## **Innovative Fire Ventilation Systems**

FOR PARKING GARAGES AND UNDERGROUND PARK LOTS.



Выставка "Security centre. Engineering and technical safety" 2015

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# Agenda [ 2.3 ]

General information about Smoke Control Systems

## Fire ventilation for enclosed car parks

- General information
- Methods of calculation and their implementation in Europe for Smoke dilution systems ("Smoke Clearance Systems")

#### Traditional ducted systems versus Innovative Impulse ventilation systems

**SMOKE DILUTION SYSTEMS** 

## **Ducted extract systems**

## In General

The most engineers and designers are using traditional ducted systems. Due to the fact that are only know this technology of air distribution and air movement.

The typical layout of these mechanical ventilation systems consist of [1]:

- Using a ductwork
- Ventilations grilles as extraction points
- Smoke extraction fan(s)
- Air inlets







The most engineers and designers are using traditional ducted systems. Due to the fact that are only know this technology of air distribution and air movement.

The typical layout of these mechanical ventilation systems consists of [2]:

- Positioning of the extraction points A usual positioning of the ventilation grilles is:
  - > 50% high level extract
  - 50% low level extract

## Fire ventilation for enclosed car parks

**SMOKE DILUTION SYSTEMS** 

## **Ducted extract systems**

#### In General







**SMOKE DILUTION SYSTEMS** 

## **Ducted extract systems**

## In General

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The main issues which often cause problems for designer are:

- Ductwork runs underneath the ceiling
  - $\rightarrow$  Reducing the height limit for the vehicles !
- Downstand beams require the ducting to be set down below them
  - → This diminishing the height even further !
- Low level extract points are required
  - $\rightarrow$  Often needing protective barriers to surround them !







**SMOKE DILUTION SYSTEMS** 

## **Impulse ventilation systems**

## The principle

Impulse ventilation systems push the air towards a single extract point. Rather than pulling it to multiple extract points as a ducted extract system would.

The typical layout of these ventilation systems consist of:

- Impulse Jet Fans located under the ceiling
  - → Create an air flow towards the extract point, moving smokes and fumes with it.
- Smoke extraction fan(s)
- Air inlets







**SMOKE DILUTION SYSTEMS** 

## **Impulse ventilation systems**

## The principle

The basic principle is as follows [1]:

The Impulse Jet Fans generate thrust and add momentum to the air. This means:







**SMOKE DILUTION SYSTEMS** 

The principle

The basic principle is as follows [2]:

Impulse ventilation systems

- The Impulse Jet Fans generate thrust and add momentum to the air. This means:
  - The mass of air get an moment of force.
  - A small volume of air with higher speed, moves a large volume of air with a lower speed.







**SMOKE DILUTION SYSTEMS** 

## **Impulse ventilation systems**

## The principle

The basic principle is as follows [3]:

- The number and location of fans are carefully chosen to match the system design requirements.
- It must ensured that there are no dead spots for fumes and smoke to stagnate and collect.









## **Traditional ducted extract systems versus Innovative Impulse ventilation systems**

## Which works more efficiently ?

Relating to circulation of air.





## **Ducted systems versus Impulse ventilation systems**

## Example

- Dimensions : 60,0 x 25,0 x 2,5 m (length x width x height)
- Base area : ~1.500 m<sup>2</sup> | Volume : ~3.750 m<sup>3</sup>
- Air exchange rate : 10 ACH
- Necessary air volume flow : ~37.500 m<sup>3</sup>/h



## **Ducted systems versus Impulse ventilation systems**

## Example

- The comparison is done by a CFD simulation. (CFD is the abbreviation for "Computational fluid dynamics")
  - Stereometry of the garage











## **Ducted systems versus Impulse ventilation systems**

#### Example

- Ducted mechanical extract system
  - Stereometry | Layout of the ductwork





## **Ducted systems versus Impulse ventilation systems**

### Example

- Impulse ventilation system
  - Stereometry | Position of the Impulse Jet fans

















## **Ducted systems versus Impulse ventilation systems**

Comparison: Air flow Extraction points of the ductwork



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### **Ducted systems versus Impulse ventilation systems**



#### The impulse ventilation systems have a much better efficiency. This comparison is for the day-day-ventilation.

To reduce the carbon monoxide (the CO concentration).