CFA Guidance Note:

Thick Walled Sleeve Anchor (torque controlled expansion anchor)

1. INTRODUCTION

All anchors must be selected, designed and installed correctly. When this does not happen, the consequences can be serious in terms of damage to structures and human injury or even death.
To achieve safe anchorages, best practice should be followed at all times.
BS8539:2012 "*Code of Practice for the selection and installation of post-installed anchors in concrete and masonry*"[1] sets out to achieve this best practice through identifying the roles and responsibilities for all stakeholders in the process.
Complying fully with the Code and using only ETA approved anchors will provide a safe installation.

CONTENTS

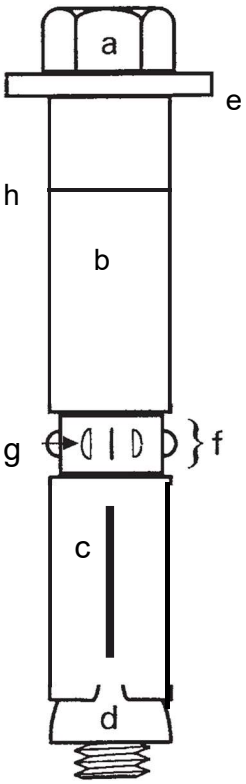
SUMMARY

- Torque controlled expansion
- Suitable for concrete only
- Strongest type of drilled construction fixing
- High strength in tension and shear
- Through fixing
- Many versions available including stainless steel
- Specifiable via data sheets or software
- Approvals available for cracked concrete and dynamic loads
- Some have indicator of correct setting depth
- Not generally removable without risking damage to substrate
- Some versions available with removable body

2 ANCHOR INTRODUCTION

Since the early 1970's the strongest type of drilled-in construction fixing has been the Heavy Duty Expansion Anchor. This Guidance note sets out to help specifiers and users of fixings for safety critical applications appreciate the benefits and limitations of this type of anchor and get the best out of them at both selection and installation stages.

3 ANCHOR DESCRIPTION



a **8.8 Grade** bolt- *for high strength in tension* Conventional bolt head shown. Projecting thread and countersunk versions also available. Projecting thread types allow the removal

and replacement of the fixture without disturbing the expansion arrangement. With special bolts they may be used for stand-off fastenings. Countersunk versions give a flush finish. Torque indicating types are available.

b **Thick walled shear sleeve-** *for high strength in shear* Load transfer from the fixture to the concrete in shear is made via this thick sleeve.

c **Expansion sleeve-** *machined or pressed*
The expansion sleeve can be either a single component, with 3 or 4 axial slots to permit expansion, or separate segments retained by a clip.

d **Expansion cone** – *specially shaped for progressive expansion*
The radiused profile featured on many products facilitates expansion in the latter stages of setting as resistance to expansion increases.

e **Thick washer** – *for clamping and pull over strength* High forces are transmitted through a thick washer. This enables clamping of the fixture and prevents it pulling over the bolt head. See figure in section 2.1.

f **Anti-rotation feature** – *helps setting*
Shown here as part of the plastic crush feature but may be part of the steel expansion sleeve. Helps stop the expansion cone from rotating while the bolt is being turned so the cone will be pulled into the expansion sleeve to expand it. Also helps retain the anchor in overhead applications

g **Collapse feature** *-caters for small gaps under fixture* To ensure the fixture is clamped against the base material the reaction force of the sleeve must be eliminated, or reduce to a minimum, after setting plastic may be used without affecting the fixing's ability to withstand heat. This feature ensures that no gap exists between the fixture and base material

h Depth mark - *also shows fixture thickness*
A groove on the shear sleeve indicates maximum fixture thickness and minimum embedment depth.

3.1 OPERATING PRINCIPLE

Sleeves anchor exhibit the "Torque controlled" operating principle, with the load resistance achieved through Friction. Turning the nut causes the tapered cone to be pulled into the expansion sleeve forcing it against the sides of the hole. Tightening to the manufacturer's recommended tightening torque induces a tensile preload and equivalent clamping force through the fixture that is larger than the recommended tensile load. Further movement, caused by additional loading, will cause further expansion. This safety feature is often referred to as "Follow-up expansion".

Shear resistance is provided by the combination of the thick shear sleeve and, in the bolt head types, the solid part of the bolt shank.

4 TYPICAL APPLICATIONS

Applications most suited for thick walled sleeve anchors include all high load and safety critical applications in concrete including cracked concrete. These involve installation of the anchor through the fixture.
All structural connections involving dynamic (shock, Fatigue or Seismic) loads as well as Static loadings.

5 SELECTION

5.1 BASE MATERIAL SUITABILITY

All thick walled sleeve anchors are suitable for cracked or non-cracked concrete. Some manufacturers allow use in hard natural stone in which case their recommendations on positioning within the stone units, and other dimensional limitations, must be followed. They should not be used in brickwork or blockwork.

5.2 ANCHOR POSITIONING

Manufacturers' recommendations for close edge distances and spacing between anchors must be followed. Many manufacturers publish tables of edge distances and centre spacing with corresponding reduction factors which make the calculation of reduced allowable loads due to these factors a straightforward process. This is most appropriate for standard non safety critical applications.

5.3 EUROPEAN TECHNICAL ASSESSMENTS AND SELECTION SOFTWARE

Thick walled sleeve anchors have gained a large number of European Technical Assessments[2] (ETAs) for mechanical anchors so there is a wide choice available in both carbon steel and stainless steel for use in both cracked and non-cracked concrete. They are covered by EAD 330232-00-0601 Mechanical fasteners for use in concrete [3]. Anchor selection for safety critical uses is a straightforward process if manufacturer's software is available.

5.4 CHANGING SPECIFICATIONS

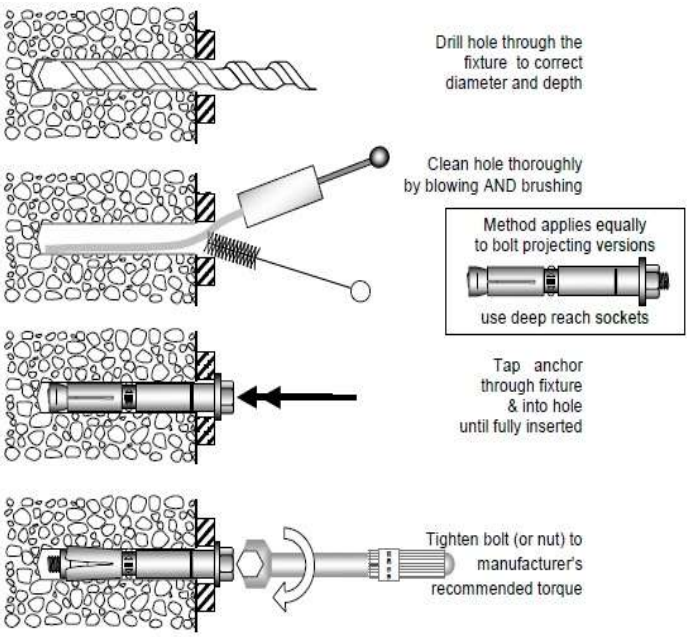
Although sleeve anchors appear to be a simple product a great deal of development work will have gone into the design and manufacturing process to ensure these anchors function correctly in the varied applications they are used in, especially those with ETAs.
They may even look very similar but performance can vary and specifications should not be changed from one type to another unless the same design considerations have been taken into account for the proposed alternative. Comparisons of basic performance data, e.g. safe working loads, or proof tests on site will not confirm the appropriate safety margin or that edge/spacing criteria are met.

5.5 EMBEDMENT DEPTHS

Some manufacturers quote alternative embedment depths for each length of anchor. Recommended loads will be reduced with reduced embedment depths and fixture thicknesses increased. Manufacturers usually mark the different embedment depths on the body of the anchor although these will not usually be visible when installed through the fixture. If visible the relevant mark should be coincident with the surface of the concrete after the anchor is tapped into the hole. Although the body will be pulled through the fixture on tightening the effective embedment depth will not change as the expander will not move in the concrete. It is important that the specifier makes it clear on all specifications and drawings which embedment depth is intended.
(See section 3 element “h”)

6 INSTALLATION

A typical installation procedure is outlined below. The manufacturer’s instructions must always be followed.



Hole depths are usually quoted for the maximum fixture thickness for a particular anchor length, so hole depths must be increased for thinner fixtures.

6.1 MAINTENANCE

Maintenance schedules should avoid the occasional retightening of nuts unless carefully carried out with a torque wrench otherwise the bolt will eventually be withdrawn from the concrete.

6.2 REMOVAL

Traditional sleeve anchors are not fully removeable. When the anchor use is finished, the bolt, washer and shear sleeve can be removed along with the fixture. The expander sleeve and taper cone will still be present in the hole, however, the hole can then be filled with a suitable structural grout.

References

[1] CFA Guidance Note: *Fixings and corrosion*. Downloadable free from www.fixingscfa.co.uk.

[2] CEO Guidance Note: *European Technical Assessments for anchors used in construction.* Go to www.fixingscfa.co.uk.

[3] EAD330232-00-0601 *Mechanical fasteners for use in concrete*. EOTA.
Downloadable from www.eota.be.