

## CFA Guidance Note: Shield Type Expansion Anchors

### SUMMARY

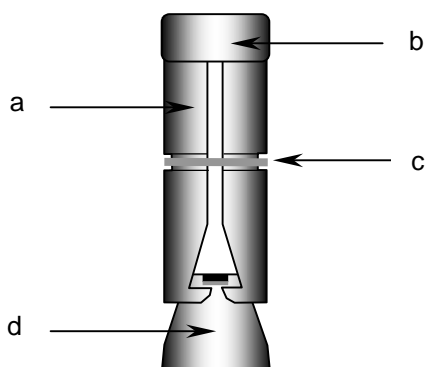
- ❑ Torque controlled expansion anchor
- ❑ M6 – M24
- ❑ Suitable for concrete, solid brickwork, hard stone and dense aggregate blockwork
- ❑ Available in basic shield, hexagon bolt, projecting stud, eye and hook configurations
- ❑ Easy setting
- ❑ High expansion ratio
- ❑ Medium duty applications
- ❑ Carbon steel versions only
- ❑ Non - through fixed

### 1 INTRODUCTION

The shield anchor is the earliest type of expansion anchor as we currently know it. They retain their popularity by virtue of a unique ability to expand very readily with a high expansion ratio. Together these features make shield anchors well suited to use in brickwork and stonework where holes may be slightly over sized due to the drilling process. A wide range of configurations enables shield anchors to be used in a wide range of applications.

### 2 DESCRIPTION

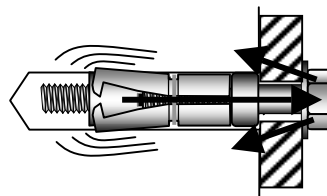
A typical shield anchor comprises a set of expansion segments (a) independently retained by a ferrule (b) and clip (c). An expander cone (d) is retained within the shield by a lug which engages with the shape of the expander segments.



The independent retention of the expansion segments means the shield is easily expanded so setting is reliable. The thick expansion segments (depending on individual design) provide the high expansion ratio. This is particularly useful in brickwork or stone where the hole may open up over size during the drilling operation.

Bolt material is usually carbon steel in grades up to 8.8. Expander segments are most commonly pressed steel or malleable cast-iron but stainless steel is rare. Alloys of zinc "Zamak" or "mazak" are weaker than steel versions and are not offered by members of the CFA.

### 2.1 Operating Principle



Turning the bolt (or nut on some versions) draws the tapered expander cone into the expansion segments forcing them against the base material where a combination of keying and friction

provides the necessary resistance against the withdrawal of the anchor from the substrate. As the expansion increases so the resistance to withdrawal increases as does the tensile force in the bolt and the tightening torque needed to turn the bolt further. This in turn produces an equivalent clamping force through the fixture. At the manufacturer's recommended tightening torque this clamping force should be large enough to ensure that the fixture cannot move during the life of the application. This torque should not be exceeded as it will also protect the bolt material from being overstressed. If the anchor is tightened insufficiently or an additional load is applied then the cone will be pulled into the shield expanding it further. This safety feature is called "Follow-up expansion".

### 3 TYPICAL APPLICATIONS

**Hexagon bolt** types are sometimes referred to as "Floor" fixings as the separate bolt means the shield can be put into the floor and a heavy fixture slid into place before the bolt is inserted and the anchor set. *Examples:* Fixing down machinery, racking.

**Projecting stud** types are thus referred to as "wall" fixings as the fixture may be hung over the stud before addition of the nut and tightening. Care must be taken to avoid thread damage. *Examples:* Bracketry to walls.

**Eye** versions provide ideal attachment points for cables, ropes or wires including vertical suspensions. Eye versions may have fully formed eyes of drop forged steel or open eyes formed from bent bar, the latter will be much weaker than fully formed eyes. Any lateral load is effectively a bending load - the capacity in this direction is poor. Refer to the manufacturer. *Examples:* suspended ceilings and signs. Shield eyes must NOT be used for Safety Harness Eyebolts or for lifting purposes.

**Hook** versions are applicable where the attachment may be temporary or frequently attached and detached. They may be forged or formed from bar and tend to be weaker than fully formed eye types. *Examples:* Temporary lighting, hanging baskets, safety chains and barriers.

**Shield only** types may be used with bolts or studs of special lengths. *Examples:* stand-off fastenings such as lift guide rails taking tensile and compressive loads only.

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## 4 SELECTION

### Base material suitability

Shield anchors work well in concrete and in solid (i.e. non-perforated) bricks and hard stone. They do not work in perforated bricks or lightweight blockwork. In brickwork the largest outer diameter that should be used is 20mm otherwise bricks may be cracked. In the case of masonry of unknown strength preliminary tests should be carried out to check suitability and determine allowable loads - see <sup>[1]</sup>.

### Anchor Positioning

In concrete the manufacturer's recommendations for close edge and spacing distances should be followed. In the absence of guidance for masonry that contained in the CFA Guidance Note: *Fixings for Brickwork and Blockwork* should be followed, in summary this means:

- ❑ Anchors should not be fixed into mortar joints\*
- ❑ Avoid fixing two anchors in the same brick
- ❑ Fix on horizontal centreline & 35 mm from the brick end
- ❑ Keep anchors at least 280mm from the edge of a wall
- ❑ Keep anchors well below the top of an unrestrained wall

\* If it is required to fix into mortar joints because of restrictions such as conservation orders, then the following guidelines should be followed: anchor diameter should exceed mortar joint width; preliminary tests should be carried out to check suitability and determine allowable loads; proof tests should be done to ensure suitable installation procedures, (see <sup>[1]</sup>).

## 5 INSTALLATION

A typical installation procedure is described opposite for a hexagon bolt version. Always follow the manufacturer's guidance.

As shield anchors are not installed through the fixture care is needed to ensure accurate hole location. This may be simplified using a template. Remember clearance holes in templates need to be +1mm on nominal drill size or the drill bit will not go through the hole. Clearance holes in the fixture should take into account possible drilling inaccuracies but may be based on the bolt diameter of the anchor.

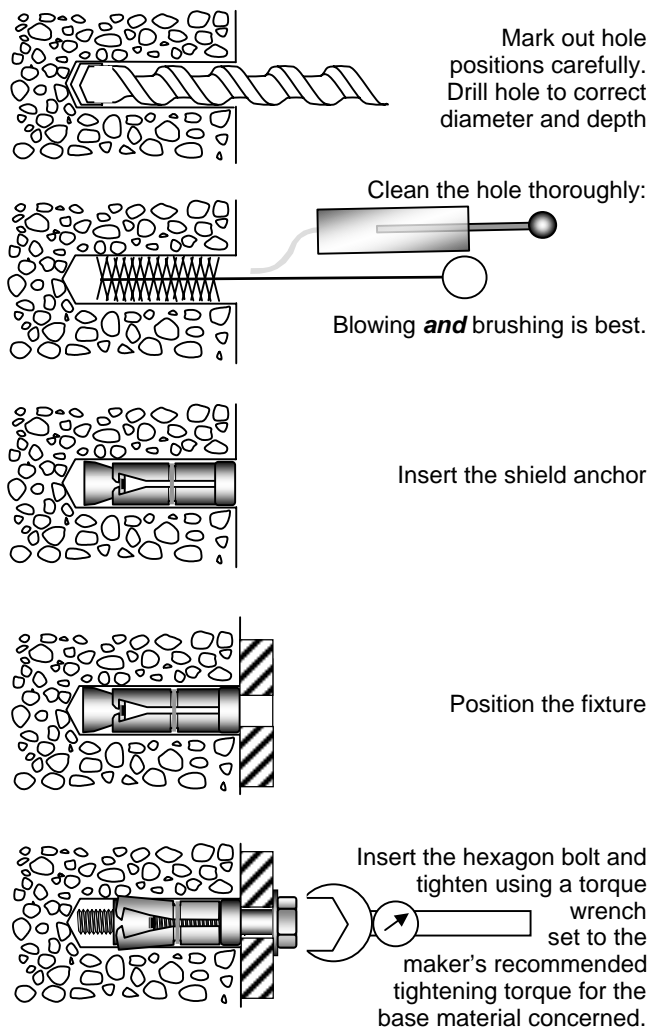
Hole depths are important. Follow the manufacturer's guidance. Projecting stud versions need hole depths sufficient only for the full shield length; Hexagon bolt versions may need extra hole depth to cater for the bolt if the fixture is thinner than the maximum quoted by the manufacturer.

For safety critical applications a torque wrench should always be used. For other, less critical, applications if a torque wrench is not available and for setting hook and eye versions then the nut or bolt head should be turned by 4 – 5 full turns to pull the cone into the shield. Torques for concrete may be excessive for weaker materials, in the absence of manufacturer's guidance reduce torque in proportion to the reduction in base material strength or relative recommended loads.

In the case of projecting stud versions care must be taken when placing the fixture to avoid damaging the projecting thread. The torque/tension relationship may be affected and hence the clamping force.

Hook and eye versions are tightened by turning the nut using an open ended spanner, not by turning the hook or eye.

**Installation – example of typical procedure for hexagon bolt type or shield based version.**



### Removal

Projecting stud type shield anchors are very difficult to remove so, if it is possible that the fixture will, at some stage, need to be removed then a hexagon bolt version should be used as the bolt may be removed leaving the anchor flush with the surface.

### References:

[1] CFA Guidance Note: *Procedure for site testing construction fixings.*

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