How to Design Easily a Smoke Management System?

Compartmentation is the only effective solution to prevent the risk of fire propagation through the HVAC system. A safe compartmentation using reliable motorized fire, smoke and heat dampers will prevent effectively the spread of fire, smoke and heat through the whole building and will thus manage to keep the smoke inside the same compartment, as mentioned in ***Aldes*** *Study. According to the report «Examination of the fire resistance requirements for ducts and dampers» made by* ***Building Research Establishment (BRE)*** *in UK in 2005, fluff, dust, food residue, grease can have an impact on both fire ignition and fire spread inside the HVAC ducts. This means that heat transfer through fire dampers could ignite any fluff or dust on the opposite side, and then spread the fire throughout the building.*

A crucial need for safe compartmentation

According to a study conducted by Aldes, an efficient compartmentation is fundamental to ensure a minimum level of safety inside a building. The main objective is to subdivide a building into fire compartments to isolate a fire at birth and limit spread of fire, smoke & heat through a HVAC ductwork with fire dampers. A fire damper is a device, installed in an air distribution system, designed to close automatically upon detection of heat, to interrupt migratory airflow, and to restrict the passage of flame, smoke and heat.

As smoke is developing rapidly at the start of the fire and spreading quickly throughout the building, stopping the smoke propagation shall be the main priority of a compartmentation system with quick activation through a smoke detection system. Therefore, fire dampers shall be motorized with a quick and instantaneous operation via a fire alarm control panel (FACP) connected to smoke detectors, airtight at low and high temperatures with intumescent fire seal, installed in a HVAC system with fan shut-off quickly after the start of the fire via also a fire alarm control panel (FACP) connected to smoke detectors.

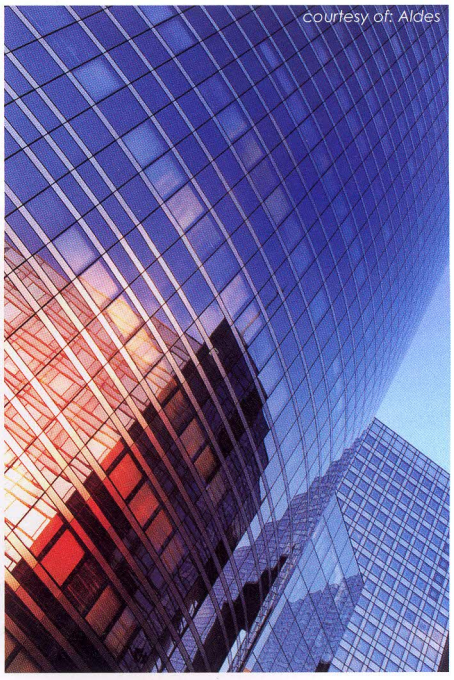
Another priority would be to prevent the flames and the heat transfer from one compartment to another in the post-flash over situation as the temperature is then increasing a lot in a fully developed fire. Therefore, the level of safety inside buildings can be easily increased with efficient fire dampers in compliance to EN1366-2.

Corridor smoke extraction for a safe evacuation of people

Each floor can be divided into two compartments with a fire door and a fire damper to separate both compartments on the same floor. Consequently, thanks to the compartmentation, the safety for the people outside a compartment under fire is theoretically preserved and guaranteed, as revealed in Aldes' study. In reality, there may still be some fire, smoke, and heat hazards in case of a careless installation with violated compartment walls and shafts, and in case of lack of maintenance, testing and regular checking of the activated devices like fire dampers. But a code compliant installation with regular maintenance during the whole lifecycle of the building will guarantee a real safety for the people outside the fire compartment.

On the contrary for the people inside the compartment under fire, an efficient smoke extraction system shall be implemented to let these people escape the building safely during the early stage of the fire (20-30min required usually). Compartmentation and smoke extraction are complementary safety systems where compartmentation confines the fire in its location of origin with an increase of temperature and emission of smoke, heat and flammable hot gases, and where smoke extraction exhausts these fumes and hot gases outside the building. The management of smoke is best done by controlling the high pressure of smoke generated directly by the fire.

The objective of a mechanical smoke extraction system (corridor smoke control) is to create a low pressure point in a corridor (opening through a smoke exhaust damper) to create a controlled smoke passage way. The goal is to extract the most smoke and combustion gases in the early stages of a fire in order to keep the escape and access


courtesy of: Aldes

routes free from smoke and gases. The advantage of the smoke extraction system is to control the amount of smoke and heat not by fighting against it, but rather by working together with its flow and leading the spread of smoke and heat towards safe exhaust openings. Even if the burning rate may increase due to the supply of fresh air, the smoke extraction system creates a "safer" environment by controlling the fire spread and intensity.

Implementing a stairwell pressurization system in the UAE

Aldes stated in its study that a stairwell pressurisation system is an essential smoke management system directly complementing the corridor smoke extraction system. The main goal of the stairwell pressurisation system is to keep the smoke inside the corridor of the compartment under fire to avoid any smoke inside the stairwell, and finally to let the people escape safely the building

under fire, and to let the fire fighters penetrate safely into the building.
In the UAE, the design criteria are quite stringent due to the number of high-rise buildings, the building occupancy and the difficulty to reach the ground level, resulting in a really important need for a safe evacuation. As per the new UAE Fire Code, the stairwell pressurization system should thus be implemented in any building with habitable height exceeding 23 m when internal exit staircases are without adequate provision for natural ventilation.

Mechanical smoke extraction for enclosed car park

Car parks are nowadays integrated directly inside buildings to gain space outside. These enclosed car parks are usually underground at basement level, and thus pose a particular fire hazard due to the amount of motor vehicles and the resulting potential for fire spread. Smoke caused by such an underground car park fire represents the major killer (smoke inhalation), and consequently smoke has to be exhausted outside to let the people escape safely.
A car park smoke extraction system is following the same principles and goals as a corridor smoke extraction system. The role of the car park smoke extraction system is also to create a smoke free layer above the floor by removing smoke, and thus improve the conditions of safe escape and/or rescue of people with a better visibility and reduced temperature. Furthermore, the car park smoke extraction system shall give assistance to the fire brigade to restrict the expansion of smoke to other areas, locate the fire in all its stages and fight it (part of the smoke control), and to clear the car park for smoke after the fire is extinguished.
Whereas ventilation systems and smoke management systems are usually totally different systems with notably different ductwork, a car park smoke extraction system is also used as a car park ventilation system which is designed to remove exhaust gases produced by motor vehicles and ensure a healthy environment with acceptable indoor air quality based on the CO level. Consequently, the design of a car park extraction system has to integrate both constraints for effective pollutants removal (CO, NOx...) and safe smoke removal at high temperature, as stated by Aldes. ■

Prepared by ACW Staff

تعتبر عملية احتواء الدخان في مبنى عبر اعتماد نظام من الحواجز والأجزاء أو الغرف المستقلة الحلّ الفعّال الوحيد لتجنّب خطر انتشار الحريق عبر أنظمة التكييف والتبريد. وتشير دراسة أجرتها (Aldes) إلى أنّ هذه العملية، إذا ما كانت تستخدم مخمّدات للحريق والدخان والحرارة مجهّزة بمحرّكات، تمكّن من تلافي انتشار الحريق والدخان والحرارة في كافة أرجاء المبنى مما يمكّن من احتواء الدخان داخل الغرفة الواحدة. وفقاً لتقرير "دراسة متطلبات مكافحة الحريق للقنوات والمخمّدات" الذي أصدرته (Building Research Establishment) في المملكة المتحدة في العام ٢٠٠٥ فإن الزغب والغبار وبقايا الطعام والشحوم يمكن أن يكون لها تأثير كبير على اندلاع الحريق وانتشاره داخل قنوات أنظمة التكييف والتبريد، مما يعني بأن انتقال الحرارة عبر قنوات الحريق يمكن أن يؤدي إلى إشعال أي ذرة غبار أو زغب في الجهة المقابلة ومن ثمّ انتشار الحريق في المبنى بأكمله.