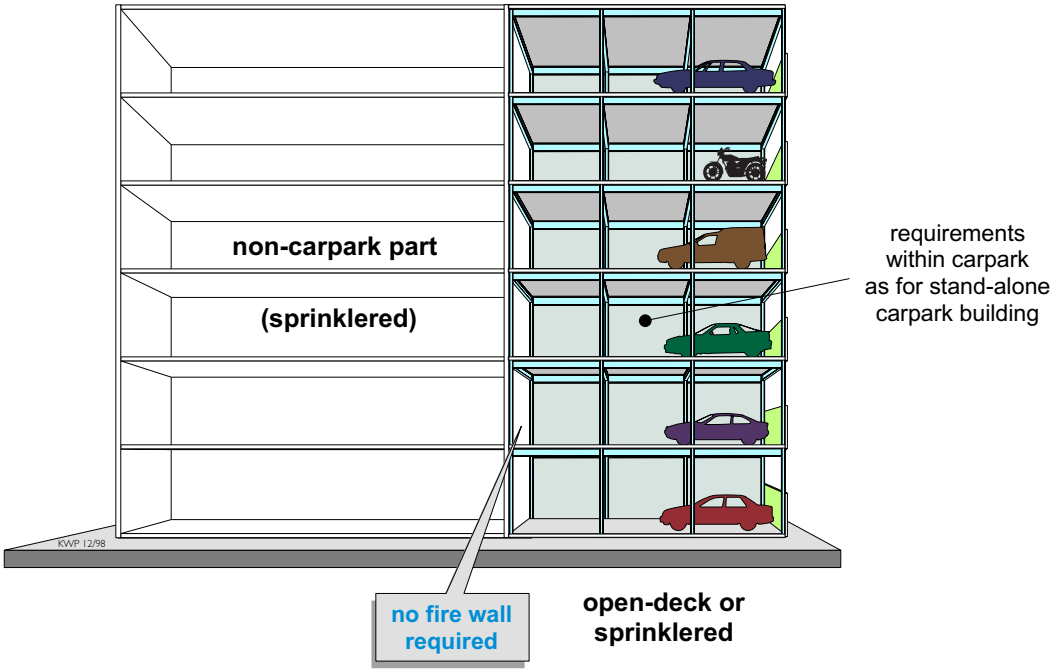
Fire-Engineering Approach

Alternative Solutions for Open-Deck or Sprinklered Carparks

The alternative solutions presented in this section are based on fire-engineering assessments of the situations and differ from the deemed-to-satisfy provisions of the BCA. The solutions are considered to satisfy the performance requirements CP1, CP2, CP4, CP7 and CP8. The solutions relate only to carparks which *adjoin* a non-carpark part of a building, or those which are located *below* parts of another classification.

Carparks adjoining other parts

Recommendation



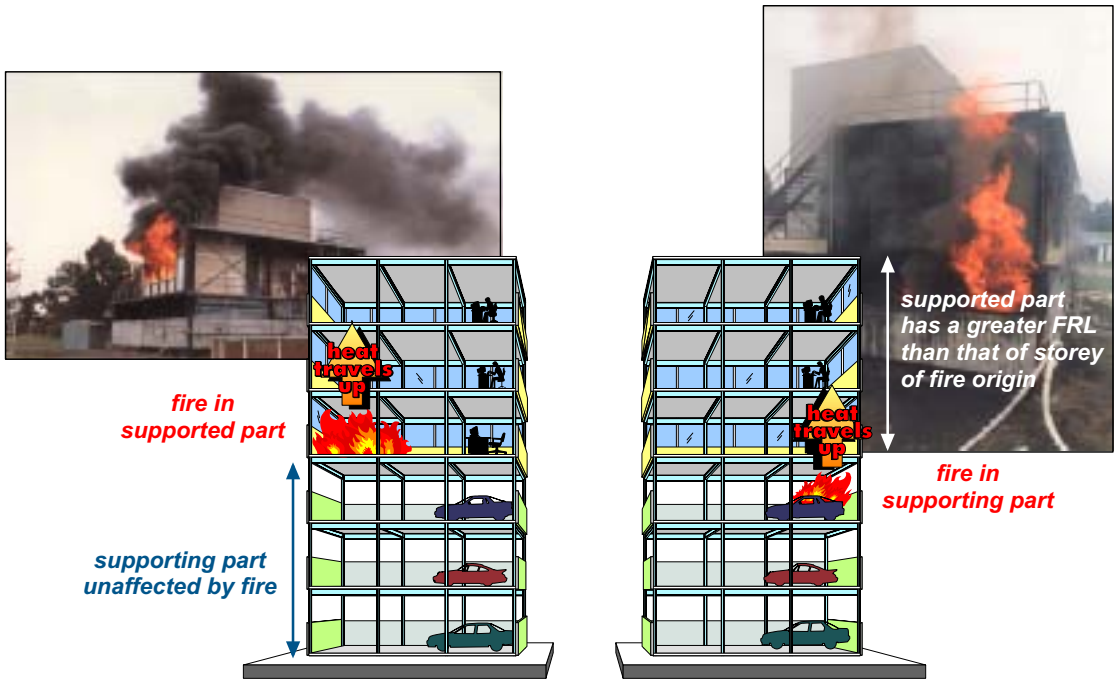
An example of such a situation is where an open-deck or sprinklered carpark is directly adjacent to a shopping centre building and where direct access between the two is required. The severity of a fire in a part of a building is dependent on the fire load, ventilation conditions and the fire-safety systems in that part. Thus the non-carpark part of the building should be designed for the fire load, ventilation, and fire-safety systems in that part, and the carpark part should be designed in a manner appropriate for a carpark. The only way that the carpark part of the building will experience the severity of fire associated with the non-carpark part, is if the fire in the non-carpark part vented itself into the carpark. The incorporation of sprinklers into the non-carpark part of the building will greatly minimise the likelihood of such an occurrence.

It is therefore argued that a *fire wall* separating the carpark part from the other part is not required in situations where the non-carpark part of the building is sprinklered.

This is not to say that some barrier between the two is not required for smoke separation purposes. The need for such a barrier, and its construction, needs to be assessed carefully for each situation. However, it is not necessary to separate the two parts with a *fire wall*.

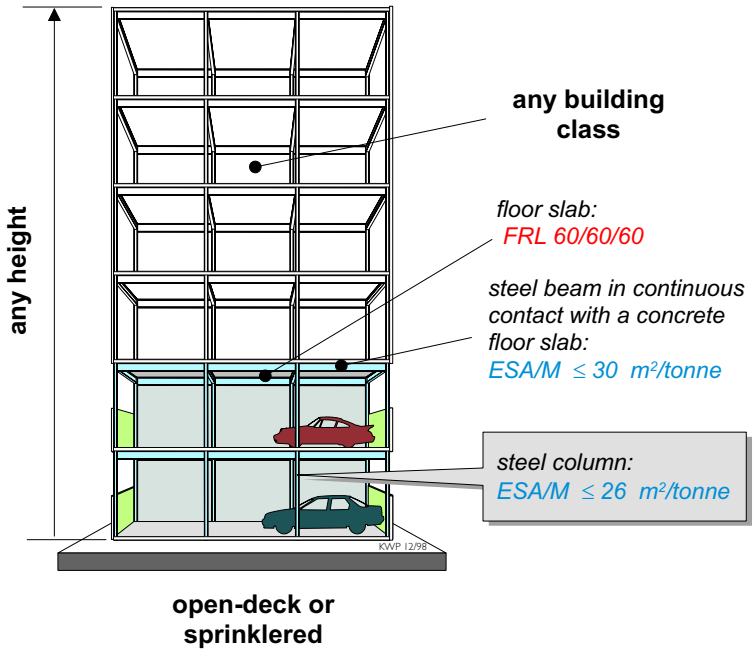
Carparks below other parts

The severity of fire within the carpark levels is a function of the fire load, ventilation, and fire safety systems within the carpark levels, not those associated with the levels above the carpark. This is because heat moves upwards, not downwards; and the hottest part of a fire is above the fire, not below it. Thus the carpark levels should be designed for the situations likely to be experienced within the carpark, and the non-carpark levels for the situations likely to be encountered within those levels.



The above position has been accepted in the BCA—as illustrated by the deemed-to-satisfy provisions of the BCA, with the exception that the columns within the carpark are required to have an FRL of 60 minutes. This requirement was added in order to gain agreement from all state regulatory authorities. However, it is our assessment that if columns have an ESA/M less than 26 m²/tonne, no further fire resistance is required.

Recommendation



The basis for the recommendation is:

i. Experimental results show that, if the carpark levels are open-deck, the maximum temperature achieved by a column directly adjacent to a car on fire is 260°C—well below the value of about 600°C at which the column will shed load to cooler parts of the structure. Thus there is a substantial factor of safety.

ii. Although the reliability of a sprinkler system within office or retail buildings can be very high, the reliability of the sprinklers within the carpark levels will be very close to 100% provided the sprinkler system for the building is designed such that the system within the carpark levels is independent of that in the non-carpark levels (see BCA Specification E1.5, Clause 11). The reason for this is that sprinkler reliability is affected most by intentional isolation of the system. The most common reason for sprinkler isolation is to allow sprinkler head relocation as required for tenancy upgrade and modifications to a level. In comparison with office or retail levels, modification of the sprinklers within the carpark levels is rarely required.

   According to fire tests conducted in a closed carpark with a functioning sprinkler system, a maximum column temperature of about 50°C was obtained—well below the value of about 600°C at which the column will shed load to cooler parts of the structure.

iii. Irrespective of the benefits obtained from the carpark levels being sprinklered, as described above, it is known that fires in carparks will tend to be localised due to the fact that each car body will act as a form of enclosure and limit fire spread. Thus, the overall stability of the building is unlikely to be affected, even in the very unlikely circumstance of sprinkler failure.

carpark with bare steel beams and columns

Is an FRL of 60/60/60 appropriate for the slab separating the carpark—given the higher levels of fire-resistance level that may be required for the levels above the carpark? In answering this question, it should be noted that:

- a fire will have a considerably greater impact on the floor *above* the fire than the floor below
- fire spread into the carpark level would be most unlikely even if the temperature of the unexposed face of the carpark floor slab reached well above the insulation failure criterion specified in AS1530.4—1997 [5]
- there are few, if any, combustibles in direct contact with the underside of a carpark floor slab, and it is much more difficult for fire to spread downwards than upwards

It is concluded therefore, that an FRL of 60/60/60 is appropriate as a practical minimum.

It is also our assessment for Types B and C buildings involving Class 2 or 3 parts, that provided the floor *slab* between the carpark and the Class 2 or 3 part has an FRL of 30/30/30, there is no need for any protective covering to be applied to the underside of the floor as currently required by BCA Clause C2.9 and Specification C1.1, Clauses 4.1(d), 5.1(e).

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ECONOMICAL CARPARKS

A Guide to Fire Safety

300 PLUS

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Abbreviations used:

ESA/M = The ratio of exposed surface area to mass per unit length (see Appendix A for ESA/M of steel sections).

FRL = Fire-resistance level—the grading periods in minutes determined in accordance with BCA Specification A2.3 for the following criteria -

(a) *structural adequacy*; and
(b) *integrity*; and
(c) *insulation*,

and expressed in that order.

Note: A dash means that there is no requirement for that criteria. For example, -/-/- means there is no requirement for an FRL.

FSF = Fire-source feature— means-

(a) the far boundary of a road adjoining the allotment; or
(b) a side or rear boundary of the allotment; or
(c) and external wall of another building on the allotment which is not a Class 10 building.

Definition: **Bare steel** — steel members which have no fire-protective coating.

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