### 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.
- If the Engineer deems it safe to do so, a bonded tendon can be simply cut through using a diamond core or saw, having first established that the grouting is sound.
- In rare cases, if the grouting is incomplete or suspect, then precautions need to be taken to minimize the risk of strands flying out of the ends when severed.
- The ends of the duct, once cut, are to be inspected to verify that the grouting was good and the strands are holding load (it is normal for the ends of the strands to pull back from the cut face by no more than 1mm). If this is not the case refer to the Engineer.
- Unless only one or two tendons are being cut, it is normal practice to apply either a mechanical or an epoxy anchorage to the severed tendon ends in order to provide even 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 PTA member companies can give further advice.

### Cutting Unbonded Tendons

- Unbonded tendons come in grease-filled plastic sleeves and are not connected to the structure other than at their end anchorages. Therefore, once cut, they will become detensioned along their whole length. Consequently, back-propping or loading restrictions in adjacent spans should be considered.
- If the Engineer deems it necessary to restress the remaining ends of the tendon once the hole has been cut, the normal procedure is as follows.
- Overbreak the hole by about 600mm, install edge reinforcement, locate new anchorages over the existing strand ends, recast the slab edge, restress the tendons from the face of the hole.
- The grease inside the sheath slows down the release of energy when a strand is cut such that the wedges normally don't disengage from the anchorage. However, this cannot be guaranteed so precautions should be taken if the consequences of impact with the facade are significant.
- Some PTA member companies have cross-over type anchorages which may be used to effect a repair to accidentally cut tendons. However, a degree of overbreak is still required to fit these devices in.

## Demolition

The demolition of post-tensioned structures is beyond the scope of this document. Please contact a PTA member for advice, contact details are on the website, address below.

## The Post-Tensioning Association; Promoting Perfect Post-Tensioning

This Guidance note has been produced with help from the following members

Freyssinet Sustainable Technology

StrongForce

www.post-tensioning.co.uk



The Post-Tensioning Association
PTA Guidance Note GN01

# Post-Formed Holes Through Post-Tensioned Slabs

This is a guide for Engineers, Contractors and Building Owners to help them safely locate and cut penetrations through post-tensioned slabs, after the slab has been constructed. Both bonded and unbonded PT systems are considered. 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. This can be done by painting the deck prior to concreting – the paint transfers to the concrete soffit upon striking, ref Fig 1, or by using support chairs with coloured feet, ref Fig 2.

Fig 1 – decking painted to indicate tendon position

Fig 2 – coloured chair

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

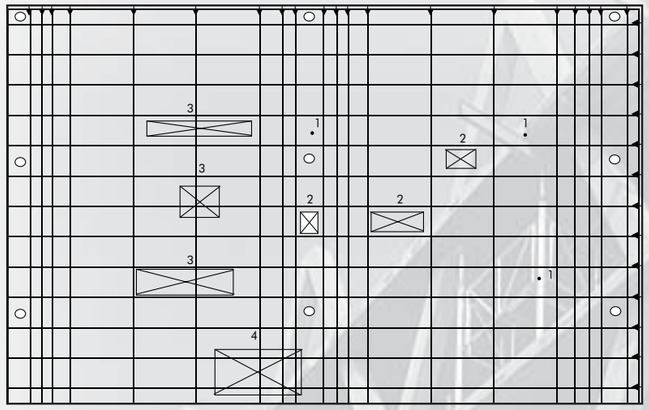


Fig 3 – four penetration classes

**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.
**Note:**
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!

## 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.



The Post-Tensioning Association
PTA Guidance Note GN01

**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). 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 with a 16mm diameter drill bit, following the "how to drill using masonry bits" box above. The spacing of the pilot holes should be less than the width of the group of strands being located.

Fig 4 – locating tendons with CAT scan

### Safety

In the case of bonded tendons, it is far better to delay drilling until the slab has been grouted. 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.

### 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.