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Report on the risks associated with naturally ventilated car parks

Foreword

Natural ventilation can be the easiest and cheapest way of ventilating a variety of buildings in a variety of applications. The simplest solutions to any application are often the best solution and naturally ventilation should be the simplest.

However, problems can occur due to the simplest of oversights, so I have prepared the following report which considers a range of pitfalls that may be encountered when naturally ventilating a car park, I consider why these pitfalls may occur and explain ways in which the most serious consequences of a vehicle fire may be limited.

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Introduction

There is an inherent problem with naturally ventilated car parks; in the event of fire, there will be no control over how quickly the fire will spread or where the smoke will go. Yes, they may be much cheaper to build and operate with not having to install, maintain and run a mechanical ventilation system; however, this can result in a number of unforseen problems.

Figure 1 – Risks of naturally ventilated car parks

Lack of Control

Naturally ventilated car parks are, by their very nature, susceptible to the unreliability of variable wind direction and wind speed. This will result in an unstable rate of ventilation or worse; in stagnant atmospheric conditions an inadequately ventilated car park can become smoke logged in the event of fire.

Even when there is no fire, stagnant conditions within a car park will result in heavily polluted air due to exhuast pollution with a consequential risk to health.

It is not only variable or unfavourable environmental conditions which can adversely effect ventilation performance within the naturally ventilated car park, the proximity, shape and size of adjacent buildings can also create such adverse conditions.

An adjacent building that when originally buillt may have caused no issues, may undergo structural changes which may have an adverse effect on the ventilation system by causing downdraughts, or starving the car park of the differential pressure across the building which is essential to the efficient crossflow ventilation.

Multi-story car parks which are naturally ventilated and have no means of fire suppression or an alarm system can be at severe risk of a rapid rate of fire spread between levels as well as across the floor of origin. If a vehicle parked at the perimeter of the car park catches fire, or if a fire spreads to a vehicle close to or at the perimeter of the car park, the fire can spread to upper levels via the perimeter ventilation openings as could be witnessed in the Liverpool Echo Arena fire.

Figure 2 - Fire spread between floors via ventilation openings.

UK Building Regulations Approved Documents B & F give guidance on the natural ventilation of basement car parks and this is discussed later in this report. However, it is important to consider not only the area of the ventilation openings to sustain the effiiency of the ventilation system, but also the proximity of the openings to the building and the consequences of a fire within the basement, particualrly bearing in mind the magnitude of the potential fire load.

For example, a naturally ventilated car park in Bristol suffered a multi-vehicle fire. The ventilation system had its ventilation openings flush with the façade of the building, causing the flames from the vehicles below to lick up the façade and re-enter the building at an upper level resulting in a fatality.

Figure 3 & 4 – example of the hazards of ventilation openings adjacent to a buildings facard

Current Building Regulations accept that ventilation openings may be located at ceiling level. Care should be taken when adopting this option. Although when venting smoke the bouyancy of the hot gases assist the ventilation of smoke, an efficient natural ventilation scheme will rely on the pressure differential across the car park to clear polluting gases, whether from a fire or from vehicle exhuast pollution during day to day ventilation.

Ceiling mounted openings serving a natural ventilation system will also be liable to downdraught which will certainly compromise the performance of the system.

Need for Alarms & Suppression System

In a naturally ventilated car park there will often be no alarm system to notify occupants and managers of a fire. The inherent risks here are two fold: first, if there is no alarm and a fire develops over night, it is quite likely that there will be a long period during which the fire can spread uncontrolled creating an extremely large fire and a serious risk to life.

Second, there could be a long delay in notifying the emergency services of the fire resulting in problems of access by fire fighters and consequential additional damage to the structure of the building.

Figure 5 – Uncontrolled fire spread

It is strongly advised that a naturally ventilated car park should have sprinklers installed. Without ventilation control of a potential fire, there is a real risk of rapid fire spread and a danger to life.

An uncontrolled fire will quickly spread with an associated build-up of smoke creating respiratory problems to any occupants of the car park and rapid rise in smoke layer temperatures with resultant damage to the structure of the building and, potentially, the stability of the building could be compromised.

Odd Rules in Building Regulations

Contained within the current building regulations Approved Documents B & F there are statements of requirements that no-one is likely to be able to give an accurate or informed answer as to where the figures quoted come from or even justify their existence.

For example, the requirement for the free area of openings required to support a car park being classified as naturally ventilated for day to day ventilation purposes is quoted in AD-F as 5% of the car park floor area or 2.5% plus 3 air changes per hour by mechanical means. These figures are to be applied to the building irrespective of car park size.

In AD-B, to provide for smoke clearance in the event of fire, 2.5% of the floor area is required to be provided for natural ventilation with no additional air changes provided by mechanical means.

These figures, without justification appear odd. Yes, the reduced area of 2.5% with no mechanical assistance in the event of fire might be explained as the buoyancy of the gases will assist in the venting of the smoke, but where does the 2.5% come from?

Also the requirement of only 50% of the openings being located equally on each side and the remainder being distributed “elsewhere” also appears odd. How can one be certain of achieving the necessary crossflow ventilation if little regard is given to the distribution of the ventilation openings?

There is no guidance provided in the regulations relating to the ventilation of loading bays, although BS9999 refers to the Smoke Control Association publication giving guidance on the venting of loading bays and coach parks. This document also refers to the adoption of 2.5% of the floor area of the loading bay for venting smoke in the event of fire and this appears to be an acceptable solution by regulators irrespective of the fact that there is likely to be a substantially larger potential fire load within a loading bay to that of a car park. And we still do not know where the 2.5% figure comes from.

Conclusions

To support a naturally ventilated car park the following should be seriously considered:

1. If natural ventilation is adopted, the installation of a sprinkler system is recommended
2. An automatic fire alarm system linked to a central monitoring station is advised
3. An alarm system could form part of a sprinkler installation by incorporating a flow switch or switches within the sprinkler pipework and linking them with an alarm system
4. Install a pollution monitoring system to activate an alarm if pollution levels hit a critical level
5. More research is needed to justify the building regulation requirements for the openings specified for naturally ventilated car parks
6. The requirements for openings for naturally ventilated loading bays, service yards and coach parks need to be more seriously considered bearing in mind the potential fire loads that exist within them.

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