

INFORMATION BULLETIN: IB 95

Drilling, Cutting or Forming Holes in Suspended Concrete Floor Slabs

INTRODUCTION

This Information Bulletin has been written to give guidance on drilling, cutting or forming holes in concrete floor slabs.

Penetrations are required through floor slabs for various reasons, most commonly for services or access.



Figure 1: Plumbing penetrations in Hollowcore

Where penetrations are detailed on the structural drawings, the engineer will have allowed for them in the design and they will not constitute a problem. When penetrations that are not detailed on the structural drawings are formed or cut through a suspended floor slab they need proper consideration. Moreover, penetrations which differ from those specified on the structural drawings, either through size or location must be checked by the engineer responsible before being formed.

Penetrations cut or formed through a suspended floor slab can seriously affect its structural capacity by reducing its bending or shear strength, or both. It is easy for one small hole to cut through a critical piece of reinforcing or to remove a section of concrete essential to the shear capacity. It is imperative that specialist advice is obtained prior to forming or cutting a penetration through a suspended floor where the penetration is not detailed on the structural drawings.

It is relatively simple to design a suspended floor to allow a number of penetrations to be cut after construction with limits on the size, location and spacing. This is done by providing additional reinforcing to ensure sufficient strength remains despite the loss of some capacity if reinforcing is cut.

These limits on size, location and spacing of penetrations must be carefully specified in the design and adhered to by the constructor. This may involve only a small additional cost that is outweighed by the convenience, flexibility and by not having to obtain further approvals.

No penetrations should be cut or formed through a floor slab unless they are either detailed on the structural drawings, or specific written approval has been obtained from the person responsible for the structural design of the floor prior to forming them.

Issues to be considered when forming penetrations through floors include the effect on:

- bending capacity;
- shear capacity, both vertical and horizontal (diaphragm action);
- reinforcing cover;
- fire ratings or fire spread;
- acoustic separation;
- the additional protection required for outdoor or harsh environments.

Each item may require input from an appropriately qualified professional. The person responsible for structural design may only be able to comment on the first three of these considerations.

The following comments are for general information only and do not override the requirement to obtain written approval from the person responsible for the structural design of the floor prior to forming any penetrations not detailed on the structural drawings.

HOLES FORMED PRIOR TO PLACING IN-SITU CONCRETE ON SITE

Prior to placing in-situ concrete on site designers will determine the effect of proposed penetrations on the structural adequacy of the completed floor. For cast in-situ reinforced or post tensioned floors, or for metal decking floors, it is relatively easy, compared with precast elements, to identify the critical reinforcing. Thus the penetrations can be located so they will not affect the structural capacity of the completed floor or compromise the integrity of the reinforcing through reduced cover. Alternatively, additional reinforcing or supports can be provided.

While floor slabs are generally located on the interior of a structure, special consideration needs to be given when making penetrations that reduce concrete cover in horizontal slabs which are exposed to the external environment. Where penetrations are needed, even in internal environments, specialist advice should be sought to determine if alternative corrosion protection is required, such as galvanizing or epoxy coating of the embedded reinforcement.

For rib and infill floors the critical reinforcing is normally contained within the rib, and designers can locate penetrations in non-critical areas. Large penetrations between the ribs can reduce the bending capacity if they leave an insufficient compression zone.

For floors incorporating precast double tees and precast single tees it is also relatively simple for designers to locate penetrations in non-critical areas away from the tee down stand. The effect of large penetrations on bending capacity through reduction of compression zone requires consideration.

The critical reinforcing in prestressed flat slab floors can be seen at the ends of the precast units.

With hollowcore floor units the reinforcing can be seen at the ends of the units. Generally the vertical webs should remain intact and penetrations should not be drilled or cut that affect the vertical webs. Penetrations must not compromise prestressing strands.

HOLES CUT AFTER THE FLOOR CONSTRUCTION HAS BEEN COMPLETED

It is far more preferable to plan and make penetrations as part of the design of the floor prior

to placing in-situ concrete, whether the in-situ concrete is topping over the precast elements, or the floor itself. The effects of cutting critical reinforcement or compromising stressing strands can render the floor unsound or unsafe, and must be fully appreciated at the installation stage.

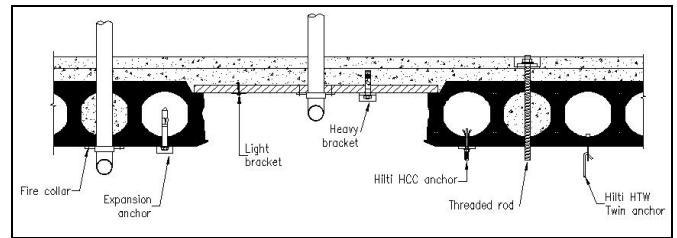


Figure 2: Fixings to Hollowcore

Once the in-situ concrete is in place it is very difficult to determine the location of critical reinforcing in the floor slab.

For cast in-situ reinforced or post-tensioned floors, the original structural drawings will give an indication of the reinforcing size and spacing but cannot be relied upon to give the precise location. The effect of cutting or damage to reinforcing depends on its location. It is unlikely that any damage to post tension ducts would be acceptable.

Rib and infill floors, and floors incorporating precast tees should be examined from the exposed underside before any decision is made (by the engineer) regarding cutting penetrations.

Determining the precise location of critical reinforcing in precast flat slabs and hollowcore units is more difficult. The manufacturer of the precast units may be able to give some guidance but may not be able to give accurate locations.

If possible, the infill sections between spaced hollowcore units are a more suitable location to accommodate penetrations and services than the units themselves.

Holes should not be cut through existing floors incorporating precast units without consulting the original supplier where known, or a specialist with expertise in precast floor units.

Drilling contractors should stop drilling or cutting where they encounter reinforcing steel. Structural engineering advice should be sought and if permitted to proceed, written confirmation should also be obtained.

Penetrations are sometimes required as part of the floor installation, but are not detailed as part of the design, for example, hollowcore floor units that need to be cut to accommodate perimeter columns. This

should be referred back to the engineer for advice before installation.

There are penetrations in completed floors that do not directly affect floor reinforcement but can still be a problem, and must be considered by the design engineer before being made. Some examples are:

- Horizontal penetrations through ribs and single/double Tee downstands, which affect both the shear and flexural capacity of the support.
- Horizontal penetrations across the hollow cores of floors; which could initiate a premature shear failure.
- Penetrations that reduce seating of precast units.
- Multiple small penetrations along diaphragm connections to perimeter frames or walls.

BEAMS, COLUMNS AND WALLS

In addition to penetrations in suspended concrete floors and slabs, penetrations are sometimes required in beams, columns and walls.

As these elements usually form the main structural system in a building, such penetrations must in general only be formed when they are shown on the design drawings, and have been specified by the structural engineer responsible. Penetrations which are not shown on the design drawings must not be made without the specific permission, in writing, of the structural engineer responsible.

FURTHER READING

- CCANZ Information Bulletin: IB 76 Precast Concrete Floors.
- CCANZ Information Bulletin: IB 72 Coring Concrete for Strength Assessment.
- NPCAA/CIA (2009). Precast Concrete Handbook. National Precast Concrete Association Australia/Concrete Institute of Australia.
- NPCAA/CIA (2002). Precast Concrete Handbook. National Precast Concrete Association Australia/Concrete Institute of Australia. Commentary for New Zealand Users.

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