

CFA Guidance note: Anchor Installation

1 INTRODUCTION

Of the millions of fixings used every year the very few which fail generally do so because of poor installation.

In any application, whether safety critical or not, the full performance expected by the specifier can only be realised if correct installation procedures are followed. In extreme cases poor installation may reduce the safety margin such that the fixing fails either during installation or while in service.

Correct installation will be achieved by following the manufacturer's instructions. Management should ensure that installers are trained in the method for the fixing concerned and supervised on the job. The correct equipment must be used.

All members of the **Construction Fixings Association** provide installation instructions, often necessarily in diagrammatic form for easy understanding. This **Guidance note** provides an opportunity for the different aspects of installation to be explained more fully.

2 BEFORE INSTALLATION

These checks should be carried out before starting:

- Fixings to be used are to the specification.
- Equipment needed for the installation is available and to the manufacturer's specification. (Special setting tools are not usually interchangeable between makes even if the fixing involved is of a similar type and the same size.)
- Drilling machines and cables are in a safe condition.
- Any special conditions are complied with e.g. for Bonded anchors allowable installation temperature range and hole condition e.g. wet, damp or dry?

Ensure the following safety guidelines are followed:

- *Wear eye protection to BS2092 Grade 1 when drilling or installing bonded anchors overhead.*
- *Wear a dust mask when drilling in a confined space or overhead or setting bonded anchors overhead.*
- *Wear ear protection when drilling continuously or in a confined space.*
- *Wear gloves to BS EN 374 when handling resins.*

3 BASIC INSTALLATION PROCEDURES

The following steps are common to all anchors:

- *Drill hole to correct diameter and depth*
- *Clean hole thoroughly*
- *Use correct setting equipment and procedure*
- *Tighten to correct torque*

These steps are discussed in more detail below followed by aspects related to particular types in section 4.

3.1 DRILL HOLE TO CORRECT DIAMETER AND DEPTH

Hole Diameter

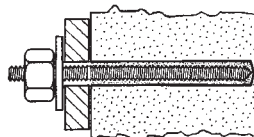
Important for all anchors

Use the correct nominal diameter drill bit. For drilling concrete and other hard base materials direct entry drill bits used in rotary hammer drilling machines give best results. For soft base materials such as aerated blocks and very soft old bricks rotary only drilling will prevent holes opening up over size.

Drill bits wear and holes may eventually become too small making it hard for mechanical anchors to enter the hole. With bonded anchors it is less obvious but just as important that hole diameter is not reduced, check tip for wear.

Hole Depth

Critical for some anchors, less so for others



**Correct hole depth means
full bond - full strength**

Hole depth is critical for those anchors which locate against the bottom of the hole such as most deformation controlled e.g. "Drop-in" anchors. Capsule type bonded anchors require correct hole depth to ensure full bond length. Some anchors, notably Undercut types, use "Stop Drills" to guarantee correct hole depth.

A few types, including Thick-walled and Thin-walled sleeve anchors and Throughbolts, may be set in holes deeper than the minimum. For these anchors quoted hole depth is usually a minimum and relates to maximum fixture thickness - increase hole depth for thinner fixtures. See below for guidance on repositioning aborted holes.

Hitting rebar

Drill through or reposition, never reduce embedment

Never be tempted to reduce anchor embedment if rebar is struck. Either obtain permission to drill through the bar from the responsible structural engineer, or reposition the anchor. Drilling through rebar is only feasible as long as the rebar does not coincide with the point of expansion of the anchor as the steel may inhibit expansion. Special rebar cutters are available for use in conventional hammer drilling machines. Otherwise use diamond drilling, (roughen holes for bonded anchors). If the rebar may not be cut the anchor must be repositioned, spaced ideally at least the embedment depth from the original hole which should be completely filled with a strong non-shrink grout. The effect of repositioning an anchor on the capacity of the anchor group to support the applied load should also be checked.

3.2 CLEAN HOLE THOROUGHLY

Important for all anchors, critical for bonded

Blowing is adequate for most mechanical anchors - use a blow out bulb for hole diameters up to 10mm and large volume air pump for larger diameters.

Bonded anchors are more sensitive to dust in the hole. Blowing removes loose dust. Brushing removes the dust impressed into the hole sides by the drilling action which would otherwise prevent bonding especially of bonding materials introduced by injection. Ideally stiff round brushes with a diameter slightly larger than the hole should be used with a plunging and rotating action.

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3.3 USE CORRECT SETTING EQUIPMENT AND PROCEDURE

Especially deformation controlled, bonded and undercut anchors.

Deformation controlled, e.g. "drop-in" anchors, are set using special punches with a projecting dowel whose length is specific to the size and the make. Similarly Capsule type resin anchors require special adaptors to drive the stud or socket into the capsule. Some Undercut anchors are set in undercut holes formed by special drill bits.

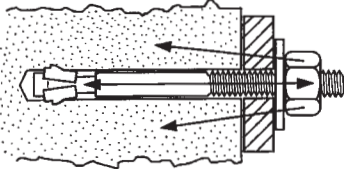
In all cases the setting equipment recommended by the manufacturer must be used.

Installation procedures are equally important and all stages must be followed carefully.

3.4 TIGHTEN TO CORRECT TORQUE

Gives a useful indication of correct setting

Manufacturers' recommended torques usually protect the bolt material from being over stressed while inducing a tension in the bolt, and corresponding clamping force through the fixture, in excess of the recommended tensile load. This means the fixture will not move.



Torque generates pre-load and clamping force - indicates correct setting

Most torque controlled anchors will set in a few turns, excessive turning before achieving the recommended torque may indicate a weakness in the base material. In bonded anchors torques valid for concrete also protect the bond from being over stressed so in weaker base materials it may be necessary to reduce the torque from the "concrete" value in proportion to the reduction in recommended load (or base material strength). Setting torques relax with time before stabilising so anchors checked even a few hours after being correctly set will show a reduced torque.

4 SPECIFIC ANCHOR INSTALLATIONS

4.1 BONDED ANCHORS

Installation may only be carried out when the ambient and bonding material temperatures are within ranges allowed by the manufacturer.

The curing of resin materials is characterised by two critical times. "Open time" and "Curing time".

"Open time" The time from the end of mixing to when the insertion of the anchor into the bonding material should be completed.

"Curing time" The minimum time from the end of mixing to the time when the anchor may be torqued or loaded (whichever is the longer).

Both times are temperature dependent. The lower the temperature the longer the time. Open times are only normally quoted for "Mix and pour" bonding materials.

Most resin anchors are tolerant of damp holes, some manufacturers even promote hole cleaning by flushing with clean water, but some resins may not be installed in the presence of water. Check with the manufacturer. Cementitious materials often require a wet hole to prevent water absorption from the grout.

Injection systems which use static mixer nozzles require the first portions of the mixture to be pumped to waste to ensure that only fully mixed resin is pumped into the anchor hole. Wait for an even colour throughout the nozzle before pumping into the hole. Take care to pump to the base of the hole withdrawing the nozzle steadily as the resin fills the hole. Use special cones to retain resin in overhead applications.

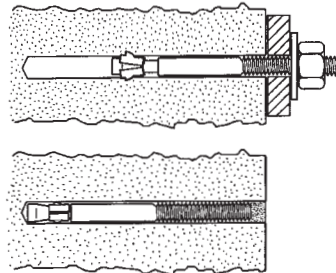
4.2 THICK-WALLED SLEEVE ANCHORS

Often referred to as High Load anchors and used for structural connections and other safety critical applications therefore setting to the correct torque is vital. Torque indicating types available. Most have a built in crush feature to help pull down modest gaps.

4.3 THIN-WALLED SLEEVE ANCHORS

Thin-walled sleeve anchors have minimal capacity to pull down a gap so ensure that any gap is minimal otherwise the clamping force will not be directed through the fixture but through the sleeve itself.

4.4 THROUGH BOLTS



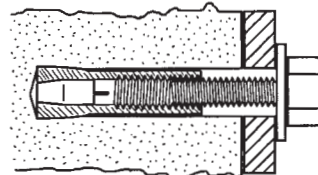
Overdrilled hole for later burial of Throughbolt

Some Throughbolts have a visual warning of excessive turns before correct setting. If the fixture may need relocating in the future the hole should be drilled to a depth greater than the length of the anchor which can be knocked into the hole and grouted over at a later date.

4.5 SHIELD ANCHORS

Not a through fixing so hole location is important. Mark hole positions carefully or use drilling template. Take care not to damage threads when positioning fixtures over projecting studs.

4.6 DROP-IN (DEFORMATION CONTROLLED) ANCHORS



Drop-in hole too deep - inadequate thread engagement

Correct bolt engagement is critical to ensure proper load transfer into the anchor. This means correct hole depth is critical as is correct bolt length which should take account of any washers/packers under the fixture.

Do not allow the bolt to bottom in the thread. Never try to use the bolt to set the anchor. Always follow Critical Edge Distance for drop-in anchors, closer setting may crack concrete due to the high expansion forces exerted during setting.

4.7 UNDERCUT ANCHORS

As long as the correct setting equipment and procedures are used Undercut anchors are relatively fool proof, many give a visual indication of correct setting.

This Guidance note is one of a series published by the

Construction Fixings Association.

Other titles include: "Procedure for Site Testing Construction Fixings" and "Anchor Selection", for details contact:

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