SMOKE AND FIRE BARRIERS

New active smoke and fire barriers are revolutionising fire engineering. **Geoff Harris** explains.

Smoke curtains being lowered in a major department store (left and below)

FIRE-ENGINEERED SOLUTIONS FOR BUILDINGS ARE commonplace nowadays, but the best way to prevent the spread of fire is by compartmentation of the building.

Over the last half century the conceptual requirements for buildings have changed beyond recognition. Technological advances have fuelled a need for architects, clients and consumers to have radically different and constantly changing attitudes to building designs. Obvious illustrations of this are the latter day building designs developed for large open compartments and the use of glass and glazing, all of which have to be incorporated into a fire-engineered solution.

These open designs, by definition, put more onus on active fire protection systems to react to fire, heat and smoke, with the objective of maintaining a safe building for occupants and emergency services in case of fire.

Fire engineers can now offer new methods of fire, heat and smoke compartmentation which open up a whole new world of fire engineered solutions allowing increased compartment sizes, removal of traditional fire walls, fire doors, lift lobbies and more thus providing architects and building owners the additional flexible open space they need.

Fire-engineered buildings allow for increased compartment sizes by utilising, for example, active fire protection systems such as sprinklers and Smoke and Heat Exhaust Ventilation Systems (SHEVS).

Another major tool in the armoury of fire protection is smoke control and this is where I am directing my attention.

What is important, and perhaps not emphasised enough, is that SHEVS will work more efficiently when sprinklers are controlling the fire. The SHEVS main purpose is to provide building occupants with a clear visible means of escape whilst assisting the fire service in locating the fire. Although an integral part of the SHEVS, the role of active barriers (curtains) is often undervalued. Active barriers are designed to function when the main SHEVS extraction system has failed, thus providing essential smoke containment.

Fire and smoke barriers

So what is a 'Barrier'? Traditionally known as curtains, the pan European word 'barrier' is now becoming more commonplace because 'curtains' can often be in glass, steel, fire rated boards and can be static, active, or combinations of both. Barriers can be made in a multitude of materials and styles. Basically they fall in to two categories, 'static' and 'active.

Static barriers are simple barriers that do not move and remain fixed in place, permanently on view e.g. glass, steel, fire rated board etc.

Active barriers are any barriers that move in the event of fire into their fire operational position. Traditionally these are of a roller type.

Active barriers that range from 600°C (smoke barriers) to full four-hour fire resistance (fire barriers). Some of these can even provide two-hour Insulation.

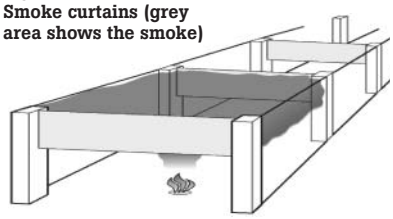
So what make these products so special or different from say, fire shutters or fire doors?

Widths of 50 metres, drops of 12 metres all contained in housing sizes ranging from as small as a paperback novel and up to, as large as a tabloid newspaper – for 6000 square feet (558 square metres) of protection – this is what makes these products so different.

How barriers work

When SHEVS were first developed, compartment size was often seen as a problem as it allowed the smoke to traverse greater distances, engrossing cold air, increasing in volume and, most dangerous of all, dropping so as to create smoke-logged areas. The need, therefore, to contain the smoke was paramount and smoke curtains were developed to provide barriers to the smoke (figure 1). Smoke curtains (automatic or static) simply created reservoirs to contain the smoke until it cooled or was extracted by the ventilation system.

Figure 1. Smoke curtains (grey area shows the smoke)



The forming of smoke reservoirs also provided other advantages. When smoke is extracted it is replaced with air. This 'make up air' is supplied from the adjacent smoke free reservoirs. The smoke, contained within a smaller area remains hotter, more buoyant and therefore higher – away from escaping occupants and easier to extract.

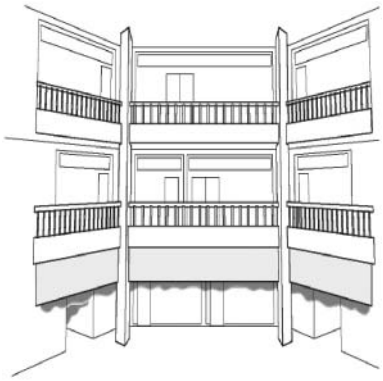


Figure 2. Void Edge containment

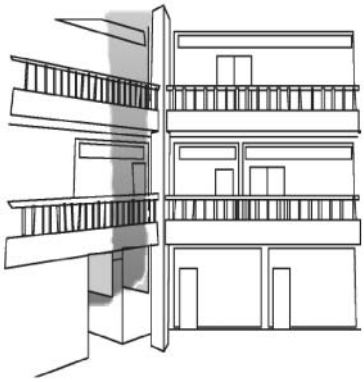


Figure 3. Channelling screens

In the examples shown (figures 2 and 3) the void edge smoke barriers contain the smoke whilst it is being extracted from the fire floor with make up air being supplied from the atrium. Figure 3 shows the smoke being channelled into the atrium from the fire floor where it can be extracted. In addition the smoke curtains should be deployed on the non fire floors for added protection.

Smoke barriers, when used within SHEVS, become a critical element of that system. If smoke barriers are not in their fire operational position, the system will not perform as designed. However, even in the event that other elements of the SHEVS do not function, smoke barriers in the fire operational position will provide essential smoke containment and channelling.

It is important to remember that when smoke curtains/barriers are installed in critical areas, protecting means of escape routes for example, they should/must fail safe into the fire operational position (i.e. not lower than 2.5m above the finished floor level or in any location hazardous to occupants or objects). The curtains/barriers are required to locate into the fire operational position in a controlled manner when

- all consumable primary and auxiliary power sources are removed,
- in the event of wiring or system corruption, or
- any combination of these faults

Such fail safes are important. It is worth noting that some smoke barriers on the market may remain in their retracted position when their back batteries fail or the mains are removed, and are subject to flap around due to lack of bottom bar weight or open up large gaps due to lack of conjoining. The new European Standard EN12101-1 highlights these points to ensure that they are fit for purpose.

Safety concerns in standards are sometimes never highlighted enough for the inspecting officer to clarify that the system being installed does the job it is required to do. Simple confirmation of the following would ensure fitness for purpose for a smoke curtain/barrier:

1. Does it have minimal gaps?
2. Does it have impermeability to smoke?
3. Is the barrier continuous or overlapped and conjoined?
4. Is a full size sample tested including all component parts?
5. Has it the required fire resistance?
6. Does it have reliability – 1000 test operations?
7. Can it operate at a controlled rate of descent, even without a consumable power source?

So how can barriers provide such huge areas of containment? The answer, as is so often the case, is very simple.

Overlapping barriers allow huge spans and drops and by conjoining the bottom bars fire and smoke leakage ceases to be a problem.

The careful use of the barriers as a directional aid would be beneficial. The 'running man sign with arrows' can be printed onto the curtains and assist in means of escape strategy in large complex areas such as airports.

Smoke can rapidly hide any exit signs at high level if the smoke is not being

SMOKE BARRIER APPLICATIONS

Typical applications for smoke barriers are:

- smoke reservoir boundaries;
- channelling screens, where smoke can be directed to a place of extraction;
- void edge screens, to prevent smoke spreading to other floors from an atria;
- void sealing screens to prevent smoke entering an atria whilst being extracted from the fire floor;
- corridor containment, this allows extended travel distances but restrains the smoke;
- shop unit containment, as opposed to smoke being extracted from a shopping mall when a unit has a fire, the smoke can be contained and extracted from the shop;
- escalator and stairwell containment, used to prevent smoke travel and to provide active compartmentation;
- lift well containment – this reduces the need for lobbies.

effectively exhausted. Directional signs on smoke barriers together with the barriers themselves provide information and protection for persons escaping a hazardous situation.

Smoke barrier to fire barrier

Smoke barrier applications have become common place. Their operating temperature rating, according to the Construction Product Directive (CPD) is that the curtain remains intact at 600°C, above which fire protection is also needed.

The development to become a fire barrier requires the barrier to withstand all the rigors of full system fire tests in accordance with applicable parts of BS 476 and/or BSEN 1363.

However users beware. To say that a smoke barrier fabric has been tested to BS 476 Part 20 and has 1000°C fire resistance for two hours does not necessary mean that the product has a genuine two-hour fire resistance at 1000°C. To have this it also has to survive the full range of pressures and vibrations of a nine square metre furnace. If the fabric disintegrated at the end of the test it is just a smoke barrier that has been tested to a 1000°C, it does not have the integrity required of a fire barrier.

Fire barriers should be fully tested in accordance with BS EN 1363 for true fire resistance and integrity.

So what are automatic fire barriers? Initially they operate in the same way as a smoke barrier. They are like a large electrically operated roller blind that can be concealed above a ceiling, contained in side guide channels with a weighted bottom bar that will be operationally activated by an alarm signal. However remember that fire barriers must be capable of moving to their fire operational position on the loss of all consumable power supplies, true fail safe. Barriers that require power to move to their operational position will stay housed in the event of total power failure.

The Fire Barrier role in simple terms, is to stop the rapid spread of fire and smoke through buildings, thus assisting the safe evacuation of occupants and aiding the emergency services.

Current developments

Since their introduction fire barrier curtains have been classified in the same arena as doors and walls. There is no existing standard (to date) that gives designers, architects and regulators a basis on which to base an acceptable design, or installation or maintenance criteria. Recent developments, applications and testing show that fire barriers can be installed into numerous situations as part of an overall fire safety engineering solution in place of:

- Fire shutters;
- Fire doors;
- Fire rated glazing etc.

In addition they can provide protection as a virtual containment wall, provide void separation (vertical & horizontal non load bearing partitions), replace lift lobbies, provide basement separation and escalator void protection and much more. What we are describing is a wall that is only functional when we need it, or a lobby when a fire threatens, or a ceiling reservoir in the structure when it needs one. This is a virtual solution.

"Fire barriers should be fully tested in accordance with BS EN 1363 for true fire resistance and integrity"

A wall that is only there when needed

The costs of a system, and maintenance thereafter, compares favourably to other fire safety solutions, for example fixed compartmentation and sprinkler systems. Without doubt there is a need for proper understanding (education) of the benefits of automatic fire barriers and how to solve problems, hence this article.

Used as an unobtrusive fire safety feature virtual compartmentation used in conjunction with SHEVS can protect lices and property. The component installation is of course an important criterion, fixed side guides; the capability of withstanding pressure and impact, the correct overlaps etc form part of a true fail safe system. If we are replacing a compartment wall then when all else fails we want the wall there.

Automatic fire barriers can be classed as uninsulated doorsets and shutter assemblies (BSEN1634-1), non-load bearing walls (BSEN 1364-1) and non-load bearing ceilings (BSEN 1364-2) with the requirement for integrity - not insulation. The fire resistance and integrity are the same level as the compartment with two hour and even four hour fire barriers are now available. For complete wall replacement, the Coopers Group has developed an insulated fire barrier that will give almost 70 minutes of insulation.

Having conducted tests on parallel fire barriers with a 150mm air gap, the myth that they will give 30 minutes insulation can be disposed of once and for all, as this is not the case. When tested in this configuration, the double barrier failed within five minutes. However, a double insulated fire barrier (Coopers FireMaster Plus) with a 150mm air gap was still performing within the allowable limits after 140 minutes.

Naturally uninsulated fire barriers installed within sprinklered buildings need not be insulated, thereby cutting the cost to the end user, likewise by deploying the barrier into a two metre wide space, say an isle in a warehouse or basement one would consider that the space and integrity was more than adequate for providing fire containment, providing of course that it is a true fail safe system.

Virtual fire doors

With the need to ensure that people of all abilities can easily access a building or move within its confines perhaps we should compare some of the restraints, such as traditional fire doors

To overcome the constant management complaint of fire doors across corridors, even those on magnetic hold open devices that are required to be closed in the quiet hours. It is now possible to fit a virtual fire door.

The virtual door permits freedom of movement at all times and provides fire protection when needed. This principle could be employed throughout a building subject to a case by case fire risk assessment. This may also extend to other scenarios such as separation of spaces in warehouses now that fire barriers are an acceptable means of separation.

The FireMaster Virtual Fire Door is a concealed automatic fire barrier that is deployed from a compact housing fitted in the ceiling, or onto the wall above the door transom to completely seal the opening in the event of a fire. In effect it provides the same function as a fire door. Under normal circumstances it remains hidden above the opening and deploys only when needed. Hence, 'Virtual Fire Door'!

One future use of the virtual fire doors could be in Aged Peoples' Homes, A Virtual Fire Door in front of every room with detection either side would

permit those who like to keep their doors open, open. In the case of a fire in one room, then the virtual door to that room would close whilst others remain open allowing easy evacuation of the remaining area.

In the case of corridors then the barriers would drop upon detection of smoke, yet remain open where there is none. This could allow the control of a small fire restricting the spread of smoke and the potential spread of toxic gases.

On a signal from the fire alarm, or its own independent smoke detector, the fire barrier will initially deploy to a pre-determined safe height, normally just above head height. This position acts as a primary smoke barrier to prevent the lateral travel of smoke and products of combustion. It also allows occupants an unobstructed escape route from the building without having to push open heavy fire doors, which will be beneficial if you are old, frail, or possibly in a wheelchair or supported by a walking frame.

After a pre-determined time lapse (determined by the fire engineering protocol for the building), the virtual fire door will fully deploy creating a completely sealed two hour fire resistant barrier.

The barrier, where required can be designed with an Activation Delay Descent (ADD) which could have adjustable timers to allow for the evacuation of occupants before deployment. The barrier can also be retracted by activating an emergency retract button, that, following a predetermined time limit, will fully deploy again once occupants or emergency services have passed.

Other fire curtain uses

The FireMaster Servery Curtain provides the benefits of an off the shelf lightweight design, offering an effective alternative to steel shutters. The barrier requires less preparation time and no additional steelwork to install.

Designed specifically for small to medium sized openings in the fire compartment wall, this new concept has the potential to eliminate the possible dangers posed by heavy steel shutters that could drop rapidly causing casualties or breakages. It is especially suited to clean and hygienic environments such as kitchens and hospitals, or is equally at home over windows and reception areas.

FireMaster is tested to BS476 Part 22, two hour fire shutter performance and BS7346 Part 3 for smoke containment and has the following system and component features:

1. Sealed to prevent the passage of fire or smoke.
2. Total power failure "Gravity Fail Safe", with safe controlled descent.
3. Choice of alarm actuations and fire/smoke sensors.
4. Slim, lightweight, easy to install, standard sizes for up to a 3m wide opening.
5. Hygienic "easy wipe" surfaces, narrow channels eliminating dust/grease traps.

In the future we could have sensors on the bottom bar that could lower the barrier progressively as the smoke layer descends. There already is the opportunity to install beam detectors to ensure the area below the space that the fire barrier will fit into is kept clear, assisting the management of fire protection in this critical area. However at least fire extinguishers will not be used to wedge these 'fire doors open!

Conclusion

The author considers that automatic fire barrier curtains can revolutionise fire safety engineering in the future, keeping access routes clear and provide the larger premise with a safe alternative to compartments. They can be fitted not only with the stage deployment facility and/or active time delay but with voice warning systems too. These can inform escaping occupants that the barrier is descending and, if required, in various languages, (ideal in airports). These messages can cease once the barrier is deployed so as not to interfere with any other voice warning systems.

Flexibility is the key in fire safety engineering and with virtual doors that only close when they are designed too, e.g. either on the receipt of a signal from a fire alarm system or an individual detector per door, freedom of movement is created and safety maintained. The other doors may remain open, which can help in the means of escape mode to those occupants that may need assistance.

Acknowledgement

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"Automatic fire barrier curtains can revolutionise fire safety engineering in the future"

Smoke curtain provides virtual fire door for small to medium size opening in fire compartment wall