CONSTRUCTION FIXINGS association

CI/Sfb
Xt6
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CFA Guidance Note:
Fixings for Brickwork and Blockwork

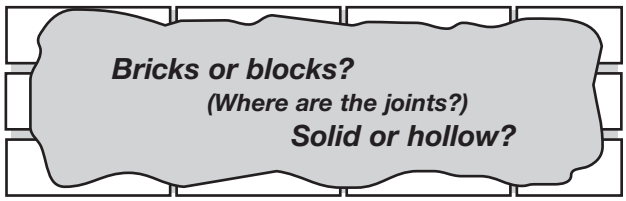
SUMMARY

Many factors make the achievement of reliable fixings in masonry awkward but the many innovative solutions and technical support available from CFA members means fixings can be made with confidence.

1 INTRODUCTION

This Guidance Note could have been called "Fixings for Masonry" as effectively that is what it covers. The emphasis is placed on Brickwork and Blockwork as these two base materials form the bulk of masonry applications. The problems they present are many and varied. The huge range in strengths, the possibility of voids, the variable quality of mortar and, when the surface is rendered, the difficulty of avoiding mortar joints, mean that extreme care must be taken in both the selection and installation of fixings.

What's behind the render?



This guide sets out the factors which must be considered and introduces the wide range of products which are available to solve the problems. All members of the **CONSTRUCTION FIXINGS ASSOCIATION**[1] offer technical advice which should be called upon for more detailed guidance and support.

2 SCOPE

All common types of brickwork and blockwork are covered, and while the characteristics of stonework, being a natural material, are harder to quantify and its shapes more diverse, many influencing factors are the same. All general purpose masonry fixings are dealt with.

3 TERMINOLOGY

"Masonry unit" is a general term for any individual brick, block or stone. "Void" means holes formed in perforated bricks and hollow blocks. The minimal industry jargon that is used is well summarised in a BDA publication [2].

4 INFLUENCING FACTORS

Strength of masonry unit.

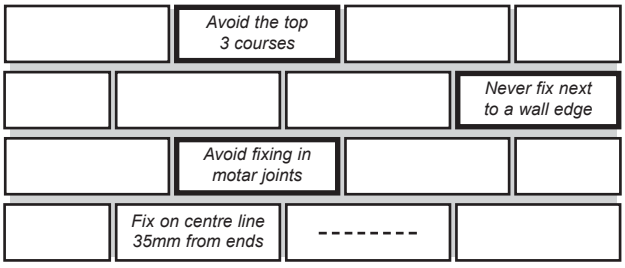
The stronger the masonry the stronger the fixing however other factors may over ride this consideration such as whether or not the unit is solid or voided. Remember some blocks are very weak indeed.

Nature of the masonry unit.

Fixings which work well in solid materials may not work at all in materials with voids whereas those shown as suitable for perforated bricks and hollow blocks in the chart on page 2 will usually work well in solid materials. Some "Cavity" fixings not detailed here, see [3], can be used in hollow blocks in unrendered walls, where the hollow area can be located. They do not generally work well in solid or partial void situations. The nature of the masonry unit must be known before the best fixing can be chosen. Site tests may be necessary - see Section 8.

Size and position of the fixing within the masonry unit

Individual manufacturers offer guidance on positioning for their own products. The following guidelines are generalised and accepted as best practice in the industry.
Limit hole diameters of expanding fixings to 20mm and bonded fixings to 22mm.
In unrendered walls, where the installer can choose where to place the fixing in the brick or block, then a wide range of fixings can be considered. However, where units are voided or where walls are rendered and mortar joints cannot be identified, then fixings suitable for "Perforated bricks" and "Hollow Light Aggregate blocks", should be considered, see page 2. Try to avoid locating more than one fixing, especially expansion fixings, in an individual unit. Position fixings well away from edges, in brickwork this means on the horizontal centreline and at least 35mm from either end. This is most important for expansion fixings which can crack weak materials, so check that the expander is not too close to the back of the unit. Most fixings shown on pages 2 and 3 will work in through holes, only bonded anchors used without mesh sleeves will need a solid end to the hole. Single skin walls tend to have less overall strength than "Solid" walls where the possible lack of mortar between leaves means that bonded anchors[4], in mesh sleeves, are often the best bet.



Position of the fixing within the wall

All fixing types need support from the surrounding structure to take a significant load so keep fixings away from edges. Allow at least one complete unit from a vertical edge and three courses from the top of a wall. Avoid fixing into mortar joints especially vertical joints ("Perps") which are often poorly filled.

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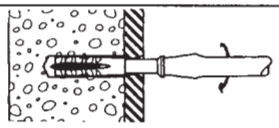
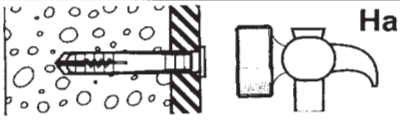
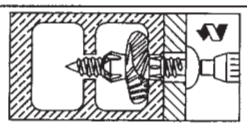
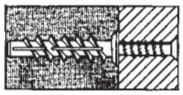
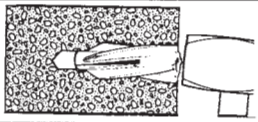
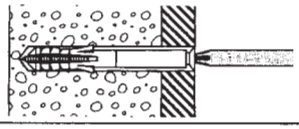
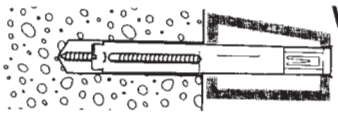
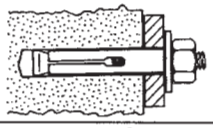
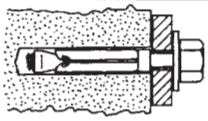
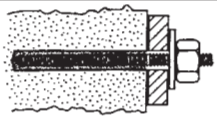
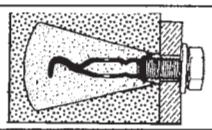
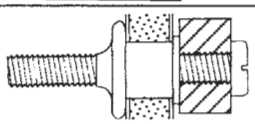
The table below shows a selection of parameters for the major types of fixings available for use in masonry applications.

BASE MATERIAL SUITABILITY								
Fixing type - description	**Brick**		**Block**					
	Solid	**Perfroated**	**Dense Aggregate**	**Light Aggreage - Solid**	**Light Aggreage - Hollow**	**Aerated**	**Stone**
Plastic* plug Base of plug expanded by the tightening of the screw, not provided. Slim top portion prevents expansion in plaster. May have lip at top to locate at the surface. Fins prevent rotation.	●		●	●			●
Hammer-in fixing (Plastic sleeved) Screw and plug combined. Special drive screw can be hammered in and unscrewed. Some have collapse feature to take up small gaps. Collar and cross head screw give neat finish.	●		●	●		○	●
Universal plug (Plastic) Various designs. A common feature is the ability to expand the body against the sides of the hole in solid material or to pull back against the back of a cavity in perforated bricks or hollow blocks.	●	●	●	●	●	●	●
Self threading plug (Plastic or zinc alloy) The anchor is inserted into a pre-drilled hole using a cross head screw driver. A coarse thread form around the body cuts a thread in the aerated concrete material without inducing expansion stresses. Available in nylon or zinc alloy.						●	
Hammer in plug (Plastic) Solely for aerated concrete. The plug is simply hammered into a pre-drilled hole. Deep fins in a shallow spiral prevent rotation as the screw is inserted and resist withdrawal to provide good holding power..						●	
Frame fixing (Steel screw with plastic or steel sleeve) Plastic version - steel screw expands a large plug whose sleeve extends through the fixture. Steel version - machined screw pulls alloy cone into the sleeve to expand it. Cover caps available with most makes.	●	○	●	●		○	●
Window fixing (Steel screw with plastic sleeve) Design similar to steel frame fixing. Cone is of glass reinforced plastic. Lugs on sleeve locate the PVC-U or aluminium frame. In common with frame fixings the frame is not pulled toward the base material.	●	○	●	●		○	●
Thin-walled sleeve anchor (Torque controlled expansion) A through sleeve is expanded by the tapered end of the bolt or a separate expander cone drawn into the sleeve on tightening. Suitable for some perforated bricks as the expansion can be pulled back to the brick.	●	○	●				●
Shield anchor (Torque controlled expansion) The large expansion ratio caters for the way holes may be opened up oversize in weaker materials. Best in strong brickwork with sound mortar joints. Diameters limited to M12, to avoid cracking bricks.	○		○				○
Bonded anchor using injection mortar Stress free fixings will not crack weak materials. Special sleeves enable fixings in hollow blocks and perforated bricks. Plastic sleeves usually have end cones for overhead use and centralising the stud.	●	●	●	●	●	●	●
Undercut anchor using injection mortar A special drill is used to ream a dovetail shape in the aerated concrete. The strongest possible bond is formed by a cementitious grout between the hole and a special shaped internally threaded socket which accepts a bolt.						●	
Rubber expansion anchor A rubber sleeve is expanded against the sides of the hole or into a void, by a nut bonded to the base of the sleeve. Equally effective in a partial void.	●	●	●	●	●	●	●

Suitability ratings ● = suitable, ○ = limited suitability. * "Plastic" is a general term which includes nylon.

Fixings for Brickwork and Blockwork

It is necessarily very generalised. Suitability does not imply a particular load capacity.

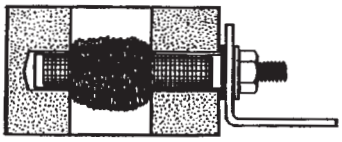
APPLICATION PARAMETERS						
Set independent of fixture	May be loaded straight away	Through fix	Screw type	Duty	Typical Size range	Fixing type
✔	✔	✗	w,c	L - M	4-20mm No. 2-18	 Plastic plug
✗	✔	✔	sp s.c.	L - M	5-10mm	 Hammer - in fixing
✔	✔	✗	w,c	L - M	6-10mm No. 8-12	 Universal plug
✔	✔	✗	w,c	L	M6-M10 (metal) No. 6-24 (nylon)	 Self threading plug
✔	✔	✗	w,c	M	8-14mm No. 10-18	 Hammer in plug
✗	✔	✔	sp s.c.	M	8-14mm	 Frame fixing
✗	✔	✔	sp s.c.	M	8-10mm	 Window fixing
✗	✔	✔	m	M	M4.5 - M16	 Thin-walled sleeve anchor
✗	✔	✗	m	H	M6-M12	 Shield anchor
✔	✗	✗	m	H	M8 -M16	 Bonded anchor Injection mortar
✔	✗	✗	m	L - M	M8 -M12	 Undercut anchor Injection mortar
✗	✔	✗	m	M	M3 -M12	 Rubber expansion anchor

* **Duty:** L = light; M = medium; H = heavy. **Screw types:** w = wood, c = coach, m = machined, sp = special, s.c. = supplied complete. **Size range:** M = machined screw diameter, mm = sleeve or body diameter, No. = screw number.

5 BASE MATERIALS

BRICKWORK

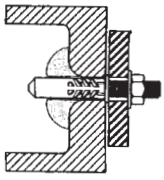
Brick dimensions are consistent - 65mm high, 215mm long and 102.5mm wide. Strengths vary from around 7N/mm² to over 100N/mm². General purpose clay bricks, which must exceed 5N/mm² compressive strength, are commonly quoted between 20 and 30N/mm², while engineering bricks must exceed 70N/mm² (Class A) or 50N/mm²(Class B). Most problematic, from the strength point of view, are old "London (yellow) Stocks" which can be a low as 5N/mm² and are usually set in very weak sand lime mortar. Bonded anchors are often the best solution. More significant for fixing suitability is the presence of frogs (the depression in the top or bottom of a brick) or perforations (3 or more vertical through holes). These voids stop expanding fixings working as well as they might and give escape routes for resin materials if not controlled by the use of sleeves. Sleeves are available in plastic or fine steel mesh. The sleeve is filled with resin which is extruded through the mesh when the anchor rod (or socket) is inserted. This resin then bonds with any adjacent brick surface and forms an interlock in the voids. Loss of resin is minimised in plastic sleeves by end cones which also centralise the rod.



BLOCKWORK

Blocks are generally 440mm long x 215mm high, thicknesses from 75mm to 215mm, most commonly 100 and 140mm. Format is dictated by material of manufacture.

Aerated blocks. Solid only, vary in strength from 2.8 to 7N/mm². **Aggregate blocks** may be solid, hollow (with vertical through holes) or cellular (voids closed at one end). **Lightweight aggregate blocks** vary in strengths from 3.5 to 10.5N/mm², **Dense aggregate** 7.0 to 24N/mm². Although aerated blocks may be identified (if unrendered) by their characteristic zigzag pattern most aggregate blocks are very similar in appearance and test drilling will tell you if they are voided but little about their strength. So it is worth trying to find the specification if at all possible. If the type of block is known but its strength is not then assume the weakest in the range. The relative softness of aerated blocks makes it worth using a fixing developed specially for that material. Resin systems are good for all block applications but the correct accessories are important. Some manufacturers offer special sleeves for the relatively thin walls (30mm - 60mm) of hollow blocks (they also work in perforated bricks).



STONEWORK Huge variation in strength from sandstone to granite which is also awkward to drill. Variable dimensions within the same wall. Treat as solid bricks.

6 SELECTION[5]

If in doubt ask the manufacturer.

Having determined the various parameters outlined in Section 4 refer to the chart on pages 2 and 3 to find the types of fixings which satisfy the application requirements. Refer to manufacturer's literature to identify the particular type and size. Check the nominal strength of the masonry against that quoted by the manufacturer. For external applications specify stainless steel versions. For particularly corrosive environments check with the manufacturer.

7 INSTALLATION[6]

Drill with care, avoid over tightening.

"If all else fails read the instructions!"

Apart from this poignant piece of advice care in drilling can avoid most problems in masonry. Powerful hammer or percussion drilling machines can produce oversized holes in soft materials, like aerated blocks and old bricks, and may break out the back of a brick within 30mm from the back face. Some flat faced bricks, notably "Red Rubbers", will walk out of the wall toward you if drilled aggressively. Drilling on rotary only can reduce these problems. Drilling hard perforated bricks may cause the drill bit to snatch. A tight grip on the side handle may avoid a sprained wrist.

Over tightening bonded anchors in weak materials can over stress the bond and fail it. Some manufacturers quote reduced tightening torques for these materials. Where torques for general purpose fixings are quoted for concrete these values should be reduced in proportion to the strength of base material or relative tensile loads.

8 SITE TESTING[7]

Where the strength of the base material is unknown then site testing may be the only way to check on the suitability of the chosen fixing and what loads it will take.

9 OTHER SOURCES OF INFORMATION

[1] CFA Guidance note: Construction Fixings Association - An introduction.

[2] Bricks - notes on their properties. - Brick Development Association. Tel: 01344 885651. www.brick.org.uk.

[3] CFA Guidance note: Fixings for Plasterboard.

[4] CFA Guidance note: Resin Bonded Anchors

[5] CFA Guidance note: Anchor Selection.

[6] CFA Guidance note: Anchor Installation.

[7] CFA Guidance note: Procedure for site testing construction fixings.

BS 6100 Glossary of building and civil engineering terms. Pt 5 Masonary. BS 6073: 1981 Pt1 Specification for precast concrete masonary units. BS 3921:1985 Specification for clay bricks.

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