ADVISORY NOTICE BUILDING 13/14

Advisory Notices are issued to assist in the interpretation of the Development Act 1993 | *October 2014*

TECHNICAL: Specification C1.11 Performance of External Walls in Fire

Specification C1.11 Performance of External Walls in Fire in Volume One of the Building Code of Australia (BCA) was introduced into the BCA on 1 January 1995. The purpose of this Advisory Notice is to confirm the importance of this Specification and the need to ensure compliance.

BACKGROUND

In the early 1990s, tilt-up construction using large concrete panels for external walls was becoming very popular, predominantly for low rise, single storey commercial and industrial buildings. Typically, these buildings have concrete wall panels connected to some sort of steel framing supporting the roof.

A number of fires in some of these buildings had resulted in the panels losing their connection to the steel framing with the result that the panels fell outwards hitting the ground.

Research into the matter was undertaken by Victoria University of Technology and this research enabled prescriptive requirements to be developed for incorporating into the BCA. As a result Specification C1.11 was developed to ensure there was adequate fixity between the concrete wall panels and the steel framing, so that in the event of a fire the whole structure would collapse in on itself as the steel framing lost strength.

Recently there have been a number of questions about the BCA provisions for this form of construction and, as it is nearly 20 years since they were introduced, this Advisory Notice has been produced to complement the information in the Australian Building Codes Board's Guide to Volume One.

DISCUSSION

Concrete panel buildings consist of two basic construction types;

A. Non-loadbearing panels, where the building's stability to any lateral loads is provided by the steel framing (usually a portal frame).

B. Loadbearing panels, where the concrete panels support the steel roof framing and also provide stability to any lateral loads. There are two sub types of buildings that are used:

   B.1 The first uses moment resisting connections at the base of the concrete panel and/or to the roof framing, so the concrete panel is used in a moment resisting capacity to provide stability.

   B.2 The second treats the whole structure as a box where cross bracing in the plane of the roof framing is used to transfer lateral loads to the side walls, which then act as shear walls to transfer the loads to the ground.

The difference is important to the way in which the steel framing and concrete panels will interact in a fire. When the inside surface of a concrete wall panel is exposed to a fire it will expand causing the panel to bow. Initially the steel will tend to expand but as the temperature rises the steel will soften and as it does it will start to pull inwards.

In the first type of building (A), as the steel framing loses strength from the heat of the fire, it will start to collapse into the building taking the external walls with it. Provided the connections of the concrete panels to the steel framing are sufficient to keep the panels attached to the steel framing throughout this movement, the panels do not pose a significant hazard to anyone outside of the building.

With the second type of building (B), overall stability of the structure is reliant on the connections between the concrete panels and the steel roof framing. Where a braced framing system is used (B.2), the ability of the bracing to transfer loads to the side walls is critical to avoiding an uncontrolled collapsed of the entire building.

The major issue in all scenarios is the ability of the connections to continue to perform their original function in the event of a fire ie to remain connected to the steel framing as it collapses into the building.

Specification C1.11

Clause 3 has minimum requirements for external concrete wall panels as follows;

- 3(a) has specific requirements regarding the anchoring of cast-in connections to ensure that they cannot be pulled out of the panel
- 3(b) determines the forces that cast-in (wall panel to roof framing) connections at the top of a panel must be designed to resist. These forces apply to the connection as a whole and not just the cast-in component. The aim of the provision is to ensure that any connections at the top of a panel are able to keep the panel attached to the roof framing well past the point at which any moment resistance at the base has been overcome (ie the base has become pin jointed with no moment resisting capacity – See Figure 3(b)). The forces must be <u>two times the larger</u> of the forces derived from two circumstances:

  (i) Where the base of the panel is designed for a specific bending moment then the ultimate moment is to be used.

  (ii) In all other instances a bending moment at the base of the panel is to be determined assuming that there is a lateral displacement at the top equal to one tenth of the panel height. This assumes a level of nominal fixity at the base that will resist any rotation in a fire and as a result increase the lateral displacement at the top, thereby placing increased forces on the connections at the top of a panel (ie you cannot assume that the base is a pure pin jointed connection).

- 3(c) determines the forces that clips or drilled-in inserts connecting wall panels at the top of a panel must be designed to resist. In this instance the moment resisting forces are as determined in 3(b) but these types of connections must be designed for <u>six times</u> the larger of the forces. This is because these types of connections are not integral with the panel itself as determined by 3(a).

- 3(d) ensures that the connection forces previously determined in 3(c) are capable of being resisted by the roof framing that provides the panel with lateral support. There should be a clear load path

for transferring these forces to the ground.

- 3(e) where the walls panels are not load bearing and span vertically, transferring any lateral loads into the floor and the roof, there must be at least two connections at the top of the panel to transfer any lateral loads into the roof framing that provides lateral support to the wall.
- 3(f) is relevant where the walls panels are not load bearing and span horizontally transferring any lateral loads into the supporting columns. A single connection is not adequate.
- 3(g) is relevant where the structure is designed as a box. It requires the framing providing lateral support to remain connected to a panel during a fire.

Clause 4 deals specifically with the situation where there is a steel frame providing stability to the building and the wall panels span vertically from the base to the roof, as in 3(e). Where these panels are adjacent to columns, there is the potential for large forces being developed on the fixings due to the restraint of differential movement between the panels and the column. Accordingly, this provision has requirements for detailing the connection of the panels to the columns to ensure the panels remain connected to the columns.

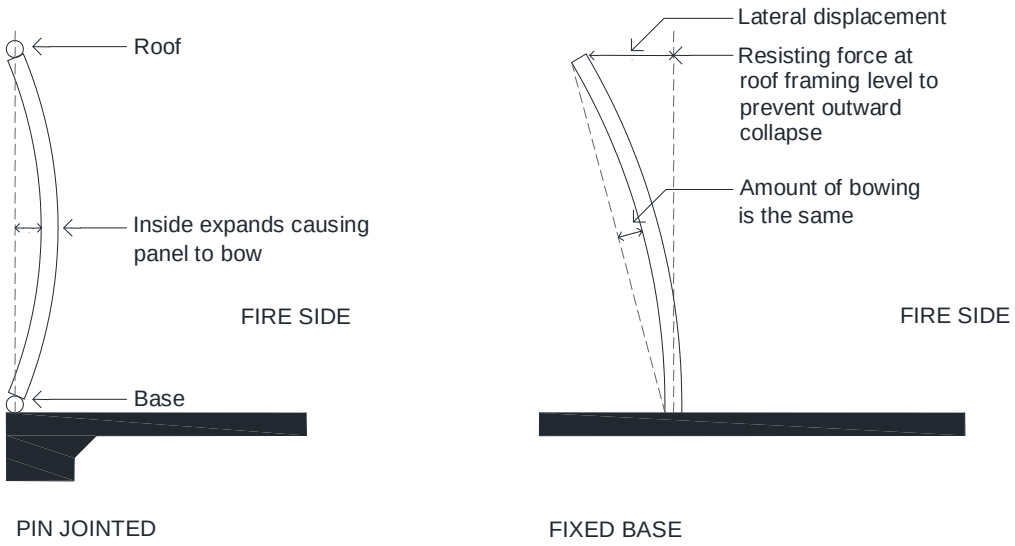

Figure 3(b) Behaviour of concrete panels exposed to fire

Further information

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