CHAPTER TWO STRUCTURAL FRAMING

The advantages of structural steel framing can be fully exploited only if the distinctive features of steel frame properties are taken into account at the design stage. An optimised steel frame solution can hardly be expected if the building (grid) was originally designed for another material structure.

Properties that a steel frame provides to a building structure at the design stage include large spans, small column sections, lower dead weight of the structure and easy provision of floor openings, which in building life culminate in greater flexibility and adaptability for change. At construction stage the prefabricated erection reduces construction time and exposure to onsite risks.

These beneficial properties of structural steelwork increase the cost efficiency of the building.

The steel frame, essentially beams and columns, performs the load bearing function in combination with the floor system, walls and bracing components.

In composite steel concrete construction structural efficiency and performance are further enhanced. Composite action between the steel and concrete is established (largely) by mechanical action via shear studs welded onto the steel beam.

2.1 Floor Structure

Steel beam frame floor construction in Australia is almost exclusively of an in-situ concrete slab cast onto a metal deck spanning between the steel beams. Concrete floor slabs of precast panels or hybrid precast components and in-situ concrete screed can provide additional prefabricated construction. Two articles by **Lam** and **Uy** (2005, 2006) present the use of and design procedures for Hollowcore flooring in composite steel - concrete construction.

A composite beam is a steel beam with its top flange connected to a concrete slab. For single span simply supported beams and in the positive bending moment region of continuous beams, the concrete slab functions as the compression element and the steel beam resists in tension. For continuous beams the reinforcement within the concrete slab provides additional tensile capacity to the negative bending region of the composite beam.

With composite action between the concrete floor slab and the steel beam a saving in weight of the steel beam is realised and a stiffer floor is obtained giving less deflection.

Unpropped composite beams and steel decking during construction provide significant advantages in the speed of construction. The back-propping that is necessary in traditional reinforced concrete construction is completely avoided; therefore fitout of the floors below can begin earlier. It is also possible to erect several levels of steelwork at one time if required. In construction up to four storeys high, it is common to erect a bay of steelwork at a time to the full height of the building using a mobile crane.

Preliminary design of beams for various occupancies, span and spacing can be obtained from **OneSteel** (Nov 2005) - *Design Note No. D3 Span Tables for Simply Supported Composite Beams* reproduced in this publication in Appendix C.

Composite beams are usually designed as single span, simply supported at ends. Web side plate connections are common, flexible end plate or angle cleats are suitable alternatives, which also all require minimal fabrication. Continuous composite beams can be designed particularly where a shallower beam is required or preferred. There are however additional connection fabrication and erection costs that need to be compared to the benefits achieved by continuity. Continuous cantilever beams are common in car park structures such as shown in Figure. 2.2.

2.1.1 Beam Orientation

In a rectangular column grid layout it is generally more cost-effective structurally to orientate the secondary beams in the longer direction, so that the heavier loaded primary beams span the shorter direction. Refer Figure 2.3. Combined panel vibration performance is also typically better with

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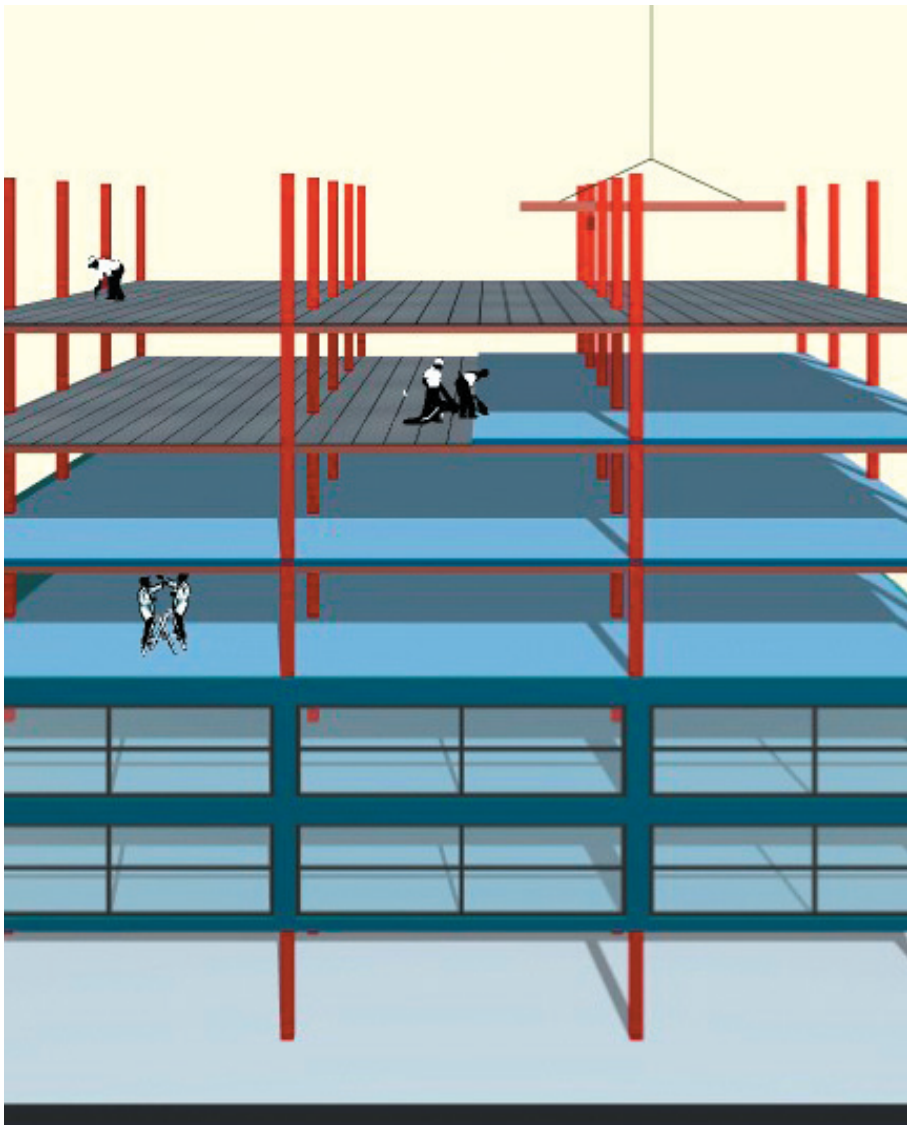

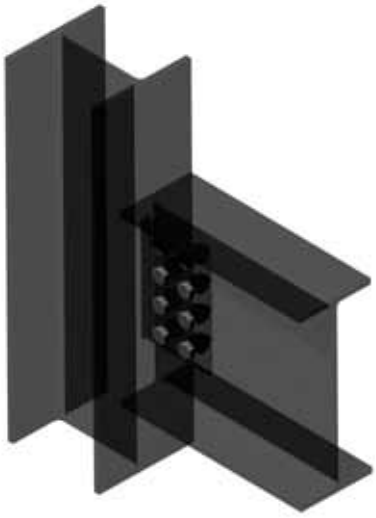

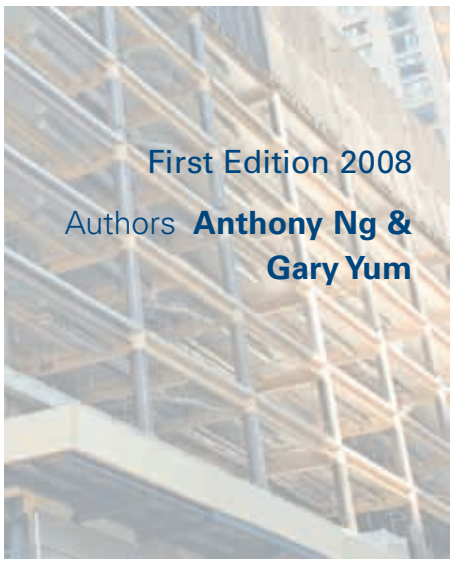

First Edition 2008

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