SCR109/20-R3

Report on considerations for dedicating the smoke ventilation strategy to the protection of the stairwell

Advanced Smoke Group Limited January 2020

Introduction

Recent events have clearly demonstrated the potential inadequacy of the current strategy adopted for the design of smoke control systems in high rise buildings.

The fire at Grenfell Tower demonstrated how important the stairwell is in both escape of occupants and as an access route into the building by firefighters. This is particularly important in buildings with a single stairwell.

The current trend in smoke control design is largely dedicated to depressurisation systems and is addressed in Advanced Smoke Group report reference SCR101/18 entitled "*Methods to improve smoke control in residential apartment buildings using pressurisation"* and published in November 2018

This report examines in more detail the reasons why more attention should be paid to the protection of the stairwell and how a more robust system can be designed to protect designated escape routes.

Why prioritise the stairwell

In the event of fire, it is usual that all lifts will be automatically sent to ground level immediately on detection of the fire and will then be inoperative except for the designated "fire-fighting" lift. As a result of this, the only escape route for occupants will be via the stairwell.

In light of recent experience, it is also now expected that, notwithstanding the direction provided in the apartment block handbook that may say "stay put" in the event of fire, most residents will, understandably choose to leave their apartment and take to the stairs for escape.

Approved Document B1 states that "*The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire,* ***and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times***"**.**

Bearing in mind that the stairwell is likely to be the only route for escape, it follows that a viable and robust smoke control system must be employed for that purpose; a pressurization system is likely to be the only viable and sufficiently robust system to achieve such a condition.

A correctly designed pressurisation system will:

- Support escape of occupants by maintaining the stairwell and refuge areas clear of smoke
- Improve firefighter access and rescue operations by improving visibility
- Further assist firefighting operations by keeping firefighting lift clear of smoke migration

Numerous papers have been posted by senior and experienced professionals in the fire industry emphasising the need to prioritise the protection of the stairwell to permit the safe escape from a high rise building in the event of fire, yet depressurisation systems continue to be installed, systems that have the potential to risk the reintroduction of smoke into the building via the stairwell.

Depressurisation systems
The depressurisation method of smoke control puts the escape routes under negative pressure in order to, in most cases, draw replacement air from the stairwell by “sucking” open the fire door linking the stairwell to the common corridor in which the smoke extract shaft is located.

Air is drawn into the stairwell via the $1m^2$ AOV at the head of the stairs and the air velocity through the interconnecting fire door is expected to stop smoke within the common corridor entering the stairwell.

The risk of reintroduction of smoke into the building occurs when the negative pressure in the stairwell causes the smoke rising from the building to be drawn back into the building through the AOV at the head of the stairs.

This risk of reintroduction of smoke into the stairwell when a depressurisation system is employed will also occur in the event of fire spread to other floors. A depressurisation system is nowadays designed to serve only a single level of the building; that is the level on which the fire is first detected.

In the event of the fire spreading to a second level, e.g. through open or broken windows, a depressurisation system is unlikely to respond by extracting from that second level as well, or any other level to which the fire may spread. Smoke will then follow occupants escaping from the second level into the stairwell which, with a depressurisation system, will be under negative pressure and will consequently induce the smoke into it.

Overcoming smoke migration
A pressurisation system that is activated under “means of escape” mode within a residential apartment building will have the capacity to cope with at least three additional doors opening with the option for enhancing the design capability.

In the event that smoke does migrate into the stairwell due to the number of additional doors onto the stairwell being opened, it will be rapidly cleared to atmosphere due to the operation of the pressurisation system.

How Modern Day Pressurisation Systems Operate
The new form of controls for pressurisation systems are simple, reliable and effective, and remove virtually all the disadvantages and problems associated with the old style pressure sensors, dampers and pressure relief terminals.

The key is to determine what needs to be measured in order to achieve the desired conditions within the building in order to control the spread of smoke and heat in the event of fire. The performance criteria for a pressurisation system remains unchanged, but the method of achieving these criteria has changed significantly.

Current Control Technology
Pressurisation systems are nowadays much simpler and more reliable than depressurisation systems as control technology has become much more reliable and affective. In addition, the equipment used is not normally exposed to the elevated temperatures that depressurisation equipment is.

Greater accuracy in operation, control and monitoring can now be achieved.

Fan Control
Inverters are now able to give extensive control over their full working range, giving extremely fast response time for acceleration and braking operation. This fast response operation is critical in achieving the speed of reaction necessary to avoid excessive pressures on escape doors such as those to stairwells.

Programmable Logic Control (PLC)
Not only has there been reduction in cost in PLC's over recent years, but there has also been a vast improvement in the programming power, bringing cost effective smart products to the area of life safety systems, including that of smoke ventilation.

Evolving Buildings
Buildings do evolve during their lives as new owners move in. there may be changes in use, changes to the in the building's internal layout as well as changes in occupancy. In modern control systems, these resultant changes can be written into the PLC's program of the building's smoke control system, enabling the system to recognize those changes, make necessary adjustments and to continue to function appropriately.

Accuracy of control and impact on system performance
The key to a reliable pressurisation smoke control system is the speed in response to changing operational conditions. For example, as doors from a residential corridor onto a stairwell close, to be compliant with standards and avoid excessive pressure build up onto the close door, the system should respond and reduce the airflow within 3 seconds.

Current tried and tested electronic controls, such as the door proximity sensor system (DPS), are able to meet this criterion, whereas the traditional means of control are unable to do so. The principle reason for this difference in accuracy of controls is down to the ability of the modern range of electronic controls to react instantly whereas the old fashioned control systems, such as pressure sensors and pressure relief dampers, tend to have a delayed reaction, responding to a condition that has already occurred, "historical" data.

The form of controls also rely heavily on frequent maintenance and regular testing to ensure continued reliability, whereas the door proximity sensor form of system control incorporates a self-diagnostic system which will create an alarm in the event of deteriorating performance.

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