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Aldes ME Flash

N°24 – May 2011

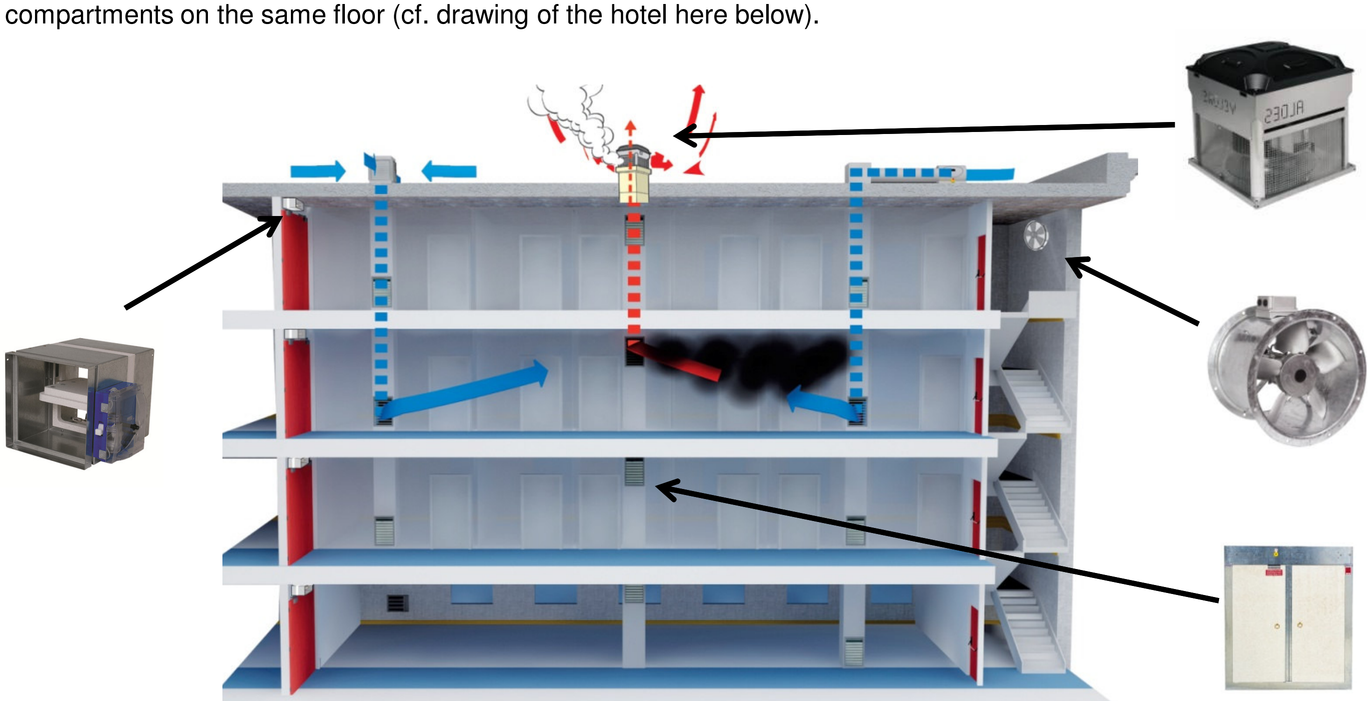
Technical Information

How to design easily a smoke management system?

Corridor smoke extraction for a safe evacuation of people

From a need for safe compartmentation to the need of an efficient smoke management system

A **safe compartmentation** using reliable motorised fire, smoke and heat dampers (cf. European ISONE Fire Damper in Aldes ME Flash 23) will prevent effectively the spread of fire, smoke and heat through the whole building, and thus will manage to keep the smoke (the major killer in fire situations) inside the same compartment. For example, each floor can be divided into two compartments with a fire door and a fire damper to separate both compartments on the same floor (cf. drawing of the hotel here below).



Consequently, thanks to the compartmentation, the safety for the people outside a compartment under fire is theoretically preserved and guaranteed. 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.

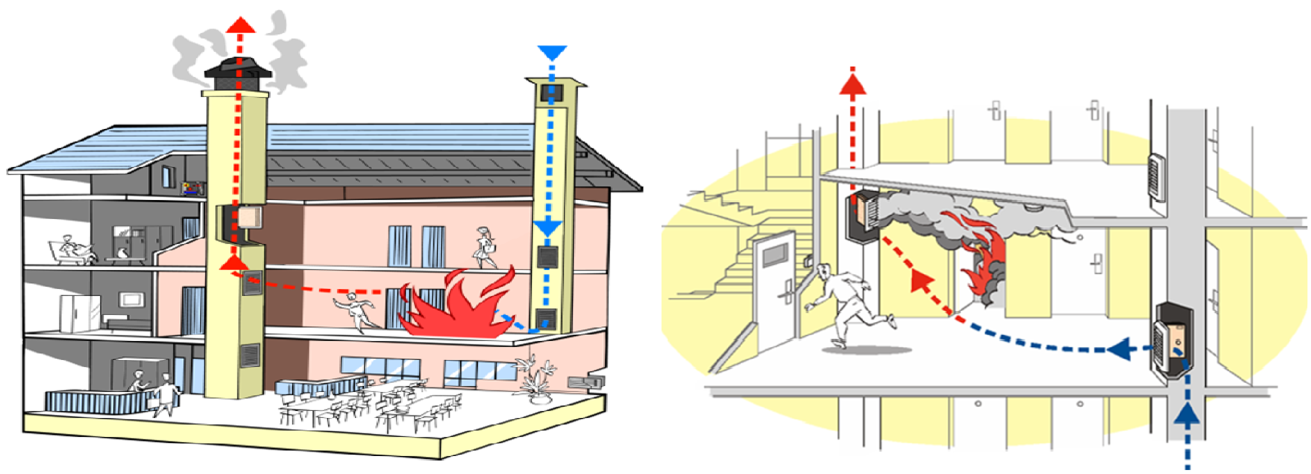
On the contrary for the people inside the compartment under fire, an efficient **smoke extraction system** shall be implemented to let these people escape the building safely during the early stage of the fire (20-30min required usually).

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.

Advantages of a corridor smoke extraction to allow people to escape safely via fire exits

The management of smoke is best done by controlling the high pressure of smoke generated directly by the fire. The way smoke spreads is by moving from areas of high pressure to areas of lower pressure, in an attempt to find a balance.

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 routes free from smoke and gases**.



Corridor smoke extraction system

A basic smoke extraction system is made by one vertical riser supplying outdoor air through an air inlet located close to the floor, and one other vertical riser that extracts smoke via a smoke exhaust fan through a smoke exhaust damper located close to the ceiling. The goal is to create a **smoke free area** (stratification) in the bottom area of a corridor to allow a safe escape and to keep smoke in the upper area of the corridor before being discharged outside.

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.

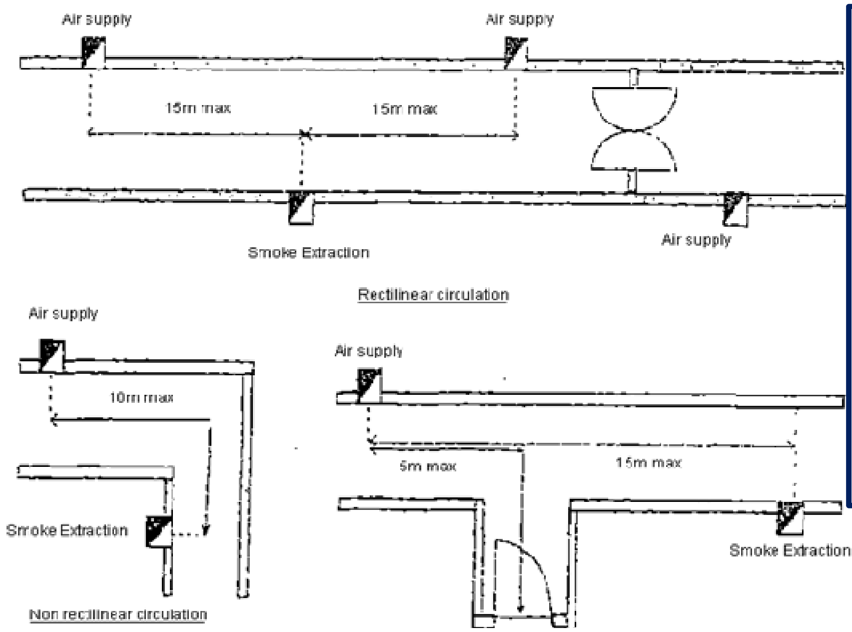
This is a key advantage considering that **fire behaviour is nearly always unpredictable and uncontrollable**. By supplying fresh air and exhausting smoke and heat close to the fire location, a **smoke extraction system reduces the dangers** for fire fighters due to an under-ventilated fire (for eg. flashover, backdraft). In turn this dramatically **eases the fire-fighters' operations** by reducing the temperature and increasing the visibility within the building. 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. This benefits both the victims and the fire fighters during the early stages of a fire.

How to implement a corridor smoke extraction system: design considerations and system guidelines

Corridor smoke extraction should take place in priority for corridors with a total length over 30m, for corridors leading to bedrooms and for corridor located undergrounds.

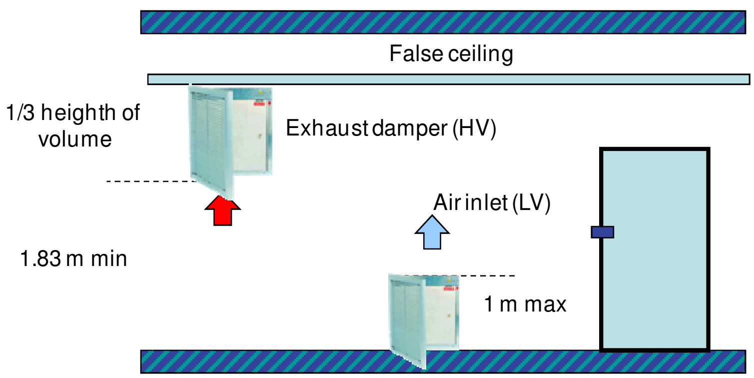
Major steps for the design :

1- Select location of air inlets and smoke exhaust dampers in the corridor



- Air supply inlets and smoke extraction outlets shall be **distributed alternately**. The horizontal distance between supply and extraction, measured along the axis of corridor, **shall not exceed 15m** in case of a rectilinear course and 10m in the contrary case. When a smoke extraction outlet is served by two air supply inlets, the distances between inlets/outlets must be equivalent.

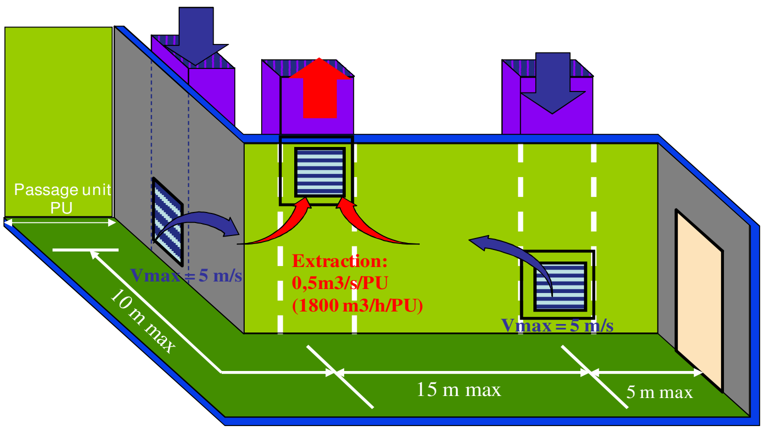
- Any door of a premise accessible to the public, not located between an air supply inlet and a smoke extraction outlet, must be at most 5m distant to one of them.



- **Smoke extraction outlets** must have their lower part at least **1m83 above the floor** and be located entirely within the higher third-part of the corridor.

- **Air supply inlets** must have their lower part at least 300mm above the floor and their highest part **at most 1m above the floor**; they are preferably located in close proximity to fire doors and access doors to staircases.

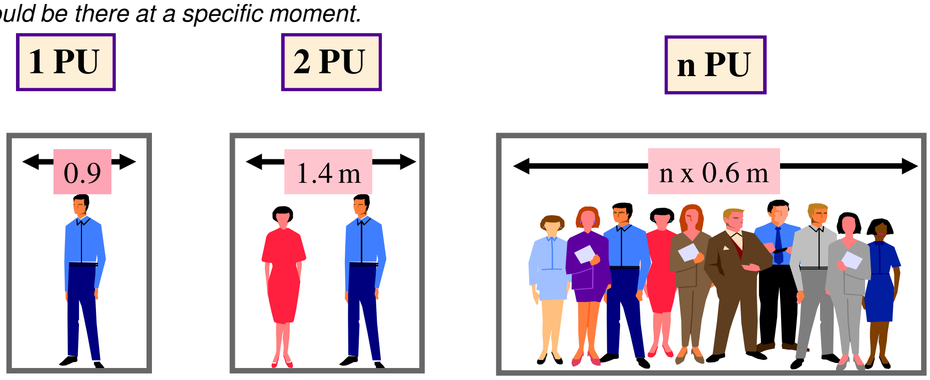
2- Select dimensions of both air inlets and smoke exhaust dampers according to airflow requirements



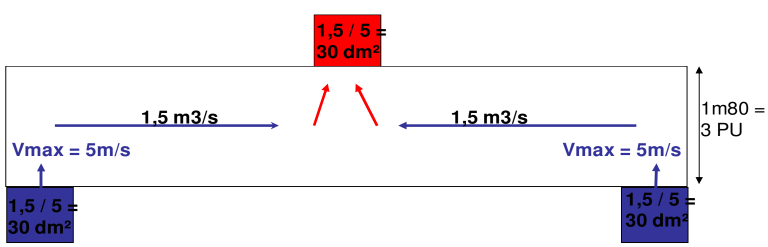
- Any section of a corridor in between a smoke extraction outlet and an air supply inlet must be swept by an extraction airflow at least equal to **0.5m³/s per passage unit** (round whole PU to the nearest value) in the corridor; however the total extraction airflow in a corridor (or a partitioned portion of a corridor) is limited to 8 m³/s.

- Air velocity through air supply inlets must always be **lower than 5 m/s**. Natural air supply inlets must be designed for the overall extracted airflow. Mechanical air supply inlets must have airflow around **0.6 times** the extracted airflow.

<u>Note</u>: A passage unit (PU) is a specific unit characterizing the width of a corridor in proportion of the maximum number of people who potentially could be there at a specific moment.



<u>Example of calculation</u>



A corridor with a length of 30 m requires two air inlets & one smoke exhaust damper. A corridor with a width of 1m80 requires 3 PU. Then the corridor shall be swept by an air flow rate of Q1 = 3 x 0.5 = 1.5 m3/s.

As the air inlet flow rate shall be less than V1 = 5m/s, then its minimum area should be: S1 = Q1/V1 = 1.5/5 = 30 dm².

The smoke exhaust damper shall extract Q2 = 2x1.5=3 m3/s. The exhaust air flow rate is in general V2 = 8m/s, then its area is S2 = Q2/V2 = 3/8 = 37.5 dm².

For example, if the total area of the fire zone is 300 m² with a height of 2.5 m, then the total volume is 750 m³ and the air change rate will be 3x3600 m³/h / 750 = 14.4 volume/hour.

3- Select the right smoke exhaust damper to ensure the best safety and to ease the installation (vertical or horizontal ductwork)

A **smoke exhaust damper** is a device within an air-distribution system to control the movement of smoke, i.e. to stay close to prevent the spread of flame, smoke & heat into other compartments or to open to extract smoke outside from the fire zone.

Aldes range of smoke exhaust dampers: SD 125 – VRFI – VANTONE+GFA 007 Grille

Smoke Exhaust Dampers Comparison

Type		Motorized Smoke Exhaust Dampers	Motorized Smoke & Heat Exhaust Dampers	Motorized Smoke & Heat Exhaust Dampers
Model		SD 125	VRFI	VANTONE
Standards		UL 555S	NF - EN 1366-10	NF - EN 1366-10
Key Features	Fire Resistance	1.5h	2h	2h
	Quick Operation	motorization	motorization	motorization
	No Smoke Leakage	Ok for cold smoke and fumes up to 120°C or 175°C	Ok for cold and hot smoke and fumes	Ok for cold and hot smoke and fumes
	No Heat Transfer	GI blades	Refractory blade	Refractory blade
	Easy Maintenance	Remote control with BMS	Remote control with BMS	Remote control with BMS
	Easy Installation	Horizontal ductwork	Horizontal ductwork	Vertical ductwork
	Energy Saving	Only power cut-off	Only power cut-off	Power cut-off + Power emission available

A **smoke exhaust damper** is always **motorised** to be operated via a fire alarm control panel (FACP) connected to smoke detectors in case of fire and via a building management system in case of preventive maintenance.

As for a fire damper, a smoke exhaust damper must be **airtight** at low and high temperature to **ensure no smoke leakage** in case it has to stay in the closing position. Indeed, they have to prevent the smoke to spread from the smoke exhaust riser towards any other floors. They have also to **ensure no heat transfer** to prevent the spread of fire as well.

Concerning their installation, the easiest and most effective installation is to mount directly the smoke exhaust damper on a **vertical smoke exhaust riser** to limit the ductwork in the building. For this application, Aldes has developed a specific smoke exhaust damper VANTONE with an aesthetic grille GFA 007. VANTONE can also be operated in a **power emission mode** allowing no power consumption at all, and thus guaranteeing **energy saving** for any low-energy building requirements.

4- Select the right smoke exhaust fan to fit the duty point calculated (airflow rate, pressure) and the space consideration for installation

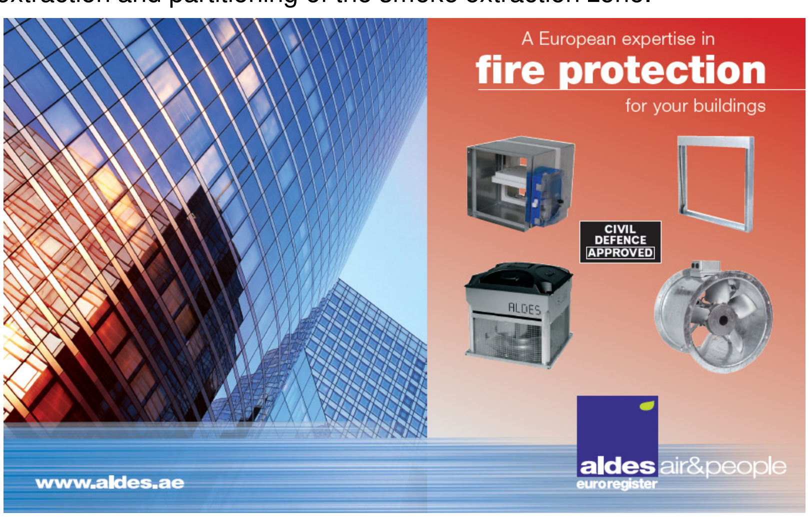
Aldes range of smoke exhaust fans: VELONE – CYCLONE – HELIONE

Smoke Exhaust Fans Comparison				
Type		Roof Fan	Cabinet Fan	Axial Fan
Model		VELONE	CYCLONE	HELIONE
Standards		EN 12101-3 (CE)	EN 12101-3 (CE)	EN 12101-3 (CE)
Key Features	Fire Resistance	400°C - 2h	400°C - 2h	200°C or 400°C - 2h
	Speeds	1 or 2	1 or 2	1 or 2
	Direct/Belt driven	direct driven	belt driven	direct driven
	Max Airflow	27000	32000	72000

Supply and exhaust fans must be designed according to the ductwork features and the rated airflow increased by an acceptable amount of **leakage** (around 20%).

Smoke exhaust fans must ensure their function during **two hours with smoke at 400°C**. Each smoke exhaust fan must be able to be shut down from the manual control location for security setting. They must be installed either **outside the building or in technical premises** separated from adjacent volumes by 1 hour degree fire resistant walls. The access door shall be 1/2 hour degree fire resistant and equipped with a door lock. The ventilation inside the premises shall be compatible with the operation of various equipments installed in these premises.

The control devices must ensure fans startup, within a **maximum delay of 30 seconds** in order to allow the operation of all activated safety devices (fire dampers, smoke exhaust dampers, and doors) ensuring smoke extraction and partitioning of the smoke extraction zone.



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