

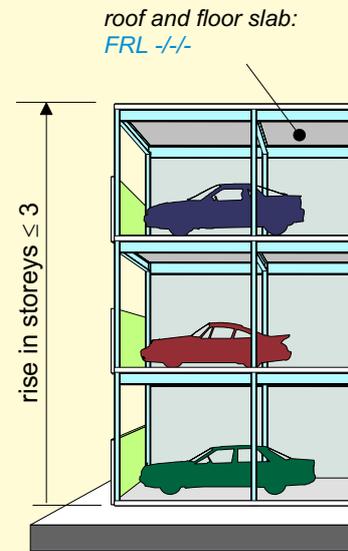
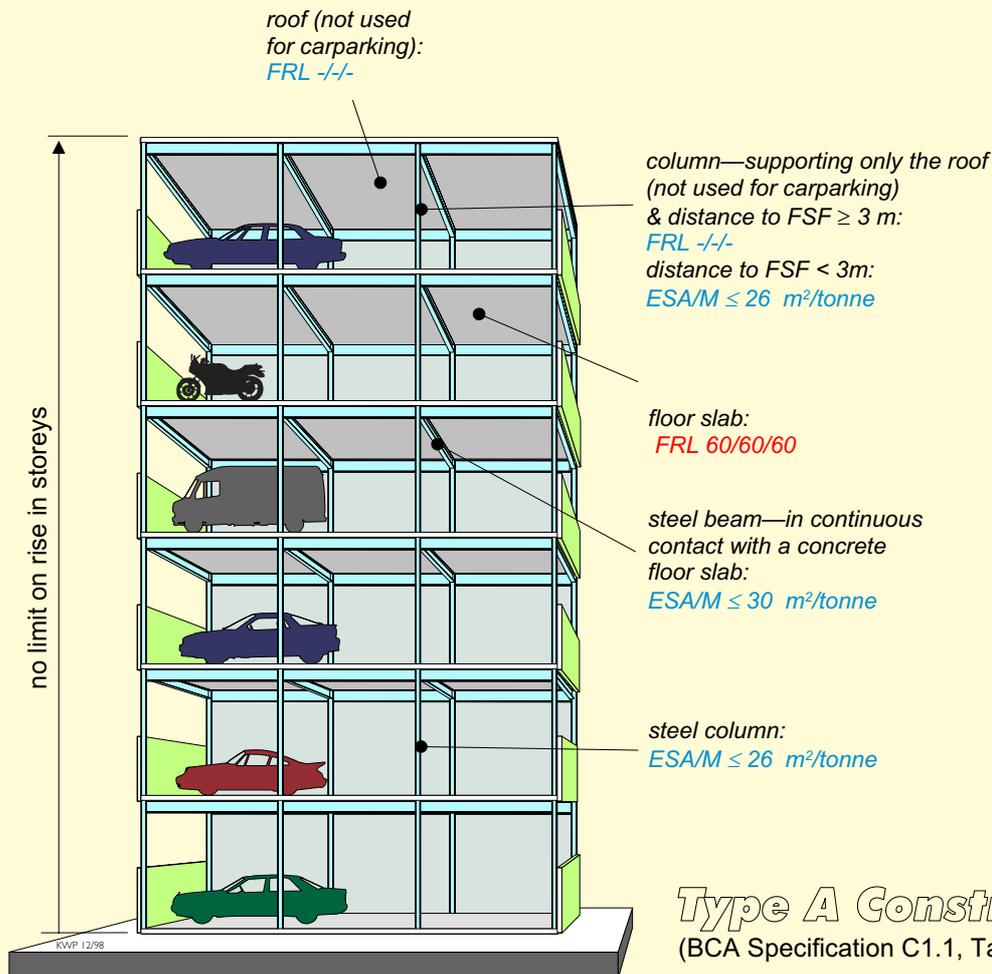


What Situations Allow Use of Bare Steel?

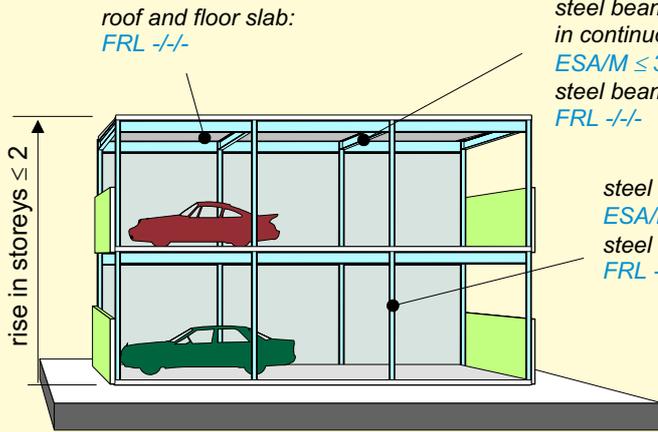
Stand-alone carpark buildings

OPEN-DECK or SPRINKLERED

In an open-deck or sprinklered carpark which does not vertically support a non-carpark part, the BCA allows bare steel beams and columns to be used provided the members comply with limiting values of ESA/M (BCA Specification C1.1, Tables 3.9, 4.2, 5.2). No limit on the rise in storeys is imposed. Neither are there any floor area and volume limitations on the size of the fire compartments (BCA Clause C2.1).



Type A Construction
(BCA Specification C1.1, Table 3.9)



steel beam—distance to FSF < 1.5 m and in continuous contact with a concrete floor slab:
 ESA/M ≤ 30 m²/tonne
 steel beam—distance to FSF ≥ 1.5 m:
 FRL -/-

steel column—distance to FSF < 1.5 m:
 ESA/M ≤ 26 m²/tonne
 steel column—distance to FSF ≥ 1.5 m:
 FRL -/-

Type C Construction

(BCA Specification C1.1, Table 5.2)

column—supporting only the roof (not used for carparking) & distance to FSF ≥ 3 m:
 FRL -/-
 distance to FSF < 3 m:
 ESA/M ≤ 26 m²/tonne

steel beam—distance to FSF < 3 m and in continuous contact with a concrete floor slab:
 ESA/M ≤ 30 m²/tonne
 steel beam—distance to FSF ≥ 3 m:
 FRL -/-

steel column:
 ESA/M ≤ 26 m²/tonne

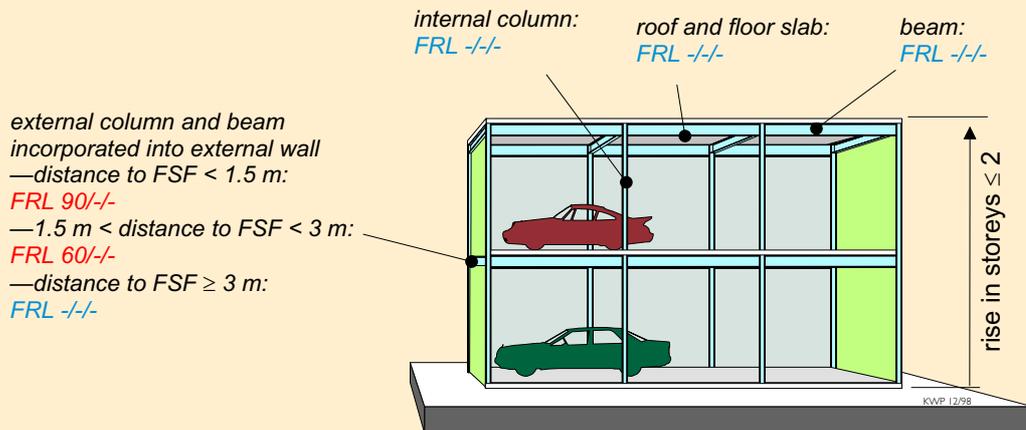
Type B Construction

(BCA Specification C1.1, Table 4.2)

CLOSED and UNSPRINKLERED

(40 or less cars)

In a closed and unsprinklered carpark the BCA allows bare steel beams and columns to be used only in Type C construction (BCA Specification C1.1, Table 5). Therefore, bare steel can be used for a building with a maximum rise in storeys of two. Also, the total floor area and volume are limited to 2000 m² and 12000 m³, respectively (BCA Clause C2.2, Table C2.2).



external column and beam incorporated into external wall
 —distance to FSF < 1.5 m:
 FRL 90/-/
 —1.5 m < distance to FSF < 3 m:
 FRL 60/-/
 —distance to FSF ≥ 3 m:
 FRL -/-

In Type B construction, bare steel beams and internal columns supporting the roof are permitted. In the case of Type A construction having a rise in storey of less than 4, bare steel columns supporting the roof are allowed.



What Situations Allow Use of Bare Steel?

Carparks adjoining other parts

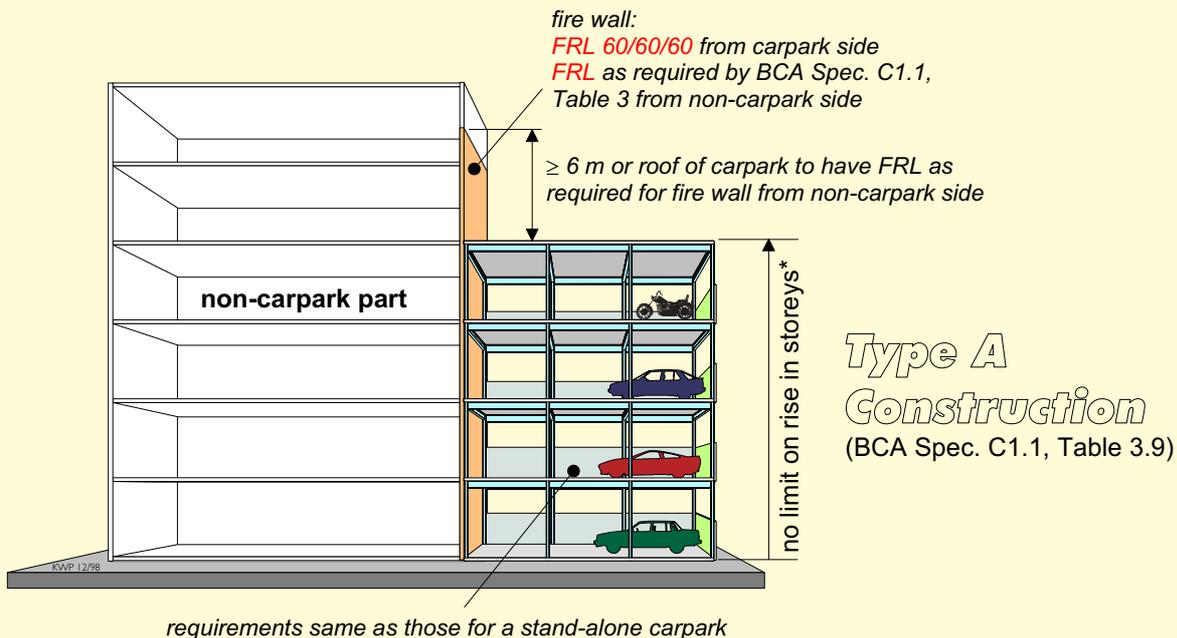
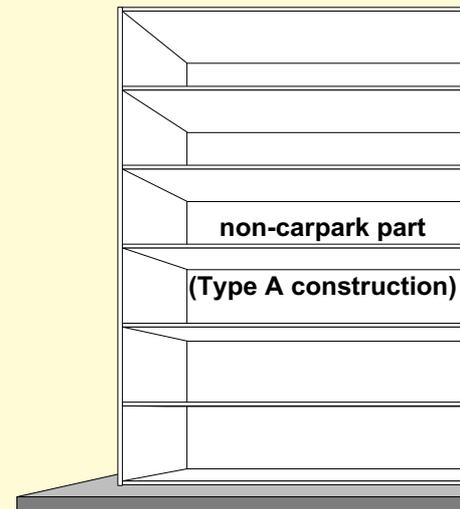
A carpark often horizontally adjoins a non-carpark part.

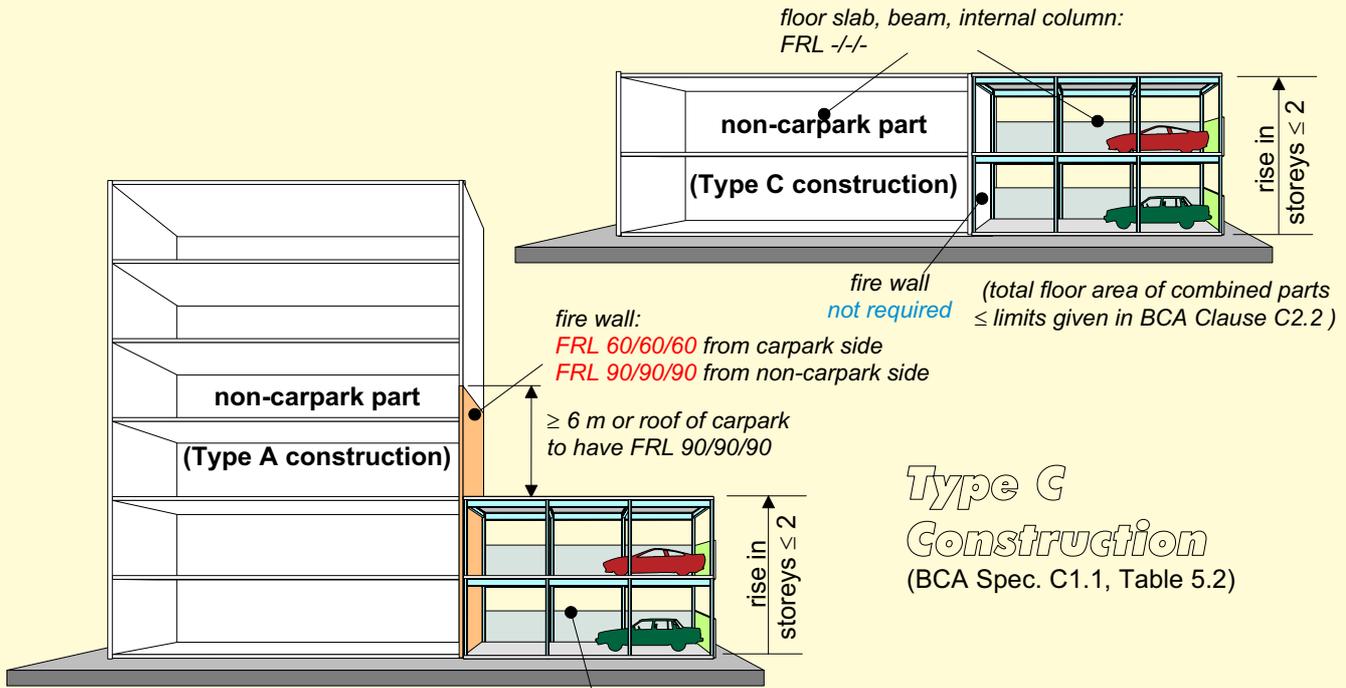
If a carpark is separated from the remainder of the building by a fire wall, the carpark can be considered as a separate building (BCA Clause 2.7(b)) and the requirements described in the previous section for stand-alone carparks apply.

However, if the carpark is not separated from the remainder of the building by a fire wall, the BCA requires each building element in that storey to have the higher FRL prescribed for that element for the classifications concerned (BCA Clause C2.8(a)). In such situations, bare steel can generally be used if the adjoining part can be constructed as Type C construction.

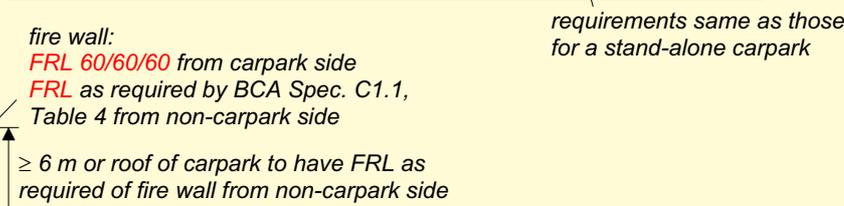
OPEN-DECK or SPRINKLERED

If the carpark is open-deck or sprinklered, the carpark may be separated from the remainder of the building by a fire wall in accordance to BCA Specification C1.1 Table 3.9, 4.2 or 5.2 (BCA Clause C2.8(c)) to enable the carpark to be treated as a stand-alone carpark.





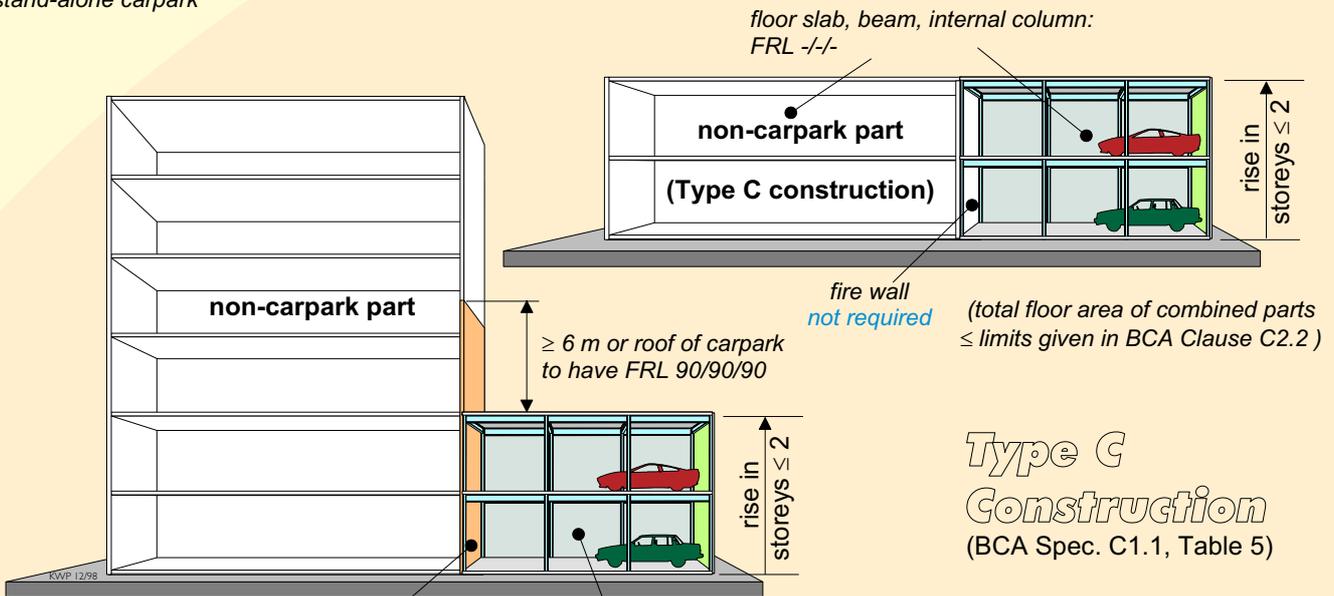
Type C Construction
(BCA Spec. C1.1, Table 5.2)



Type B Construction
(BCA Spec. C1.1, Table 4.2)

CLOSED and UNSPRINKLERED (40 or less cars)

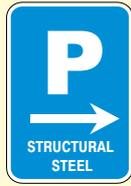
requirements same as those for a stand-alone carpark



Type C Construction
(BCA Spec. C1.1, Table 5)

fire wall: FRL 90/90/90 requirements same as those for a stand-alone carpark



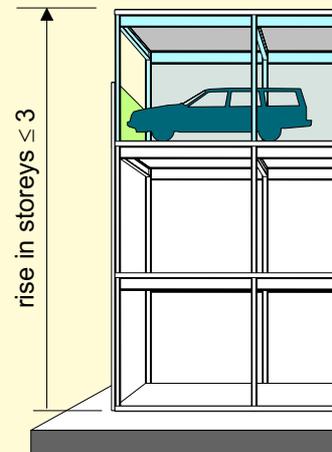


What Situations Allow Use of Bare Steel?

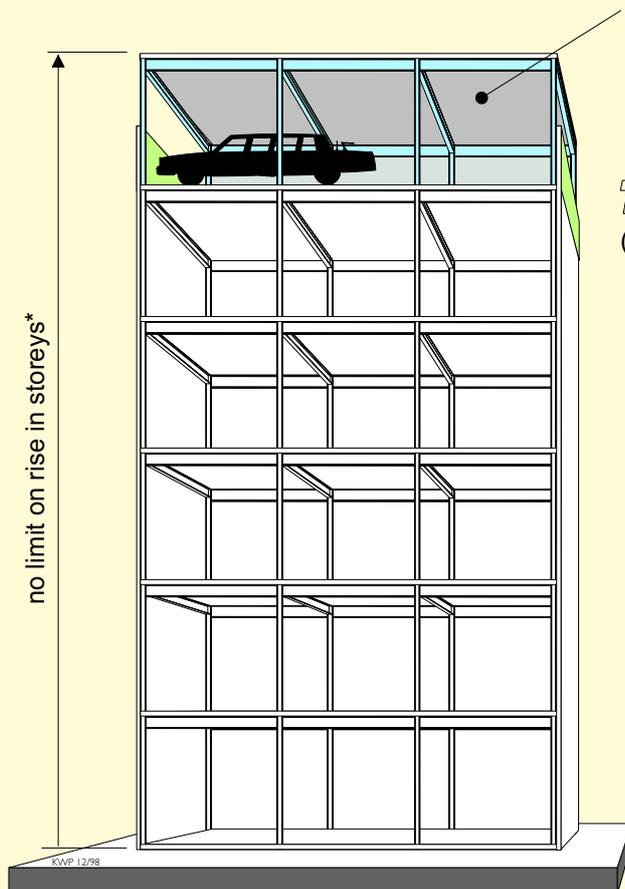
Carparks above other parts

OPEN-DECK or SPRINKLERED

The requirements for an open-deck or sprinklered carpark which is situated above a non-carpark part, are similar to those for a stand-alone carpark (BCA Specification C1.1, Tables 3.9, 4.2, 5.2). Again, no limit on the rise in storeys is imposed. Neither are there any floor area and volume limitations on the size of the fire compartments (BCA Clause C2.1).



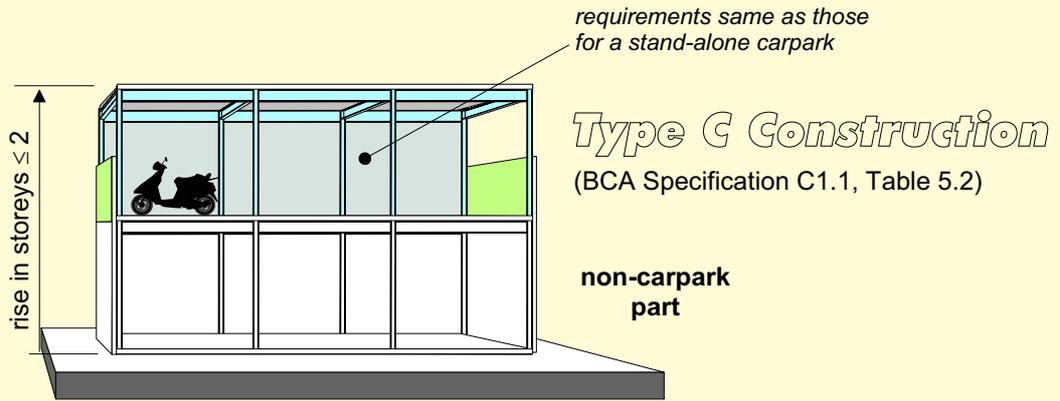
requirements same as those for a stand-alone carpark



Type A Construction
(BCA Specification C1.1, Table 3.9)

non-carpark part

* If effective height ≥ 25 m, the BCA requires the building to be sprinklered (see page 8).



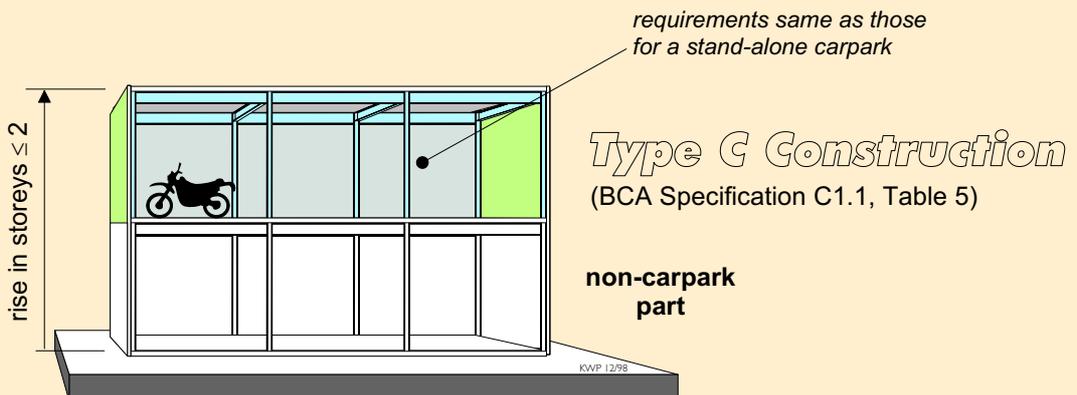
requirements same as those for a stand-alone carpark

Type B Construction
(BCA Specification C1.1, Table 4.2)

non-carpark part

CLOSED and UNSPRINKLERED (40 or less cars)

In a closed, unsprinklered carpark, the BCA allows bare steel beams and columns to be used only in Type C construction (BCA Specification C1.1, Tables 5). Therefore, bare steel can be used for a building with a maximum rise in storeys of two. Also, the total floor area and volume are limited to 2000 m² and 12000 m³, respectively (BCA Clause C2.2, Table C2.2).





What Situations Allow Use of Bare Steel?

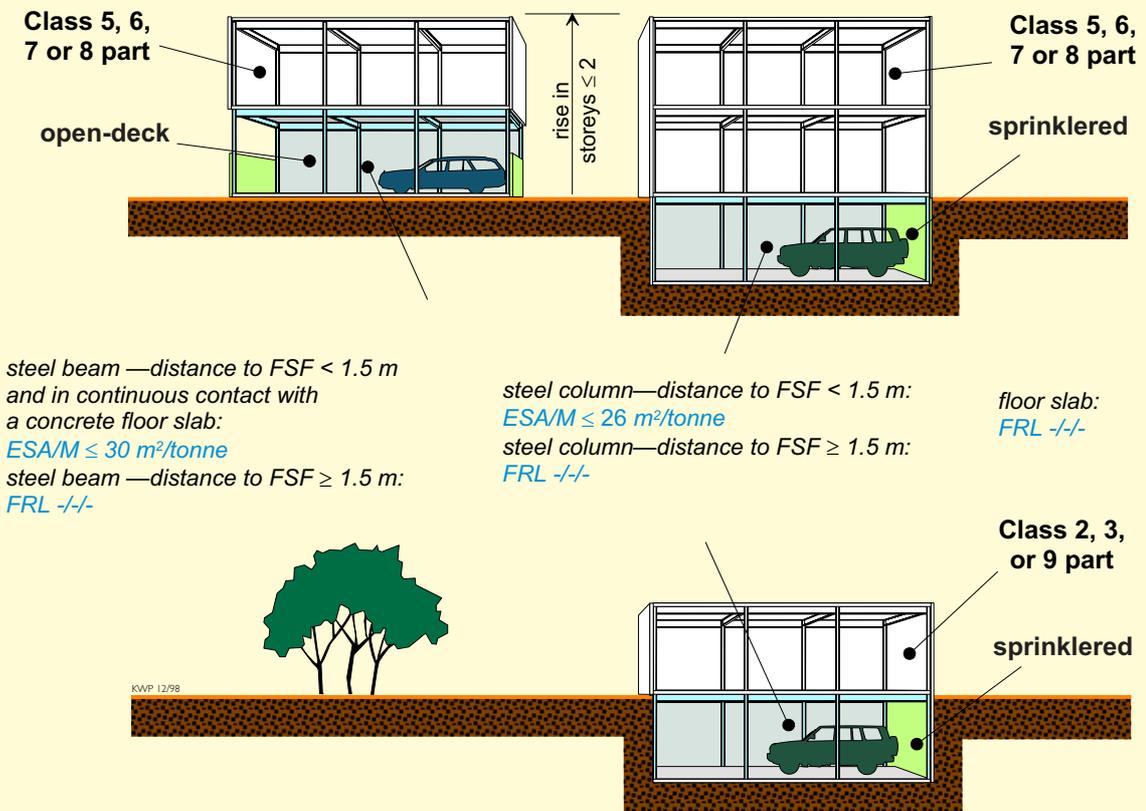
Carparks below other parts

OPEN-DECK or SPRINKLERED

If the carpark is constructed under a non-carpark part, the BCA allows bare steel beams *and* columns in the carpark only when the building is required to be of Types B or C construction (BCA Specification C1.1, Tables 4.2 and 5.2). This includes buildings up to a rise in storeys of 2, when the topmost level of the building is a Class 2, 3, or 9 part (eg. apartment, hotel, public buildings). In the case where the topmost level is a Class 5, 6, 7 or 8 part (eg. office, shops, factory, warehouse buildings), buildings with a rise in storey of up to 3 are allowed. Otherwise, bare steel beams are permitted in all situations but columns are required to have an FRL of 60/-/-.

Type C Construction

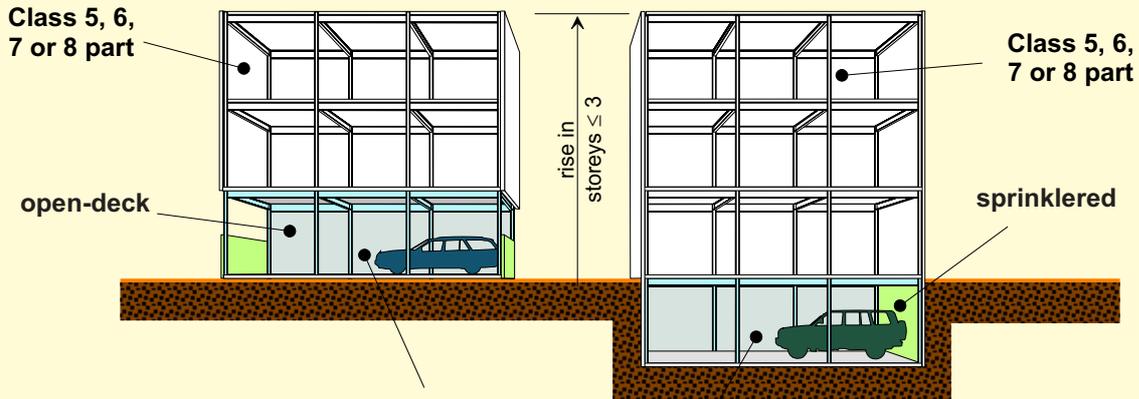
(BCA Specification C1.1, Table 5.2)



In the case of buildings with Class 2 or 3 parts, the BCA requires the underside of the floor above the carpark level to have a fire-protective covering (BCA Clause C2.9 and Specification C1.1, Clause 5.1(e)).

Type B Construction

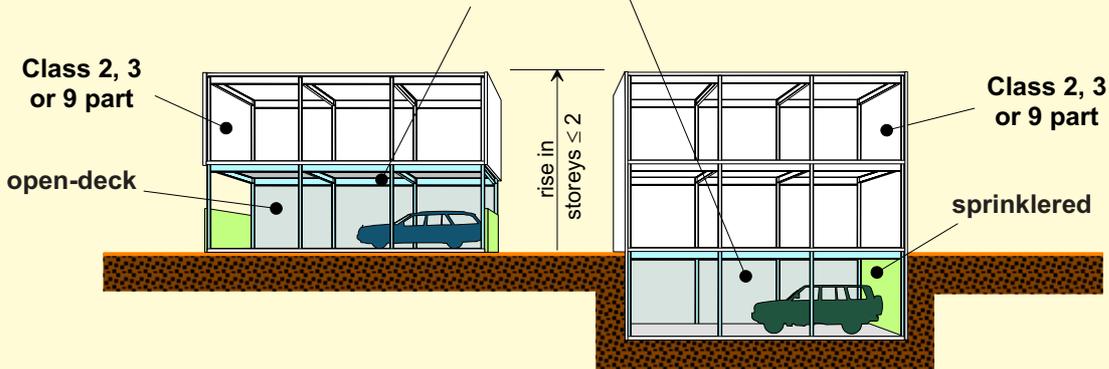
(BCA Specification C1.1, Table 4.2)



steel beam—distance to FSF < 3 m
and in continuous contact with
a concrete floor slab:
ESA/M ≤ 30 m²/tonne
steel beam—distance to FSF ≥ 3 m:
FRL -/-

steel column:
ESA/M ≤ 26 m²/tonne

floor slab:
FRL -/-



In the case of buildings with Class 2 or 3 parts, the BCA requires the underside of the floor above the carpark level to have a fire-protective covering (BCA Clause C2.9 and Specification C1.1, Clause 4.1(d)).

Type A Construction

(BCA Specification C1.1, Table 3.9)

In buildings with greater rise in storeys, Type A construction is required. Bare steel beams still can be used but the columns are required to have an FRL of 60/-/-.



* This interpretation is not shared by all regulatory authorities. Some require the floor slab to have an FRL which is equal to that required for the level above (see also pages 21-22).



What Situations Allow Use of Bare Steel?

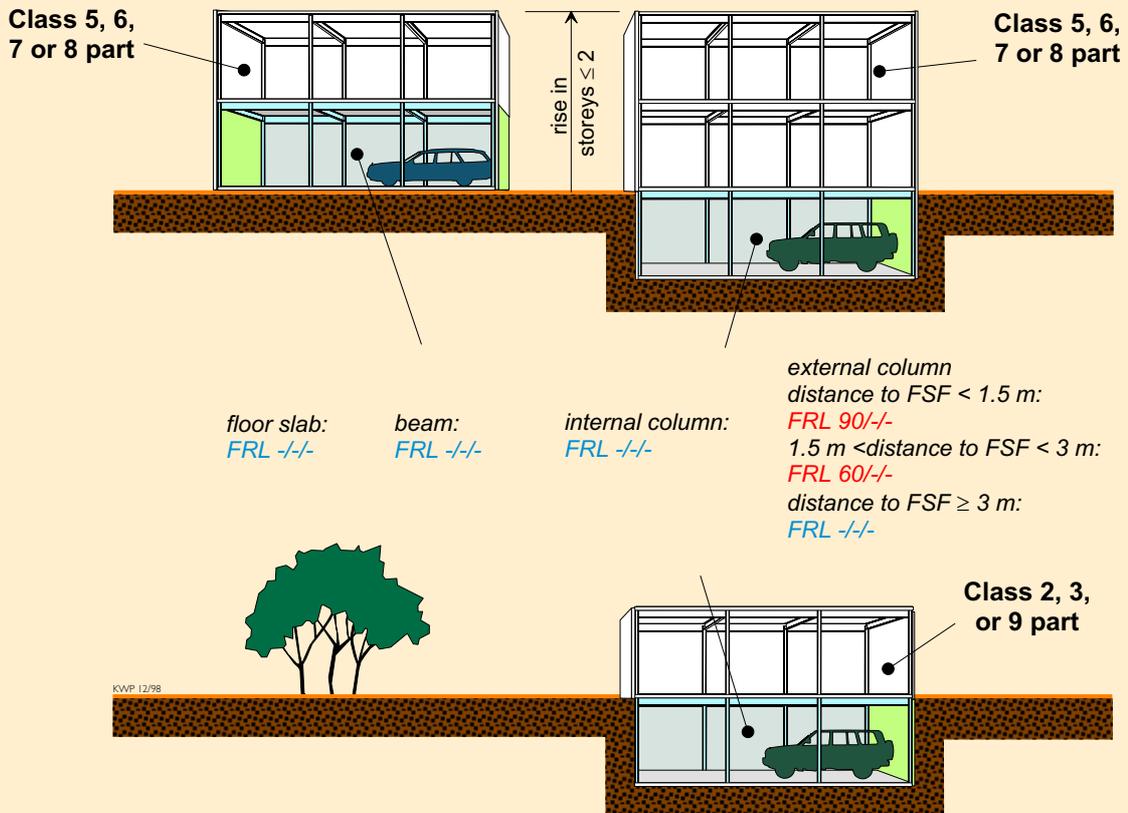
Carparks below other parts (continued)

CLOSED and UNSPRINKLERED (40 or less cars)

For closed and unsprinklered carparks constructed under other parts, bare steel is allowed only within buildings of Type C construction.

Type C Construction

(BCA Specification C1.1, Table 5)



In the case of buildings with Class 2 or 3 parts, the BCA requires the underside of the floor above the carpark level to have a fire-protective covering (BCA Clause C2.9 and Specification C1.1, Clause 5.1(e)).

ECONOMICAL CARPARKS

A Guide to Fire Safety



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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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