CHAPTER THREE – FLOOR DESIGN ASPECTS

3.1 Floor Flatness

Floor flatness, or levelness tolerance, is a control applied to concrete slabs cast on ground. A flatness is specified by a codified number, FL. The FL tolerance can also be applied as a flatness measure to suspended slabs (on conventionally formed or on metal decking) whilst shored at the time the measurement is taken, and is typically measured within 72 hours after the slab concrete placement. The FL method does not apply to slabs placed on unpropped formwork or metal decking or unpropped steel beams or to slabs cast on pre-cambered beams. Flatness of suspended floors is a measure of deflection and possibly variation to elevation.

3.2 Deflection

Designing a composite floor to satisfy specified tolerances of levelness and slab thickness tolerance involves the calculation of the deflections due to concrete placement, shrinkage, creep, dead load and superimposed dead and live load and whether the floor system is pre-cambered or propped during construction. It is important that the deflection criteria specified is clearly defined and that only the appropriate deflection components are used. For example, if floor tiles require a deflection limit of span/500, then it is only the deflection that occurs after these tiles are laid that is required to be considered. It is typical in the serviceability design of floors to check several limits, such as incremental deflections (i.e. after installation of floor finishes or partitions) or instantaneous live load deflections as well as total deflections. For floors with exposed soffits as in car park structures the total deflections may be the main criterion. Propping or pre-cambering can be used to achieve limits whilst maintaining floor economy.

Methods of concrete placement to slab profiles and levels are described in the Construction Aspects section of this publication (page 26).

3.3 Propping

There are basically three alternative methods for the construction of composite beam floors; each have different design considerations as discussed below.

Propped non pre-cambered beams: The beams act as composite beams for all load actions therefore design is for stress, strength and deflections occurring after the removal of props. If the slab is continuous over the ends of the beams then slab cracking is controlled by adding rebar to the top of the slab. Unless the slab (in-situ on metal deck) is also propped, the slab will be thicker at mid-spans between beams due to deck deflection during concrete placement. Consideration needs to be given to the adequacy or continuity of support from the floors below and the staged removal of propping.

Unpropped non pre-cambered beams: Since the deck and supporting beams will deflect under the weight of wet concrete, the bare steel beams are designed for adequate strength and stiffness to minimise floor deflection, hence additional ‘concrete ponding’ weight that would occur to beams and slab at this construction stage. The composite beam properties are used to calculate the deflections for the in-service live and superimposed dead loads, which are added to the ‘Stage 3’ deflections of the bare steel beam to get the total deflection. The top of floor is to be level prior to in-service loads.

Unpropped pre-cambered beams: The steel beams are designed to support floor construction loads and pre-cambered to just under the calculated deflection due to floor weight. Allowance is made for concrete ponding to the metal deck and if relevant, minor concrete ponding due to beam deflection if it is to be slightly larger than pre-camber. This method is similar to above with the added benefits of minimal ‘concrete ponding’ weight and a nominally straight beam soffit prior to the in-service loading. The top of floor is to be level prior to in-service loads.

Current practices and relative costs of materials and cambering generally suggest that un-propped pre-cambered floor systems are the most cost effective.

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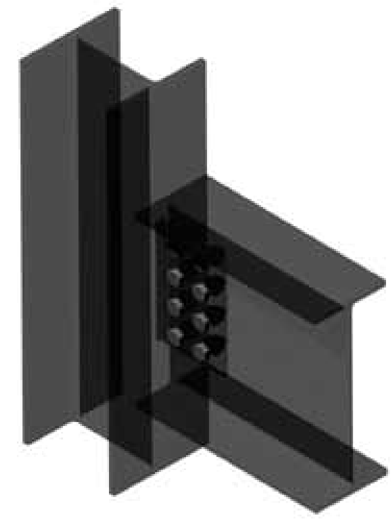

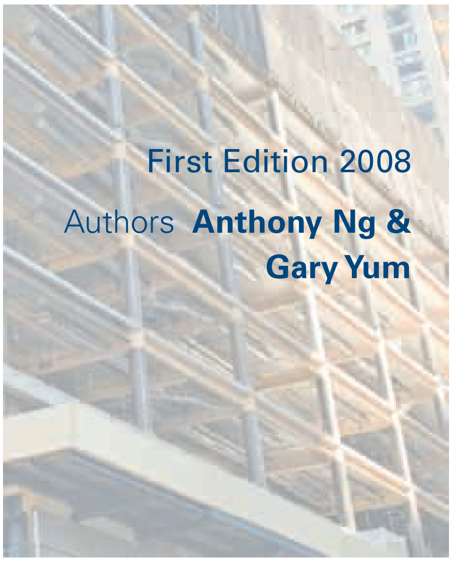

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Authors **Anthony Ng & Gary Yum**

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