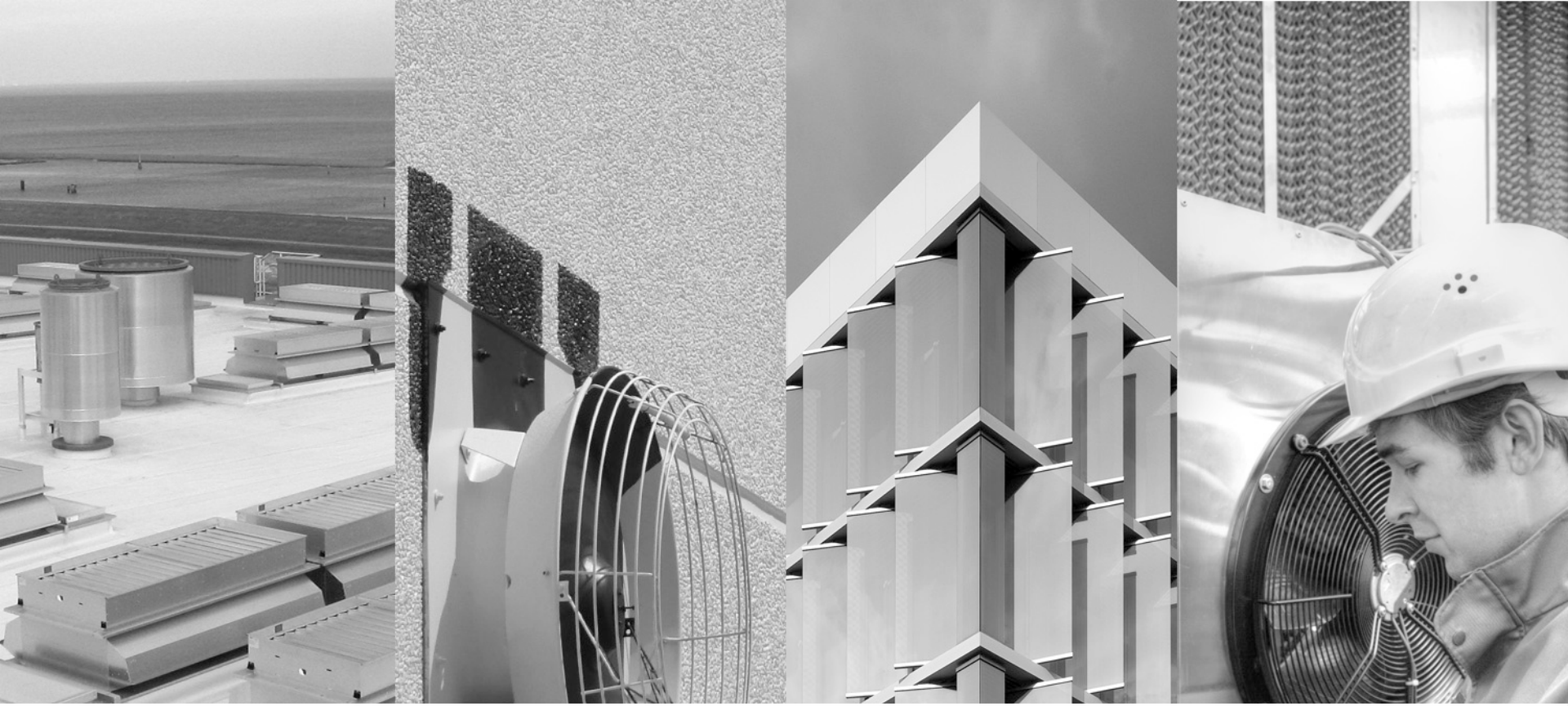


Colt International Ltd

Pressurisation systems in residential and commercial buildings

Colt CPD Technical Seminar

CPD Accreditation

Colt International Limited

CIBSE CPD

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

Olga Mendes
Membership Development Manager
CIBSE

The Chartered Institution of
Building Services Engineers
222 Balham High Road
London SW12 9BS
T: 020 8675 5211
E: info@cibse.org
www.cibse.org

CIBSE CPD

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

Accreditations and Memberships

Colt International Limited

Accreditations

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

PPQ still required by clients

IFC certification

CERTIFICATED INSTALLER OF ACTIVE FIRE PROTECTION

smas worksafe contractor www.smasltd.com as recognised by SSIP Safety Schemes in Procurement

health in CONSTRUCTION leadership group

QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001

ENVIRONMENTAL SYSTEM CERTIFICATION DNV·GL ISO 14001

SAFETY SYSTEM CERTIFICATION DNV·GL ISO 45001

Memberships

BSRIA

CIBSE PATRONS

ASFP www.asfp.org.uk

CIBSE CPD

FETA

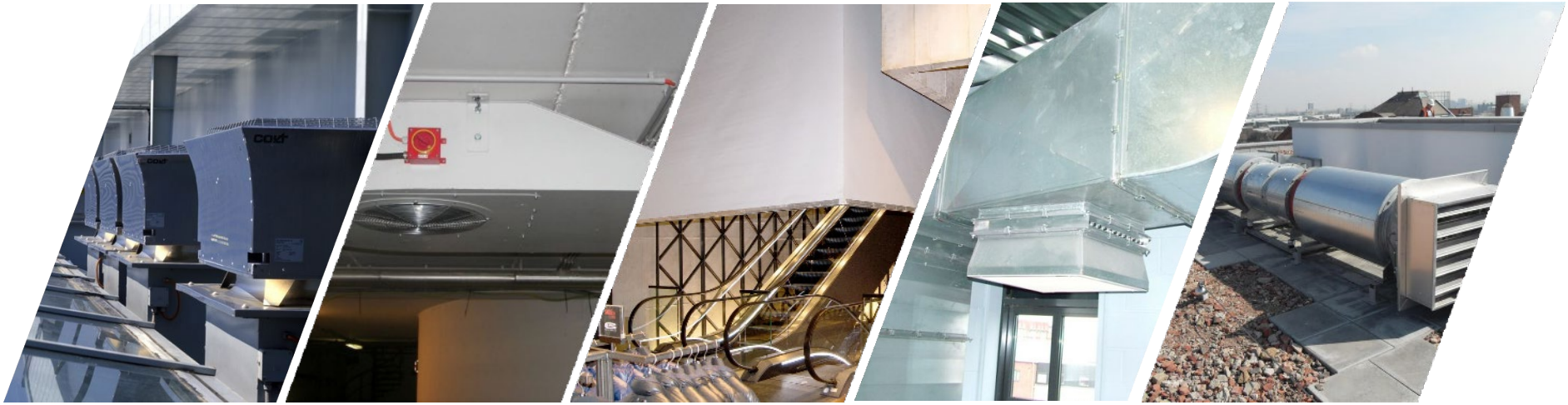
Smoke Control

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

Hybrid Ventilation

Mechanical Ventilation

Evaporative Cooling

Louvre

Screening | Ventilation & Rain Defence | Shading | Acoustic

Service

24 hour call out

Nationwide Coverage

Spare Parts

Surveys

- Approved Document B to the Building Regulations requires smoke ventilation to escape stairs in residential buildings and, under most circumstances, adjacent common lobbies and/or corridors and to fire fighting stairs in all buildings.

- Pressurisation is one way of meeting this requirement

- Alternatives to pressurisation are:

  – Natural AOVs

  – Natural Shafts

  – Mechanical Shaft

- Alternative to natural ventilation when escape stairs or fire fighting stairs are landlocked

  Note: BRE shaft and Colt Shaft have significantly reduced this market for pressurisation of fire fighting stairs

- A requirement for some fire fighting stairs

- An alternative to lobbies and/or discounting of a stair in some buildings

- Pressurisation systems should conform to the requirements of EN 12101-6:2005

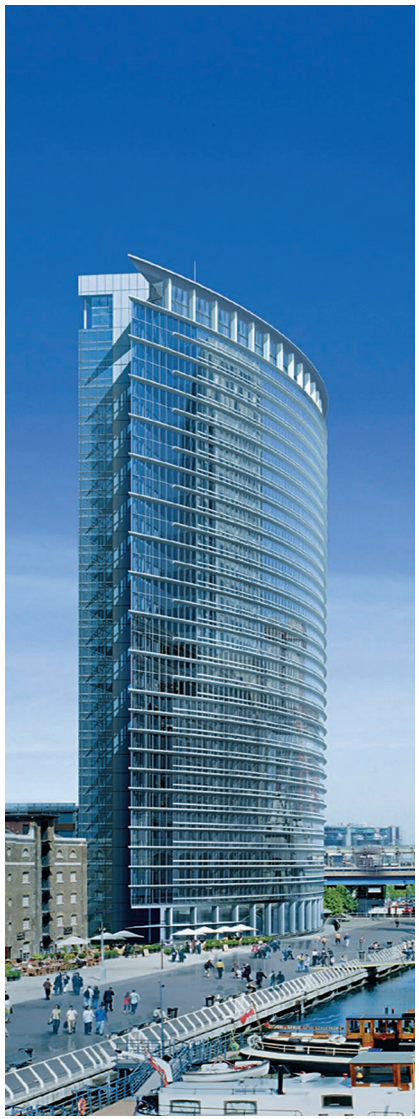
BS 9999: 2017 recommends Pressurisation (designed to EN12101-6) to:

- Avoid discounting a stair in the sizing escape stairs
- Allow a single stair to extend down to a basement
- Protect fire fighting shafts over 10m deep and over 30m tall (Class B)

Pressurisation Systems - Installations

Pressurisation systems in residential and commercial buildings 2020

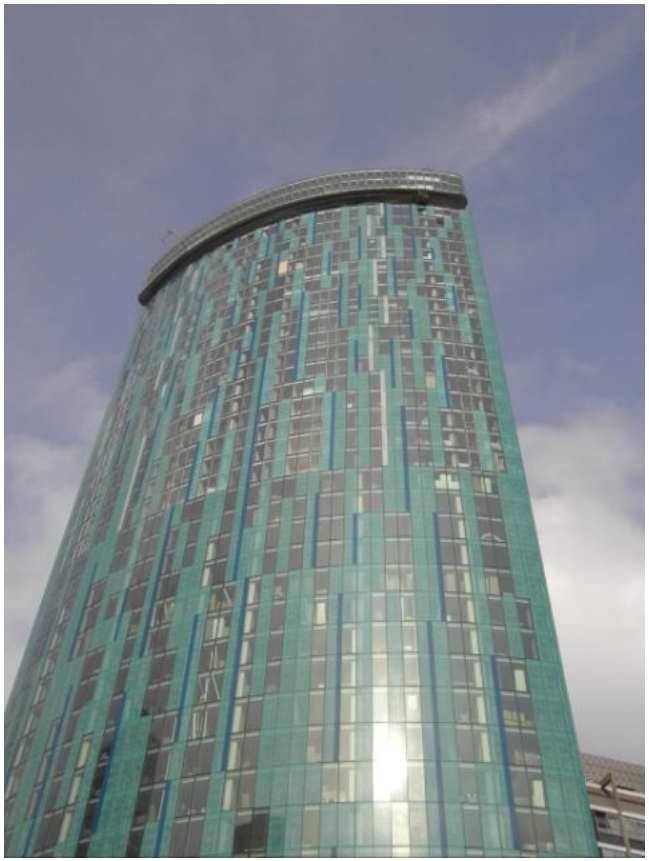
Oxford Road, Leicester



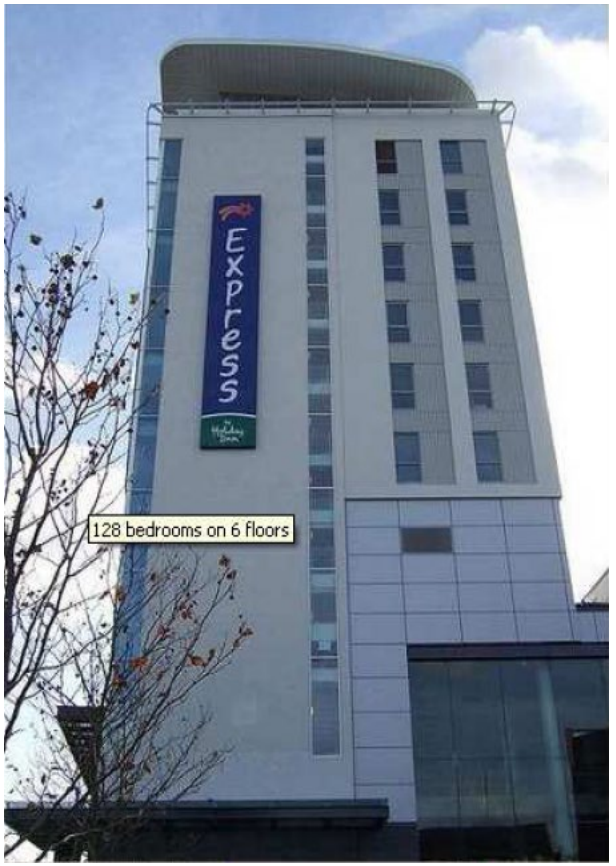
West India Quay, London

Pressurisation Systems - Installations

Pressurisation systems in residential and commercial buildings 2020



Beetham Tower, Birmingham



Holiday Inn Express, Hull

System Class	Application	Typical Building Type
A	Means of Escape Stay put policy	Residential
B	Means of Escape and Fire fighting	Where fire fighting core is required
C	Means of Escape Simultaneous Evac.	Commercial
D	Means of Escape Sleeping Risk	Hotels/Hospitals
E	Means of Escape Phased Evacuation	High rise offices

- The system must protect against smoke entering the stairs or travelling between storeys via lifts accessed from protected lobbies

- The intent is to have the highest pressure in the stairs and a reducing pressure gradient through to the accommodation

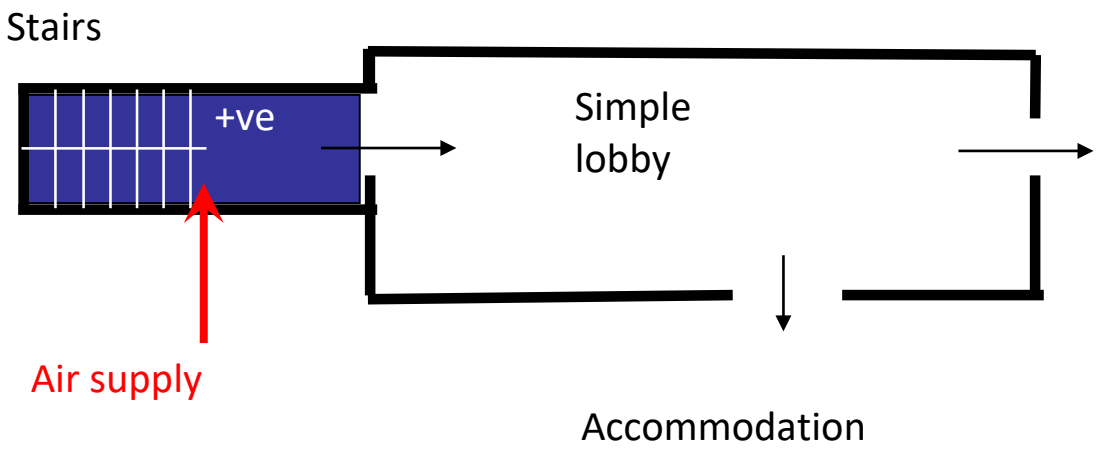
- All ‘pressures’ described are actually pressure differentials to the accommodation

- All pressurisation systems require 3 basic components:
- A means of supplying clean air to pressurised areas
- A means of ensuring excessive pressure differentials do not occur
- A means of relieving pressure from the accommodation

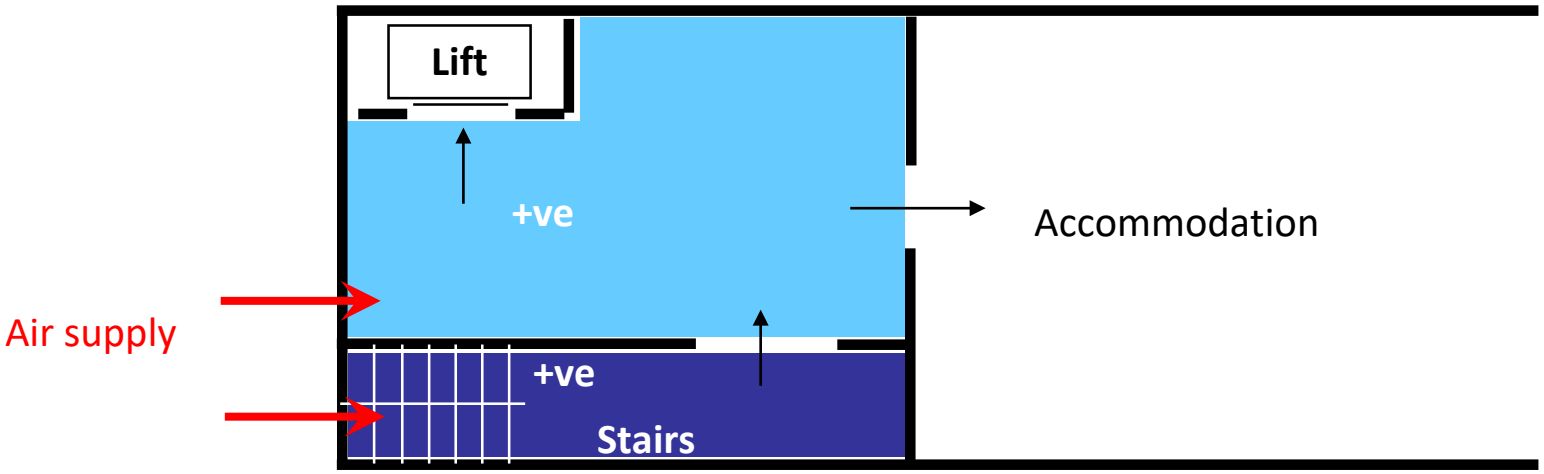
The first decision to make for any system

- Depends upon class of pressurisation
- Depends upon building layout
  - Is there a lift?
  - Where is suitable for accommodation air release

Pressurise the stairs only. Only used where the staircase is entered via a simple lobby (i.e. a lobby without lifts or other possible escape route) or directly from the accommodation.

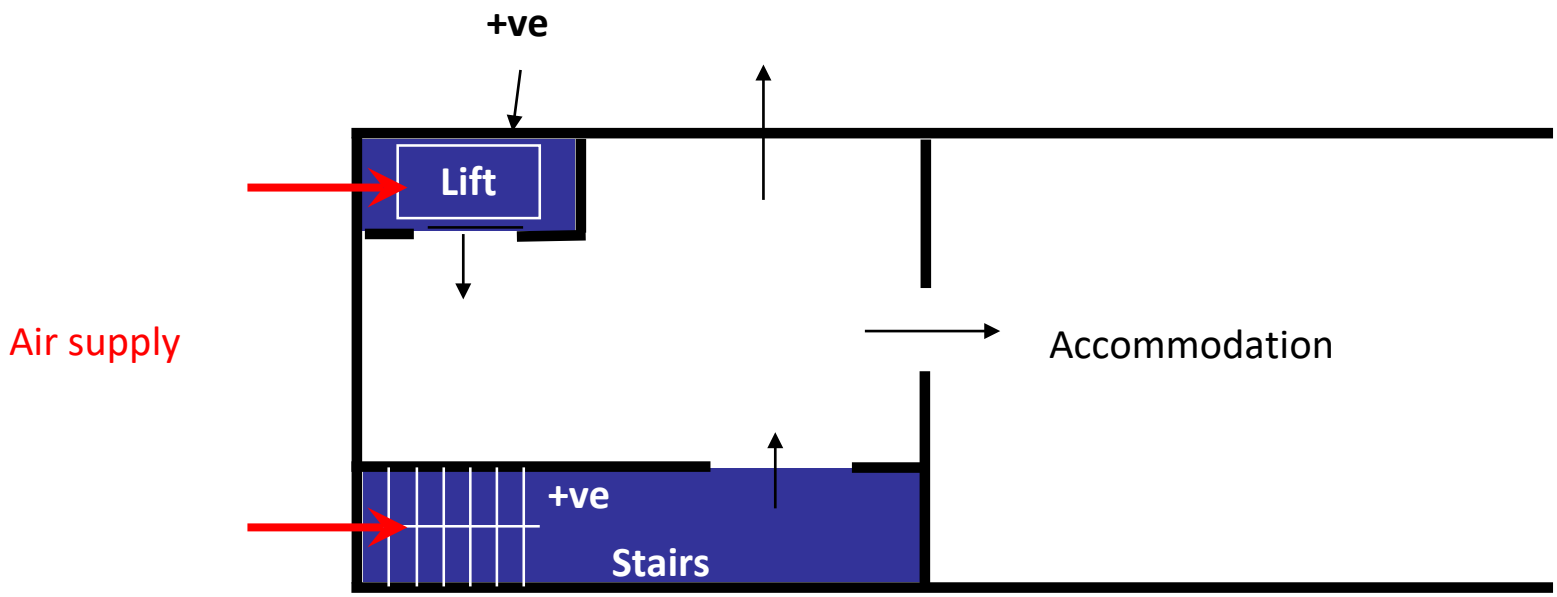


Pressurise stairs and lobbies.
Used to extend protection to lobbies

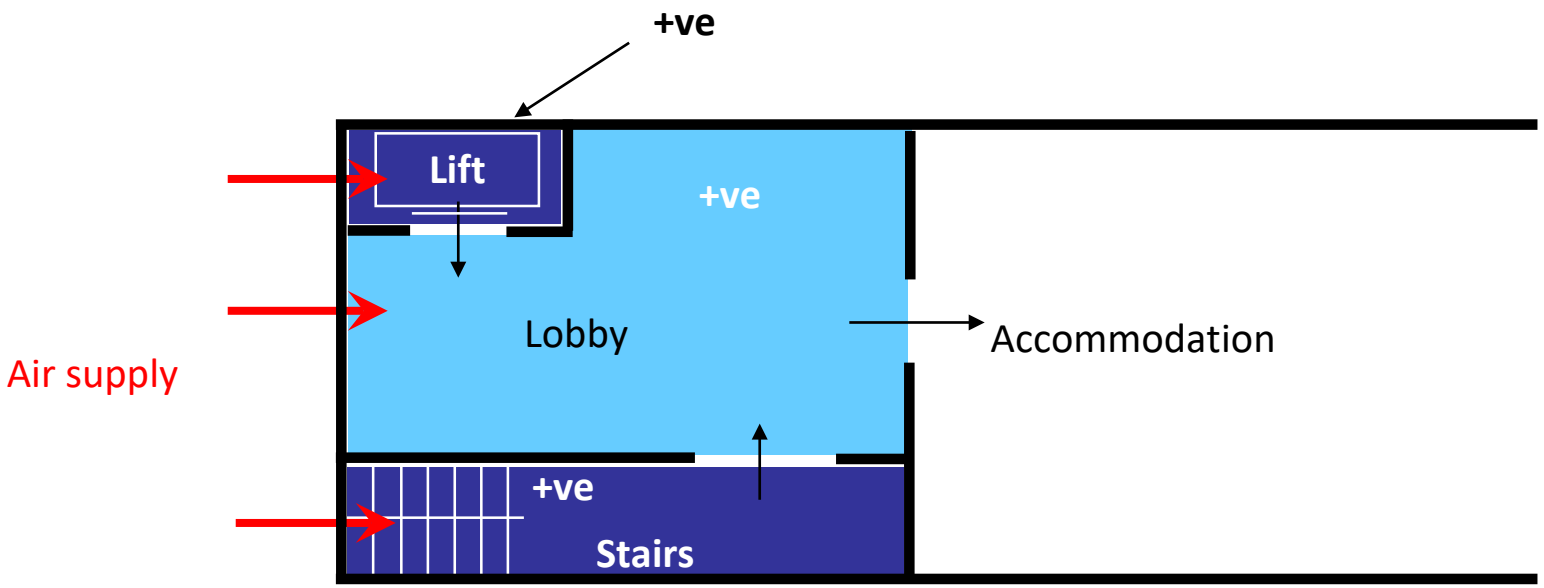


Pressurise stairs and lift.

Used when the lobby is not pressurised to prevent smoke from spreading via the lift well. The lobby becomes a simple lobby



Generally only used in fire fighting – Class B

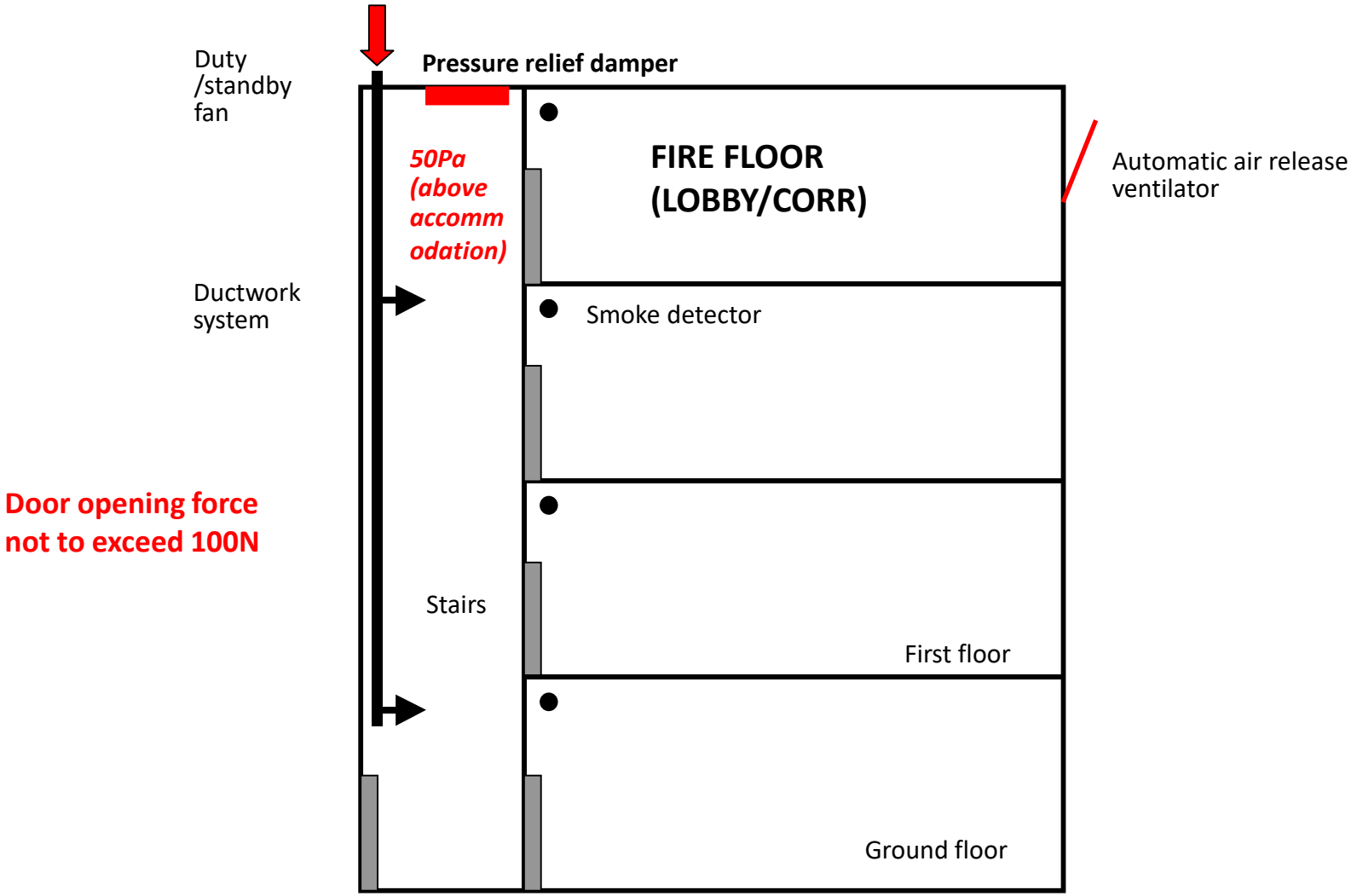


Depending upon the class of system we have set criteria to achieve:

- Pressure differentials
- Velocity through open door
- Limited door opening force

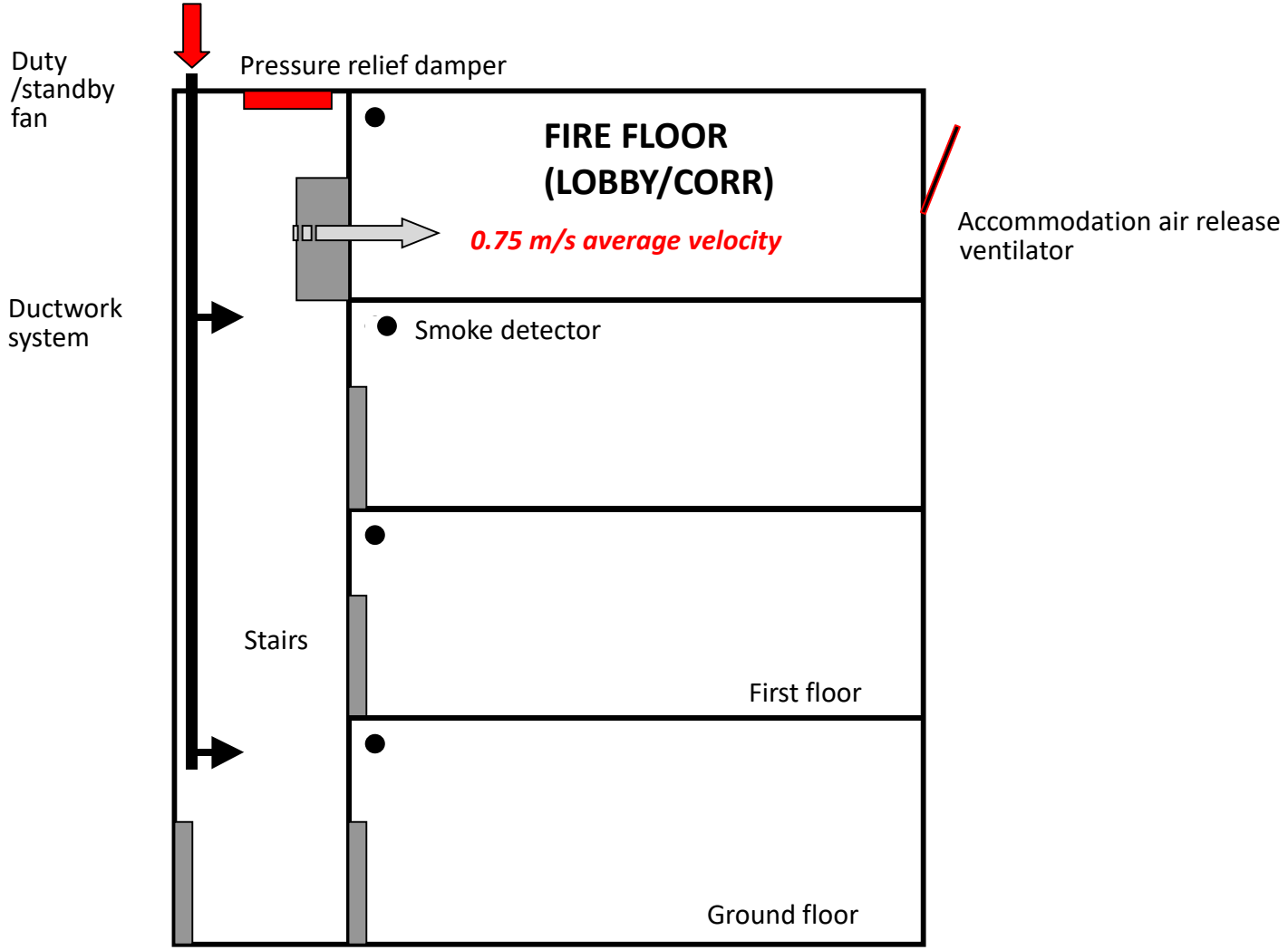
Pressurisation Systems - Class A - Doors closed

Pressurisation systems in residential and commercial buildings 2020

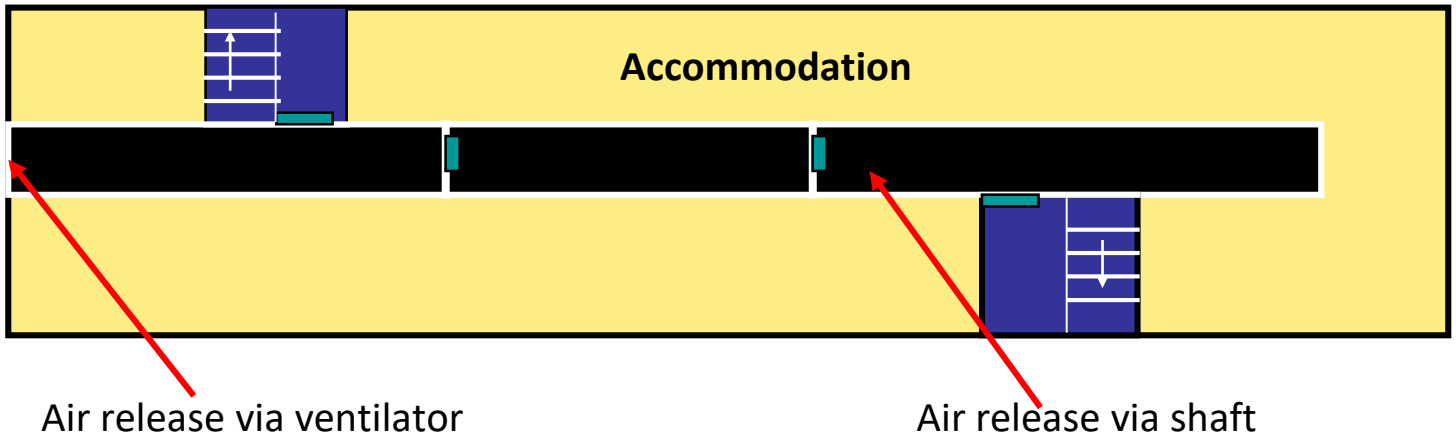


Pressurisation Systems - Class A - Door open

Pressurisation systems in residential and commercial buildings 2020



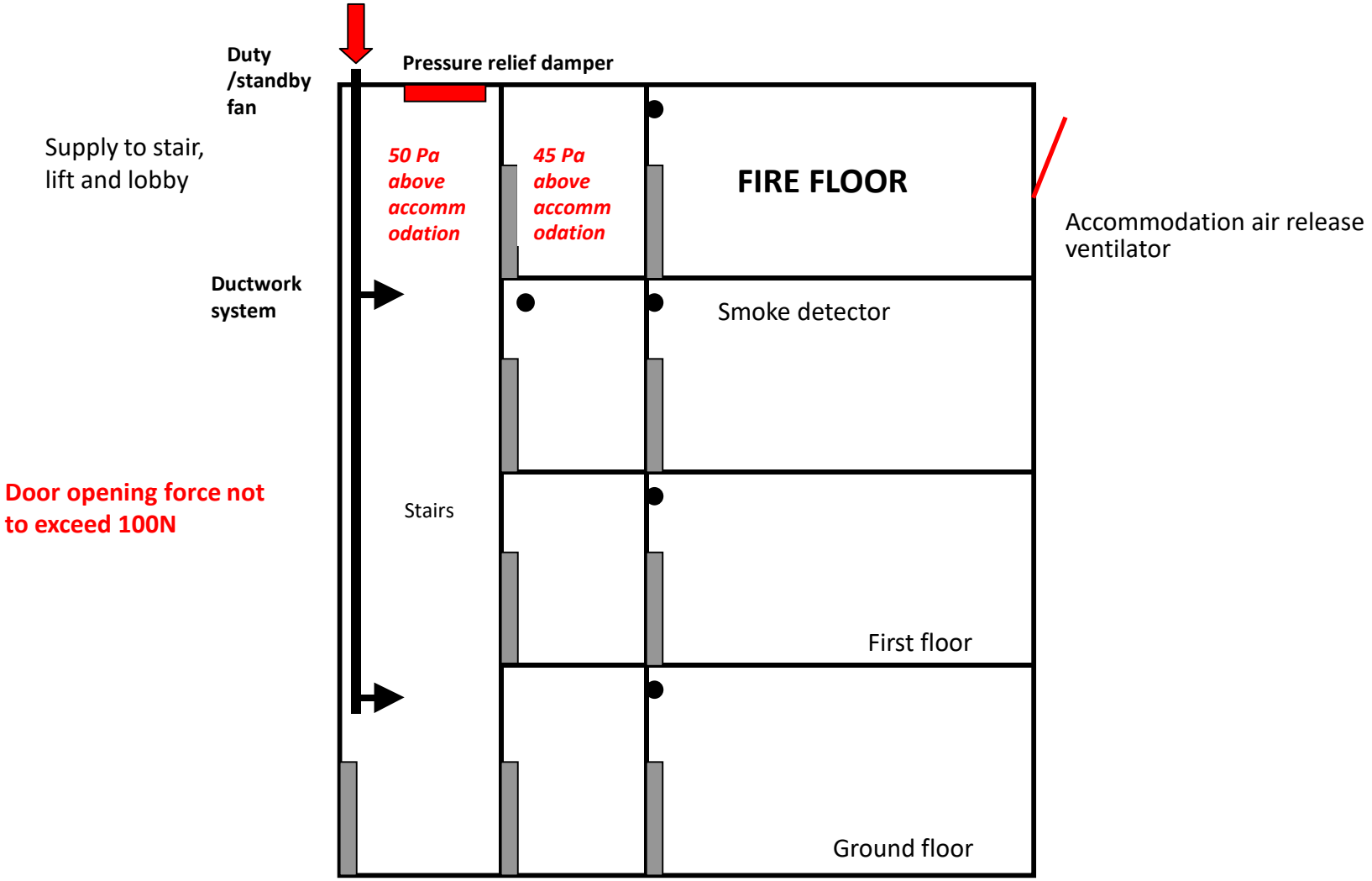
- Do not attempt to pressurise the corridors up to dwelling front doors
- Provide air release from the corridor or lobby
- Long corridors will be fitted with smoke seal doors - air release needs to be on stairs side of nearest doors


Accommodation
Air release via ventilator
Air release via shaft

- Requirement for stairs set by ADB and BS 9999
- Pressurised lobbies essential
- Lobbies may contain fire fighting lift, which also needs to be pressurised

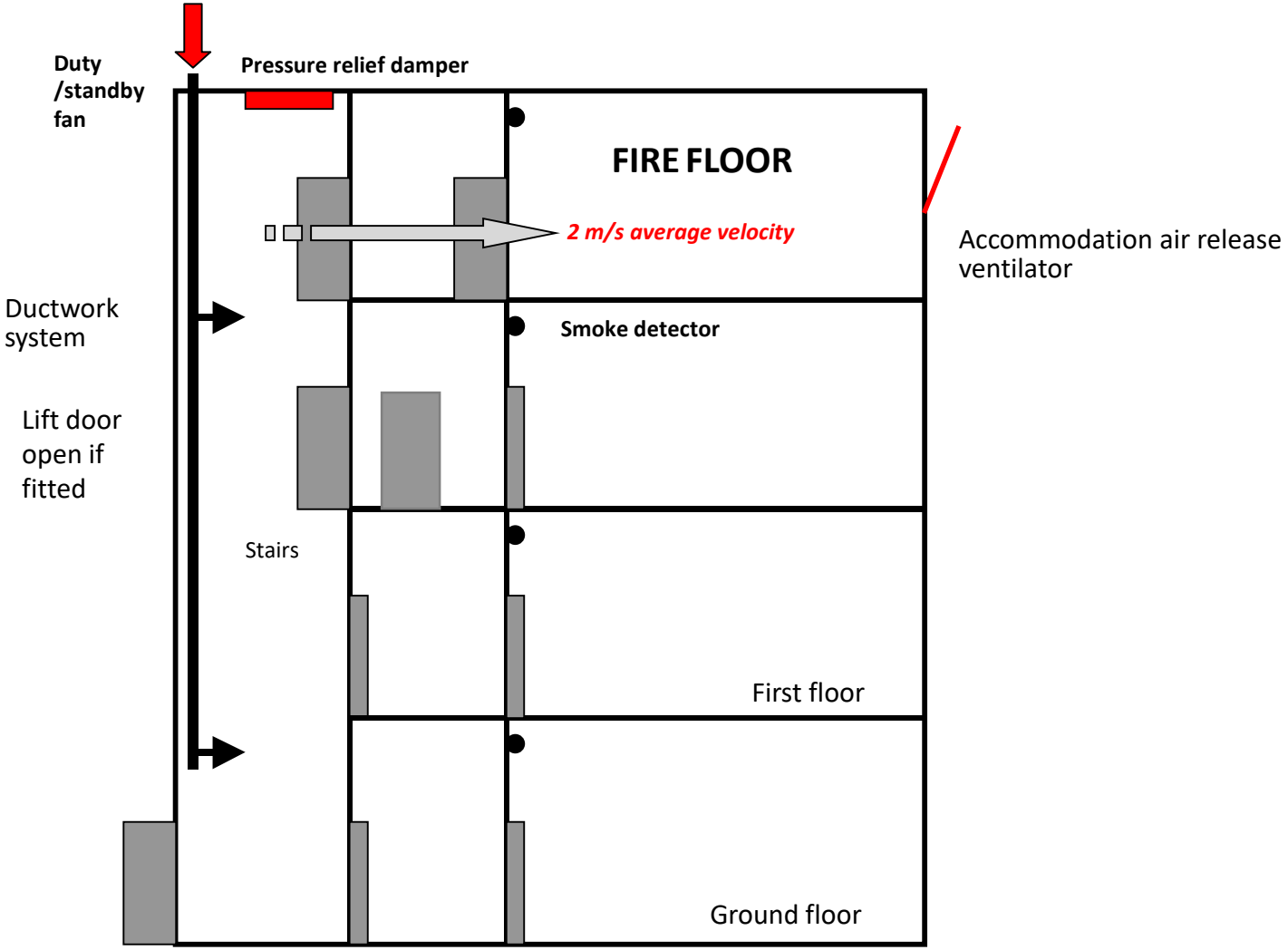
Pressurisation Systems - Class B - Doors closed

Pressurisation systems in residential and commercial buildings 2020



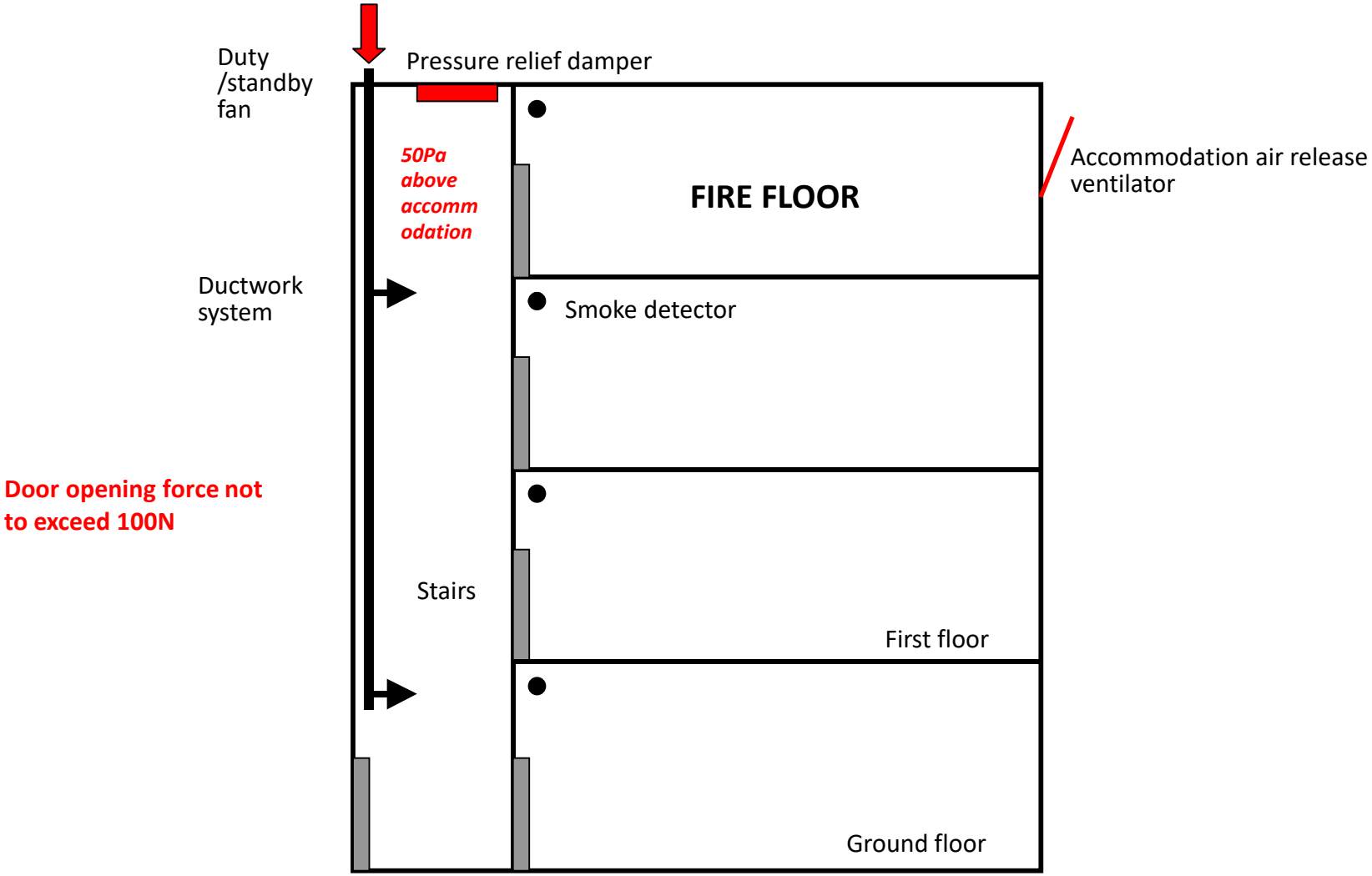
Pressurisation Systems - Class B - Doors open

Pressurisation systems in residential and commercial buildings 2020



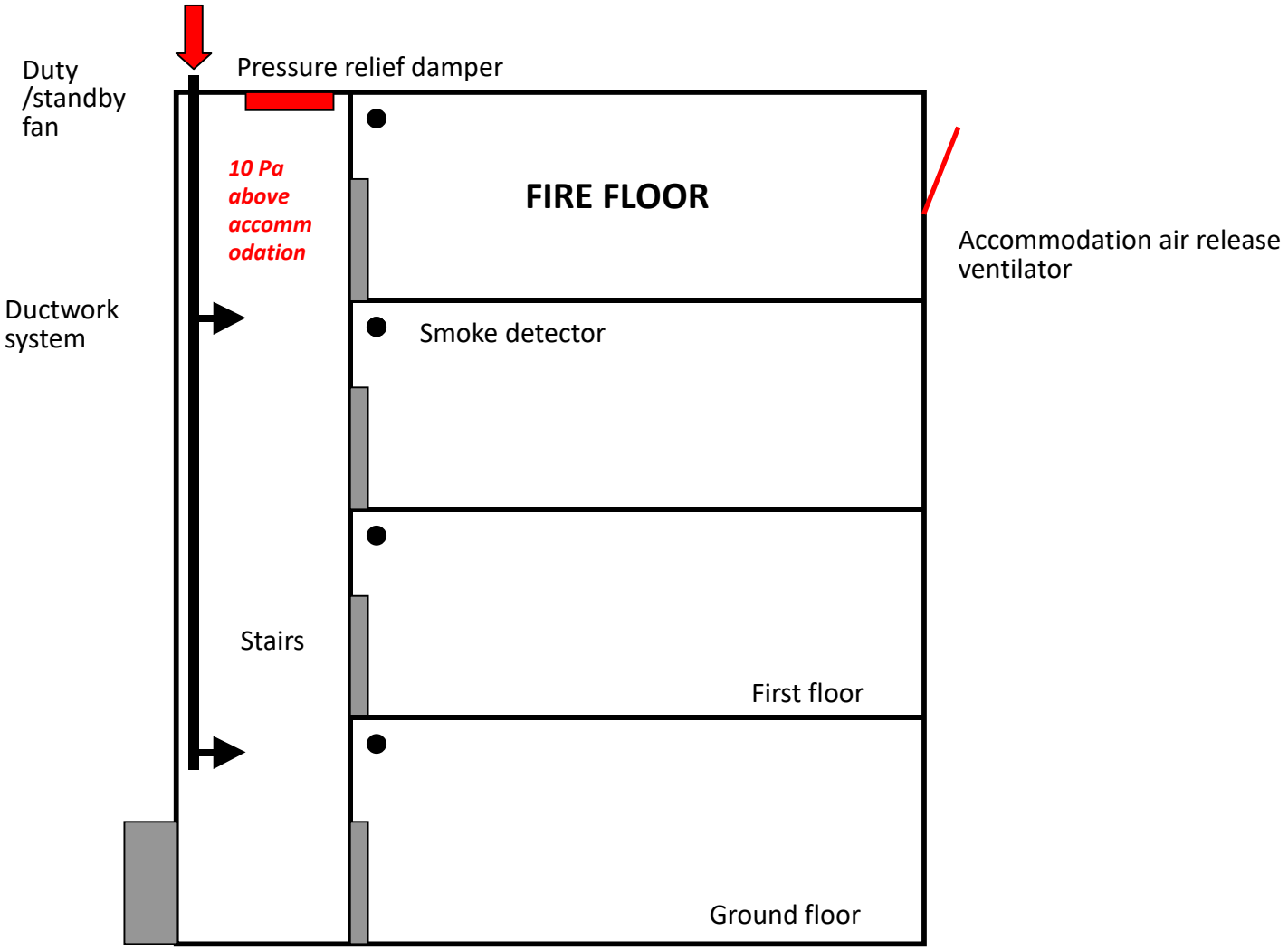
Pressurisation Systems - Class C Doors closed

Pressurisation systems in residential and commercial buildings 2020



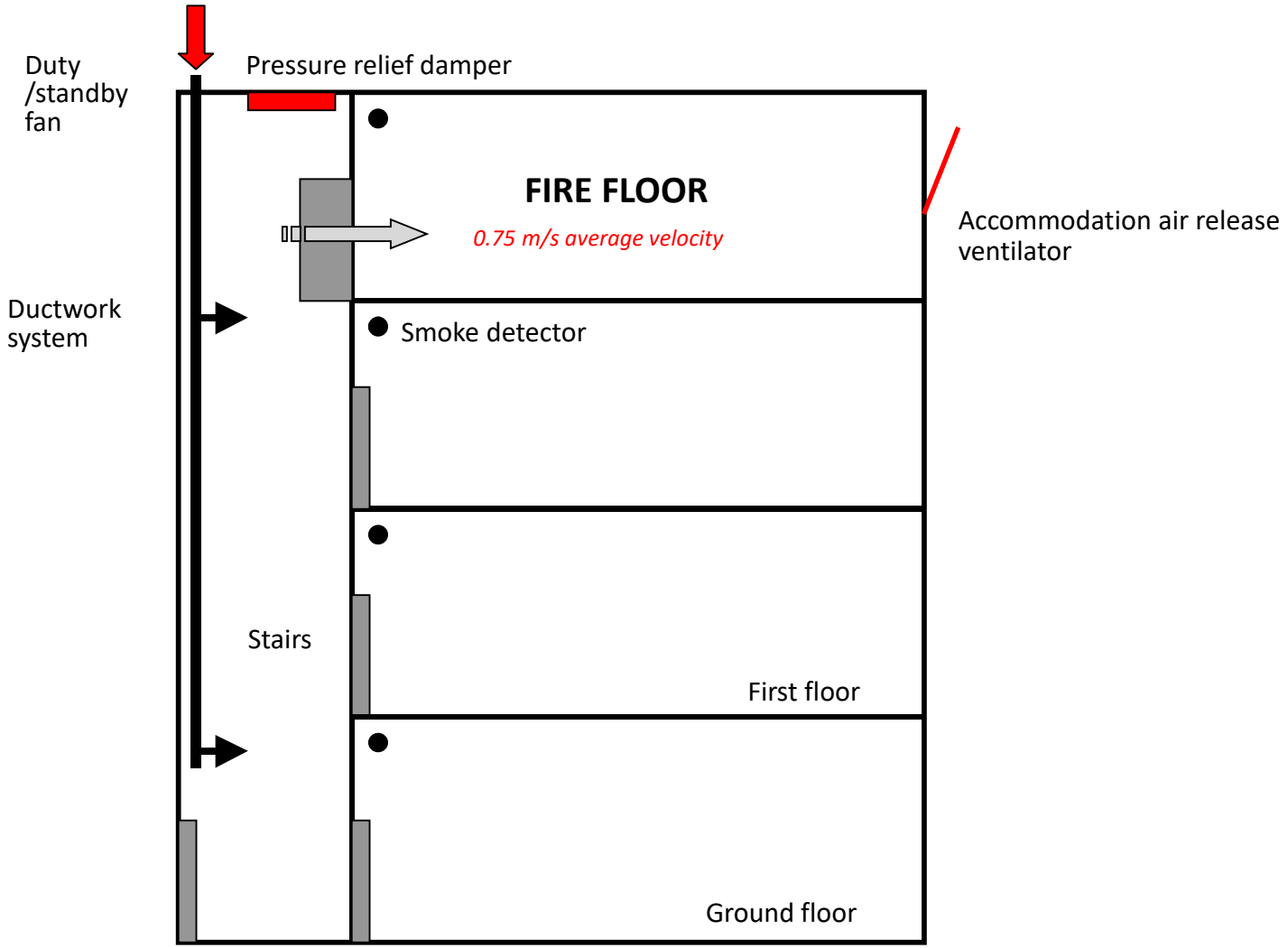
Pressurisation Systems - Class C - Exit door open

Pressurisation systems in residential and commercial buildings 2020



Pressurisation Systems - Class C - Door open

Pressurisation systems in residential and commercial buildings 2020



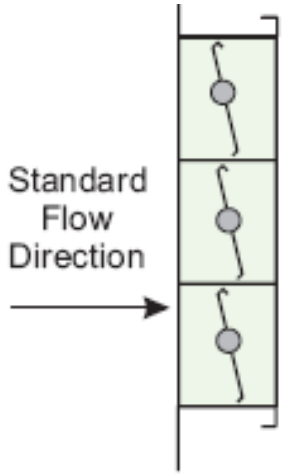
Closed Door Requirements				Open Door Requirement	
Class	**Stair (Pa)**	**Lift Shaft (Pa)**	**Lobby (Pa)**	**Velocity (m/s)**	**Open Doors**
A	50	50*	45*	0.75	Stair door on fire floor
B	50	50	45	2.0	Stair door on fire floor Stair door on floor below Lobby door on fire floor Lift door on floor below Final exit door
C	50	50*	45*	0.75	Stair door on fire floor + 10Pa pressure difference with final exit door open only
D	50	50*	45*	0.75	Stair door on fire floor and final exit door + 10 Pa pressure difference with final exit door open and one stair door other than the fire floor
E	50	50*	45*	0.75	Stair door on fire floor and another floor and final exit door + 10 Pa pressure difference with final exit door and two stair doors open other than the fire floor

*** Pressurising these spaces is at the discretion of the system designer**

- Fans
  - ambient rated
  - duty + standby (or standby motor) if only one MOE route; usually in series to save space
  - One fan set may supply stairs, lobbies and lift shaft
  - not usually attenuated unless needed for test periods
  - In 1 hour fire rated enclosure or roof

- Power supplies
  - primary + secondary
  - Mains + generator or separate mains supply

- Pressure relief
  - usually gravity damper in stair
  - inverter control of fans possible but difficult due to response speed requirement



- Ductwork
  - separate vertical ducts for stair, lobbies, lift shaft
  - ambient rated unless breaching fire compartmentation
  - Builders work shafts are suitable if well sealed
  - VCD required at each tee and grille for balancing
  - Two separate inlets facing different directions with smoke detector operated inlet dampers if at roof level

- Grilles
  - one per 3 storeys in stair
  - one per lobby
  - one per 30m in lift shaft

Twin air intakes on separate facades of the building with motorised dampers and smoke detector control

Volume control dampers on each section of ducting

- Accommodation air release
  - by leakage, ventilators, natural or mechanical shaft
  - leakage can be from building fabric, HVAC ductwork, permanent trickle vents, but not window breakage
  - ventilators must be provided on at least 2 sides, discount the side with the largest vent area (2.5m/s)
  - Natural shaft terminations need to be located to minimise adverse wind effects (2m/s)
  - Mechanical shafts should operate whenever the pressurisation system does and should not cause excess pressure differentials

- Initiation – From automatic fire detection system
  - Needs to identify fire floor (AAR only from fire floor)
  - Locate detector close to door to pressurised space

- Class B initiation
  - Can be manual switch from MOE state or direct from automatic fire detection system

- Accommodation air release
  - only opened on fire floor (to prevent risk of fire/smoke spread)

- Fire fighter controls
  - provided at base of stair

- Pump air into a ball or a tyre and we have a positive pressure inside
- If there is a puncture then to maintain a positive pressure we need to keep pumping air in
- For a given pressure and a given puncture size we will require a fixed rate of air input to balance the air lost through the puncture

- From Bernoulli's equation:
- $\Delta P = 0.5\ \rho \sum (Q^2/A^2)$
- Rewriting and correcting for effective area
- $Q = 0.83 \sum (A\ \Delta P^{0.5})$
- Q is the leakage rate from the pressurised space that we need to balance with supply air

- Easy in principle but we have a complex network of leaks and conditions to fulfil
- Therefore the calculation becomes complex
- EN 12101-6 devotes a 12 page annex to this
- Results are:
  - Closed door total air flow
  - Open door total air flow
  - 10Pa total air flow (C-E)
  - Pressure relief air flow

- Select duct layout and dimensions
- $\Delta P = 0.5 \rho k v^2$
- v is duct velocity
- k is the pressure loss coefficient for a duct fitting (bend, tee, grille, etc)
- By summing ΔP for all fittings and duct we obtain the resistance the fan has to overcome
- Obviously the operating pressure of the system should be added to the fan duty.

- Most difficulties are caused by building structure being leakier than allowed for

- Good liaison is needed with architect, builder and services contractor to get well sealed construction

Design process requires:

- an assessment of the build quality and an allowance for additional unidentified leakage – this is in effect a ‘guess’
- Loose, average or tight construction will affect the leakage rates used in calculation
- add 50% safety margin + 15% margin for duct leakage + 20% duct pressure loss margin

There is often a temptation to reduce the allowances at design stage – this can lead to problems at completion of the project when pressures/velocities cannot be achieved.

- Check equipment is installed as per design
- Carry out normal mechanical and electrical checks
- Set all dampers to fully open
- Check operation and direction of running of fans
- Before doing any performance tests - check the state of completion of the protected core

- Main power supply and standby supply
- Duty and standby fan
- Automatic change over
- Fan located in protected area
- Fan Inlet protected from effects of smoke
- Smoke detection provided adjacent to lobby/accommodation door
- Manual override provided
- Supply point located at every 3 floor levels
- Pressure relief damper provided in stair
- Venting provided from accommodation
- No smoke seals provided on doors

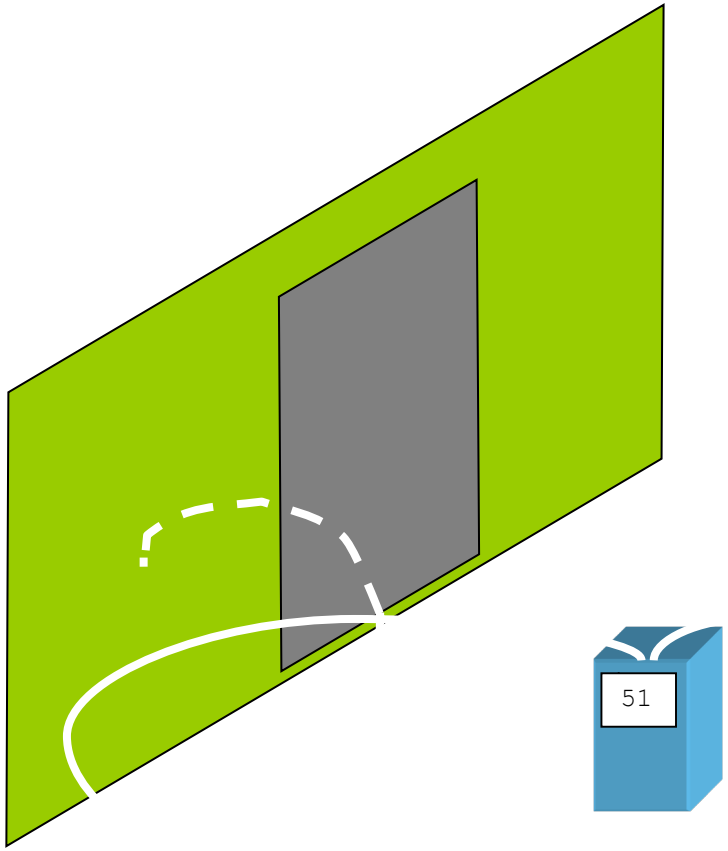
- All doors must be fitted and close properly
- All finishes must be complete - carpets laid etc
- All false ceilings must be in place
- There must be no temporary openings or unsealed service penetrations

- While the test method aims to neutralise the effects of wind, testing on windy (and especially blustery) days should be avoided if possible

- Be prepared and organised before starting testing since there is a maximum time limit between test stages of 15 minutes

- Ensure all other H&V systems are shut down

- Pressure differential



- Requires a manometer and 2 long flexible tubes
- Locate end of one tube in the accommodation and the other in the pressurised space, both away from draughts and at least 50mm above floor
- Manometer then reads pressure differential directly

- Requires a rotating vane anemometer
- Standing to one side (out of air stream) place anemometer in the plane of the door
- Measure flow rate at 8 locations spread evenly
- Do not move the anemometer during readings
- Take arithmetic average of readings

Pressures

- On each floor in turn open all doors, allow them to close and then measure the pressure differential across each relevant door

- Measure the opening force required on each relevant door at the door handle

Velocities

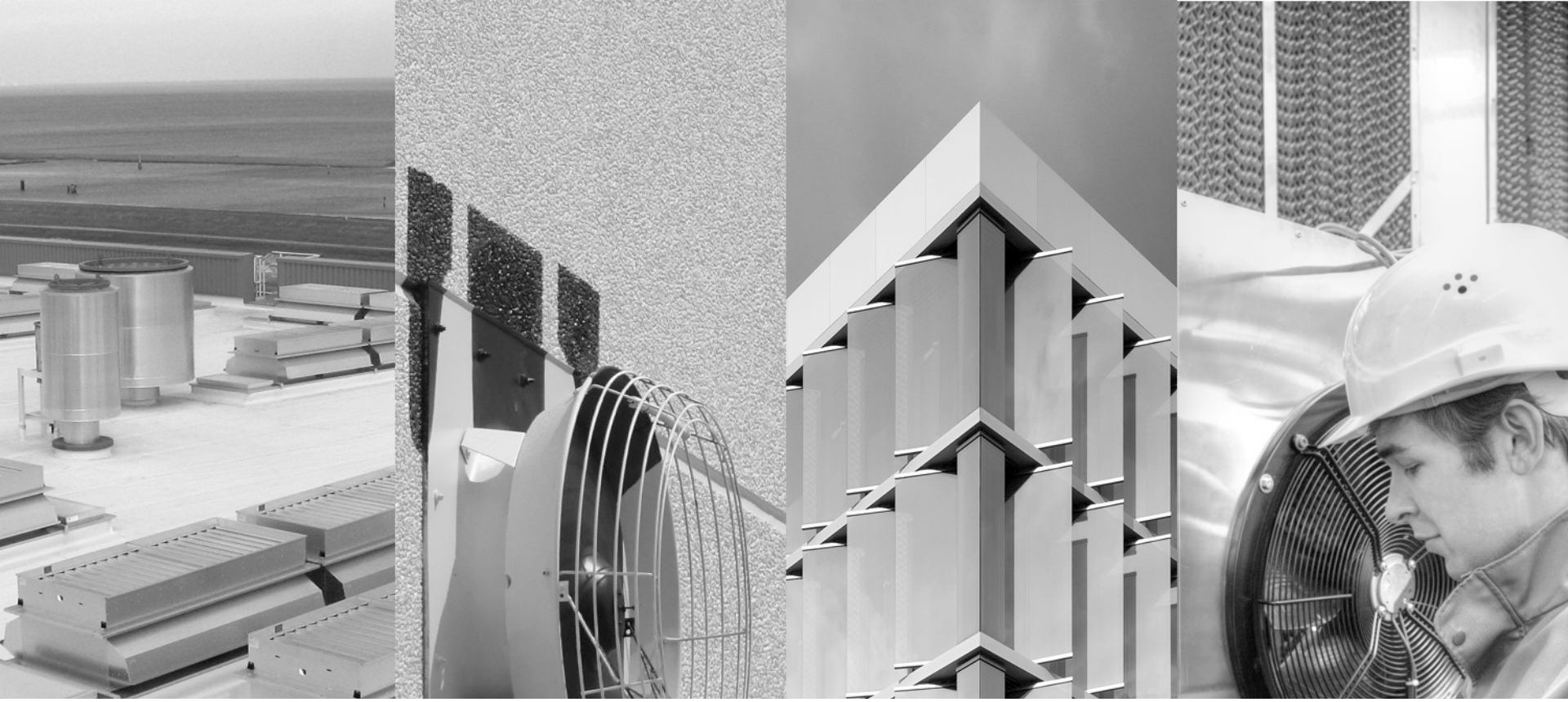
- On each floor in turn open doors as specified in EN 12101-6 and measure average air velocity
- For classes C, D, E on each floor in turn open doors as specified in EN 12101-6 and measure pressure differential between stair and accommodation
- Adjust system as necessary and retest until all pressures and velocities are correct

- The procedure is simple, but in practice:

  - Excessive leakage is often a problem and can lead to a need for multiple commissioning visits and arguments with the builder

  - Testing and balancing large systems can be very time consuming, especially with pressurised lobbies

- Do you need pressurisation?
- Select system Class
- Decide on areas to be pressurised
- Select AAR method
- Calculate flows
- Select equipment
- Install and commission



Q&A Session…