CHAPTER FIVE – FEATURES OF DIFFERENT BUILDING TYPES

All building structures are designed for required service performance criteria and strength and stability. Equally, building construction for different occupancy and function may require additional or more stringent performance aspects of the structure. This chapter of four different building types discusses criteria that are particular to each.

5.1 Multi-Storey Offices

The features for consideration in multi-storey office buildings may include:

Figure 5.1 Latitude East during construction.

- Checking floor vibration.
- A beam layout to minimise interference with services reticulation within the ceiling plenum.
- Limiting building edge beam deflections to suit the façade system used, including the connection tolerances. Fire proofing with fire engineered design and an appropriately designed and maintained sprinkler system.
- Review of need for painting or corrosion treatment of internal steelwork.
- Large spans and / or column free floor areas.
- Future proofing.
- Specific frame design for erection purposes.

5.1.1 Floor Vibration Performance

Generally vibration of office floors is not a problem as most floor beam layouts satisfy the acceptance criteria with very little if any cost penalty to strength and deflection design. Office fitout is a significant factor in damping, however, damping is lower in electronic office fitouts. In such cases edge panels of floors may require attention to primary-secondary beam orientation and design or increase in slab thickness to lower potential dynamic acceleration. Refer to Ng and Yum (2005) for typical and special arrangements of floor beams and resulting dynamic performance.

5.1.2 Beam Layout

The main structural performance issues relating to beam layout are discussed in the body of this publication. ***The coordination of the mechanical air-conditioning ductwork with the structural steelwork is an important factor in the beam layout and orientation***. The ability to insert rectangular and circular penetrations through the web of a steel beam depends on the depth of beam and the degree of bending and shear at the web penetration location. Locating a web penetration away from areas of high shear and / or bending moment avoids using reinforcing plates, giving an economical beam which in fabrication can be cut on a beam line.

Preliminary composite beam sizes can be read off tables such as shown in Appendix C.

CompPen®, a spreadsheet based software published by OneSteel enables design checks of a beam at non-composite erection stage and in-service composite stage for circular or rectangular web penetrations with or without stiffeners.

5.1.3 Edge Beam Deflection

In an office floor structure the edge beam deflection is generally required to satisfy two criteria. After the installation of the façade the incremental live and superimposed dead load deflection needs to be limited to values specified by the façade manufacturer. Excessive incremental movement may compromise the panel stack joint. The total deflection at the top of slab (refer to Section 4.2 in this publication) at the beam midspan must be limited to visually satisfy skirting boards typically limited to span/360 or 20mm maximum. Larger steel section beams designed non-compositely may provide the better option. Connection assembly of the façade typically consists of a small length of Unistrut welded to a plate to allow horizontal adjustment parallel to the edge and a steel angle bolted to the façade mullion for adjustment perpendicular to the edge. Refer to Figure 3.11.

5.1.4 Fire Safety Engineering

For multi-storey offices with up to four aboveground storeys and floor area per storey not exceeding 1850 m², guidance on the use of unprotected steel via the performance-based approvals process is provided in the OneSteel publication, Low-Rise Office Construction (Bennetts et al, 2000). This document presents 18 Alternative Solution cases covering a range of numbers of storeys, usage classifications (where incorporated in conjunction with office use) and both sprinkler-protected and non-sprinkler-protected buildings. It suggests reasonable Fire Resistance Level (FRL) requirements for each of the main member types, based on a risk assessment methodology.

For office buildings outside the limits of the 'Low-Rise Office Construction' publication, fire engineered solutions are being used incorporating FRL requirements, which are less than those under Deemed-to-Satisfy (DTS) provisions. These are typically based on largely qualitative risk assessment arguments combined with evidence from large-scale fire testing. In some cases, alterations to the proposed structural details are suggested to aid the fire performance.

For buildings which are less than 25m in effective height and where sprinkler protection is to be provided, substantial reductions in the DTS requirements are often possible. Where the provision of sprinklers is voluntary (i.e. not required under DTS), then an Alternative Solution can be justified on the basis of risk comparison against DTS. Where the sprinkler protection is required by DTS rules not related to building height, such as the atrium rules or 'large isolated building' rules, more detailed arguments may be required taking into account the particular conditions and the associated fire risk, but savings can often still be made.

Where sprinkler protection is not provided and the building is only slightly less than 25m in effective height, it may be difficult to justify any reductions in the DTS FRL requirements.

Office buildings that are above 25m in effective height will be sprinkler-protected as required under DTS. The sprinkler system is normally considered to be the most effective fire safety system within such buildings. Enhancements to this system which are likely to further increase its effectiveness can be shown to allow the possibility of reducing the requirements for other fire safety systems, including FRL requirements [Thomas et al, 1992]. To gain regulatory approval, it may be necessary to assess the sensitivity of the solution to failure in some part of the fire safety system, sometimes called a redundancy analysis. Where complete failure of the sprinkler system is considered an extremely low probability event, care should be taken to ensure that the other inputs to the analysis are not overly conservative (analogous for example to considering extreme earthquake plus extreme live load).

For consideration of high-rise buildings in conjunction with sprinkler failure, data from the large-scale fire tests which have been conducted represents the best evidence of structural performance. Six

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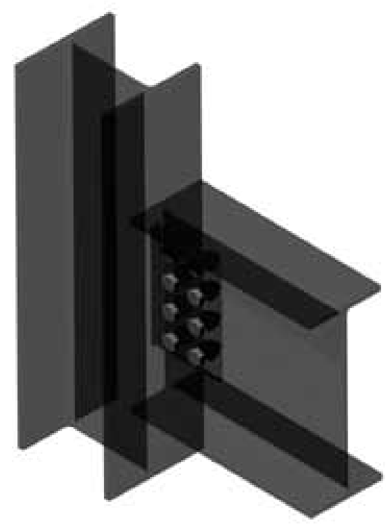

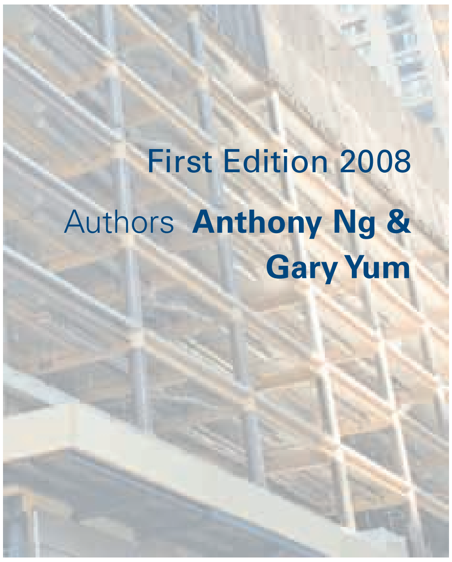

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