GENERAL DESIGN CONSIDERATIONS

FORMWORK

Steel Decking Bearing and Fixing

It is the responsibility of the structural design engineer to determine the bearing and fixing requirements for the steel decking sheets specific to each design case, including consideration of adequate sheet hold down as well as bearing support.

The minimum bearing requirements for sheet ends are given in AS/NZS 2327 (Section 2.2.2). The recommended minimum bearing for steel decking sheets are:

- Sheet ends and side edges on steel or timber beams: 50mm
- Sheet ends and side edges on concrete block walls or in-situ concrete beams or walls: 75mm
- Bearing for internal support (continuous steel decking sheet span) of all types: 100mm

The steel decking sheets must be continuous when laid over temporary bearers.

Fixing to steel beams is usually with shear studs welded through the steel decking sheets whether the beam is designed as a composite beam or not. The size and number of studs and their placement must be specified by the design engineer. Refer Section 3.2.2 Composite Beam Design for more information.

For temporary hold-down the steel decking sheets can be fixed to steel beams with either self-drilling screws or powder actuated fasteners. Fastener strength and spacing must be sufficient to ensure resistance to wind uplift and other expected loads during construction. The recommended maximum fastener spacing along the beam is 300mm (i.e. at least one fastener in every steel decking sheet pan).

For concrete block construction, fixing into the grout cores is recommended as break out of the concrete block is likely if fixings are to the edge of the block. Temporary timber bearers can be used to provide extra bearing support and enable hold down of the steel decking sheet profile with nails. Fixing to tilt slab or in-situ concrete walls is usually by way of a steel angle fixed to the wall, refer to CAD details on-line (**www.dimondstructural.co.nz/products/hibond-80**).

Pre-cambering of Steel Decking Sheets

Pre-cambering of the steel decking sheets will result in less overall deflection of the composite floor slab, and is generally achieved by installing props which are higher than the supporting structure.

Caution is required when using pre-cambered steel decking sheets as the concrete must be poured to constant thickness, as flat screeding will result in less than the minimum design composite floor slab thickness at mid-span.

In any case the pre-camber must not exceed span/350.

Temporary Propping

When required to provide extra support to the steel decking sheets during construction, propping must be adequately braced and installed prior to laying the steel decking sheets. The floor design specifications and drawings must include instructions for the location of the propping lines.

The temporary bearers, props and bracing used must be specifically designed to support wet concrete and construction loads for each build project, taking ground conditions into account.

Suitable propping can be achieved with either Acrow props or braced 100 x 50mm timber props (for prop heights that do not exceed 3m) supporting timber bearers of minimum 100mm bearing width and a depth to suit prop spacing. Refer section 3.6.4.

Propping lines must be continuous and parallel to the permanent supports.

Temporary propping must remain in place until either the concrete has reached 80% of the design strength of the concrete for application of construction loads, or the concrete is fully cured for application of full design loads.

COMPOSITE FLOOR SLAB

Point and Line Loads

Placement of transverse ductile reinforcement is required to distribute point loads and line loads within the composite floor slab. Where a point load is not in a fixed position (e.g. carpark loads) placement of transverse reinforcement is required throughout the composite floor slab.

The effective width of point and line loads, and the required transverse reinforcement are to be designed in accordance with AS/NZS 2327 (Section 2.4.3).

Composite Floor Slab Penetrations

Penetrations of up to 250mm x 250mm square may be formed as part of the composite floor slab construction by formwork or polystyrene infill with the addition of 2 x HD12 ductile reinforcing bars laid in each adjacent steel decking sheet pan. The steel decking sheet is cut away after the concrete has cured.

Larger penetrations will require specific design of additional ductile reinforcment for structural Integrity and crack control, and may also require additional supporting beams to the structural design engineer's specific design. If cutting of the steel decking sheet is required prior to concrete placement, temporary propping will be required.

In-floor Heating

If in-floor Heating is to be incorporated in the composite floor slab, consideration must be given to the structural impact of placing heating systems within the compression zone of the composite floor slab, and the overall composite floor slab thickness increased to compensate for any loss of structural integrity. Commonly available systems include:

- Heated water within 20mm diameter polybutylene tubes at spacing as close as 200mm and with minimum 25mm top cover.
- Electrical wires up to 8mm diameter at spacings as close as 100mm

Heating tubes/wires are recommended to be laid parallel to the span of the steel decking sheets to minimise the impact on structural integrity.

The in-floor heating system must not be used to cure the concrete as it will likely cause excessive cracking in the composite floor slab.

Thermal Insulation

For a composite floor system to comply with the requirements of NZS 4218 using the method of calculation described in NZS 4214 it is necessary to add some form of insulation to the composite floor system. The thermal resistance of a composite floor slab without any covering to the top surface is low (less than 0.1m^2°C/W excluding the thermal resistance of internal and external surfaces), and dependent on concrete density and moisture content, and therefore does not contribute significantly to the overall R value usually required.

Rigid insulation board laminated to the underside of the steel decking sheets is recommended as a suitable solution.

For example, and R value of at least 1.3m^2°C/W can be achieved using either 50mm EPS or 30mm PIR board of appropriate thermal conductivity.

Composite Beam Design

The use of composite beam design can result in significant strength and stiffness gains over non-composite beam design. Composite beam design uses shear connectors to interconnect the composite floor slab and the beam.

The shear connection between the composite floor slab and the beam resists slipping at the interface, resulting in an interaction between the two members. This allows compressive forces to develop in the composite floor slab and tensile forces to develop in the beam.

The strength achieved in the composite beam is generally dependent on the strength of the shear connection provided between the composite floor slab and the beam. It is assumed that the shear connection is ductile.

Three types of construction are commonly used with composite beams.

<u>Unpropped</u>

- Where composite floor slab, secondary and primary beams are all constructed in an unpropped condition.
- Unpropped construction generally uses larger member sizes. However construction time is minimised, on this basis unpropped construction is preferred.
- The composite floor slab is poured to level for unpropped construction.

Propped

- Where secondary and primary beams are propped during construction. The composite floor slab is propped but may also be unpropped.
- Propped construction results in more efficient member sizes. However access to sub-trades is restricted until props have been removed.
- The composite floor slab is poured to level for propped construction.

Pre-cambered

- Where secondary and/or primary beams are fabricated with a pre-camber. The composite floor slab is unpropped for this type of construction.
- Pre-cambered construction provides member size efficiency and minimal soffit deflection and is effective on large spans.
- Pre-cambered construction requires the composite floor slab to be poured to constant thickness.

Timber Structure

Composite floor slabs are not intended for use on permanent supporting timber beams unless the beams have been specifically engineered to ensure undue deflection due to moisture, long term creep or shrinkage do not affect the concrete floor slab performance.

Contact between the galvanised steel decking sheets and the timber beam must be avoided. Refer Section 3.1.3.2.

Shear connectors into timber require specific design by the structural design engineer, and could include galvanised coach screws or reinforcing bar epoxy glued into the timber beams and turned into the composite floor slab.

Two-Way Composite Floor Slabs

Composite floor slabs are intended specifically for use in one-way composite floor slab construction. However, specific design as a two-way composite floor slab may be carried out to the requirements of NZS 3101 provided the concrete strength contribution below the steel decking sheet ribs is ignored in the transverse direction.

Bridge Structures

Composite floor slabs are not intended for use in bridge structures other than as permanent formwork, unless specifically designed outside the scope of this manual.

Earthquakes

Design considerations for composite floor slabs for earthquake are provided in AS/NZS 2327 Section 8 as a modification and supplement to the requirements of NZS 3404.