Fire Safety Guideline

Guideline No: GL-03

Car Parks without Sprinkler Systems

Prepared By:                           Authorised By:                   DocCentral Number: 953841
MFB Fire Safety Advisory Group         Director Fire Safety

1. PURPOSE
The purpose of this guideline is to provide a consistent MFB position for Report and Consent applications under Regulation 309 of the Building Regulations 2006, where the prescribed fire safety matter pertains to an alternative solution for the deletion, part deletion or variation of an automatic fire sprinkler system in an enclosed car park.

2. SCOPE
This guideline is applicable to car park buildings with the following characteristics:

- Enclosed (basement or above ground);
- Enclosed with partial openings (but not deemed open deck for the purpose of the BCA);
- Multiple level (any combination of the above); &
- For guidance on enclosed car parks incorporating multi-tiered vehicle stacking devices, please refer to MFB Guideline - 32 Car parks incorporating multi-tiered vehicle stacking device.

3. DEFINITIONS

“BCA” means the Building Code of Australia 2009 and includes any amendment, remaking or replacement of the BCA.

“DTS” means the deemed-to-satisfy provisions of the BCA.

“MFB” means the Metropolitan Fire and Emergency Services Board.

“Open-deck car park” means a car park in which all parts of the parking storeys are cross-ventilated by permanent unobstructed openings in not fewer than 2 opposite or approximately opposite sides, and—

(a) each side that provides ventilation is not less than 1/6 of the area of any other side; and

(b) the openings are not less than ½ of the wall area of the side concerned.
“Prescribed fire safety matter” the fire safety matters prescribed under Building Regulation 309;

4. INTRODUCTION

Anecdotally, fire incidents within general vehicle parking areas, relative to other classes of buildings are infrequent but can result in large severe fires [1]. Aspects of design that do not manage fire growth and spread have the potential to increase the risk to occupants and firefighters, and also result in increased losses in a facility causing greater economical, social and environmental impacts.

5. BCA COMPLIANCE

The Deemed-To-Satisfy (DTS) provision E1.5 of the Building Code of Australia (BCA) requires all enclosed car parks containing more than 40 cars to be sprinkler protected however, car parks deemed to be “open deck” are excluded from this provision. The 40 car criteria level would appear to be considerate of the inherent fire risk, whereby limiting the number of cars limits the fuel load and indirectly the size of the building compartment.

Any alternative solution relating to the deletion, part deletion or variation of an automatic fire sprinkler system in an enclosed car park must meet the Performance Requirements of the BCA. The relevant Performance Measures of Clause E1.5 of the BCA are:

- CP1 Structural Stability
- CP2 Spread of Fire
- EP1.4 Automatic Fire Suppression System
- EP2.2 Occupant Evacuation (including fire brigade intervention)

All aspects of the above requirements should be addressed in each design and where compliance with all requirements has not been adequately demonstrated the design may not be acceptable. Further commentary and examples of this process are contained within Section 1.2.8.2 of the International Fire Engineering Guidelines 2005, and MFB Guidleline - 33.

6. CONSIDERATION OF VARIATIONS UNDER BUILDING REGULATION 309

When assessing an application for variations under Building Regulation 309, the Chief Officer is required to determine if a “satisfactory level of fire safety” will be achieved by the proposal. In determining the level of fire safety, the Chief Officer is not only considerate of the specific prescribed matter for which the application is in regard to. The total context and encompassing fire safety solution must also be considered. Additionally, the MFB has the legislative requirement under the Metropolitan Fire Brigades Act 1958, to attend, control and extinguish all fires. All the above considerations will impact on the final determination.

Where a prescribed matter is proposed to be varied in a building with an enclosed car park, and the car park will not be fitted with an automatic fire sprinkler system, there is an increased likelihood of greater fire spread and development. If not adequately treated by suitable means, this may increase the risk to life, health and safety of occupants and firefighters. Additionally, it may also impact on the effectiveness of firefighting with regard to search, rescue and prevention of property loss.
Where the applicant does not demonstrate that the total fire safety system, and not just the matter to be varied, will achieve a satisfactory level of fire safety through correct legislative process and procedure, the Chief Officer may refuse the application.

7. BRE RESEARCH - FIRES IN ENCLOSED CAR PARKS IN (OCTOBER 2009)

BRE Research undertook a Project titled - Fires In Enclosed Car Parks in October 2009 on behalf of the UK Department of Communities and Local Government. The aim of the research project was to gather information on the nature of fires involving recent model cars for inclusion into existing guidance on fire safety strategies for enclosed car parks. Specifically, “the objectives of this task were to benchmark car fire sizes for a range of vehicle types in a typical car park, determine the spread of fire between cars and the severity (heat release) of car fires and to seek to determine the associated conditions (heat, smoke, toxic gas) to car park occupants exposed to such a fire, under typical conditions.”

The project involved eleven full scale tests including tests on single cars, several car involvement due to horizontal fire spread and two cars in a multi-tiered vehicle stacking device in a vertical configuration. Ignition factors ranged from no. 7 cribs* on drivers seat with and without ventilation, engine bay fires and subjecting the external car surface to incident radiant heat. Spread of fire was studied in a vertical configuration with an adjacent car and empty spaces, vertically in a multi-tiered vehicle stacking device and from the engine bay to another car in a “nose to nose” configuration.

The findings of the research included “The ease with which a car fire in a car park might spread to nearby cars has been demonstrated. Once a very severe fire has developed, fire will spread to other cars separated by an un-filled parking bay”.

“In this situation, where a number of cars are burning simultaneously, the fire is exacerbated by heat-feedback and heat release rates in excess of 16 MW might be achieved from two or three cars. In Test 1 the initial car fire, Car 1, burned at around 2 MW for about 20 minutes and it was only then that Car 2 became involved (although Car 3 then ignited very soon after). However in Test 3, all three cars were burning after around 10 minutes. In Test 4 (Buxton – LPG), Car 2 was alight after 21 minutes and all four cars were burning after around 23 minutes. In Test 8, an engine fire test with a nearby car “nose to nose” the fire spread to the second car within 5 minutes.”

“The ventilation limitations on such a fire in an enclosed car park result in a very hot ceiling jet, which spreads the fire to nearby cars with the dominant mechanism of heat transfer being radiation from the flames and hot gas layer, but with some direct flame contact. There were only a limited number of cars in each of the tests (a maximum of four); however escalation to many cars within a specific proximity in an actual car park must be expected under these conditions.”

Gas temperatures in the enclosed rig (beneath parts of the ceiling) reached 1100°C in all the enclosure tests, exceeding 1200°C briefly in Test 4.
8. FIRE ENGINEERING ANALYSIS AND DESIGN CONSIDERATIONS

Design fires

The key to a realistic fire engineering assessment is to use a “worst credible case” fire scenario. The following test results have typically been adopted for car fires to assess the fire safety of a particular design and are considered a reasonable representation of the heat release rate curve associated with car park fire assessments.

(a) Research detailed in Natural Fires in Closed Car Parks: Car Fire Tests. Daniel Joyeux, 1997. demonstrates a peak heat release rate of 8MW for later model vehicles (1990’s) where the ignition source is the internal passenger cabin, which was a significant increase from earlier model vehicles. Fire tests by others [6] demonstrated a HRR of up to 8.5 MW and a van fire of up to 15MW. It is important to remember that large cars such as vans and larger four wheel drive vehicles make up a significant proportion of modern vehicles.

The BHP tests [2] on car fires showed that considerable amounts of smoke were produced by old model cars. It is reasonable to expect that current vehicles would produce more smoke due to an increased use of plastics, rubbers etc.

(b) The Design Fire recommendation made in Profil ARBED Recherch [4] refers to a two and a three-car fire. The two car fire Heat Release Rate (HRR) is approximately 1.5MW at 4 minutes which remains steady until 17 minutes, at which time the HRR rises to 5.5MW at 24 minutes, and then rises to a peak HRR of 8.5MW at 26 minutes before decaying with completion at 70 minutes.

The three-car fire HRR is approximately 4MW at 12 minutes and is constant until 15 minutes before rising to a peak HRR 16MW at 26 minutes, then decays to 9MW at 38 minutes, peaking again slightly to 11MW at 40 minutes and decaying further with completion at 60 minutes.

(c) Conditions within the car park should remain tenable for the duration of a primary search by responding firefighters. A primary search is limited to teams of 2 firefighters travelling along the primary vehicle circulation paths. Use of appropriate tenability limits for firefighters and the FBIM is critical.

(d) Tenability is considered to be exceeded when radiant heat and temperature conditions outlined in MFB Guideline GL-17 are exceeded.

(e) This shows that while (purpose-built) car parks have a low injury rate (only offices are “safer”), the injury rate for car park fires in flats is high. 12 years of data was reviewed (from 1994 to 2005. The bulk of the UK fire statistics are collected by the CLG (formerly Home Office) Research, Development and Statistics Directorate. They are based on the FDR1(94) forms filled in by the fire brigades after a fire has been attended

CAR PARK DESIGN RECOMMENDATIONS

(a) Fires in enclosed basement car park can create an extremely hot and toxic environment if adequate ventilation or means to restrict fire spread and development is not provided. The BRE Research7 demonstrated the occurrence of very hot ceiling jets (>1100oC) which spreads the fire to nearby cars through radiant heat from the hot gas layer and flames.
Smoke exhaust systems should be designed appropriate to the expected conditions within the compartment to ensure continued operation in a fire event;

(b) There are difficulties associated with accounting for the number of occupants, especially in public car parks. Therefore a search of the area is highly likely in a fire situation and may be the only way to confirm that all occupants have evacuated.

In an unsprinklered car park, fire continues to develop, spread and generate large quantities of toxic smoke. Even in partially open sided and undercroft car parks, severe acrid smoke would potentially make it extremely difficult to access, locate and fight a fire. Therefore ventilation openings in car parks need to be assessed so that an acceptable level of smoke spill to the outside of the building is provided. Where natural ventilation is proposed, the head of the opening should be located above 2.1 m to allow the spill of smoke and hot gases which may increase the time for occupant and fire fighter tenability. Low ceiling heights should be avoided.

(c) Any storage areas near parked cars that could contribute to the overall fuel load should also be taken into account. Residential buildings commonly have storage areas within mesh enclosures inside the car park.

(d) Exit routes and locations should be kept simplistic, predictable and readily identifiable. Design acceptance should be considerate of a smoke filled environment. Access difficulties for firefighting personnel and equipment that lead to a delayed response in terms of search and rescue, water setup and initial firefighting activities. Delays can lead to greater risk to life and property. Access should again be simplistic, predictable and readily identifiable in a location that provides firefighters with safe access to all parts of the car park.

(e) Open connections from the car park to other parts of the building should be avoided unless adequately separated to prevent the passage of smoke and fire. Smoke and fire protected lobbies are recommended to provide redundancy in the separation between fire compartments;

(f) An "Interactive" type addressable detection system may be proposed to provide early detection and avoid spurious alarms in the car park. A heat detection system may be considered, however, due to the delayed response time, would result in a slower intervention and evacuation time. (The expense of capital investment and maintenance with these systems should be analysed from a cost benefit point of view in comparison with sprinklers).

(g) A reliable and effective Emergency Warning and Intercommunication System (EWIS/SSISEP) should be retained where required by the BCA or alternatively included as a non-required design addition.

(h) Building occupant training in emergency and evacuation procedures should be provided along with site specific tactical fire plans.

9. AUTOMATIC FIRE SPRINKLER SYSTEMS

Automatic fire sprinklers have been demonstrated as an effective means of preventing fire spread and development in car fires and therefore must be a major consideration in the fire safety design of enclosed car parks. The advantages of fire sprinkler systems are:

(a) Increased level of life safety for occupants afforded by sprinklers in the car park due to a significant delay in the onset of untenable conditions;

(b) Reduction in the amount of heat and smoke to assist with effective Fire Brigade Intervention, especially in search, rescue and locating the seat of the fire;
(c) Fires in a sprinkler protected car parks can often be readily extinguished with first aid firefighting equipment resulting in decreased loss of property and risk to the structural integrity of the enclosing structure;

(d) Sprinklers will control the fire size but in an unsprinklered car park, the provision of a smoke exhaust system may accelerate the fire growth, depending on ventilation environment.

Generally the MFB does not support large enclosed car parks without sprinklers. If sprinkler systems are proposed for other areas of a building then consideration should be given to extending these through to car parks.

10. FURTHER TECHNICAL REFERENCE

MFB Guideline 33 - Performance Based Design within the Built Environment;

- MFB Guideline - 32 Car parks incorporating multi-tiered vehicle stacking devices;

PN 2007 59 - Sprinkler Systems - alternative solutions and role of chief officer

(Building Commission Practice Note)

11. REFERENCES


1. [7] BRE Research Project - Fires in Enclosed Car Parks (Oct 09) on behalf of the UK Department of Communities and Local Government,

2. [8] BD2552 - Fire Spread in Car Parks (BRE - Department for Communities and Local Government December 2010)


Note: This is a controlled document and may only be modified by authorised personnel after review by the MFB Fire Safety Advisory Group.