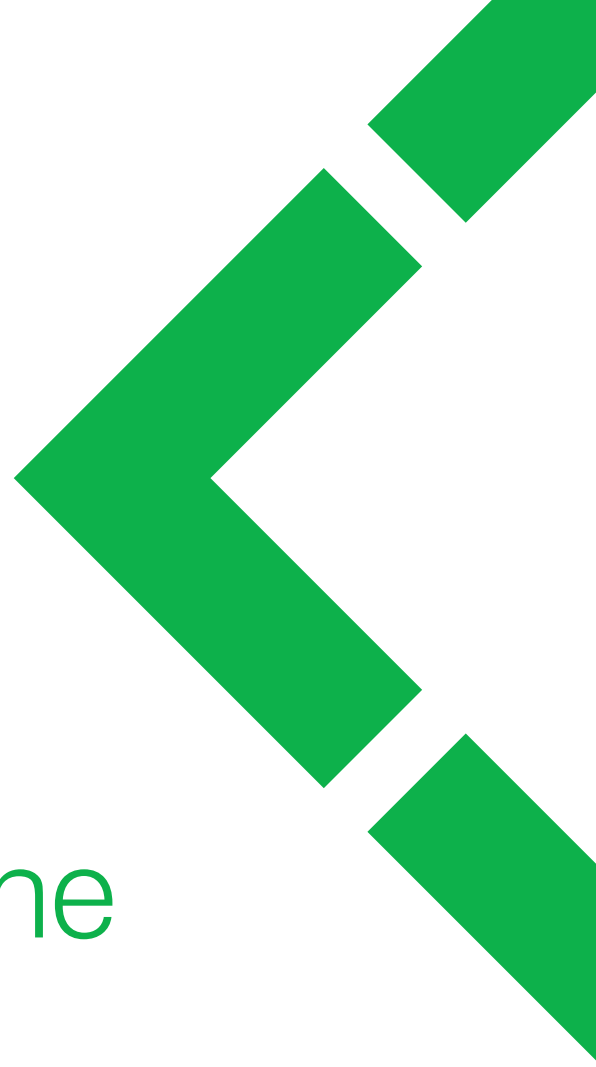




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FDN5 Bare Steel and the DTS Provisions

2006

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STRUCTURAL STEEL MEMBERS

BARE STEEL AND THE DTS PROVISIONS

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Introduction

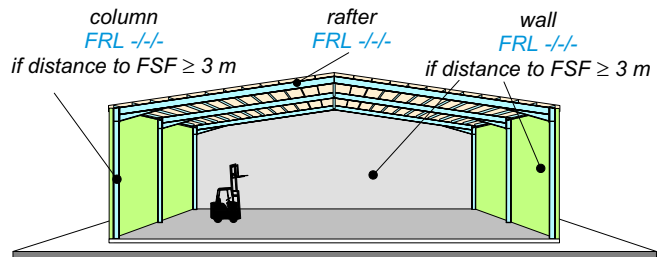
There are numerous building situations where the current Deemed-to-Satisfy (DTS) provisions of the Building Code of Australia (BCA) [1] allow the use of bare steel construction. These situations are sometimes not realised by building practitioners and accordingly some economical steel construction alternatives are not being considered.

This publication seeks to summarise the various situations where bare steel construction is currently permitted by the DTS provisions of the BCA. In other situations, it must be the subject of a fire-engineering design to demonstrate that the BCA performance requirements are met.

Factories and Warehouses (Class 7b & 8 Buildings)

Single-Storey, Single-Compartment Building (Figure 1)

All single storey factory and warehouse buildings can be constructed using bare steel construction. This is permitted by Clauses 2.5 and 3.5 of Specification C1.1 of the BCA, provided the roof covering is *non-combustible*.



Note: FSF= Fire-Source Feature

Figure 1 Single-compartment building

Single-Storey, Multi-Compartment Building (Figures 2 & 3)

This occurs when the building is required to be divided into separate compartments through the provision of *common* or *fire walls*. This is required if the maximum compartment area (5000 m²) (see BCA Clause C2.2) is exceeded or if the building is divided into parts to effectively form a number of separate buildings or parts with different titles. There is no requirement for elements to have a Fire Resistance Level (FRL) except for columns that are providing vertical support to the roof at a *common* or *fire wall* and are positioned such that failure of these columns due to a fire on one side would result in the roof loads being transferred to the wall causing failure of the wall. This situation is illustrated in Figure 2. If the wall is capable of resisting the imposed roof loads (i.e.

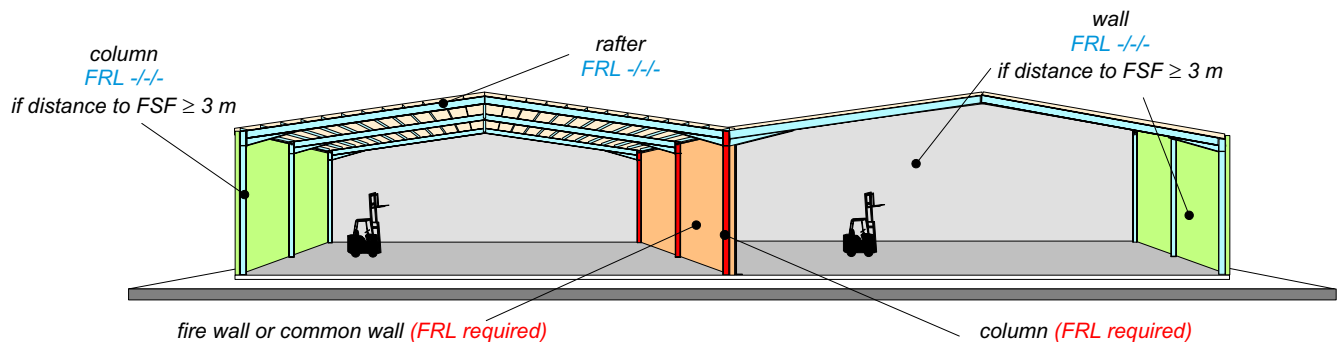


Figure 2 Multi-compartment building - protection of column giving vertical support

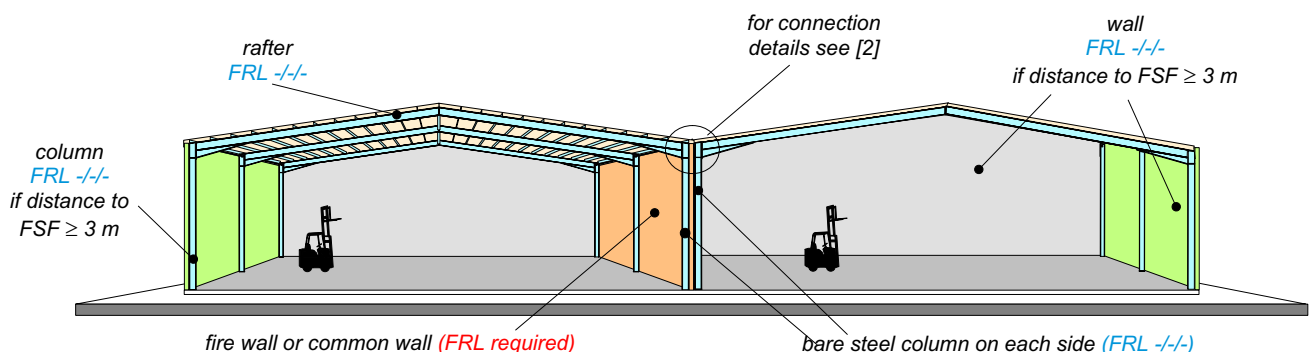


Figure 3 Multi-compartment building - bare steel columns providing stability on both sides of wall

the wall is a loadbearing wall) under fire conditions or if bare steel columns are located on *both* sides of the wall (Figure 3) then no protection of structural members is required. In such cases both vertical and lateral support to the wall will be maintained with lateral support being provided by the lateral load resistance associated with the adjacent (non-fire) compartment. This is permitted by Clause 2.2 (b)(v) of BCA Specification C1.1.

Single-Storey, Single-Compartment Building with Mezzanine (Figure 4)

A mezzanine floor is not counted as a storey provided its area is not more than 200 m² or 1/3 of the total plan area, whichever is the least (see BCA Clause C1.2(d)). Subject to this area constraint bare steel construction can be used to support the mezzanine floor and there is no requirement for the floor to have an FRL. The *total* floor area must be less than 5000 m² or the building must be compartmentalised such that the total floor area of each compartment is less than 5000 m².

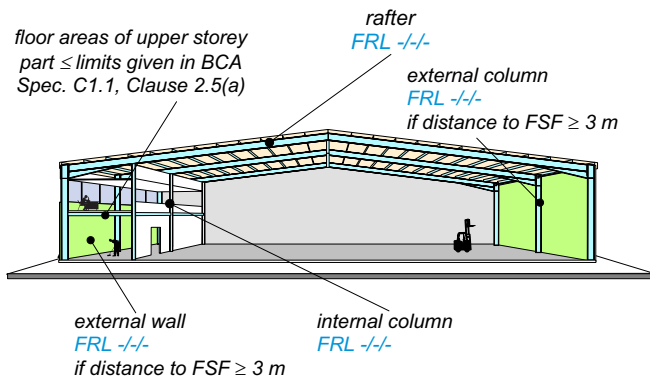


Figure 4 Single-storey single-compartment building with mezzanine

Single-Storey Warehouse with Attached Two-Storey Office Part

If the office is separated from the warehouse/factory building by a *fire wall* (Figure 5) then the two situations can be considered separately. The warehouse can be designed as a single-storey warehouse (see above) and the office as a two-storey office (see below).

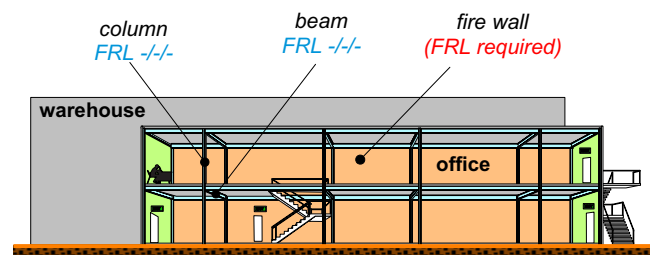


Figure 5 Warehouse with fire-isolated Type C two-storey office

If there is no *fire wall* between the office and warehouse/factory parts then bare steel can be used throughout provided the area and volume limitations for Type C construction are not exceeded. These are given in BCA Clause C2.2. If the Type C limitations are exceeded but those for Type B are not, then bare steel can again be used throughout. The Guide to the BCA [3] suggests a method for considering buildings with more than one occupancy classification. A similar but simpler (and slightly more conservative) method is shown in Table 1 for Type B construction.

Table 1 Simplified floor area and volume limitations for Type B construction for combined office and factory/warehouse

$\frac{\text{total warehouse floor area}}{3500 \text{ m}^2} + \frac{\text{total office floor area}}{5500 \text{ m}^2} \leq 1$
and
$\frac{\text{total warehouse volume}}{21000 \text{ m}^3} + \frac{\text{total office volume}}{33000 \text{ m}^3} \leq 1$
and
area of top storey office $\leq 1/8$ of area of warehouse, and $\leq 350 \text{ m}^2$

If the area and volume requirements for Type B construction are exceeded then bare steel can be used for the columns and roof beams provided the area and volume requirements for Type A construction are not exceeded. These are also given in BCA Clause C2.2, Spec. C1.1 Clause 2.5 and [3]. A similar but simpler (and slightly more conservative) method is shown in Table 2. In those cases the floor beams in the office part will be required to have an FRL.

Table 2 Simplified floor area and volume limitations for Type A construction for combined office and factory/warehouse

$\frac{\text{total warehouse floor area}}{5000 \text{ m}^2} + \frac{\text{total office floor area}}{8000 \text{ m}^2} \leq 1$
and
$\frac{\text{total warehouse volume}}{30000 \text{ m}^3} + \frac{\text{total office volume}}{48000 \text{ m}^3} \leq 1$
and
area of top storey office $\leq 1/8$ of area of warehouse, and $\leq 500 \text{ m}^2$

Figure 6 shows the requirements for buildings meeting the Type B and C limitations. Figure 7 shows the requirements exceeding the Type B limitations but meeting the Type A limitations.

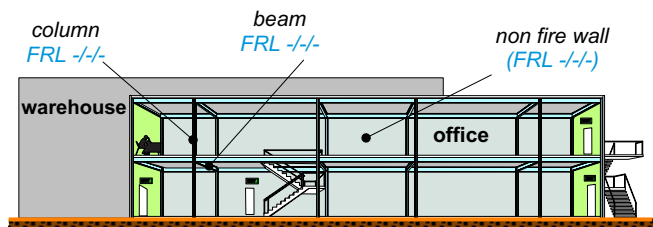


Figure 6 No separation between warehouse and two-storey office (Types B and C construction)

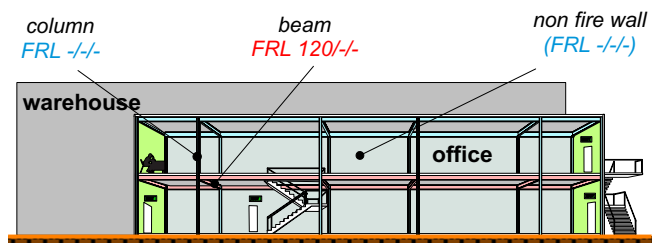


Figure 7 No separation between warehouse and two-storey office (Type A construction)

Large Isolated Building with Two-Storey Part

Factory and warehouse buildings incorporating two-storey parts can be constructed as large isolated buildings utilising bare steel construction. The specific requirements for large isolated buildings (including isolated office and retail buildings) are considered later in this publication.

Open-deck or Sprinklered Closed Carpark Buildings

Stand-alone Carparks (or Similar Carparks Adjacent to a Firewall of Another Part)

In this case, provided the columns and beams have the appropriate limiting exposed surface area-to-mass (*ESAM*) ratios then bare steel construction can be used (see Figure 8 for Type A construction). Type B and C have less stringent requirements. A detailed description of the requirements for carparks is given in [4].

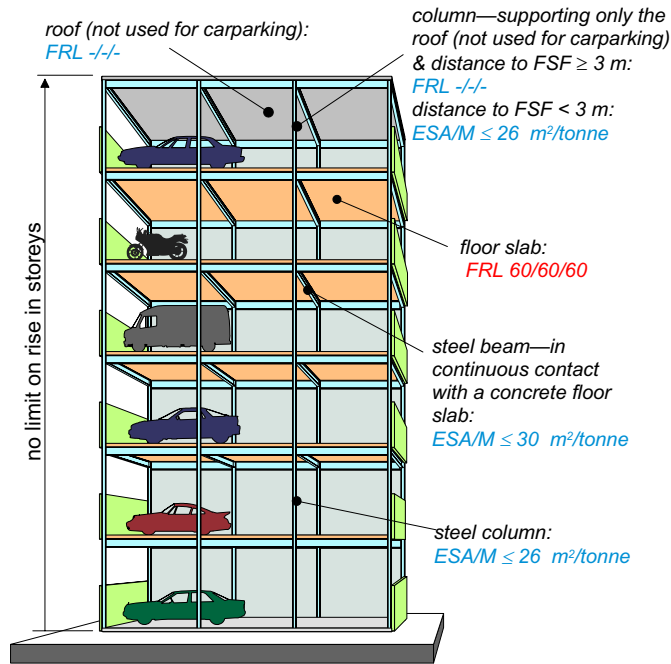


Figure 8 Open-deck or sprinklered stand alone closed carparks (Type A Construction)

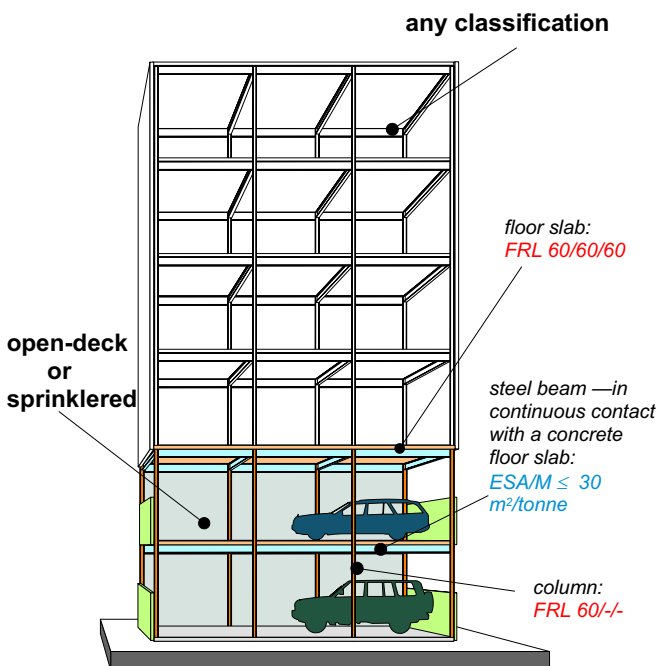


Figure 9 Open-deck or sprinklered carparks below other buildings

Carparks below Another Building Classification (Including below Ground)

The DTS provisions require the columns to have an FRL of 60/- only if the building is classified as Type A construction (see Figure 9). For the carparks situated below ground it is necessary for the columns to have $ESAM \leq 26 \text{ m}^2/\text{tonne}$ if it is Type B construction and also Type C construction if $FSF < 1.5 \text{ m}$. Type B and C can have bare steel beams and no FRL for the floor slab [4].

Two-Storey Office Buildings

Bare steel construction is allowed for a building with a rise-in-storey of two provided it is of Type C construction (see Figure 10 and details given in [5]). This means that the total floor area must be less than 3000 m², otherwise the building must be compartmentalised or be treated as a large isolated building. Bare steel construction can also be used for the top storey of larger area buildings of Type A or B construction [5].

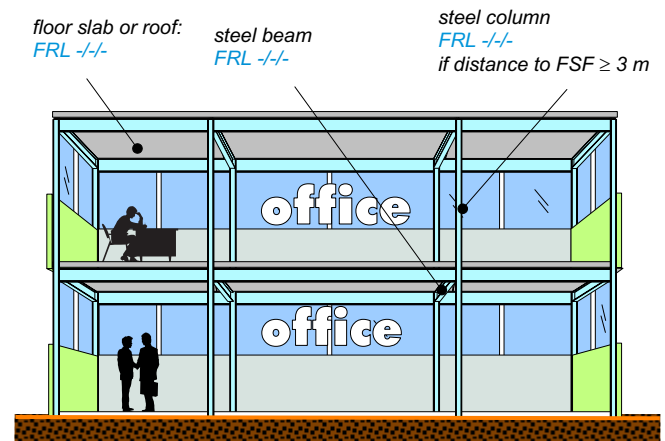


Figure 10 Bare steel two-storey office building

Two-Storey Retail Buildings

In this case the building (Figure 11) can be of Type C construction provided the total floor area does not exceed 2000 m² unless the building can be considered as a large isolated building. No FRL is required.

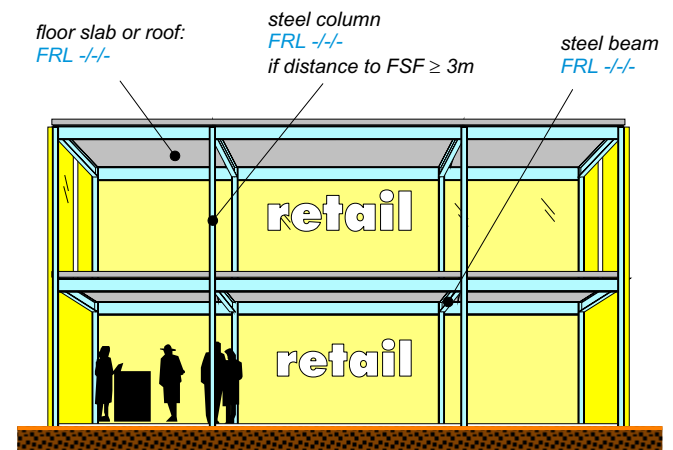


Figure 11 Bare steel two-storey retail building

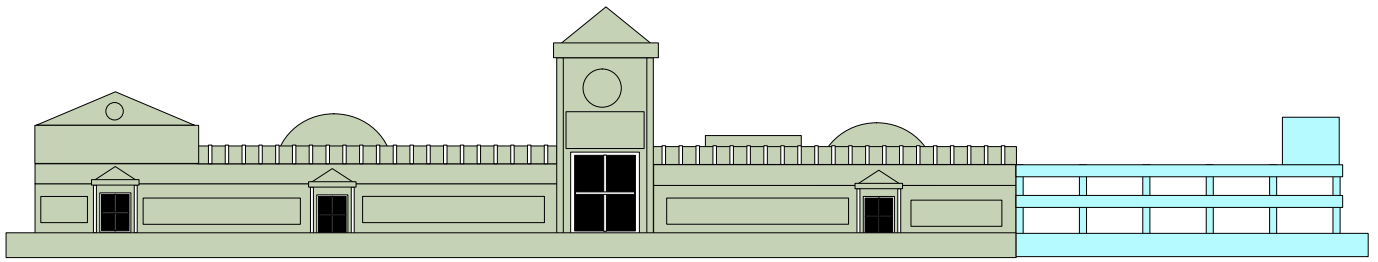


Figure 12 Large isolated building with two-storey part

Large Isolated Building with Two-Storey Part

Large isolated buildings can be office (class 5), retail (class 6), factory (class 7b) or warehouse buildings (Class 8) or a combination of these. Provided the requirements for large isolated buildings (BCA Clause C2.3) are met, the building can be of bare steel construction, irrespective of the relative extent of the two-storey part (see Figure 12). A summary of the large isolated building requirements are given below:

(i) if the total floor area of building does not exceed 18,000 m² or volume 108,000 m³, the building is required to have:

- (a) For Class 7 and 8
 - o rise in storeys not more than 2, and 18 m wide space around the building and,
 - automatic detection and alarm system, or
 - automatic smoke exhaust, or
 - automatic smoke-and-heat vents, or
 - natural smoke venting
 - or
 - o sprinkler system and vehicular access around building

(b) For Class 5 and 6

- o a sprinkler system, and
- o vehicular access around building.

(ii) if total floor area exceeds 18,000 m² or volume exceeds 108,000 m³, the building is required to have (for class 5, 6, 7 and 8):

- o a sprinkler system, and
- o vehicular access around building, and
 - smoke control, or
 - smoke-and-heat vent if the ceiling height is less than 12 m (ceiling height is the roof height unless there is a fire resistant intermediate floor i.e. compartment height is reduced by fire-resistant construction).

In the case of large isolated buildings with a two-storey part, the type of construction for the two-storey part is decided by the *rise in storey*. This means that for a two-storey building the relevant Type of construction is Type C construction for which there are no FRL requirements for floors, beams or columns. There are no requirements for external members since the fire-source features are sufficiently distant due to the fact that these are isolated buildings.

REFERENCES

- [1] "Building Code of Australia 2005", Volume 1—Class 2 to 9, Australian Building Codes Board, 2005
- [2] Bennetts, I.D. and Poh, K.W., "Steel Portal Frame Buildings - Support of External Concrete Wall Panels", Fire Design Note 1, OneSteel Market Mills, August 2000
- [3] "Guide to the BCA 2005", Building Code of Australia—Class 2 to 9, Australian Building Codes Board, 2005
- [4] Bennetts, I.D., Thomas, I.R. and Poh, K.W., "Economical Carparks A Guide to Fire Safety", OneSteel Market Mills, April 2005
- [5] Bennetts, I.D., Goh, C. C., Thomas, I.R. and Poh, K.W., "Low-rise Office Construction A Guide to Fire Safety", OneSteel Market Mills, November 2000



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