

Colt smoke control and ventilation systems for multi-storey buildings

COLT SMOKE CONTROL

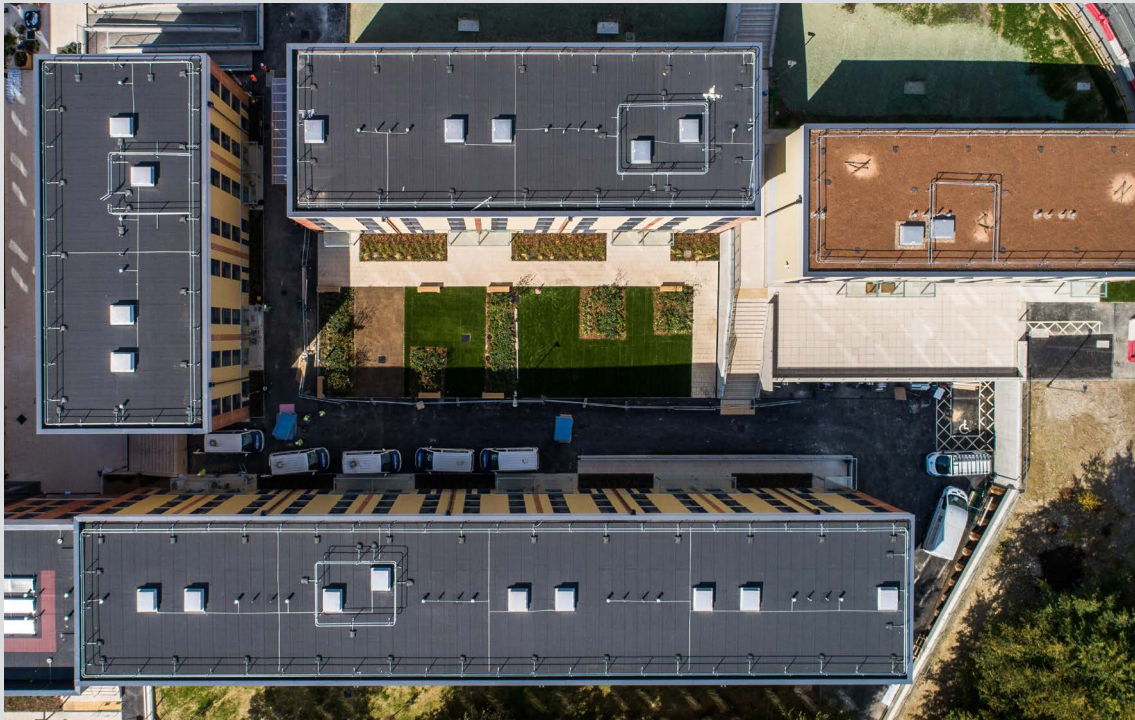


COLT CLIMATE CONTROL



COLT

Ventilation systems that help meet legislative requirements and achieve design objectives



University of Sussex, Student Accommodation

Front cover: 22 Bishopsgate, London

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- The commercial team and the construction triangle
- Design support from the experts
- Fully controlled manufacturing for reliable quality assurance
- Expert project management for stress-free installation
- Colt service and maintenance. The UK's best
- Colt commissioning. Because anything less is risky
- The Draft Building Safety Bill is all about competency. So is Colt
- Colt Service and Maintenance engineers. The best in UK smoke control
- A tall story. All true, by Colt
- Size is not important to us

WHY PROVIDE SMOKE CONTROL FOR MULTI-STOREY BUILDINGS?

- In multi-storey buildings, the main escape route is typically via common corridors and/or lobbies to protected stairs.
- Smoke can easily spread from the accommodation and, if a door is left open even for a short period of time, it can quickly fill a corridor or lobby, making escape difficult for occupants.
- Smoke entering the stairs can make escape difficult for occupants of higher storeys and slow down fire-fighters on their way in.
- In taller buildings the fire and rescue services need clear access to stairs and lobbies to form a bridgehead for operations, using a fire fighting shaft which is protected from smoke.

In this leaflet we:

- Provide an understanding of the legislative framework within the UK
- Explain how ventilation systems can both help meet legislative requirements and achieve design objectives
- Look at the equipment options. In addition, we look at opportunities for a smoke control system to provide both smoke control and day to day ventilation.

THE LEGISLATIVE FRAMEWORK AND STANDARDS WITHIN THE UK

The legislative requirements for the design and construction of new buildings in England derive from the Building Regulations (2010). Detailed recommendations to meet these requirements are provided by the Ministry of Housing, Communities and Local Government (MHCLG) in the form of the Approved Documents – Part B refers to Fire Safety and was last updated in 2020. Please note that the Building Regulations and associated guidance for Scotland, Wales and Northern Ireland follow other documents, however there are several similar approaches for smoke control in multi-storey developments.

- The requirements vary slightly from country to country and are detailed in the documents mentioned below:
 - England: Approved Document B to the Building Regulations
 - Scotland: Scottish Buildings Standards Technical Handbooks
 - Northern Ireland: Technical Booklet E
 - Wales: Approved Document B to the Building Regulations (for use in Wales).

Furthermore, within these guidance documents there is a requirement for buildings with a floor more than 18m above fire service access level, or with a basement more than 10m below it, to have a protected fire-fighting core with a fire fighting lift, whether these be residential buildings or not. Certain other buildings just require a fire-fighting core.

See our Page 7 for further information on those buildings which fit within this category. However in residential buildings ADB permits the common corridors to be used as the firefighting lobby.



THE VENTILATION SYSTEM OPTIONS

The ventilation system options depend largely upon the building layout. A choice has to be made between:

1. Natural ventilation using AOVs. Openable ventilators or windows (OVs) or automatically opening ventilators (AOVs) may be used to evacuate smoke where common stairs, corridors or lobbies extend to external walls. For product options, go to pages 14-15. If BS 9991 is being followed, there is a recommendation that natural AOVs are not used in residential buildings where there is a storey above 30m.

2. Pressure differential systems are an alternative method of protecting escape routes and firefighting cores against the ingress of smoke by maintaining the pressure within the protected escape route at a higher pressure than that in the adjacent spaces, or alternatively, the adjacent spaces at a lower pressure than the protected escape route.

HELP RESOURCES

For further help resources on deciding whether a natural or a mechanical shaft is right, please visit our blog: <http://blog.coltinfo.co.uk/topic/smoke-shaft-series> or talk to a Colt expert.

Benefits of natural shafts

- **No fans.** The primary benefit is that no fans are needed, together with their cabling and controls and, of course, their standby power requirements.
- **Low noise.** The systems are virtually silent, although they can still be a source of noise transmission in noisy areas, such as under flight paths.
- **Low costs.** Purchasing and operating costs are low, with a very small power requirement and limited equipment to be tested and maintained.
- **No roof top plant.** Little roof space is required, simply room for the termination at the top of the shaft.

Benefits of mechanical shafts

- **Size.** They can be designed to occupy a smaller amount of floor space than a natural shaft system.
- **Flexibility.** They can be more flexible in layout, with bends and horizontal sections, without a reduction in performance.
- **More ventilation.** They can provide improved ventilation in lower heat conditions – natural shafts rely on buoyancy to be the driving force of the system. With cooler smoke, mechanical systems can be more effective. Mechanical systems are less adversely affected by climatic effects such as internal temperature conditions and wind pressures.



SMOKE CONTROL FOR MEANS OF ESCAPE (MOE) IN RESIDENTIAL BUILDINGS

Approved Document B (ADB) notes that, in the event of a fire in an apartment, some smoke may spread from the apartment into the corridor as the occupants make their escape.

Consequently, it is a requirement that any corridor or lobby that opens into a staircase has ventilation to allow smoke to be removed and, most importantly, to prevent that smoke from getting into the staircase.

For small single stair buildings: If the building is under 11m high, has no more than 3 storeys and the staircase does not connect to a covered car park, then only a stairwell ventilator is required, provided that the escape

distances are limited to 4.5m in the corridor. If the corridor is also ventilated, then escape distances can be extended up to 7.5m. See below and pages 8-9 for the ColtShaft System.

For all other kinds of residential buildings:

In all other apartment buildings, the travel distances are limited to 7.5m in one direction and 30m if escape is in two directions, and any corridor or lobby that opens onto a staircase should be ventilated. If BS 9991 is being followed, a dead end travel distance of up to 15m is permitted in buildings with sprinkler protection to all apartments, with 60m in more than one direction.

If the corridor has outside walls, as in figure A, then an AOV is a suitable means of ventilation, with a minimum free area of 1.5m².

If the corridor is landlocked, as shown in figures B or C, then a shaft system will be required. This can be either natural or mechanical.

If a natural shaft is used, ADB recommends that the shaft:

- is closed at the base
- has a minimum cross-sectional area of 1.5m² with a minimum dimension of 0.85m in either direction
- extends at least 0.5m above the highest structure within 2m
- extends 2.5m above the ceiling of the highest level served by the shaft
- is constructed from non-combustible material (Class A1) and the vent should either be a fire doorset (minimum E60) or a smoke control damper. Further guidance from the Smoke Control Association recommends a smoke control damper only should be used
- is vertical with no more than 4m at an inclined angle (max 30°).

The vent into the shaft, the vent at the top of the shaft and any safety grilles in the shaft should all have a minimum free area of 1.0m².

Alternatively, mechanical ventilation or a pressure differential system may be used.

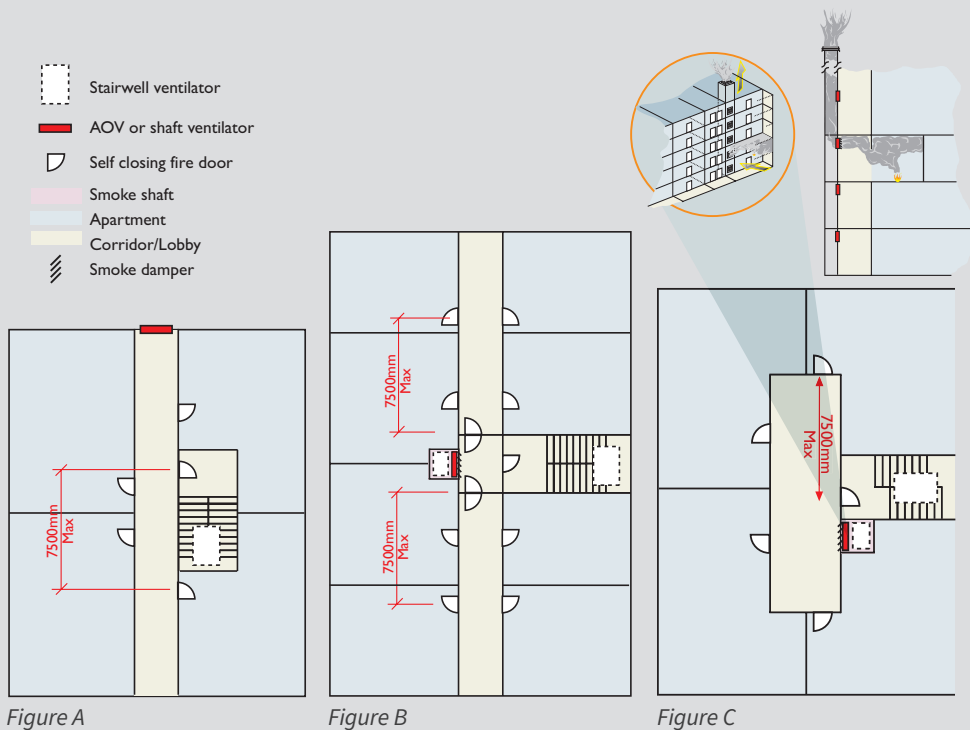


Figure A

Figure B

Figure C

SMOKE CONTROL FOR FIRE FIGHTING SHAFTS IN COMMERCIAL BUILDINGS

The requirement for buildings other than residential is slightly different – Smoke shafts are only required where there is a firefighting shaft. These shafts are a combination of firefighting lifts, firefighting stairs and firefighting lobbies designed to provide firefighters with the facilities to safely tackle a fire on any level.

Firefighting shafts generally become a requirement in both ADB and BS 9999 for buildings that have a floor more than 18m above or more than 10m below fire service vehicle access level, but there are additional requirements for some building types, and basements, that are over 900m² in area.

One of the many requirements for firefighting shafts is that they are provided with smoke control to keep the stairs clear of smoke. The strategy for smoke ventilation of firefighting shafts is described in BS 9999 Section 27 – the requirement is similar to residential, except that the sizes differ slightly.

- Pressure differential systems or mechanical shafts system may be used in any firefighting shaft.
- Natural AOVs can be used in any firefighting shaft providing it is less than 30m above ground or less than 10m below ground.
- Natural Shafts can be used in any firefighting shaft providing it is less than 10m below ground.

Pressure differential systems should meet the requirements of a Class B system (for fighting) to EN 12101-6.

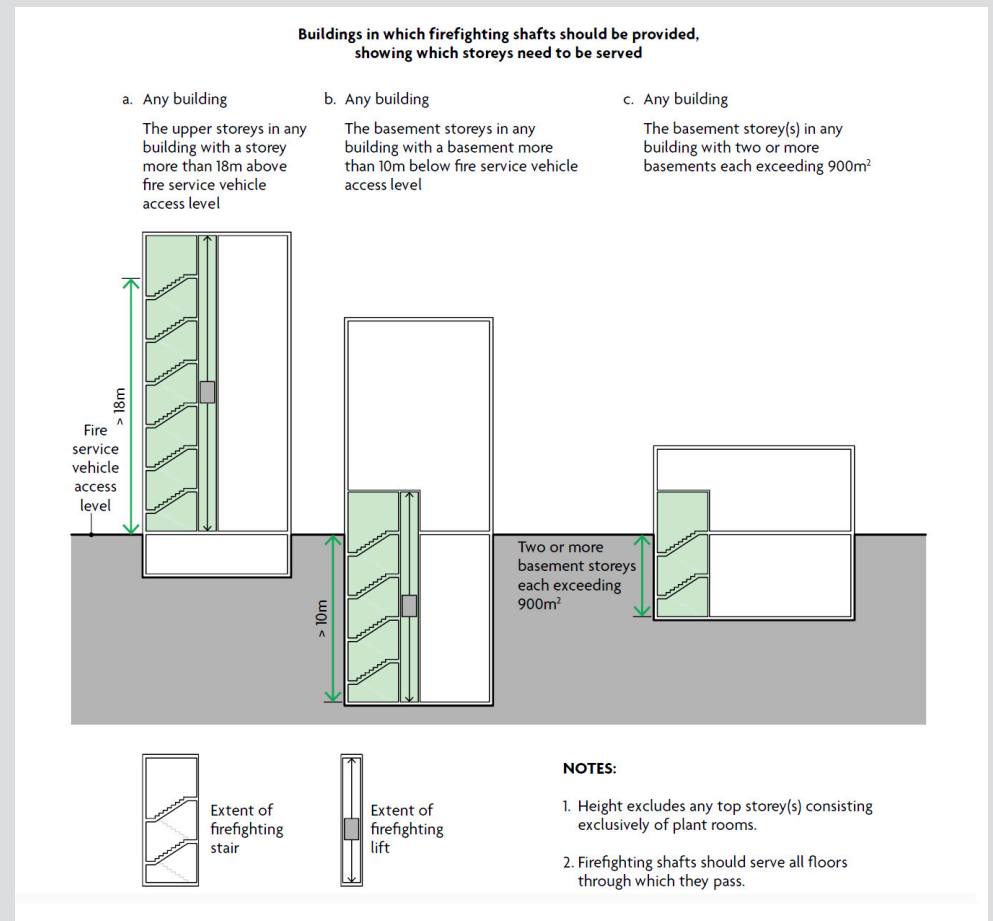


Figure D: Provision of firefighting shafts

Source: MHCLG



SYSTEM OPTIONS FOR SMOKE CONTROL AND VENTILATION

THE ADB SHAFT

In 2006 the ADB smoke shaft for residential buildings was introduced. The requirement is for a 1.5m² cross section shaft with a ventilator at the top and 1m² dampers to each lobby; there is no requirement for inlet air at ground level. Automatic ventilation is required to the stairs, comprising a 1m² AOV at the head of the stairs. BS 9991 now mentions the ADB smoke shaft as an alternative form of ventilation to an AOV scheme or pressurization.

THE COLT MECHANICAL SHAFT

Colt recognised that the performance of natural systems can sometimes be unreliable due to a lack of heat in the early stages of a fire or unpredictable due to adverse climatic conditions. They can also be inflexible with regards size and routing, Colt therefore developed the Colt Mechanical Shaft, with the added benefit of reducing the size of shafts when space for smoke shafts can be difficult or expensive to find.

The Colt Mechanical Shaft has been extensively modelled using computational fluid dynamics (CFD) for a variety of geometries and timelines and has been demonstrated to provide equivalent performance in most instances to an ADB shaft for the ventilation of residential lobbies and corridors and for fire-fighting lobbies. It can therefore be considered an equivalent to the recommendations of Approved Document B and BS 9991.

This shaft performs as well as or better than the ADB shaft and requires only 40% of the shaft area.

More effective ventilation combined with space-saving

The Colt Mechanical Shaft, which is suitable for use in any stair core (escape or fire-fighting), requires a shaft which can be as small as only 0.6m² (this may increase for taller buildings). It opens up the space on each floor, which allows architects to be more creative in their designs and makes the smoke control system easier to accommodate into the building layout.

However, the main benefit of the Colt Mechanical Shaft is that it can perform better than a natural shaft in many situations since it extracts at a defined rate – this means that it is also less affected by low smoke temperatures or adverse climatic conditions. It is also less susceptible to obstructions to the airflow within the duct.

Automatic ventilation is required to the stairs, comprising a 1m² AOV at the head of the stairs.

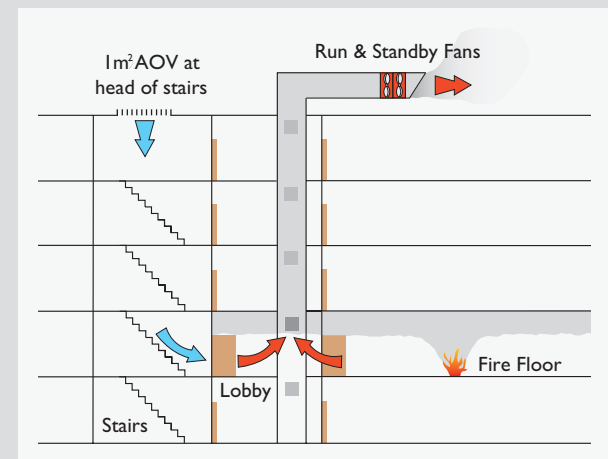


Figure E

Wandsworth Riverside, London



The Colt Mechanical Shaft in detail

The Colt Mechanical Shaft solves a common problem associated with mechanical extraction. Since the lobby is fire rated, it is usually well sealed, so even a small amount of extract will cause a high negative pressure in the lobby, which could make doors difficult to open, making evacuation difficult.

Two versions are available, the ColtShaft Variable and the ColtShaft Constant.

THE COLTSHAFT VARIABLE

The ColtShaft Variable incorporates duty and standby variable speed extract fans linked to a pressure sensor via the control panel.

The ColtShaft Variable avoids excessive negative pressures without compromising the integrity of the stairs by automatically reducing the ventilation rate when the stair doors are closed. It does this via a pressure sensor linked into the control system that varies the fan speed.

With all doors open, the fan runs at full speed to extract smoke discharging from the accommodation. With all doors closed, the fan runs at low speed to help mop up any smoke leaking past the closed door. In intermediate conditions, the fan speed modulates to ensure adequate ventilation without excessive depressurization.

THE COLTSHAFT CONSTANT

The ColtShaft Constant is a simpler and lower cost variation which can be used in situations where there is a source of inlet air open to the extract system, or the stair door can be mounted so that it swings into the space containing the extract system.

The fans run at full speed and excessive negative pressure is avoided by either the inlet air source, or allowing the suction to pull open the (reverse hung) stair door slightly against a carefully adjusted door closer. The latter is only suitable when:

- no more than 60 people are expected to escape via the stair door
- a reverse hung stair door will not cause difficulties such as blocking corridor access.



Testing of the ColtShaft

We have conducted a series of computer modelling simulations and smoke tests which demonstrate that the ColtShaft can perform as well as a standard 1.5m² ADB Shaft when this is fitted in the same situation. The tests also showed that the system reacts quickly to pressure changes, smoke clears quickly from the lobby when the accommodation or stair doors are opened, and the lobby is kept clear of smoke once the accommodation door is closed.





THE COLTSHAFT EXTENDED CORRIDOR SYSTEM

A further development of the Colt Mechanical Shaft is the ColtShaft Extended Corridor system, which can be used to compensate for extended travel distances in means of escape corridors. Such systems offer developers substantial space and cost saving benefits, while providing a safe evacuation route, aiding firefighters by allowing the corridor to be cleared of smoke rapidly, even during the later stages of a fire, when a conventional natural system might well be overwhelmed.

Rapid response and enhanced performance

The ColtShaft Extended Corridor system may be shown to allow safe escape conditions to be maintained in the corridor, even when the travel distance is extended by a factor of 2 or 3 in one direction. This can remove the need for an additional staircase in conjunction with an established fire engineering strategy.

The Extended Corridor system out-performs the conventional solution for both evacuation and fire-fighting but does need a dedicated source of inlet air to allow the corridor to be continually flushed with clear air, preferably from one end to the other.

There are four types of Extended Corridor system:

- (a) pull system – mechanical extract / natural inlet
- (b) push system – mechanical inlet / natural exhaust
- (c) push-pull – balanced system.
- (d) push-pull reversible – balanced system but with added flexibility

Justification and approval for extended travel distances

Since extended travel distances are a performance based solution forming part of an overarching fire engineering strategy, they are an area of design risk. We would always recommend that the application of such a

system is agreed with the appointed Fire Engineer and discussed with Building Control early to obtain agreement in principle.

At the detail design stage, CFD analysis is inevitably required to satisfy the authorities that the proposed system provides adequate performance. Originally CFD was simply used to show that conditions were demonstrably better than for a compliant solution, but nowadays it is more common to show compliance with set performance objectives. The SCA publication, “Guidance on smoke control to common escape routes in apartment blocks” provides guidance on what these objectives might be. It is available as a free download from www.smokecontrol.org

Building Control may also request physical smoke tests to be carried out upon completion to confirm compliance.

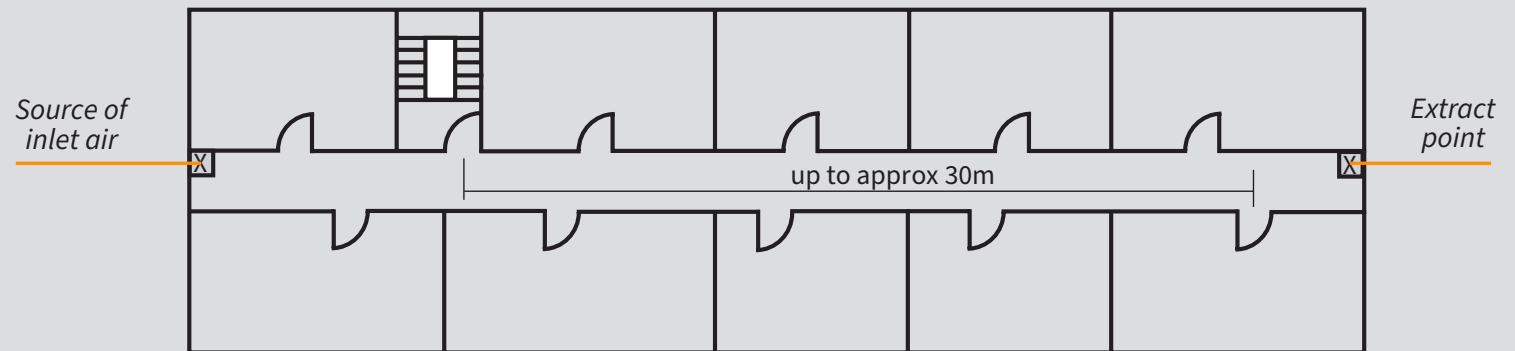


Figure F

Extract should always be away from stairs →

With extended travel distance systems, location is critical

In a compliant building the location of the smoke outlet from the lobby or corridor is not legislated for. As long as the system is compliant it can be located anywhere. For an extended travel distance system it is very different. Location is critical.

On these systems:

- the inlet and extract should be as close to the opposite ends of the corridor as possible
- the direction of airflow should draw smoke away from the stairs whenever practicable
- mechanical extract is almost certainly a requirement
- remember that if natural inlet is used, it needs to be generously sized to avoid excessive depressurization of the corridor.

The aim is to continuously flush through the corridor to ensure that any smoke entering from the fire room is quickly extracted, keeping the corridor fully tenable for as long as possible.

LABC Certification

The ColtShaft Variable and ColtShaft Extended Corridor systems are LABC Registered Systems.

Improved effectiveness

Colt has carried out extensive CFD modelling in both escape and fire-fighting modes, and compared its Extended Corridor Solutions with a compliant corridor that has a natural AOV system. In the model zero wind conditions have been assumed in assessing the relative performance of the AOV. A typical example is shown here.

Extended Corridor System

This modelling compares the relative performance of a natural shaft system against a mechanical system. The natural shaft system is protecting a stair with a corridor with standard escapes distances. The mechanical system provides extract and inlet and is designed to not only keep the stair clear but also significantly improve the conditions in the corridor, potentially justifying an extension of travel distances.

This is just an example – project specific modelling is recommended for all non-standard applications.

This modelling shows that in the early stages of the fire, the two systems perform satisfactorily. The fire starts in an apartment, the occupants evacuate and smoke spills into the corridor. Both the natural shaft and the mechanical system keep the stair clear of smoke, although smoke in the mechanical corridor is more quickly cleared. At this stage, the fire is relatively small.

Later, when the fire brigade arrive, the fire is much more severe. Large volumes of smoke spill out, completely filling the corridor, and the system is overwhelmed. However, once the apartment door is closed, the mechanical system can clear the corridor within 60 seconds.

After the same amount of time in the corridor equipped with a conventional AOV, the visibility is almost zero – the corridor is still completely smoke logged.

A video of a similar illustration is available at:
<http://www.coltinfo.co.uk/extended-corridor.html>.

Natural Shaft: Compliant Travel

Mechanical Shaft: Extended Travel

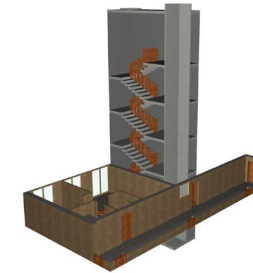


Figure G

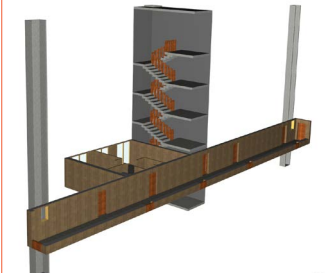


Figure H

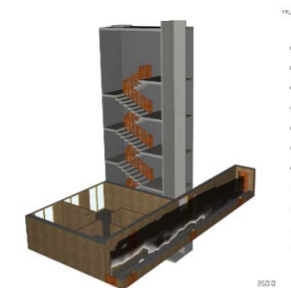


Figure I

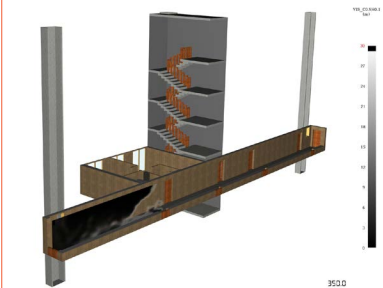


Figure J



Figure K

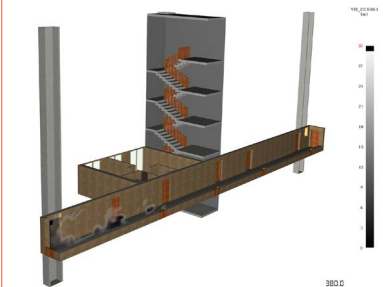


Figure L

HELP RESOURCES

For further help resources on designing smoke shaft systems, please visit our blog: <http://blog.coltinfo.co.uk/topic/smoke-shaft-series>

This series covers a variety of topics including builder's work shafts, noise, power, extended travel distances, natural vs mechanical shafts, smoke ventilation only and dual purpose systems.

Pressurization systems protect escape routes against the ingress of smoke by maintaining the pressure higher than that in the adjacent spaces.

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PRESSURE DIFFERENTIAL SYSTEMS (OR STAIRWELL PRESSURIZATION SYSTEMS)

Pressurization is one of the possible solutions to provide smoke control in escape stairs, common lobbies and corridors in residential buildings.

Guidance on design of pressure differential (pds) systems is provided in BS EN 12101-6:2005.

PDS offer these benefits:

- protection of escape routes
- compliance with Approved Document B and BS EN 12101-6

However pressurization systems are often more complex and considered relatively expensive, so they are normally used only where demanded by regulations or standards or by Building Control, usually as a trade-off for another exception from a standard solution, for example, where there is a reduction in the number of staircases from the prescribed guidance due to space constraints.

PROTECTING ESCAPE ROUTES: SMOKE SHAFTS VERSUS PRESSURIZATION

How do you decide which to use? The decision is influenced by legislation and standards, building configuration, budget and space requirements. There is no universal "right" choice, but there's certainly a best choice for each individual building. We can advise on this.

For example, shaft systems are usually designed to protect only one level, the first level to be activated (usually by the fire alarm system). Pressurization systems maintain a positive pressure in the staircase over its full height, so if the wrong floor is activated first, there is at least some positive protection afforded to the stair.

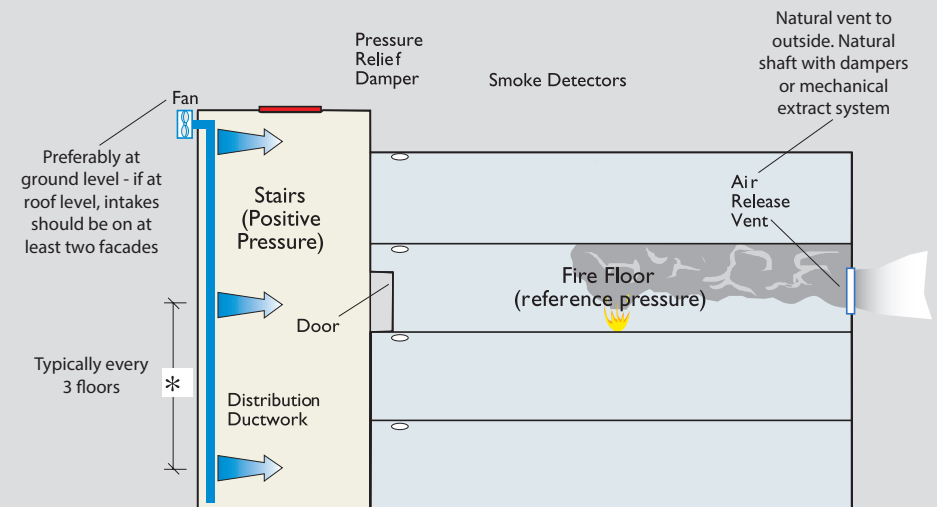


Figure M: Arrangement suitable for means of escape applications

HOW A PRESSURIZATION SYSTEM WORKS

A pressurization system provides supply air (where air is injected into the area that is to be protected), pressure relief (to avoid overpressure when doors are closed) and air release (air and smoke is released from the adjoining fire area). Combining these elements creates a positive pressure difference which prevents lobbies and staircases from filling up with smoke.

In residential buildings it is usually impractical to carry pressurization up to each apartment door due to the difficulty of providing air release from each apartment. Therefore stairs and lobbies are usually pressurized with air release from the corridor.

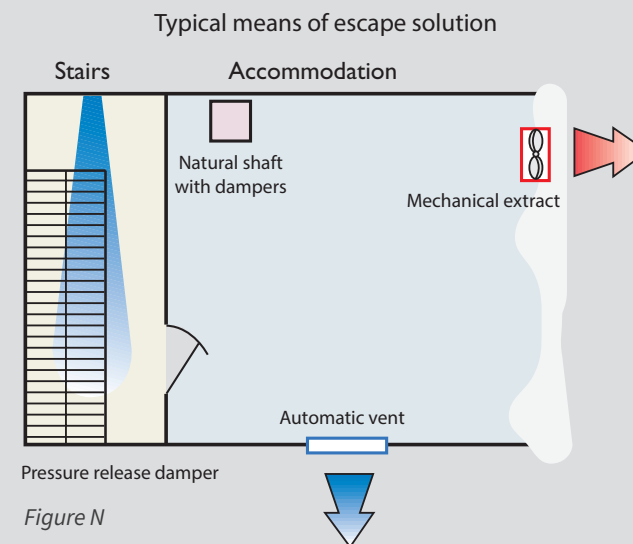
Pressurization systems need to meet the recommendations of Approved Document B and in particular BS EN 12101-6 “Specification for Pressure Differential Systems”.

SYSTEM COMPONENTS

A pressurization system comprises:

- inlet fans for introducing air into the designated area. The run and standby fans and control equipment should be housed in a separate plant room or outdoors and the inlet should be protected from smoke. Dual inlets with automatic smoke dampers are required for roof level inlet
- ductwork and outlet grilles, to provide distribution of air exactly where it is needed
- pressure relief dampers, to release excess air in the closed door condition from the stair area. This should be ducted to discharge directly to atmosphere independent of the wind direction. Damper blades are set to start opening at 50 Pa pressure differential
- automatic air release to prevent unwanted pressure build up in the adjacent spaces. This may be automatic vents, natural shafts with dampers or mechanical extract systems.

The control system should operate automatically from the smoke detection system with a manual on/off switch also provided within either the pressurization plant room, near the building entrance (to suit the fire service), or within the central building services control room.



SYSTEM REQUIREMENTS

Two performance objectives are needed to be achieved by a pressurization system.

- 1 Maintain a pressure difference when the doors are closed. Here the pressure difference is required to overcome buoyancy pressure generated by the hot smoke layer, expansion of the gases in the compartment due to heating, stack pressure and wind pressure.
- 2 Maintain an air velocity for an open door condition to hold back the smoke on the fire floor.

Getting the right balance for a pressurization system needs careful design in order for the system to work effectively. Insufficient pressure difference across a closed door will allow the passage of smoke into the protected space. Excess pressure will impede door opening and hence escape.

It is critical that the walls to pressurized areas should be carefully constructed to minimise air leakage and that all services penetrations should be properly fire stopped.

PRODUCT OPTIONS: ROOF / FAÇADE VENTILATORS

These natural ventilators can be used at the head of a shaft, in the stairwell or as AOVs.

CASEMENT VERSUS LOUVRED AOVs

Instead of shaft systems or pressurization, Approved Document B permits that lobbies / corridors should be ventilated by an AOV with a free area of at least 1.5m² where there is an external wall available and the building is less than 30m tall. This does not sound like very much, but the definition of 'minimum free area' for an AOV makes this difficult to achieve simply with opening windows.

If using a casement ventilator, the side opening sections are not taken into account and the top section is measured at 90° to the casement. As a result, a 1.5m wide (throat) ventilator opening to an angle of 30° needs to have a throat height of 2.0m and the stroke of the motor will need to be around 1.2m in order to achieve the required area. Clearly this results in a large ventilator size and in a lot of instances this may prove impractical.

As a result it has become more common to use natural louvred ventilators to provide the necessary area of AOV. As this requirement is for smoke exhaust, ventilators certified to EN12101-2 should be used.

Lobbies/corridors should be ventilated by an AOV with a free area of at least 1.5m².

As per current version of ADB:

1.5m² can only be achieved via open area at 90° to direction of airflow, i.e. area ①.

Total area = ① only = 1.5m². Refer to figure O.

To achieve 1.5m², a 1.5m wide vent opening to 30° needs to be at least 2.0m high and the stroke of the motor will need to be around 1.2m.

An alternative method of measurement is to use the aerodynamic free area of the ventilator – this is preferable as it is a quantifiable measurement determined during the EN12101-2 certification process BS 9999 and the Smoke Control Association Guide to Apartment Buildings give alternative requirements for the Aerodynamic free area for AOVs.

KAMELEON CASEMENT VENTILATOR

Kameleon 5 is a glazed natural casement ventilator, suitable both for day to day and smoke ventilation. Kameleon conforms to EN 12101-2 and EN 14351-1. It is suited for installation into the façade.



[DOWNLOAD PRODUCT DATA SHEET](#)

COLTLITE LOUVRED VENTILATOR

Coltlite is a natural louvred ventilator suitable for natural day to day and smoke control ventilation. Coltlite is CE marked to both EN 12101-2 and EN 14351-1. It is suited for installation into the façade.



[DOWNLOAD PRODUCT DATA SHEET](#)

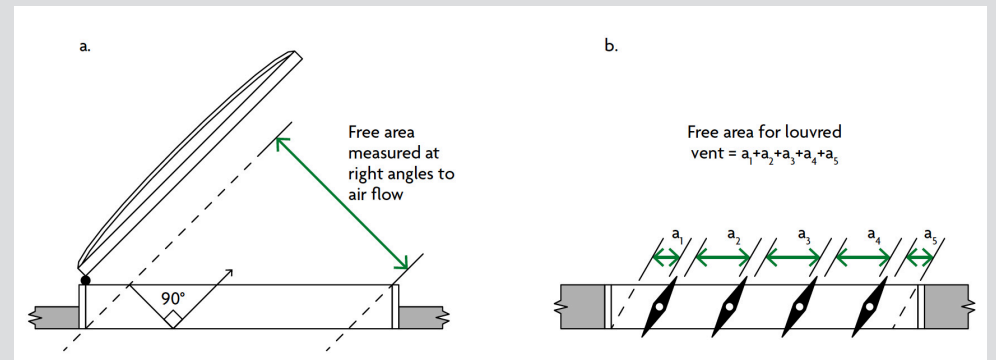


Figure O: How to size a louvred vent
Source: MHCLG



AXS 140 VENTILATOR / ROOF ACCESS HATCH

AXS 140 is a combined AOV smoke ventilator and roof access hatch designed to provide either 1.0m² or 1.5m² measured free area in accordance with Approved Document B, Appendix C. It is suitable for use as a staircase ventilator or roof mounted lobby/corridor ventilator and to provide external roof access. It has been tested to and is in compliance with BS EN 12101-2 and is CE marked.

[DOWNLOAD PRODUCT DATA SHEET](#)



AIRLITE LOUVRED VENTILATOR

Airlite is a natural louvred ventilator suitable for natural day to day and smoke control ventilation. It conforms to EN 12101-2 and is CE marked. It is suited for either façade or roof applications.

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SEEFIRE LOUVRED VENTILATOR

Seefire is a natural louvred ventilator suitable for natural day to day and smoke control ventilation. It conforms to EN 12101-2 and is CE marked. It has a lower thermal performance than Airlite, so is generally suited to unheated areas and as shaft terminations.

[DOWNLOAD PRODUCT DATA SHEET](#)

London City Island





10 George Street, Edinburgh

ENABLING A SMOKE CONTROL SYSTEM TO PROVIDE BOTH SMOKE CONTROL AND DAY TO DAY VENTILATION

The quest for energy efficiency 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.

One solution is to make dual use of the equipment specified to provide smoke control of the common areas. In this way it is possible to provide a simple and effective cross flow ventilation system to extract warm, stale air from these spaces and their ceiling voids.

Please go to the Colt blog to access the “Ventilation solutions for overheated corridors in residential buildings” whitepaper, which describes the options and pros and cons of each of the following approaches in detail.

- Natural ventilation using AOVs. See pages 14-16 for the product options
- Natural ventilation or mechanical ventilation using shafts. We have described the various options for shafts in detail above, see pages 8-9 and 17. This can involve either smoke fans with separate day to day fans, or inverter-controlled dual purpose main fans, possibly with attenuators
- Another solution may be to provide active cooling in the corridors using a mechanical shaft ventilation system with cooling.

COLT COOLSHAFT: PROVIDING SMOKE VENTILATION AND COMBATING OVERHEATING IN COMMON AREAS OF BUILDINGS

CoolShaft is a combined smoke and day-to-day shaft system which uses evaporative cooling technology to provide active precooling of the incoming air, without compromising the ability of the shaft system to ventilate the common area in a fire – and this with exceptionally low energy consumption.

While a ventilation system supplying untreated outside air is able to achieve temperatures in the corridor at typically 3-5°C above the outside ambient, a CoolShaft system is able to reduce temperatures to below the outside ambient by providing active cooling in the corridors.

Since CoolShaft is a combined smoke and day-to-day shaft system, our design ensures that if there is a fire there is no compromise in its ability to ventilate the common area and allow smoke to escape.

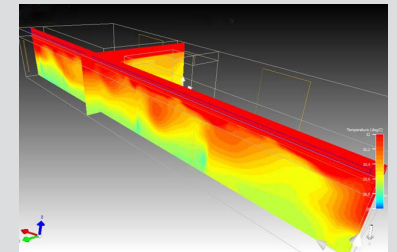


Figure P: No ventilation

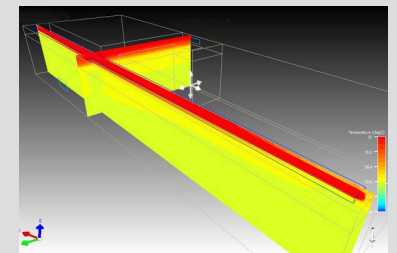


Figure Q: Ventilation without cooling

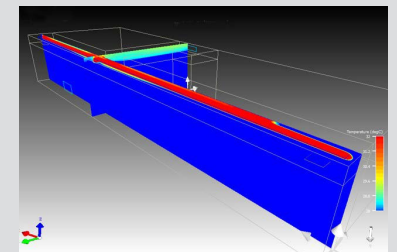


Figure R: Coolshaft

The many benefits of CoolShaft begin with low energy cooling

It doesn't need to cost the earth to cool a building: using the cooling power of water, it's possible to achieve low energy cooling.

Key features and benefits

- **Cooling of corridors.** Whereas basic day-to-day ventilation systems for common corridors and lobbies use outside air to ventilate the space, CoolShaft provides active cooling with incoming air up to 10°C below ambient temperatures, providing highly desirable conditions for residents
- **Economical.** CoolShaft systems offer cooling that is 4 - 7 times more economical than conventional air conditioning systems, with lower initial costs. CoolShaft runs much of the year in free cooling mode, with evaporative cooling brought on-line when temperatures rise.
- **Low energy use.** Evaporative cooling is up to 90% more efficient. CoolShaft needs only a small quantity of electricity for the fan that circulates the air and for the water pump.
- **High cooling capacity.** One CoolShaft unit can cool multiple floors, and often the complete building, owing to its inherent high cooling capacity.
- **No refrigerants.** CoolShaft is free from refrigerants, thus there are no F gas compliance issues, and there is no need for refrigerant pipework in the building.

- **Hygiene certificate.** CoolShaft has an integrated water quality system using simple and robust technology. It provides safe circulation with temperature control and regular renewal of water to avoid the growth of bacteria and scale. It has been extensively tested and certified hygienically in compliance with VDI 6022 ("Hygienic Requirements for Ventilation Systems and Units for Internal Spaces"). This is a rigorous standard for air conditioning systems and confirms the high quality of supply air.
- **A space saver.** CoolShaft has a smaller rooftop footprint and saving on rooftop ductwork compared to conventional air conditioning systems, freeing up space.
- **Lightweight.** CoolShaft is more lightweight than conventional air conditioning systems.

HELP RESOURCES

View our white paper, "Ventilation solutions for overheated corridors" for further info.

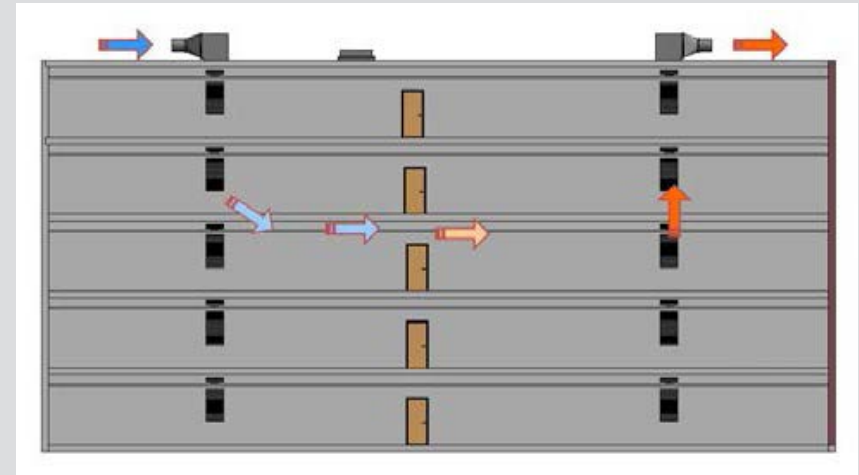
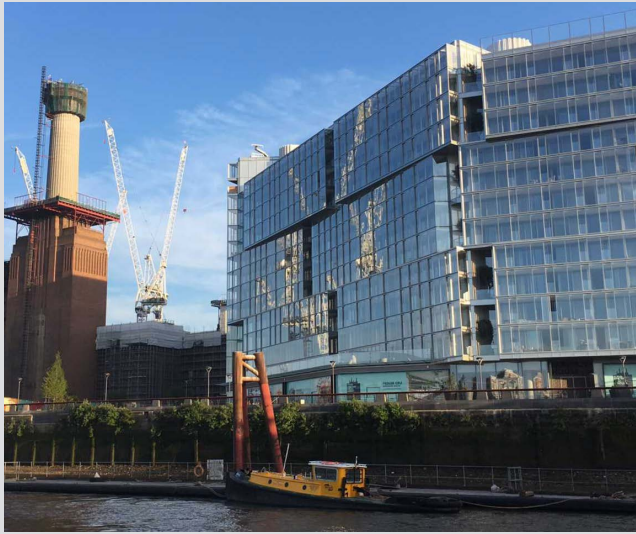


Figure S: With CoolShaft, the incoming air is pre-cooled adiabatically when temperatures reach a set point.



Figure T: A CoolShaft evaporative cooling unit is integrated into the smoke ventilation shaft plant.

SOME RECENT MULTI-STOREY PROJECTS COMPLETED BY COLT



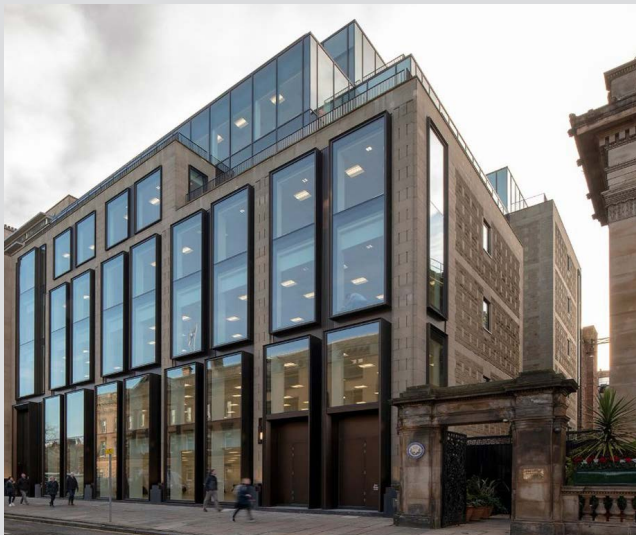
Battersea Power Station



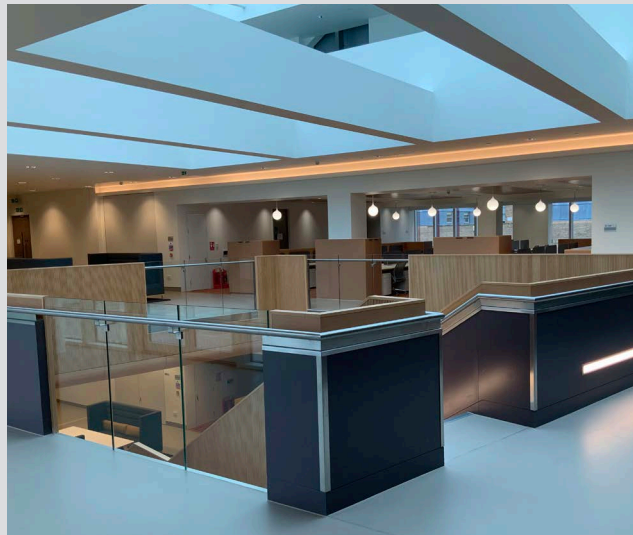
Bolands Quay



Deptford Landings



George Street, Edinburgh



University of Oxford



University of Sussex

COLT OPV: AN INTELLIGENT ELECTRONIC CONTROL SYSTEM

Colt's OPV control systems enable the integration of any smoke control components into an addressable smoke control system.

Whilst it is primarily intended for fire safety applications, it may be used to control all manner of natural ventilators, fire and smoke curtains, dampers and fans in much the same way as a BMS.

FEATURES AND BENEFITS

Proven performance – As life safety equipment, all OPV components meet the most stringent manufacturing and test procedures. Its communication network uses the proven and robust Apollo® protocols.

Conforming to the latest standards – OPV is CE marked for compliance with the Low Voltage Directive and the Electro-magnetic Compatibility Directive.

Flexible – Each OPV panel can control up to 504 addressable units per spur with a maximum of 4 spurs. There is a maximum of 10 additional remote fire-fighter's override panels (FOPs), each controlling a maximum of 12 control zones.

Addressable – Addressability provides flexible control. Each addressable unit can be controlled individually and as part of the specified automatic control system. The control software is configured to suit the automatic scheme requirements and should these change, it is a simple matter of reprogramming the software accordingly.

Complete control – Besides the ability to re-configure the system in response to alterations in the scheme, the user can operate the system manually at the display module using the navigation key pad and can amend the daily parameters such as the temperature settings and operating times.

Battery backed-up system – OPV offers two independent power sources to maintain continuous operation. During normal operation the network is powered from the mains, which also charges the integrated battery back-up module. The control system monitors the health of the communications network. The system is so designed that if there is a power failure and no fire signal, all ventilators controlled by the system maintain their current status while the battery supply is healthy. If a fire signal is received during this period, the system will respond as designed.

Monitoring and diagnostics – Software and hardware watchdogs detect faults in the system and then act upon these in a logical controlled fashion. These actions extend from merely flagging up an alarm to putting the system into failsafe mode, depending on their severity and the type of system provided. Faults are recorded and can be viewed/cleared at the display module, and they can also be outputted as a signal to a BMS, for example.



Low maintenance – OPV systems are very low in maintenance requirements.

Minimal power requirements – The OPV system only requires a 1 phase 230 V AC supply and imposes a 5A load. A 10A fuse is recommended.

We are at your service – We provide a pre-order design service. We also offer complete project management, installation, wiring and commissioning, which means that we take complete responsibility to ensure that the product is in full working order within one package of works.

WHY CHOOSE COLT

Every type of building presents different dynamics and requirements, and when you work with Colt, you can count on full peace of mind in every phase of the project and for the full life cycle of your system because our experts understand the engineering and architectural challenges of different buildings.

We are able to provide all the equipment necessary for smoke control of multi-storey buildings: OVs, AOVs, shaft systems, access hatches, smoke dampers, smoke door and window actuators, smoke detectors, break glass switches, and manual and automatic controls. Colt gives you more expertise and experience, across every aspect of your project, than anyone else in the industry. And it's all in-house.

No one else provides you with a genuine one stop shop, offering a full turnkey service from concept to completion. Where others subcontract out much of the work, Colt takes complete control of the whole process, from design, manufacture, installation, through to commissioning and ongoing maintenance.

IT STARTS WITH THE COMMERCIAL TEAM AND THE CONSTRUCTION TRIANGLE

The Colt approach combines the three key disciplines of Design and Technical, Commercial and Operations. This tripartite approach is mirrored from when we first start talking about your project, right through the whole process, all the way down to operational project level.

Our Commercial team is highly experienced: its 26 people are mainly technical consultants and surveyors, led by our Commercial Director who has 35 years with Colt. Our Regional

Managers each have over 20 years' experience; some of our Technical Consultants have longer still. And we make sure they also have the expertise: they are fully trained in processes and procedures; our Technical and Engineering Directors run regular training sessions (typically every six weeks) for all consultants to ensure that their knowledge of products, systems and the regulatory landscape is always up to date.

A regional approach. Our regional presence makes it possible for us to carry out site surveys prior to the contact period if required. More importantly, it means our technical consultants and regional managers are on hand locally to pull the entire project together. And they have the expertise and experience to know what they're doing.

DESIGN SUPPORT FROM THE EXPERTS

Our vastly experienced Design and Technical team, comprising some 25 people, enables us to provide CFD, CAD and BIM in-house. Only Colt can do this for you. Both our Technical Directors have over 30 years' experience with us; all our Technical Designers are graduates, several at M. Eng. level. Unusually, the team also includes electrical controls specialists and software programmers.

Thanks to our highly trained and experienced staff, we can develop tailor made smoke

control systems that will meet both your building's needs, as well as the legalities connected with your project.

At Colt, we scale across multiple markets, which means we have the staff and expertise to develop tailor made systems integrating climate control, natural ventilation, solar shading and smoke ventilation. Our systems

can help you unlock your building's potential for energy efficiency, ensure fire safety and create architectural impact. Our experts have an in-depth knowledge of technologies and techniques across a wide spectrum. We have the experience to advise architects and consultants on the best combination of products and systems to achieve the desired effect and performance.





To assist with designing effective building conditions, we use in-house *computational fluid dynamics* (CFD) and other design tools to simulate airflows and heat transfer within buildings. This knowledge enables us to design tailor-made concepts fully suited to every specific situation.

On solar shading projects, Colt experts can provide calculations of sun angles and heat loads to ensure the building's best performance.

FULLY CONTROLLED MANUFACTURING FOR RELIABLE QUALITY ASSURANCE

With our modern manufacturing hub in Havant, you can rest assured about the quality of Colt products. We manufacture from raw materials right through to finished goods. This means that we control the whole process from start to finish, so we can ensure the quality, performance and reliability of all the products we manufacture. All our products have the highest available level of certification.

Real-life testing to ensure you get the best solution. We combine extensive testing with our manufacturing processes to ensure that the systems we provide are the most effective solution for your building. Our R&D Centre uses the latest technologies to carry out evaluations and simulations, with comprehensive testing to verify the performance of our products and systems. We use independent accredited test houses to carry out fire testing, environmental testing (for wind, rain, snow) and safety testing (for load and impact).

EXPERT PROJECT MANAGEMENT FOR A STRESS-FREE INSTALLATION

Colt's smoke control team is one of the best in the world. All our project managers, site managers and commissioning engineers have the qualifications, technical knowledge, resources and experience to provide you with a stress-free experience, from installation through to commissioning. As a vertically integrated company involved in not only the

management and installation of projects, but also the design and production of systems and products, our lead times are more reliable, because we manage the supply chain from manufacture through to installation and service. We deliver the entire project without needing to joint venture with other companies, saving you time, money and resource. Systems and products can be tested in our own project-testing laboratory in order to identify problems before they arise.

As well as exceptional training, all the necessary qualifications and the latest management technology to deal with the installation and project management, the Colt team has something that other teams don't – the benefit of over 70 years of experience. We can predict problems before they happen and we have the skills to guide your project around obstacles before they become a problem, all the while keeping you informed at each stage of the process. This is one reason why we have the widest range of successfully completed smoke projects in our fields.

We work closely with the client's project team, using industry leading software that many of our customers use.

Our operations division has over 40 people, including 16 project managers, six site managers, eight commissioning specialists and five more in QHSE. All have the relevant H&S qualifications that identifies that they are SMSS or SMTS. Many of our staff have taken CIOB (Chartered Institute of Building) and APM (Association of Project Managers) qualifications to be able to deliver world class project management.

We have strong and long-established relationships with carefully chosen installation sub-contractors who are well versed in our values and understand the importance of the five key objectives.

Our success is based on our ability to excel in the Colt five-part plan for successful project delivery.

- 1 **Safety.** We will never compromise on safety. Read about our H&S awards and accreditations.
- 2 **Quality.** We ensure that we provide the highest possible standard of service throughout the delivery phase. Download our quality assurance certificate.
- 3 **On time.** We use the latest planning and programming tools to help us plan, agree and, through regular review and adaptation of our plans, meet all deliverables including our clients' key milestone dates.
- 4 **To the contract.** We will ensure that we fully understand the contractual requirements at the earliest possible stage. Whilst avoiding "scope creep", we will ensure that all deliverable requirements will be met.
- 5 **Within budget.** At the pre-order stage we can assist with accurate cost estimation. Having secured the above four key objectives, we will also be able to deliver the project according to the client's budget.



COLT COMMISSIONING. BECAUSE ANYTHING LESS IS RISKY

It is crucial to carry out correct commissioning with ample time allowed for it. Yet there are many companies who would have you believe that commissioning involves turning the system on and off again, then handing it over to the building managers. Typically, other companies do not employ commissioning staff directly, but sub them in only when needed. Commissioning is an absolutely critical part of the process for life safety systems; we uniquely have the resources and expertise to do this properly.

Only Colt has an in-house team of eight commissioning engineers and managers. All our commissioning engineers are SSTS accredited. Properly done, the Colt way, the commissioning process often takes over a week, just at that end stage. Our Commissioning staff also are involved earlier in the process, to ensure that all the prerequisite

stages have been properly completed. Colt complies fully with BS7346-8, the one piece of smoke control legislation that is specific to the commissioning process. The first stage, Commissioning and Verification, involves thorough Static Testing, Functionality and Cause & Effect and Performance testing. The final stage is the System Acceptance, which covers Witness Testing, Demonstration and Sign-off and Client Training. This last item provides a handover pack, testing instructions, staff occupant training and a log book.

THE DRAFT BUILDING SAFETY BILL IS ALL ABOUT COMPETENCY. SO IS COLT

Since 1931, Colt has been leading the way in smoke control technology and regulation and we're still doing it now.

With two chartered engineers on eight regulatory committees, including British Standards and European Construction Product Regulations.

We are true thought leaders and are actively involved in updating legislation. Who else would you trust to negotiate the labyrinth that is the regulations and guidance documentation?

Competency is crucial. Colt is the first UK smoke control business to be certified to both IFCC SDI 19 and SDI 05 standards, developed by the SCA. These certifications, which have been provided by IFC, have been awarded in recognition of Colt's skill as an installer and servicer of both smoke control systems and fire curtains.

SDI 19, which is mandatory for all smoke control installations, aims to ensure that installers are competent in areas such as fire strategy, scheme design and installation. SDI 05 demands the same levels of competency in regards to the installation, commissioning and servicing of active and fixed barriers for fire and smoke control. Colt accreditation and certification overleaf.

“ ”

This certification scheme will ensure quality and competency, affording the end user confidence that their safety critical system is fit for purpose. Certified contractors will have clearly demonstrated that their trained staff consistently adhere to industry best practice and fully appreciate the importance of correct installation, inspection and maintenance.

SCA Chairman

COLT SERVICE AND MAINTENANCE ENGINEERS. THE BEST IN UK SMOKE CONTROL

Colt support doesn't stop when your system is installed: we remain at your side to service a wide variety of building services equipment, whether we supplied it or not, to ensure that it continues working at its greatest efficiency throughout its life cycle.

70 years of experience in servicing smoke control systems. Colt service engineers are trained up to the highest available standards. When one visits your site, you can rest assured that your buildings' systems are in competent, professional, trustworthy hands. Each one of our 60 engineers has been expertly trained with one aim in mind – to keep your buildings safe and legal. Our team is so dedicated to delivering good quality service that our longest serving engineers have an average of 20 years each at Colt. That's truly unparalleled experience.

For Colt engineers, the training never stops. Each one of our engineers undergoes comprehensive, initial training from our technical department upon joining. This is topped up regularly with knowledge and skills in the latest technology and regulations. Our engineers also know that a simple smoke or functionality test is not a service. Many of the engineers we hire from other firms are often staggered at the sheer thoroughness of a Colt site visit.



IFC SDI 19 & SDI 05
SDI 05 "Requirements for Contractors Installing, Commissioning and Servicing Active and Fixed Barriers for Fire and Smoke Control". SDI 19 "Requirements for Contractors Installing Smoke Control Systems".



Smoke Control Association
Smoke Control Association (SCA) members lead the way in promoting and enhancing the design, manufacture, installation and maintenance of life safety smoke ventilation systems.



Association for Specialist Fire Protection
Colt is a member of the ASFP, who are dedicated to the protection of life, property and the environment, seeking continuous improvement in all aspects



Quality Management System
Colt operates a Quality Management System for the design and manufacture of its products which complies with the requirements of



Environmental Qualifications
Colt operates an Environmental Management System which manages the environmental impacts associated with its business.



Management System Certification
ISO 45001:2018 specifies requirements for an occupational health and safety (OH&S) management system.



CHAS Assessment Scheme
Colt holds accreditation which is within the Contractors Health and Safety (CHAS) Assessment Scheme.



Worksafe Contractor
Colt's health and safety documentation has been checked and approved by Safety Management Advisory



Altius Assured Vendor Award
Colt is an Altius Assured Vendor.



Constructionline
Colt is a member of Constructionline which demonstrates that its Health and Safety systems are robust.



CIBSE Patrons
Colt is a CIBSE Patron and all our CPDs seminars are fully accredited by them.



Avetta Safety Schemes in Procurement
Colt is compliant with Health & Safety and CDM regulations.



RoSPA Order of Distinction Award
Colt has been awarded the RoSPA Order of Distinction for Occupational Health and Safety performance in 2018.



Health in Construction Leadership Group
The HiCLG aims to unify the construction industry in its approach to worker health protection and promotes the best practice processes and initiatives.

Nationwide service coverage and fast response times. Colt is the UK's only smoke control maintenance provider big enough to offer truly nationwide coverage and regional contracts. Because of this, our engineers can be found stationed everywhere up and down the country and have an average response time of 4 hours and a guaranteed response time of 24 hours. You can count on them 24 hours a day, 365 days a year, no matter where you are.

A TALL STORY. ALL TRUE, BY COLT

As Building heights have increased so has our experience and expertise in smoke control. We have unrivalled experience. In 1954, we designed the UK's first-ever smoke control system to be installed in a manufacturing plant. And, ever since, year in, year out, we've been busy installing our systems into all sorts of buildings, big and small, throughout the UK and abroad.

Our top 10 current/recent projects

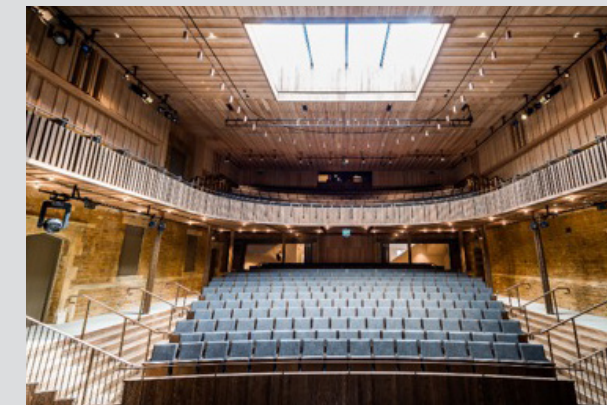
- 22 Bishopsgate – 65 storeys (London's tallest commercial building.)
- 20 Fenchurch Street – 38 storeys
- Principal Place – 48 storeys
- St George's Tower – 52 storeys
- Newfoundland – 60 storeys
- South Quay Plaza – 68 storeys
- 1 Park Drive (Wood Wharf) – 57 storeys
- Pan Peninsula – 48 storeys
- West India Quays – 36 storeys
- 1 Nine Elms – 56 storeys

SIZE IS NOT IMPORTANT TO US

Given our involvement in so many taller and more complex projects, you could be forgiven for thinking that we are not interested in taking on smaller and more straightforward projects. You couldn't be more wrong. We're equally at home at the smaller end of things. In fact, we handle everything from straightforward stairwell and underground car park smoke clearance systems right through to complex mechanical and environmental life-saving systems.

We treat these smaller projects with the same care and attention to detail with which we treat large ones. And, because we're big, with broad shoulders, we don't run out of steam; we'll stay with you all the way to the completion of your project.

As ever, our aim is to make the use of our smoke control systems as hassle-free as possible.



Nevill Holt Opera Theatre

If you need help with a multi-storey project, talk to us today.

Email us: project.admin@uk.coltgroup.com

Call us: 02392451111

Visit our site: <https://www.coltinfo.co.uk/smoke-control.html>

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“Expertise built on experience.”

