POST-TENSIONING INSTITUTE
OF AUSTRALIA LIMITED

ENSURING EXCELLENCE AND ACCREDITATION FOR THE POST-TENSIONING INDUSTRY
Post-Tensioning Institute of Australia Limited ABN 86 121 218 228 PO Box 861, Five Dock NSW 2046
T: 02 8767 6292 F: 02 8767 6291 E: info@ptia.org.au W: www.ptia.org.au

PTIA Guidance Note
GN06/v.2
December 2014

Post Cut Holes through Post-Tensioned Slabs

This is a guide for Engineers, Contractors and Building Owners to help them safely locate and cut penetrations through bonded post-tensioned slabs, after the slab has been constructed. This guide is applicable to PT flat slabs, PT beams and PT band beam slabs.

Marking Tendon Positions

Post-tensioning strands are made from hard steel so it is difficult to damage them with a Tungsten Carbide (Masonry) drill bit if care is taken. However, a diamond core can quite easily cause significant damage. Services are often suspended from the soffit of the slab using post-drilled fixings and, if there are a lot of fixings to be installed such as for hospitals or plant rooms, consideration should be given to marking the soffit to show the tendon positions and have the relevant trades trained and supervised in the procedures to avoid damage to the tendons. This can be done by painting the deck prior to concreting – the paint transfers to the concrete soffit upon striking, refer to Fig. 1, or by using support chairs with coloured feet, refer Fig. 2 or by fixing Tendon Markers to the formwork under the tendons, prior to pouring the concrete.

However, this won't help with coring, which is normally done from the top of the slab. Unless it is known that a lot of coring will be required, it is not normally economic to mark the top surface of a slab during construction. Far better to locate and mark tendons locally using one of the methods below, once a new penetration requirement has been identified.

Fig. 1, far right
Decking painted to indicate tendon position

Fig. 2, right
Coloured chair

One way to manage this process is to introduce a “permit to core” system on site and in the O&M Manual.

How to Safely Form Holes.

Post-formed penetrations can be categorised by four classes, depending upon the likely impact on the post-tensioned structure. Ref to Fig 3.

If an experienced PT design engineer is consulted early in the planning process, it is frequently possible to optimize the modifications so as to minimize or reduce the extent of strengthening required. PT systems often possess high levels of redundancy and reserve capacity that could be utilized in such situations.

Class 1 (Small Drilled Hole – no tendons cut)

Minimal risk to structural integrity

Penetration size is 20mm or less and does not cut tendons. e.g. post drilled fixings.

- This type of penetration may be made anywhere in the structure, however the design of the inserting element is to be carried out by a competent engineer and resultant forces checked on the slab capacity remembering that PT slabs often have minimal conventional reinforcement.
- Limit the depth of the hole to “cover to tendon less 5mm”. If a deeper fixing is needed, treat the hole as Class 2.

Class 2 (Minor Penetration – no tendons cut)

Low risk to structural integrity

Penetration size is likely to be no more than 200mm diameter if located in a beam or near a column but could be significantly larger in less-highly stressed areas. Penetration is located between tendons such that tendons are not cut.

- Engineer to carry out a punching shear check for holes within 6 times the slab depth of a support or concentrated load or for holes greater than 500mm located elsewhere.
- Locate tendons using the guidance in the “How to locate a tendon” box and then core the hole in a safe place.

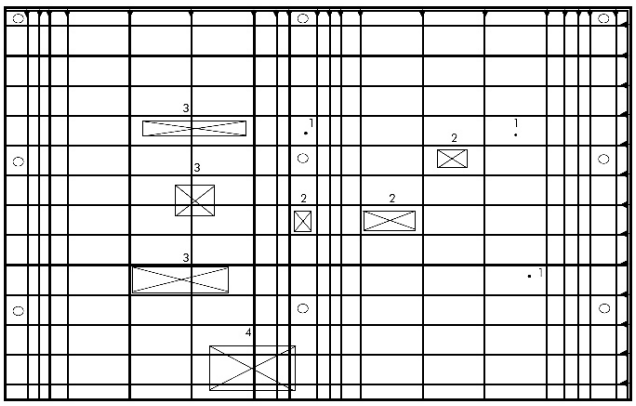

Fig. 3 – four penetration classes

How to drill using masonry bits.

The hole is to be drilled using a percussion drill with a Tungsten Carbide (Masonry) bit, a diamond core drill bit is not to be used.

If metal is struck cease drilling immediately and relocate the hole.
DO NOT LEAN HEAVILY ON THE DRILL – drilling through a strand is difficult but not impossible for a sufficiently determined operative!

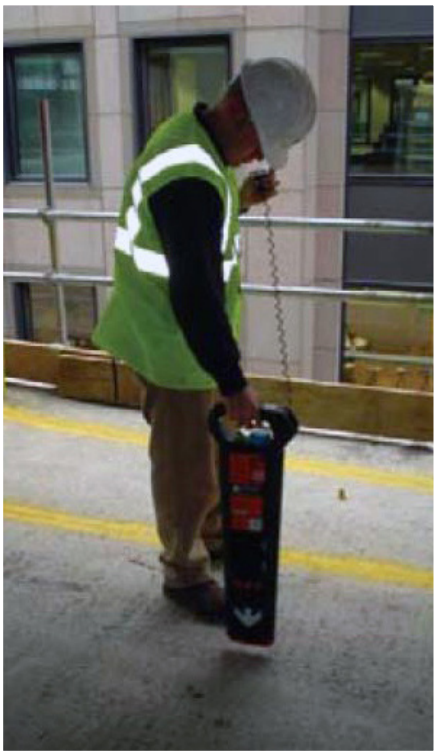

Fig 4 – Locating and marking tendons on the top surface.

How to locate a tendon

As-built drawings, staple points or chair feet marks on the soffit and grout vent positions on the top surface serve as a guide to tendon location but they are not foolproof methods. Therefore, one of the following two methods is recommended to verify that it is safe to core.

- Locate tendons using a cover meter or an induced current metal detector (CAT scan or Ground Penetrating Radar - GPR). This can give clear tendon positioning away from areas of conventional reinforcement. Tendons are to be locally set out on top of slab. See Fig 4.
- Ensure tendons are not present in the coring zone by drilling vertical pilot holes through the full depth of the slab with a 16mm diameter drill bit, following the "how to drill using masonry bits" box above. The spacing of the pilot holes around the perimeter of the penetration should be less than the width of the group of strands being located.
- In all cases, refer to the post-tensioning shop drawings as a guide to location of tendons in both directions of the slab.

Class 3 (Medium Penetration – up to two tendons cut)

Moderate risk to structural integrity, some strengthening possibly required

Penetration cuts one or two tendons and cannot be relocated to miss them, e.g. service riser. This class of penetration is unlikely to be permitted in a beam or near a column without strengthening.

- Refer to Class 4 for necessary actions.

Class 4 (Major Penetration – several tendons cut)

Severe risk to structural integrity, strengthening very likely

Cutting several tendons in one or other direction, e.g. escalator pit. This class of penetration is unlikely to be permitted without major strengthening. The remaining surrounding slab system needs to be reviewed by an engineer for the new loading, continuity and support conditions.

- Engineer is to assess whether strengthening is required, and produce full method statements and risk assessments for the works.
- Tendons are to be cut using the guidance below.
- Consideration is to be given to corrosion and fire protection of the severed ends and whether edge trimming reinforcement is required.

Safety

In the case of bonded tendons, it is far better to delay drilling until the slab has been grouted and let cure for seven days. This is because, if a non-grouted strand is severed, it can fly out of the end anchorage which could be dangerous. Additionally, if the operative strikes the strand and relocates the hole (as he should do) grout can leak from the abandoned hole during the subsequent grouting operation. For this reason, any abandoned holes should be filled. Unbonded tendons are packed with grease inside their plastic sheath, which means any release of energy is less dramatic.

Cutting bonded tendons

- Bonded tendons are located in grout-filled ducts and therefore are permanently bonded to the structure. There is no loss of strength other than local to the cut.
- It is normal practice to apply either a mechanical or an epoxy anchorage to the tendon ends immediately outside the area to be demolished or cut, before demolition or cuting takes place. This will provide greater surety of anchoring. Refer to PT specialist contractors for details.
- If a bonded tendon is accidentally severed, the usual strengthening method is to apply FRP laminate strips. Most of the PTIA member companies can give further advice.

Demolition

The demolition of post-tensioned structures is beyond the scope of this document. Particular care must be taken with Transfer structures, especially those that were staged stressed during construction. Please contact a PTIA member for advice, contact details are on the website, www.ptia.org.au.