

Smoke Control in Shopping Centres



Colt Design Service

Front Cover

Golden Square, Warrington.

Jetstream impulse fans for the car park, Cyclone induction fans and reversible Jetsream impulse fans for the service road tunnel. OPV Seefire and Labyrinth ventilators for natural ventilation of the malls. Defender dampers, Seefire ventilators and Doorman door operators for the firefighting shafts. All the equipment controlled by an OPV system.

INTRODUCTION

In retail premises such as shopping centres, the Building Regulations have a strong emphasis on the provision of life safety systems such as smoke control.

A well designed smoke control system should be able to maintain smoke free escape conditions at low level to allow the building to be evacuated with minimum risk of smoke inhalation, injury or death.

Colt has considerable experience in the design and implementation of smoke control systems in Shopping Centres and a vast number of installations have been carried out throughout the UK.

Colt products are specifically designed to blend into the building structure, concealed until needed and compliant with all relevant codes and standards.

In city centre developments, where space is a premium, many of these projects have an underground car park, which may also require smoke and day to day ventilation. Colt can provide all manner of Car Park Ventilation systems. Please see the Colt Car Park Ventilation Systems leaflet. Colt is also active in the design and supply of Tunnel Ventilation schemes.

Many developments may also require one or more fire fighting shafts, which may require smoke ventilation. Colt can provide these. Please see the Smoke Control in Apartments leaflet.

DESIGN SERVICE

You will be reassured to know that Colt has a wealth of experience in designing smoke control systems for shopping centres and has an impeccable track record to match.

Colt offer a complete package - including a free design service with technical advice at the initial design stage, through to the service and maintenance of the system.

You will receive a fully detailed report complete with CAD.

CONFIDENCE

When choosing a smoke control supplier you need reassurance that the company you select has sufficient track record, experience and after sales service.

By investing in innovation, products, services and people, Colt has established itself as a world leader in smoke ventilation control.



“A product range, design capability and a service standard to rival anyone in our field.”

UK TRACK RECORD

Aberavon Shopping Centre, Aberavon
Kingsbury Court, Aylesbury
BHS Castle Quay, Banbury
Castle Quay, Banbury
Festival Place, Basingstoke
Brunel Centre, Bletchley
Bull Ring, Birmingham
Pavillions, Birmingham
Perry Bar, Birmingham
Star City, Birmingham
Wades Building, Birmingham
Castlepoint, Bournemouth
Rawson Market, Bradford
The Baytree Centre, Brentwood
Coopers Square, Burton-on-Trent
Union Arcade, Bury
Grafton Centre, Cambridge
Grand Arcade, Cambridge
Cannock, Cannock
Eagle Centre, Derby
Corn Exchange, Doncaster
Frenchgate Centre, Doncaster
Merry Hill, Dudley, West Midlands
Milburn Gate, Durham
Swan Centre, Eastleigh
Ocean Terminal, Edinburgh
Princesshay, Exeter
Callender Square, Falkirk
Retail Unit Tesco, Galashiels
Metro Centre, Gateshead
Eastgate Centre, Gloucester
Oak Mall, Greenock
Victoria Centre, Harrogate
The Cornbow, Halesowen
New Cross, Hamilton
Jacksons Landing, Hartlepool
Hastings Shopping Centre, Hastings

The Meridian Centre, Havant
Princes Quay, Hull
St Stephens Retail, Hull
Bluewater Park, Kent
Regency Arcade, Leamington Spa
Corn Exchange, Leeds
Merrion Centre, Leeds
St Johns, Leeds
The Bridges, Leeds
White Rose, Leeds
The Shires, Leicester
Retail Unit Sports World, Lewisham
Swan Centre, Lincoln
Metquarter, Liverpool
Paradise St, Liverpool
Ludgate West, London
Stratford, London
Nicholson Centre, Maidenhead
Trafford Centre, Manchester
Debenhams, Stamford Quarter, Manchester
Next Retail, Stamford Quarter, Manchester
Central Milton Keynes Shopping Centre, Milton Keynes
IKEA Thurrock, Brent Park, Milton Keynes
Midsummer Place, Milton Keynes
Milton Keynes Food Centre, Milton Keynes
Eldon Square, Newcastle Upon Tyne
Kingsway, Newport
Grosvenor Centre, Northampton
Weston Favell, Northampton
Chapelfield, Norwich
Victoria Centre, Nottingham
Tesco, Pollok
Dolphin Quays, Poole
The Cascades, Portsmouth

Gunwharf Quays, Portsmouth
Broad Street, Reading
The Oracle, Reading
Kingfisher Centre, Redditch
Market Hall, Rochdale
Churchside Arcade, Rugby
Runcorn Shopping Centre, Runcorn
Crystal Peaks, Sheffield
Meadowhall, Sheffield
Orchard Square, Sheffield
Touchwood Court, Solihull
Marlands Centre, Southampton
West Quay, Southampton
The Forum, South Shields
Elmsleigh, Staines
Swadlincote Shopping Centre, Swadlincote
Tamworth, Tamworth
Telford Shopping Centre, Telford
Lakeside, Thurrock
The Chimes, Uxbridge
Ridings, Wakefield
Saddlers Centre, Walsall
Golden Square, Warrington
The Heart, Walton-on-Thames
Queens Square, West Bromwich
Peacocks, Woking
Mander Centre, Wolverhampton
The Wulfrun Centre, Wolverhampton
McArthur Glen, York

Introduction

In recent years, the development of the shopping centre concept has grown in significance and complexity due to the phenomenal increase in the number of proposals being submitted for consideration. Today, practically every major town and city has at least one such centre.

To the design teams, each project represents a new challenge and an opportunity to be creative and innovative, but it can also mean significant problems.

The principal task of the team is to create a building on time and within budget which fully meets the requirements of the client. However there are many other influences, such as Building Regulations and Codes that could have a major impact on the design.

HOW DO FIRES START?

The cause of all fires can be generally divided into two categories, accidental or malicious ignition (arson). Arson is still the largest cause of fire in occupied buildings, and the main cause of death and casualties is smoke.

SMOKE

Killer facts:

Over 4,000 fires occur in retail outlets every year.

On average, large fires cause over 5 million pounds of damage every year in shops. (This excludes fires under £250,000).

Following the outbreak of a small fire in a shop, it can take less than three minutes to fill a mall with smoke.

It can take 30 minutes to evacuate a mall, taking into account parents with children, the elderly and the disabled.

An alarm is often not heard. When it is, people often ignore it or misunderstand the situation.

Once the alarm has been raised, people do not necessarily react as expected.





“Experience shows it can take 30 minutes to totally evacuate a shopping centre.”



GUIDANCE AND REGULATIONS

Many regulations and codes must be met and the safety and comfort of the building's occupants have to be the priority.

Reference can be made to the following:

BS 5588 Part 10

Fire precautions in the design, construction and use of buildings.
Code of practice for shopping complexes.

BS 5588-12:2004

Fire precautions in the design, construction and use of buildings.
Managing fire safety.

BR 186

Design principles for smoke ventilation in enclosed shopping centres

BR 368

Design methodologies for smoke and heat exhaust ventilation

BS 7346

Components for smoke and heat control systems

EN12101

Smoke and heat control systems

SPRINKLER SYSTEMS

Sprinklers and smoke control do different, but complementary jobs. A sprinkler system will control the size of the fire and thus reduce the amount of smoke generated.

In shopping centres it is generally recommended to protect shop units with sprinklers to control the fire size, but not to install sprinklers in the malls to prevent overcooling of smoke and the risk of wet and slippery surfaces on escape routes.

Protection of People (means of escape)

THE PROTECTION OF PEOPLE

With as many as 100,000 people in one day visiting some of the largest Shopping Centres, the burden of responsibility carried by the Design Team is awesome. Each scheme presents its own complexity of design problems that relate to the protection of those evacuating from the building in a fire situation.

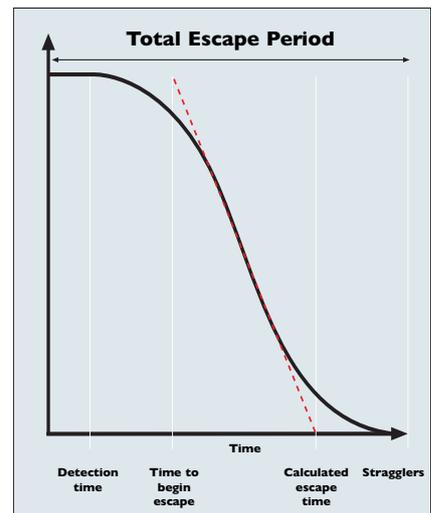
The problem is particularly acute with Shopping Centres that incorporate a central atrium or those which have multi-storeys.

MEANS OF ESCAPE

Regardless of the location of a fire, once people are aware of it, they should be able to proceed safely along a recognisable escape route to a place of safety. In order to achieve this, it may be necessary to protect the route.

In large or complex Shopping Centres, a smoke control system is an effective way of keeping means of escape routes clear of smoke.

Smoke ventilators are installed to help maintain smoke free escape routes and stairwells to enable occupants to evacuate the building quickly and safely.



Most significant factors concerning fire - such as evacuation time and rate of fire growth - are time dependent, and subject to a high degree of variation.



“An alarm is often not heard. When it is, people often ignore it or misunderstand the situation.”



BUILDING DESIGNERS

Building owners and designers share a responsibility to limit the potential for damage and tragedy caused by fire. Choice of building materials, the layout of escape routes, the number of exits and the installation of alarms, together with the installation of a smoke control system, are all key building design considerations.

Using the principles of ventilation and containment, designers can ensure that occupants can escape quickly and safely and that fire-fighters can see and tackle the fire source.

Smoke control systems have a critical role to play in the design of the building.

One in four businesses never recover from a serious fire



Smoke can travel at a speed of over 2m/s (5 mph), this is faster than the probable escape speed of an occupant

This fire exit shows the effects of smoke over a period of just a few minutes

Smoke Control (general principles)

Figure A

Smoke from a fire in an enclosed area, rises in a plume to the ceiling. As it rises, air is entrained into it which in turn increases the volume of the smoke.

As the smoke reaches the ceiling, a layer is formed, which is referred to as the smoke layer. Control of this layer is the main task of a smoke ventilation system.

Figure B

Smoke can fill a room in just a few minutes. Thick smoke can obscure exits signs and doorways, making escape hazardous and slow.

The typical speed of smoke travel is between 1 and 2 m/s. This can be faster than the escape speed of an occupant.

When the smoke reaches a dead end, it will dip down and be drawn back towards the fire, possibly confusing occupants and causing them to move towards the fire.

Figure C

By using smoke ventilation and smoke barriers, drop down smoke curtains for example, the smoke layer is contained above a pre-calculated height (normally 3m minimum) and is either extracted naturally or by mechanical means by ventilators installed in the ceiling.

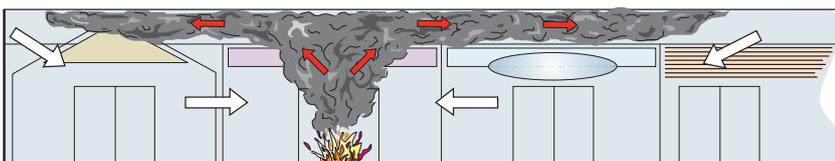


Figure A.

Smoke starts within a shop unit and spreads out onto the mall. Smoke starts to rise. White arrows show the movement of displaced air

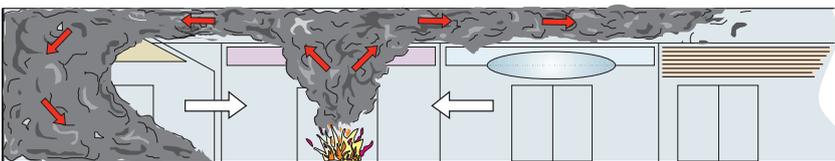


Figure B.

Smoke starts to quickly recirculate in an unvented building

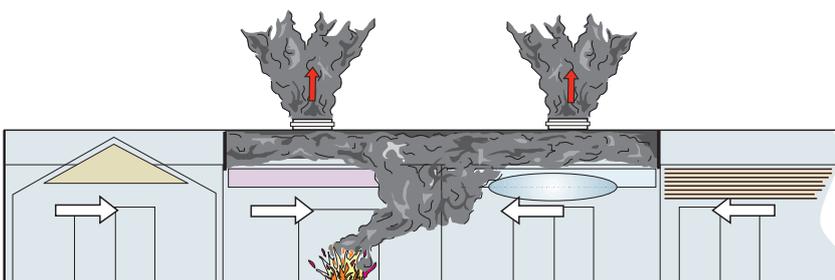


Figure C.

Smoke vents within zones



“4% of all building fires occur in retail premises. This equates to over 4,000 fires per year.”

Photographs (above & below).

*Star City, Birmingham.
Colt was in contact with Crown House Engineering/Carillion to supply OPV glazed Meteor natural flap ventilators in the atrium and OPV Seefire natural louvred ventilators for the staircases, lobbies and corridors, as well as automatic smoke curtains*



Smoke Control (atria & multi storey)

SYSTEM DESIGN

The design procedures for smoke control in multi storey Shopping Centres are more complex than single storey buildings.

This is largely because the geometry of the building is significant, and Shopping Centres tend to have multiple levels, complex layouts with junctions and changing roof lines.

Fire on the ground floor is clearly the worst case scenario. With potentially thousands of people within the Shopping Centre at any one time, engineered systems are required to channel the smoke to designated areas without affecting other floors.

Channelling screens are required to limit the width of the plume and reduce the mass flow of smoke. This can be achieved by either fixed screens or automatic drop down curtains.

With multi storey Shopping Centres, especially those with central open malls, the design of the smoke control system must be considered on a floor by floor basis.

Looking at figure G for example, the smoke layer in the mall must be contained above the second floor ceiling level. If a fire breaks out on the lowest floor, the height of rise of the smoke plume through the mall will make this design impractical.

To avoid this situation, a solution would be to remove smoke from the lowest floor without it entering the central mall. This can be achieved by extracting the smoke with the help of powered ventilation and smoke dampers. Automatic smoke curtains could be used to contain the smoke within the floor of the origin of fire.

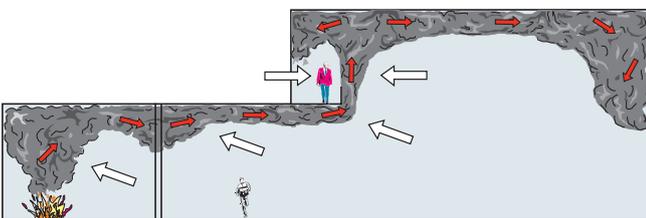


Figure D.

*Without smoke ventilation.
The red arrows depict the predicted movement of smoke, whilst the white arrows show the direction of fresh air movement without smoke ventilation.*

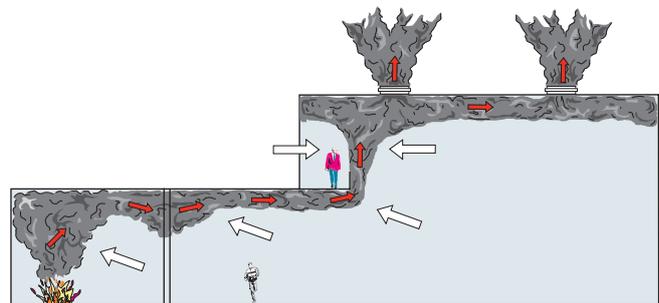


Figure E.

With smoke ventilation.

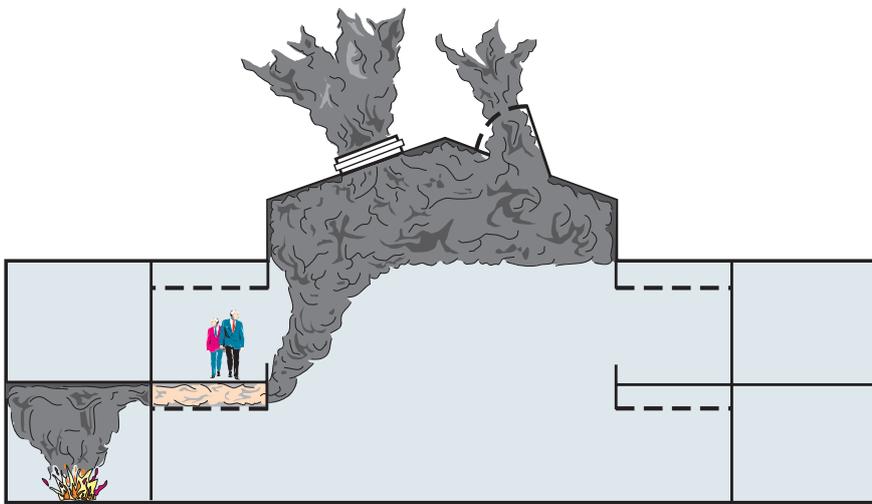


Figure F.

Channelling screens limit the spread of smoke under balconies, reducing the amount of ventilation required.

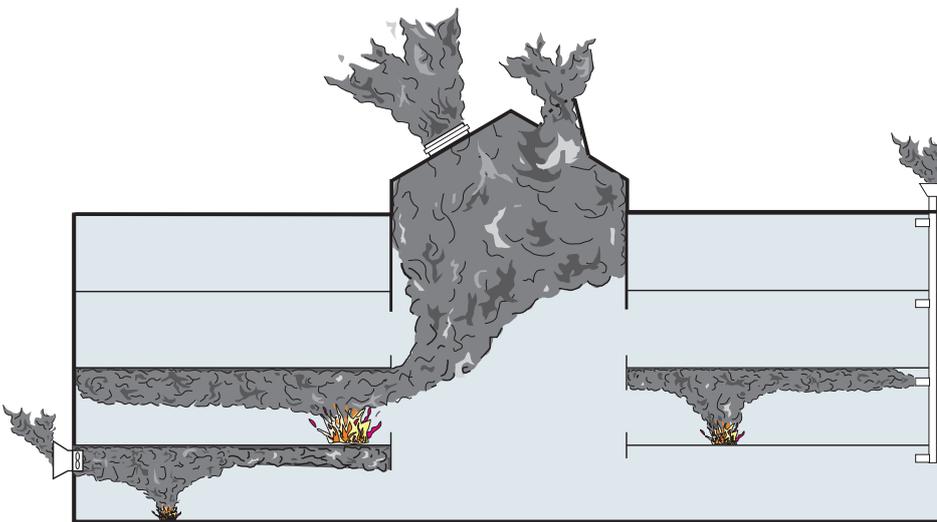


Figure G.

There are many ways to ventilate a multi-storey complex depending on the actual design and layout of the building.

This illustration depicts three different methods:

1. Ventilation utilising the central atrium.

2. Ventilation direct from the fire floor using ventilators in an external wall.

3. Ventilation direct from the fire floor using a fire rated mechanical extract system.

Smoke Control (inlet air)

INLET AIR

Inlet air is an important element of a smoke control system.

For a smoke control system to operate effectively, inlet air must be provided via a dedicated source, remote from the smoke reservoir.

Possible solutions are as follows:

- a) Utilising adjacent non fire zones by opening natural ventilators there.
- b) Low level inlet ventilation located below the designed smoke layer.
- c) Opening entrance doors automatically.

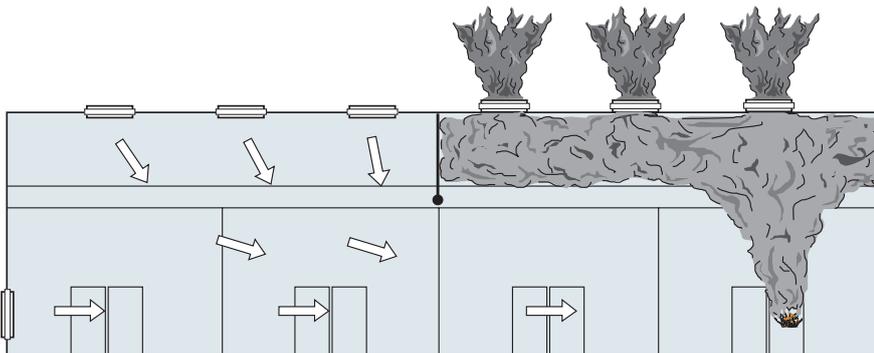


Figure H.

This illustration shows a two zoned system where the ventilators in the fire zone are providing extract and the adjacent zone is providing air inlet.

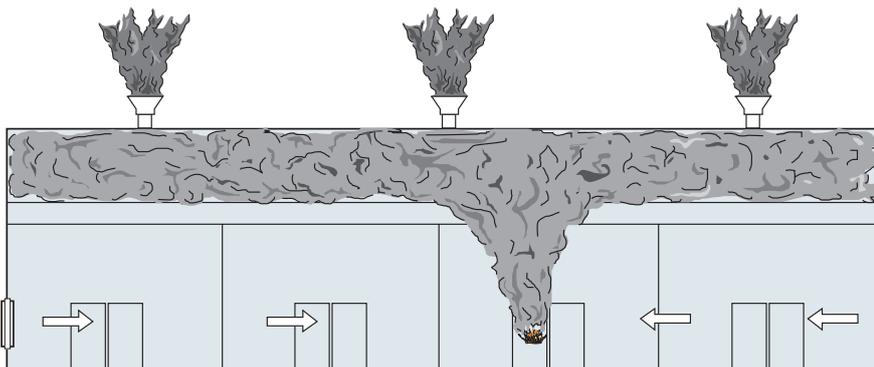


Figure I.

A single zone where adjacent zones are not available for inlet, therefore an air inlet source needs to be provided at low level either by automatically opening ventilators or by automatically opening doors.

A similar solution is also required if the shopping centre is mechanically ventilated.

*Shenley Pavillions, Milton Keynes.
Automatic opening ventilators provide air inlet
above the entrance doors.*



*Chapelfield Shopping Centre, Norwich.
Alongside a stairwell ventilation scheme,
Seefire and Kameleon natural ventilators provide
smoke ventilation for the malls and the
House of Fraser anchor store.*



*Metquarter Shopping Centre, Liverpool.
Colt installed Seefire natural ventilators to provide
natural day to day and smoke ventilation on the
roof, as well as smoke curtains in the mall.*

Smoke Control (natural louvred ventilators)

NATURAL VENTILATORS

Natural ventilation can offer a number of important advantages in smoke control systems.

A natural louvred ventilator can provide the dual benefit of day-to-day climate control and smoke control. Depending on the louvre blade option, it can also permit natural daylight entry.

Louvred ventilators can be installed vertically or horizontally and have optional blade types, including;

- Aluminium
- Translucent polycarbonate
- Glass

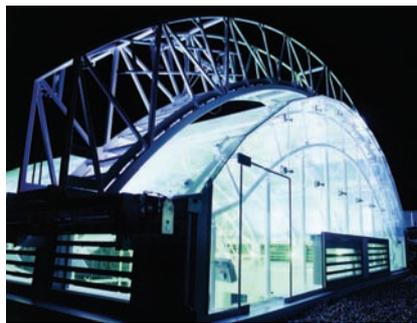
Available in a variety of product types to suit each building application, natural ventilators are increasingly specified by building designers who are sensitive to the conflicting demands of energy conservation and occupier safety and comfort.

Associated Products:

- EN Seefire
- FCO (Façade Clear Opening)
- WCO (Weathered Clear Opening)
- Collite



Gunwharf Quays, Portsmouth.
Colt OPV controlled Seefires installed into a Colt roof glazing system. Fixed glass smoke curtains are also installed at high level.



House of Fraser, Guildford.
OPV controlled FCO Ventilators with polycarbonate louvres are installed at high level within the main glazed central atrium.



Left - Cooper's Square, Burton-upon-Trent.
The refurbished shopping centre in Burton-upon-Trent has a smoke control installation which includes over 100 Seefire louvred ventilators installed into the roof glazing system.

Above - Lakeside Shopping Centre, Thurrock.
Colt Seefires are installed along the malls to provide automatic smoke control and also day to day natural ventilation.

Smoke Control (natural flap ventilators)



*Star City, Birmingham.
Colt Meteor glazed flap natural extract ventilators
installed within the main central atrium with OPV
Seefire louvred ventilators on the staircases,
lobbies and corridors.*

Automatic smoke curtains were also supplied.

Castle Quay Shopping Centre, Banbury.
Kameleon glazed natural ventilators
installed into the malls glazing system to
provide high level natural smoke
and heat extract.



NATURAL VENTILATORS

Natural glazed ventilators offer the benefit of smoke control ventilation combined with the additional advantage of day to day ventilation.

Glazed flap ventilators, such as the Colt Meteor, have large unobstructed openings combined with high performance levels, and are suited for installations from the horizontal through to the vertical.

The Colt Kameleon is a more discreet ventilator and has a smaller frame with hidden controls to integrate better into its surroundings.

Both the Meteor and the Kameleon have excellent air leakage performance levels and can help the building to meet the requirements of the Building Regulations part L2.

Associated products:

- Meteor
- Kameleon
- Firelight
- Coltlite



Above - The Chimes Shopping Centre, Uxbridge.
Colt worked closely with the design team and the contractors Costain Skanska Joint Venture, on the design and installation of the smoke ventilation system which included 88 Colt glazed natural Kameleon ventilators and 6 trapezoid shaped glazed natural double flap Meteor ventilators.



Left - Midsummer Place, Milton Keynes
Kameleon glazed ventilators, smoke curtains and stairwell ventilators.

Smoke Control (powered extract and dampers)





POWERED EXTRACT

Some scenarios, as previously illustrated, require the smoke to be discharged from the building via fire rated ducting. Roof mounted powered extract units can assist in this.

Powered extract is also used when positive wind pressure occurs at ventilator locations, normally due to taller buildings being within close proximity. Natural ventilation may not perform as required in this situation, and powered extract must be used.

Associated products:

- Liberator
- Mechanical Extract
- Doorman
- Defender

Aupark Shopping Centre, Slovak Republic.
A large number of powered exhaust ventilators in conjunction with natural ventilators and smoke curtains were installed as part of a complete smoke control system.



Festival Place, Basingstoke.

Powered fans connected to ductwork are used for the extraction of smoke. Colt Seefire ventilators are used for terminal cowls.

A complete air handling system was also designed and installed by Colt.

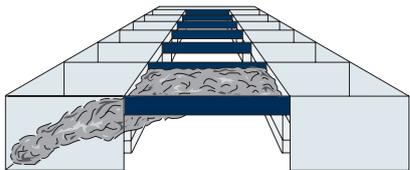
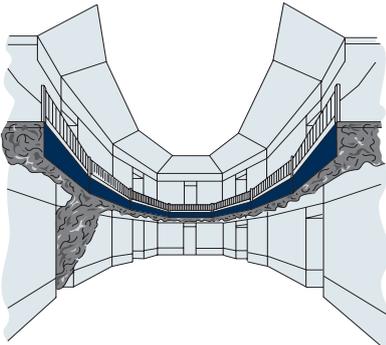
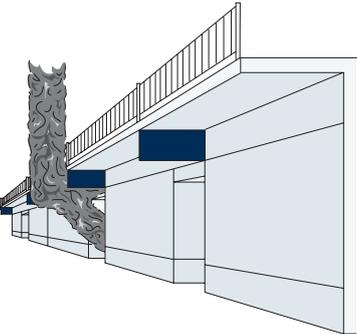
Smoke Control (Smoke Barriers)

SMOKE BARRIERS

The need to form smoke barriers means that large spaces must be divided at high level. These divisions between smoke barriers can be a building feature such as a permanent screen or a failsafe automatic smoke curtain operated on detection of smoke. Permanent screens are often constructed from glass.

BS 5588 part 10 recommends that smoke barriers should be arranged to prevent smoke from a shop unit flowing into more than one reservoir.

Modern shopping centres with high glass rooflights allow deep smoke barriers which creates an efficient smoke control system. Conversely, low narrow malls often found in refurbishment projects present additional challenges due to the limited height available to obtain an effective solution.



Eagle Centre, Derby
 Seefire ventilators for the malls. Colt
 Doorman door operators, Defender
 dampers and Seefire ventilators for shaft
 and stairwell ventilation. Smoke curtains
 for general areas and lift entrances. An OPV
 system controls both Colt and third party
 smoke control equipment.



“Fire-fighters must be able
 to quickly identify and safely
 tackle the fire source.”

Associated products:

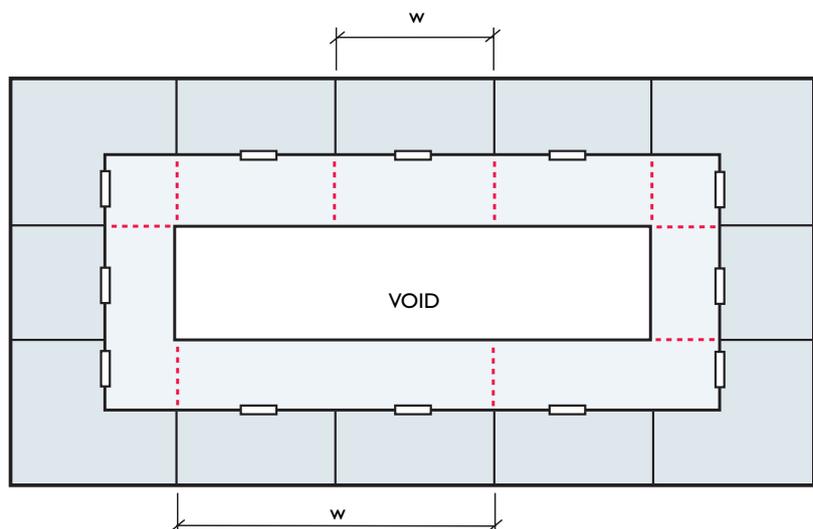
- Smokemaster
- Firepath
- Fixed Curtains

House of Fraser, Guildford.
 Automatic drop down smoke
 curtains were installed around the
 atria for smoke containment.
 A pressurisation system was
 also installed for the staircases.



Channelling screens can be positioned
 for every shop unit facing the mall.
 However it may be possible to
 increase the span of the channelling
 screens over two or more shop units.

W = channelling width



Smoke Control (control systems)

OPV 2000

The Colt OPV 2000 is an intelligent electronic control system which uses Echelon technology for its communications network.

OPV 2000 revolutionises the control and operation of natural smoke ventilators and readily incorporates all other addressable equipment into the total smoke control system.

As life safety equipment, all OPV 2000 components meet the most stringent manufacturing and test procedures.

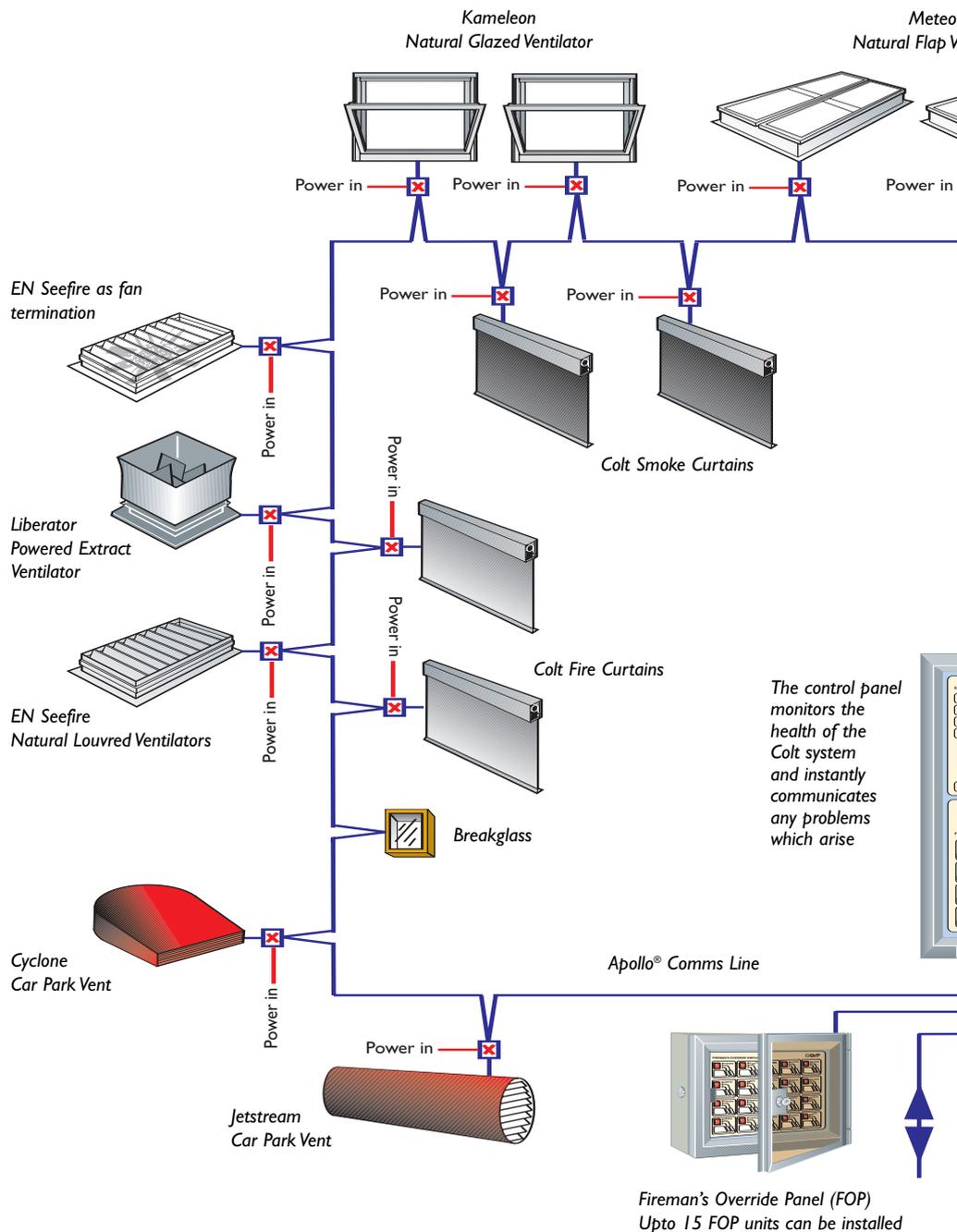
TOTAL CONTROL FLEXIBILITY

Each natural ventilator or addressable unit can be controlled individually and as part of the specified automatic control system.

The control software is configured to suit the requirements of the scheme and should these change, it is a simple matter to re-program the software accordingly.

TOTAL SAFETY

OPV 2000 incorporates a patented safety system. The microprocessors in each natural ventilator control module are able to distinguish emergency data signals from normal operating signals, which will be ignored if the battery charge level reaches a critical state. This means that battery power will always be protected for emergency use.



THE COLT PACKAGE

Colt International offers the following services:

- Scheme design of all types of Smoke and Heat Exhaust Ventilation Systems (SHEVS)
- Scheme design of pressurisation systems
- Scheme design of smoke containment systems
- Provision of performance specifications
- Project management
- Supply, installation, commissioning and maintenance of systems, including all necessary controls, which will be designed to interface with others' control systems.

A free full system check will be carried out approximately 9 months after a Smoke Control System has been installed and commissioned by Colt. Besides the opportunity to check that the system is performing as designed, this will allow for any further training of local personnel that may be necessary. Assuming that this visit falls within the warranty period, any defective parts are replaced free of charge. A test certificate will be issued.

Other reasons to choose Colt:

- Colt Smoke Control systems are suited to both commercial and industrial buildings, and may be adapted to suit most architectural requirements.
- Over the years Colt has funded a large proportion of the research into smoke control, and its representatives maintain an unparalleled level of technical expertise.
- Colt's in-house research and development capability ensures that Colt smoke control systems are designed, tested and updated by Colt to meet or exceed relevant legislation and standards.
- The majority of Colt's Smoke Control systems are manufactured in the UK under BS EN ISO 9001:2000 and BS EN ISO 14001:2004. They are also CE marked, where relevant, in compliance with EN 12101-2.



COLT SERVICE

Part of the Colt Group of companies, Colt Service offers a comprehensive range of maintenance packages incorporating the maintenance and repair of all building services equipment including non Colt products.

Colt Service provides a 24 hour, 365 day emergency cover as standard.

MAINTENANCE

Maintenance of a smoke control system is essential. Regular maintenance protects your investment and brings peace of mind that the system will operate effectively in an emergency.

The British Standard, BS 5588-12: 2004 recommends that smoke control systems should be serviced at least once a year and tested weekly.

"People feel better in Colt conditions"



Architectural Solutions
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Smoke Control
Service and Maintenance

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