

## GUIDELINES ON THE USE OF DUCTLESS JET FAN SYSTEM IN CAR PARKS

### 1. OBJECTIVES

The objectives on the jet fan system (under fire mode operation) are as follow:

- a) To relief heat and smoke from the car park in the event of fire
- b) To assist fire-fighters in locating and attacking the fire

### 2. APPLICATION

This set of guidelines is only applicable to conventional basement car parks where passenger cars /light weight vehicles are parked alongside each other with common driveways and is not intended for mechanized car park system or other forms of car parking systems.

### 3. PRESCRIPTIVE & ENGINEERED SYSTEM DESIGN

#### 3.1 Provision of sprinkler system in car park

- 3.1.1 The basement car park shall be sprinkler protected in accordance with the MS 1910:2006 (Fixed Firefighting Systems - Automatic Sprinkler Systems – Design, Installation and Maintenance)
- 3.1.2 The arrangement or the sprinkler heads and the jet fans shall be such that, upon operation of jet fans, the effect on the spray pattern of the sprinklers is minimized. To achieve this, the jet fan shall be located such that the inlet & outlet are not less than 1 meter from any sprinkler point.

### 3.2 Zoning of car park

3.2.1 The car park space shall be divided into smoke control zones with each zone not larger than 2600m<sup>2</sup> (excluding plant rooms and circulation spaces) for purpose of containing smoke within the zone boundaries, unless the fire is located across the zone boundaries

3.2.2. Each smoke control zone shall have its own jet fan system (with dedicated exhaust fans and fresh air make-up) to purge smoke from the affected zone.

3.2.3. The jet fans shall be spaced not more than 15m apart (sideways) and not more than 30m apart (air-throw distance). The same limit applies to distance between jets fans and main exhaust inlet.

### 3.3 Jet fan system

3.3.1 The jet fan system shall be connected to the fire alarm system for automatic and immediate activation of the exhaust fans but with a 2-minutes time delay for the jet fans in the event of fire alarm activation (but excluding manual call point alarm). A manual ON switch for each group of jet fans shall be provided at the Main Fire Alarm Panel (MFAP). Main exhaust and supply fans shall be activated without any delay.

3.3.1 The jet fan system shall be provided with a secondary source of power supply through automatic operation of an emergency generator in case of failure of the primary power supply source.

3.3.2 Interlocking of the jet fan system shall be done in the following manner:

i. Each exhaust fan shall be interlocked with its corresponding groups of jet fans.

ii. If the exhaust fan stops/fails, its corresponding groups of jet fans shall stop.

- iii. The exhaust fan shall continue to run even if any corresponding group of jet fans fails.
  - iv. All remaining groups of jet fans shall continue to run even if any one group of jet fans fails.
  - v. If the fire alarm signal is isolated, the exhaust fans and jet fans shall continue to run under fire mode condition (at high speed where applicable). If the fireman stops the fans and restart them, both the exhaust fans and jet fans shall continue to run under fire mode condition (high speed where applicable). This mode of operation shall continue until the fans are reset to normal condition (or low speed where applicable) at the field control panel.
- 3.3.3 The jet fan system (for fire mode operation) shall be independent of any system serving other parts of the building.
- 3.3.4 The jet fan system design shall be such that the bulk air velocity induced by the jet fans is sufficient to stop the advance of the ceiling jet within 5m from the fire location in the direction opposite to the induced bulk air flow.
- 3.3.5 The Mechanical Ventilation (MV) sub-panel in each smoke control zone shall be connected to the main MV panel, such that any isolation of a jet fan system at a particular zone is automatically displayed at the main MV panel.
- 3.3.6 In the event of failure of the primary source of power supply and subsequent operation of the secondary power supply, the mode of operation on the jet fan system during the fire mode shall follow that prior to the failure of the primary power supply. For example, if the operation of jet fan system in a particular smoke control zone is switched off by the fireman during fire mode condition and the primary source of power fails, the subsequent operation of the secondary power supply will be such that the jet fan system remains in the previous fire mode condition i.e. non-operational mode for that smoke control zone while the other smoke control zones resume operation.

- 3.3.7 The jet fan system design shall take into consideration the presence of any down-stand beams and other obstruction of depths more than 1/10 of the car park floor to ceiling height so as to minimize any resistance to airflow and turbulence.

### 3.4 Operation of jet fans

- 3.4.1 On activation of the jet fans, the movement of smoke towards the extract points should not adversely affect the means of escape and cause smoke to be blown into the lobby area or exit staircases.
- 3.4.2 The operation of the jet fans should be such that there are no stagnant areas (below 0.2m/s air velocity) exceeding 10m<sup>2</sup> where smoke can accumulate in the event of fire.
- 3.4.3 The operation of the jet fans should not cause the volume of air movement to be greater than that extracted by the main exhaust fans.

### 3.5 Wiring arrangement of jet fans

- 3.5.1 All jet fans shall be connected to the local jet fan control panel in groups of not more than 3 jet fans.
- 3.5.2 Each group will be connected by minimum 2-hour fire rated cabling of minimum 2.5mm<sup>2</sup>.
- 3.5.3 Each group of jet fans shall be protected by a miniature circuit breaker (MCB).
- 3.5.4 The incoming power supply shall be protected by an MCB of the appropriate rating and a residual current circuit breaker (RCCB). Should there be a fault with one jet fan, it will trip the RCCB of the group only; it should not trip the RCCB protecting the other groups. As each group of 3 jet fans is also protected by a MCB, this MCB will trip before

affecting the main MCB at the incoming power supply in the event of an overload.

- 3.5.5 The connection of the jet fans shall be such that in the event the motor "burns out" for any one of the jet fans, it will not trip the other 2 fans in the group. And in the event the motor "shorts to earth", the RCCB protecting the group will trip first before affecting the RCCB protecting the main incoming supply.
- 3.5.6 The jet fans shall also be wired in a zigzag configuration such that in the event of failure of 1 group of jet fans, the next corresponding group will be able to entrain the smoke towards the exhaust location to be extracted (please refer to diagram under **Annex A**). Should one group of jet fans fail, all other groups shall still continue to run.
- 3.5.7 The local control panel for the operation of the jet fans within each zone should be located such as to minimize the risk of a fire affecting the control panels serving jet fans of other zones.

### 3.6 Provision of supply air

- 3.6.1 Supply air to the car park can be provided via mechanized supply air fans or by permanent openings equal to or not less than 2.5% of the floor area. The permanent openings should be distributed over the car park areas.
- 3.6.2 The air velocity within escape routes and ramps shall not exceed 5m/s to prevent escapes from being hindered by the air flow.
- 3.6.3 The make-up air intakes should face away from any smoke exhaust points and sited at least 5m apart so as to prevent recirculation of smoke.
- 3.6.4 The make-up air intake should also be located on the opposing end of the smoke exhaust point so that there is

no opposing flow between the supply air and the smoke that is drawn towards the exhaust fan.

### 3.7 Exhaust fan design

- 3.7.1 The car park should be provided with at least 10 air-changes per hour during fire condition.
- 3.7.2 The capacity of the exhaust fans and any associated ducting should be calculated on the basis that the pressure in the car park close to the extract points is equal to the external atmospheric pressure.
- 3.7.3 Each smoke control zone of the car park shall have its own exhaust fan system. The exhaust fan system in each zone should be designed to run in at least two parts, such that the total exhaust capacity does not fall below 50% of the required rate of extract in the event of failure of any one part and that a fault or failure of the exhaust fan system in one zone will not affect the operation of the exhaust fan system in the other zones.
- 3.7.4 The smoke discharge points should be located such that the smoke extracted from the smoke exhaust fans does not affect any occupied area or means of escape at the level where smoke is discharged.
- 3.7.5 The jet fan system should be designed such that air flow of one group of jet fans will not affect more than one (1) escape route or staircase exit.
- 3.7.6 The main exhaust points shall be spaced not more than 60m apart.

### 3.8 Fire resistance of jet fan system

- 3.8.1 The jet fan system such as the mechanized air supply fans, smoke exhaust fans, jet fans, duct works and wiring shall be capable of operating effectively at 250°C for 2 hours.

The fans, ducts and wiring shall be tested in accordance with relevant approved standards such as BS7346: Part 2, BS476: Part 24 or equivalent.

**4. CFD MODELING**

For applications to car parks exceeding 2,600m<sup>2</sup>, the jet fan design shall be demonstrated with CFD modeling and submissions are to be endorsed by the submitting person (Professional Mechanical Engineer).

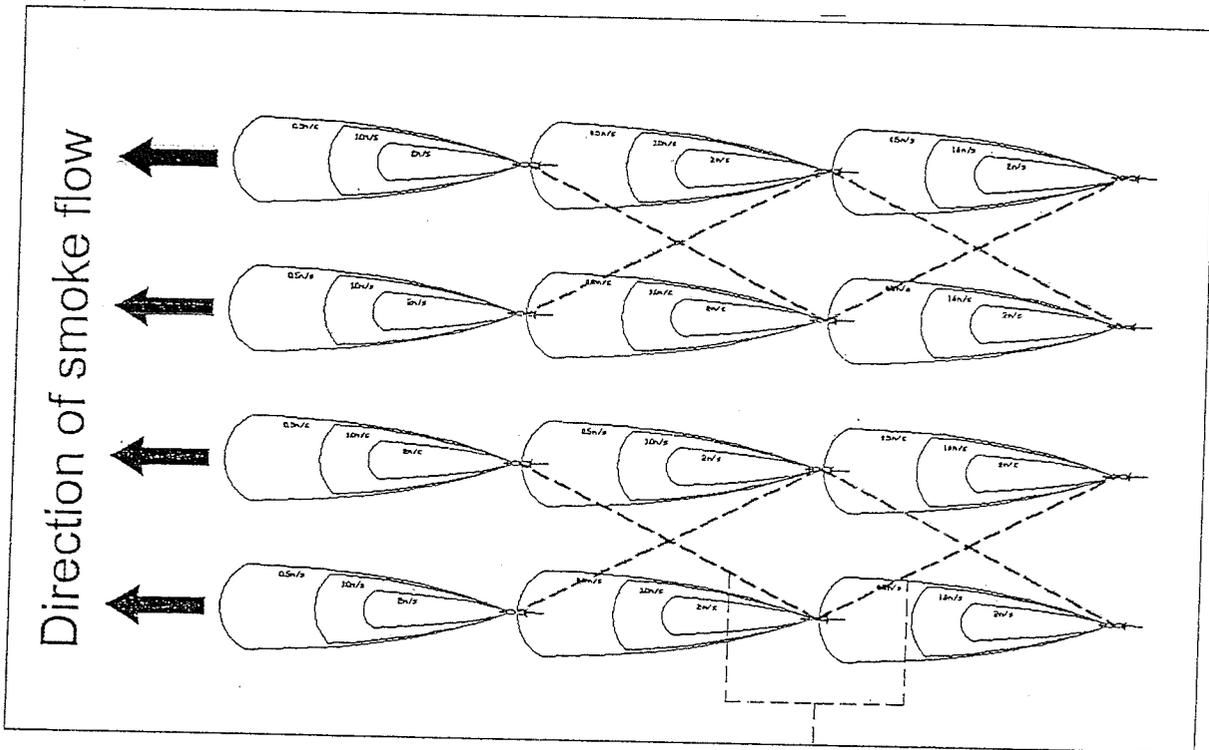
**5. SMOKE TEST**

For applications to car parks exceeding 2,600m<sup>2</sup>, a smoke test shall be carried out to verify the system performance according to requirements by Authorities Having Jurisdiction (AHJ)

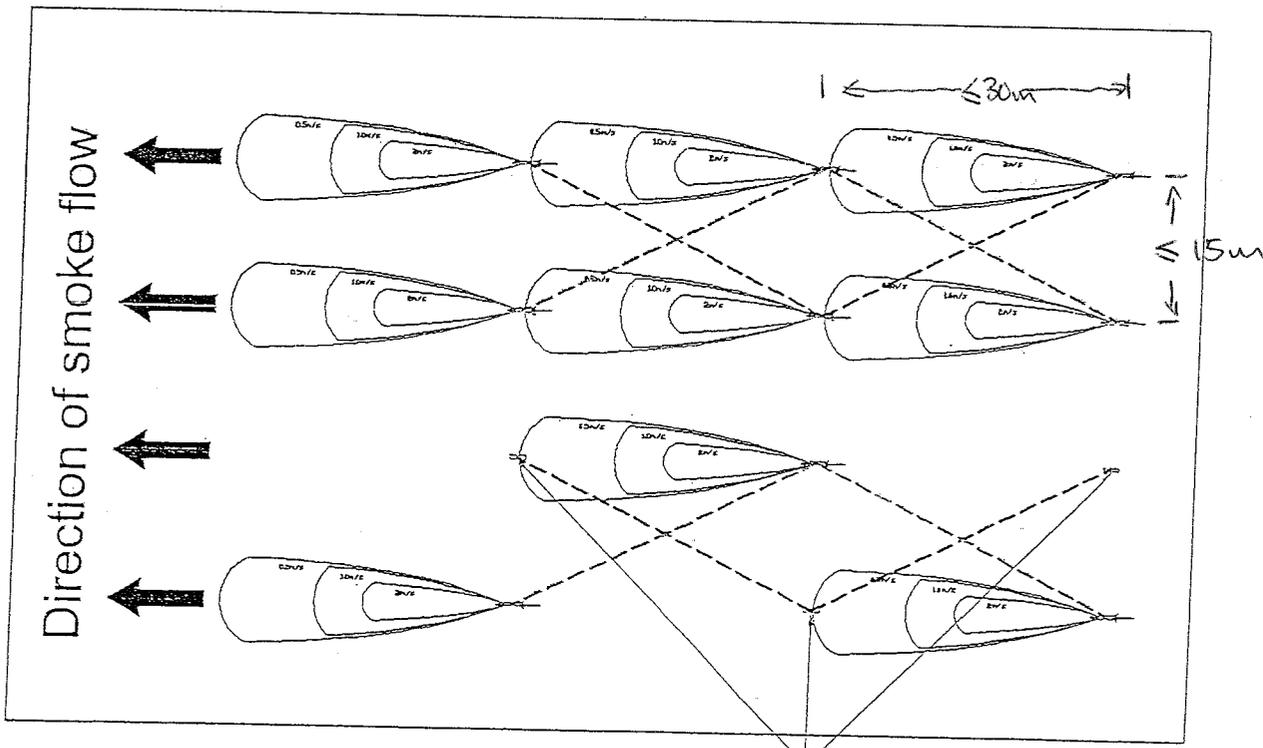
**6. OPERATIONS AND MAINTENANCE MANUAL**

An operations and maintenance manual shall be submitted. The manual should contain the roles and responsibilities of the building owner/operator, the restrictions placed on the building, identification of the sub-systems, servicing and maintenance plan, fault identification, etc. The manual is to be used as a guide for future renovations and changes to the building.

### Normal operation of jet fans



### Operation during group failure



Fan failure