INFORMATION BULLETIN: IB 76

Competitive Concrete Solutions

Precast Concrete Floors

CCANZ concrete answers

INTRODUCTION

In New Zealand, the vast majority of suspended floors used in commercial and domestic buildings are constructed in precast, prestressed concrete.

Precast, prestressed concrete floors offer significant advantages in many types of building construction. They offer design, time and cost advantages over other flooring materials and systems, and are suitable for use with all structural systems, i.e. concrete, masonry and steel.

This Information Bulletin outlines the various types of precast, prestressed concrete flooring systems available in New Zealand, provides information on their properties, and discusses their advantages.

PRECAST CONCRETE FLOORING SYSTEMS

The following precast, prestressed concrete flooring systems are used in New Zealand:

Flat Slab

Flat Slab floors (see **Figure 1**) consist generally of a series of 75 mm thick precast, prestressed concrete slabs with a reinforced concrete topping, which provide economic solutions for spans up to 6 m but are capable of spans up to 8 metres. 150 mm thick units are used for high fire rating applications. The slabs are usually 1.2 m or 2.4 m wide, and require 75 mm end seating. When the slabs have been placed, they provide an immediate working platform for subsequent work.

Temporary propping is normally required during casting of the topping slab.

Rib and Timber Infill

Figure 2 shows a typical section of a Rib and Timber Infill floor, which consists of a series of 150 to 200 mm wide precast, prestressed concrete ribs, which are normally spaced at 800 or 900 mm centres with timber infills and tied together with a reinforced concrete topping. Rib and Timber Infill floors provide a comparatively lightweight construction.

Temporary propping is normally required for this type of floor.

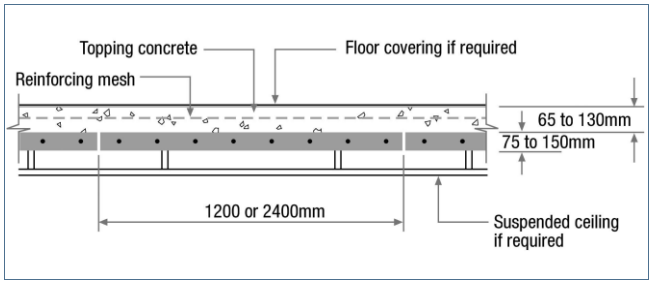

Figure 1: Typical Section of a Flat Slab Floor

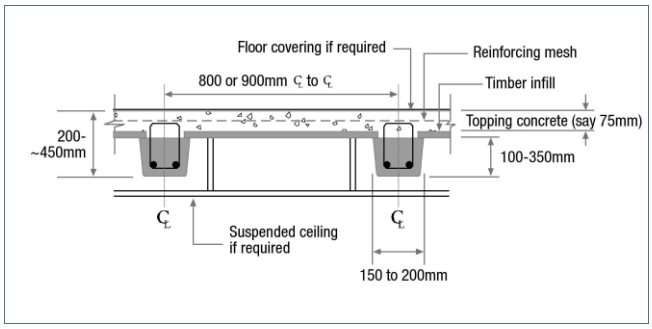

Figure 2: Typical Section of a Rib and Timber Infill Floor

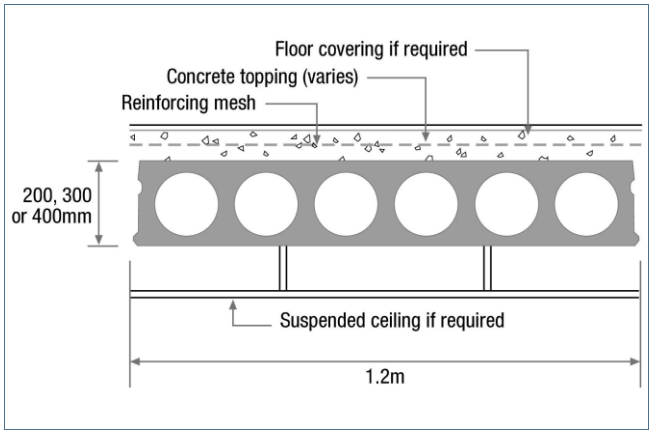

Figure 3: Typical Section of Hollowcore Floor

Hollowcore

Figure 3 shows a section of a precast, prestressed concrete hollowcore panel with continuous longitudinal voids to reduce self-weight. In addition to being capable of spanning up to 18 m (at 400 mm depth), hollowcore slabs provide a working platform immediately after being positioned. Hollowcore

slabs are generally unpropped during the casting of the topping.

Spaced Hollowcore

Figure 4 shows hollowcore slabs spaced apart with timber infills being used between the units. This results in more economical floors. Temporary propping may be required.

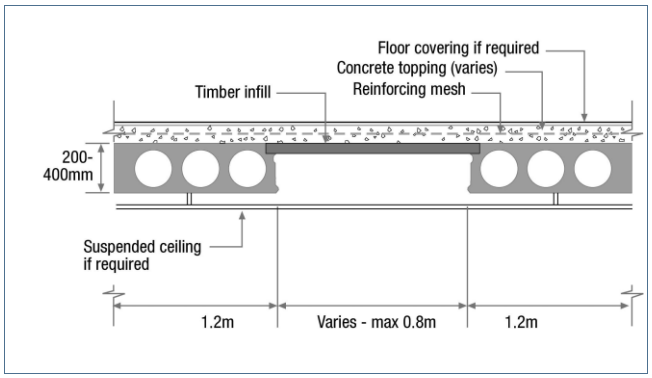

Figure 4: Typical Section of a Spaced Hollowcore Floor

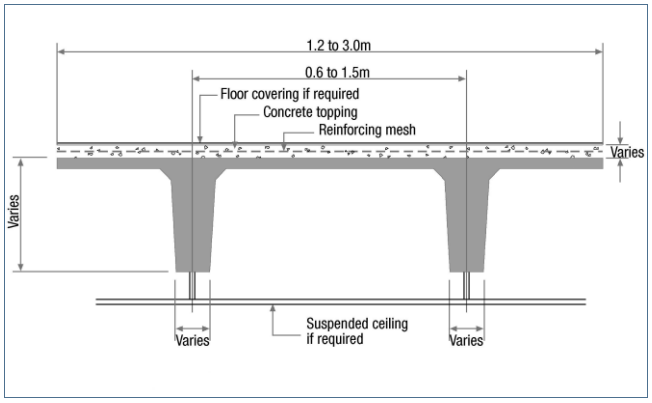

Figure 5: Typical Section of a Double Tee Floor

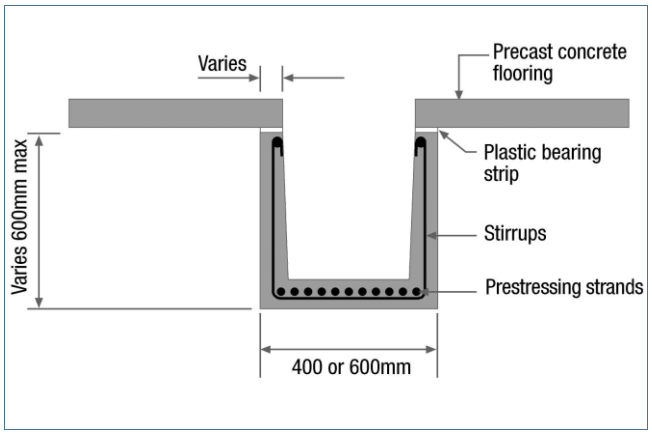

Figure 6: Typical Section of a Shell Beam

Double Tee

Figure 5 shows a double tee unit consisting of two prestressed ribs with an integral floor connecting top slab. The ribs can vary in depth from 200 to 600 mm, and the units are generally 2.4 m wide, although units from certain manufacturers may be 1.2 m to 3.0 m wide.

Double Tees typically span up to 19 m, and provide a safe platform, directly after placing, for subsequent work.

Shell Beams

Shell Beams speed up and simplify precast concrete floor construction.

Shell beams – see **Figure 6** – are precast, prestressed, u-shaped beams that can be used in ductile moment resisting frames. They offer many advantages in building construction, including fast turnaround and savings on formwork.

PROPERTIES OF PRECAST CONCRETE FLOORS

Table 1: Fire Resistance Ratings (FRR) and Acoustic Properties - Sound Transmission Class (STC) and Impact Insulation Class (IIC).

SYSTEM	FRR	STC	IIC
Flat Slab *1	up to 1.5 hrs	> 55	*5
Rib & Timber Infill *2	1 hr	53*3	*5
Hollowcore 200	2 hrs	> 55*4	*5
Hollowcore 300	2 hrs	> 55*4	*5
Hollowcore 400	2 hrs	> 55*4	*5
Spaced Hollowcore	up to 2 hrs	55*6	*5
Double Tee	1.5 hrs	> 53*4	*5

*1 75 mm slab and 65 mm topping (will be greater by insulating the ceiling and/or floor coverings).

*2 75 mm topping.

*3 65 mm topping, no ceiling or floor coverings.

*4 Can be made greater by insulating the ceiling and/or floor coverings.

*5 Without floor coverings: 25-30. With floor coverings: 65-70 (and can be increased with specific design).

*6 Up to 55, and depends on insulation in the ceiling and/or floor coverings.

Note: Values are indicative only. Actual values should be discussed with individual manufacturers.

Span Lengths

The chart on page 5 (**Table 3**) of this Information Bulletin shows indicative spans for flooring systems used in New Zealand. Individual precast manufacturers should be contacted for section properties and more detailed load span tables of their particular products.

BENEFITS OF PRECAST CONCRETE FLOORS

Speed and Cost

Precast concrete floors provide efficient and cost effective solutions for construction. The floor panels are cast in a precast yard independent of on-site work, which can remove their manufacture from the critical path.

Fast floor-to-floor construction times reduce the construction programme, which leads to earlier project completion, and earlier returns on investment.

Thermal Mass/Fabric Energy Storage

The thermal mass/fabric energy storage properties of concrete reduce and delay heat flow from a building, reducing running costs for air conditioning and heating.

Long Spans

The long spans available with precast concrete flooring systems reduce the number of secondary beams required and maximise the column-free floor space. Spans of up to 19 m are possible with hollowcore and double tee flooring systems.

Fire Rating

The Fire Resistance Ratings (FRR) of precast concrete floors are generally between one and two hours. Fire resistance ratings can normally be increased by design, if required.

Acoustic Performance

The Sound Transmission Class (STC) values of precast concrete floors are generally greater than 55.

As with all types of flooring system, the Impact Insulation Class (IIC) values of precast concrete floors depend on the type of floor coverings (carpet, vinyl and underlays and tiles, etc.) which insulate the impact on the top surface of the floor from the floor construction.

Vibration Damping

The mass of precast concrete floors makes them less susceptible to occupant-induced vibrations than other, lighter flooring systems.

Durability

Concrete has a proven track record in providing excellent weathering and corrosion-resistant qualities, and long maintenance-free periods.

Prop-free

Hollowcore and double tee precast concrete floors can generally be constructed without the need for propping, leading to savings in cost and time.

Immediate Working Surface

Flat slab, hollowcore and double tee precast concrete floors provide an immediate working platform for following trades.

High Load Capacity

Hollowcore and double tee precast concrete floors can support the heavy loads carried in most factories, warehouses and storage buildings.

Design Efficiency/Diaphragm Action

Precast concrete floors can be designed to act compositely with the structure to reduce member sizes, and can provide a structural deck with full diaphragm action where required in multi-storey structures.

Minimal Floor-to-Floor Height

Prestressed precast concrete floors are generally thinner than other floors, making good use of ceiling space for services, and reducing the floor-to-floor height – resulting in materials and construction savings, or giving extra floors.

Table 2: Summary of Benefits of Precast Concrete

Type of Floor	Factory Produced	Fast Erection	Cost Effective	Thermal Mass	Span Length	Fire Rating	Acoustic Performance	Vibration Damping	Durability	Prop-free	Immediate Working Platform	High Load Capacity	Design Efficiency	Minimal Floor-to-Floor Height	Prestressed
Flat Slab	✓	✓	✓	✓	See Table 3	See Table 1	See Table 1	✓	✓	Depends on Span and Loadings	✓	✓	✓	✓	✓
Rib and Timber Infill	✓	✓	✓	✓				✓	✓		×	✓	✓	✓	✓
Hollowcore	✓	✓	✓	✓				✓	✓		✓	✓	✓	✓	✓
Spaced Hollowcore	✓	✓	✓	✓				✓	✓		×	✓	✓	✓	✓
Double Tee	✓	✓	✓	✓				✓	✓		✓	✓	✓	✓	✓

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Table 3: Comparative Selection Chart for Floor