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CPD Article

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The Use of Glazed Screens to Control the Spread of Smoke and Fire in Buildings

One of the earliest forms of fire screen dates to about 1750 and was placed in front of an open fire to reduce radiant heat. Perhaps not the most resilient of fire screens when we think of today's high performance buildings, but its early use gives us an insight as to why fire protection within our modern buildings today is so important.

Radiation of heat can range anywhere between uncomfortable to deadly when fire is present so is an important issue to consider in all buildings. One of the simplest approaches will be a non combustible wall - but this leaves little to the designers imagination, not to mention the need for natural; light.

It was only in the late 1920's when wire was introduced into glass that the first fire resistant glasses became available. Wired glass was extensively used in commercial buildings as a safety glass in areas where light was required. Many overhead areas of glazing still use this type of glass which still meets current legislative standards.

This short CPD Article offers an insight to the standards and what is achievable today. The CPD is also available in a face to face presentation format.

Key Learning outcomes

- Understand and acknowledge the risk of smoke in a building fire.
- Understand how to advise the client on The Regulatory Reform (Fire Safety) Order 2005.
- Understand how to ensure installations are completed with the correct documentation.
- Understand how to ensure that screens supplied form part of a building fire safety system.

1.0 Fire Facts

The number one cause of death in fires is smoke inhalation - 50% to 80% of deaths occur before any injuries due to burns (data from a government report ‘Fire Statistics: Great Britain April 2013 to March 2014’). Often smoke incapacitates so quickly that people are overcome and can’t make it to an otherwise accessible exit. The synthetic materials commonplace in today’s homes and offices produce especially dangerous substances. As a fire grows inside a building, it will often consume most of the available oxygen, slowing the burning process. This “incomplete combustion” results in toxic gases.

Death can occur by, simple asphyxiation, chemical irritation or chemical asphyxiation. ‘Asphyxiation’ can be due to inhaling carbon monoxide which takes the space of oxygen within our blood supply. ‘Chemical irritants’, such as sulphur dioxide, ammonia, hydrogen chloride and chlorine can cause the airways to swell and/or mucus to build up blocking the airway. ‘Chemical asphyxiation’ damages cells and stops the supply of oxygen to the body, carbon monoxide, hydrogen cyanide and hydrogen sulphide are often produced in fires. It is known that the worst of these gasses produced in combustion is carbon monoxide. With this in mind all our offices, places of work and dwellings must be adequately protected, but are they?

The owners of all buildings are are now held personally responsive for fire safety under he Regulatory Reform (Fire Safety) Order, 2005. Employers and/or building owners must carry out a fire safety risk assessment and keep it up to date. This shares the same approach as health and safety risk assessments and can be carried out either as part of an overall risk assessment or as a separate exercise. Based on the findings of the assessment, employers need to ensure that adequate and appropriate fire safety measures are in place to minimise the risk of injury or loss of life in the event of a fire.

Building Bulletin 100: Design for fire safety in schools (2007) This fire safety design guide applies to nursery schools, primary and secondary schools, academies and city technology colleges, special schools and pupil referral units. It is the normal means of compliance with building regulations for fire safety design in new school buildings and sets out the Department's policy on sprinklers in schools, which was launched in March 2007.

Two to three breaths of toxic smoke will affect your ability to breathe, a sensation similar to drowning and will render you unconscious.

2.0 A Short Explanation of ‘E’, ‘I’, ‘W’, ’R’, ‘Sa’ and ‘Sm’

Screens are often referred to as having an ‘E’, ‘EW’ or ’EI’ rating. ‘E’ is the ability to isolate smoke gasses and slow the progress of fire, however, in the case of glazed screens fire can radiate heat so if there is combustible material on the other side of the screen an ‘E’ only rated screen may not stop the spread of fire. ‘W’ refers to radiation, an ‘EW’ rating will limit the spread of fire and smoke. ’I’ stands for insulation, in a ‘EI’ rated screen, insulation in the profile keeps structural integrity and holds the glass in a screen. It is the glass itself which will stop radiant heat and help prevent the spread of fire. ‘R’ is the ability to continue to carry load, especially important where high screens are installed in ‘glass above glass’ assemblies.

Common resistance time ratings, for either E or EI, are commonly 15, 30, 45, 60, 90, 120, 180 or 240 minutes.

So a screen with a classification E30 should be able to withstand smoke gas for 30 minutes. The Screen does not have any insulating function, so heat can pass through the screen in a fire, and thereby spread the fire unless other measures are taken.

A fire separation building screen made to EI60 should be able to prevent the spread of both heat and smoke gas for at least 60 minutes.

Fire doors are normally classified in respect of their resistance to fire, with class E and class EI ratings. The European classification system now also includes a special classification for smoke tightness of doors, indicated by S. Two different classes are available: Sa for smoke tightness at room temperature, and Sm for smoke tightness at 200 °C. This means that there are now two types of doors for ‘fire separation’, one which is fire-separating, and one which is smoke-separating. In certain cases, a particular design of door may possess both properties, but not always.

Up to 80% of all deaths in building fires is due to smoke inhalation.

3.0 Doors and Screens as Part of the Solution

Some buildings are designed to be compartmentalised - a design where it is expected that a fire will either burn itself out because it cannot spread, or run out of oxygen and extinguish itself. High rise dwellings are now being designed this way to minimise panic and to stop the spread of the fire.

The secondary reason for containing a fire is to reduce the impact of fire damage on both the fabric and contents of a building. Fire will destroy much of a building, however, smoke and water from fire hoses/sprinklers will also destroy contents and building fabric. If areas can be compartmentalised then there should be much of the building saved from damage which can be occupied again when safe to do so. These designs are becoming more common today as our knowledge of the spread of fire improves and the products used to minimise the spread of fire are developed.

So doors and screens play an important part in an overall plan, opening to allow safe escape passage, but also closing and remaining closed to stop the spread of smoke and ultimately the spread of fire.

One huge area of concern is areas of IT within factories and offices where the smallest amount of smoke will cause damage to data storage. These areas are normally protected by at least EI60 doors and screens. But the issue to remember is that these screens stop the majority of smoke and also stop the spread of fire, but some smoke is allowed to get through the screen but not enough to impede safe exit for occupants.

In IT critical areas such as data storage areas, fire screens are backed up with additional smoke screens with the lobby in between being well ventilated.

Doors and screens come in a wide range of styles designs and finishes. All designs must have been fire tested in their configurations in order to be certified.

Used externally there is an issue of surface spread of flame if used over 18m in height where dwellings are concerned. All external finishes must be capable of achieving a rating of A2-s1, d0, a limited combustibility material or A1 a non-combustible material. Powder coating meets the requirement for the A2-s1, d0 rating. Window and door frames, including curtain walls are exempt, but infix panels and column casings for example are required to comply. The specifier should ensure that where dwellings are located within buildings over 18m in height that materials do meet a minimum rating of A2-s1,d0.

Aluminium screens can easily be constructed, match other finishes in the building structure and can offer very high levels of fire resistance.

4.0 Glazing Options

Typical annealed glass, basic float glass, would break and fail during a fire. Early fire rated glasses were wired which helped keep the glass from falling out of the frame. Current fire rated glasses are laminates of glass and interlayers which can be clear or textured. The interlayers serve to bond the glass together, but also to offer insulation and protection from radiant heat.

In the example shown below, the test on the glazing has just begun and as can be seen by the interlayer already beginning to expand to offer insulation. As can be seen, the interlayer has become opaque to block much of the radiant heat.

The importance of specification comes back to the tests undertaken by the systems provider. Designs of tested systems which have used specific glasses must be used in order to be certified as passing the rating that is required. Systems providers through fabricators will offer this data so that an informed specification can be made. It is crucial that once specified, the specification remains in place.

Laminated glass normally uses a special Polyvinyl butyral (or PVB) interlayer, for fire rated glazing glass is laminated with special transparent intumescent interlayers. When exposed to fire, the pane facing the flames fractures but remains in place, and the interlayer immediately foams up to form a thick, resilient and tough insulating shield that absorbs the energy of the blaze. This takes place at relatively modest temperatures around 120°C, such that protection is provided right from the early stages of a fire.

Gel filled glass systems consist of two or more sheets of toughened safety glass. The cavity between the sheets of glass is filled with a transparent intumescent gel interlayer which reacts when exposed to fire. The number of sheets of toughened safety glass and interlayers is determined by the level of required fire resistance. This product satisfies the highest demands of fire protection. It is robust in handling and UV stable with numerous variations available.

Correct specification and proper installation of fire-resistant glazing is critical to the fire-resistance of the products. The glazing should always be installed in exact conformance to the test certification documentation. Minor changes to any elements of the installation can have a massive impact on the fire-rating of the glazing, which could mean, for example, that there would no longer be enough time to safely evacuate a building.

A frame and glazing under fire test - note how the glazing has become obscured by heat to reduce the transmittance of radiant heat.

5.0 Fixing, Standards and Recommended Reading

Crucial to the integrity of the fire screen is the fixings through the frame to the building fabric. Poor fixings could allow the fire to creep around the screen and continue to spread. It is vital that the fixing method and centres of fixings are part of the specification and are clearly detailed.

It is crucial that all fire doors, screens and curtain walls are provided and installed by a reputable company who can provide the correct documentation to support product compliance. Furthermore, as the building owner (sometimes the tenant) is now responsible for the fire safety of their building, the handover documentation is crucial on completion of a project where clear maintenance instructions are provided to maintain compliance.

If a fire officer is to inspect a building for compliance against the RRO and documentation is not available, then often the doors and screens will have to be replaced.

Standards:

Approved Documents: B : Fire Safety:

Volume 1	Dwelling houses
Volume 2	Buildings other than dwelling houses

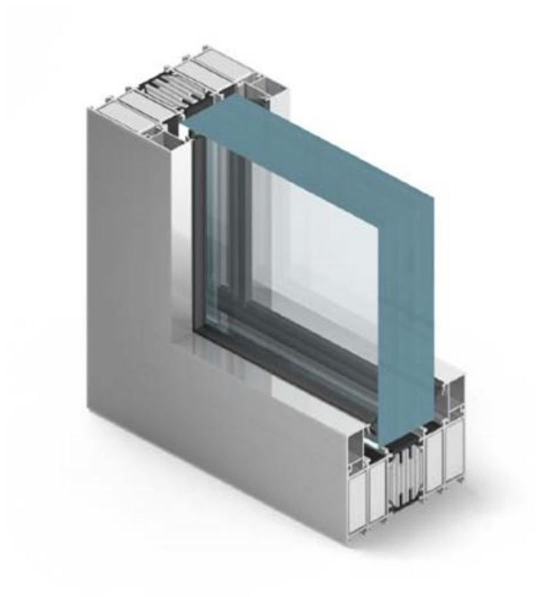
The Regulatory Reform (Fire Safety) Order (RRO), 2005.

Fire test and classification standards for building materials and structures:

BS 476-22:1987	Methods for the determination of fire resistance of non-load bearing elements of construction (under review).
BS EN 1364-1:2015	Fire resistance tests for non-loadbearing elements. Walls.
BS EN 1365-1:2012	Fire resistance tests for-loadbearing elements. Walls.
BS EN 1634-1:2014+A1:2018	Fire resistance tests for door and shutter assemblies. Fire doors and shutters.
BS EN 1634-3:2004	Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Fire resistance test for door and shutter assemblies and openable windows.
BS EN 13501-2:2016	Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services.
BS 9999:2017	ire safety in the design, management and use of buildings. Code of practice.
BS EN1363-1:2012	Fire resistance tests. General requirements.
BS EN1365-2:2014	Fire resistance tests for load bearing elements. Floors and roofs.
BS EN1364-4:2014	Fire resistance tests for non-loadbearing elements. Curtain walling. Part configuration.
BS EN 12101-2:2017	Smoke and heat control systems. Natural smoke and heat exhaust ventilators.

Other:

HTM 05-02	Fire safety in the design of healthcare premises
CWCT TN73	Fire performance of curtain walls and rain screens
BB100	Design for fire safety in schools



A typical fixed aluminium framed fire screen showing insulated cavities and monolithic fire rated glazing.