

Methods of test for

Structural fixings in concrete and masonry

**Part 2: Method for determination of
resistance to loading in shear**

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- Association of Building Component Manufacturers Ltd.
- Brick Development Association
- British Precast Concrete Federation Ltd.
- Cement and Concrete Association
- Concrete Society
- Construction Fixings Association
- District Surveyors' Association
- Federation of British Hand Tool Manufacturers
- Greater London Council
- Institution of Civil Engineers
- Institution of Structural Engineers
- National Association of Scaffolding Contractors
- Stainless Steel Fabricators' Association of Great Britain
- Suspended Access Equipment Manufacturers' Association
- Suspended Ceilings Association

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Foreword

This Part of BS 5080 has been prepared under the direction of the Civil Engineering and Building Structures Standards Committee and describes a method for conducting tests under shear forces on structural fixings installed in concrete or masonry materials used in building and civil engineering construction.

A structural fixing joins, supports or retains components, and may be defined as one that has been designed to resist some form of loading, since its failure will have structural significance.

This method of test applies to a fixing installed according to the supplier's recommended procedure in a solid base material. It is a test of the composite assembly comprising the fixing and the base material and not just of the fixing itself. Failure of a fixing assembly under a shear force may be due to failure of the material from which the fixing has been manufactured or failure of the base material in which it has been installed.

The test is not intended for fixings comprising small plugs of metal, plastics or fibrous composition which are used in conjunction with woodscrews, or for fixings that pass through the base material (such as those for use with thin rigid sheet materials for walls, roofs or partitions) or for cavity fixings for use with hollow clay or concrete block masonry. Displacement fixings, i.e. pins or studs inserted by a cartridge-operated tool, are not included as the method of test is not appropriate to their use. However, should a design demand structural considerations and testing, the procedures given in this standard should be followed as far as possible.

The standard relates to the method of test only; it is not a performance standard. It has to be stressed that any recommendations on the interpretation of the results of tests for the purposes of design, selection or use of fixing are outside the scope of the standard.

If the method in this standard is used for proof testing the applied load and/or relative movement limits should be specified by the user.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

1.1 General

This Part of BS 5080 describes a method for conducting tests under shear force on structural fixings installed in concrete or masonry used in building and civil engineering.

1.2 Type of test

The test consists of applying a shear force to a fixing installed in a solid base material.

1.3 Type of fixings

The test is intended for expanded and undercut anchors, bonded fixings, cast-in fixings and channel inserts.

1.4 Construction materials

The materials in which these fixings may be installed are as follows:

- a) concrete;
- b) natural stone;
- c) cast stone;
- d) brick or block masonry.

1.5 Application of test

There are two distinct situations in which the test can be applied. These are as follows.

- a) For comparative or reference purposes, for which a standard specimen of base material is specified (see 5.1).
- b) For a specific application, for which the base material should be appropriate to the intended use of the fixing. In this situation the base material may be either a specimen manufactured for the purpose or a representative section of the base material in place (see 5.2).

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 5080, the definitions given in BS 5080-1 apply together with the following.

2.1

expanded anchors

anchors held in drilled holes by friction or wedging action

2.2

bonded fixings

fixings held in drilled holes by grout or other bonding material

2.3

cast-in fixings

anchor bolts and sockets cast into the material during construction

2.4

channel inserts

slots and channels cast into the material during construction

2.5

undercut anchors

anchors held in drilled holes by interlocking in under-reamed shapes during drilling or setting (see Figure 5)

3 Principle

The principle of the test is the subjection of a composite assembly consisting of a structural fixing installed in solid base material to a shear force applied through the structural fixing until failure occurs. Measurement of the load applied is carried out to determine the strength of the assembly.

4 Apparatus

4.1 *Shear testing apparatus*, being a loading frame incorporating a means of applying load through a block of steel having a diameter equal to $5d$ and a thickness equal to $d + 0.8$ mm, where d is the outside diameter of the part of the fixing that projects from the surface of the base material (see Figure 1). There shall be a hole in the block, located in the centre, the diameter being such that the clearance for the stud or bolt of the fixing is in accordance with BS 4186, medium fit.

The block of steel shall comply with either:

- a) grade 665 M17 of BS 970-1, case hardened 0.5 mm to 0.8 mm deep with hardness HV 700; or
- b) grade 43A of BS 4360 and bushed with a hardened steel sleeve having the same specification as given in a). The bush shall have a minimum wall thickness of 3 mm.

The edge of the hole in the block or the bush shall be radiused at each end, 0.4 mm radius.

After each series of tests the block and bush shall be visually inspected and shall be replaced if any wear or deformation is observed.

An example of a suitable form of apparatus is shown in Figure 2.

4.2 Measuring equipment, to measure the relative movement between the fixing and the base material to an accuracy of 0.02 mm.

4.3 Load measuring device, being a pressure gauge, proving ring, load cell or other suitable device, capable of measuring to an accuracy of 5 %.

4.4 Structural fixings, as appropriate.

4.5 Drill bits, or other devices used to install the structural fixings.

4.6 Mould, if required to cast standard specimen of base material (see 5.1).

5 Base materials

5.1 Standard specimen of base material

NOTE The dimensional criteria given in 5.1 are intended to ensure that the behaviour under test of any one fixing does not affect that of adjacent fixings. The dimensions given here are not to be taken in any sense as guidance for field installation.

5.1.1 General. The standard specimen of base material shall be manufactured from concrete complying with the dimensional and casting requirements of 5.1.2 and 5.1.3.

5.1.2 Concrete. The concrete from which the standard specimen is prepared shall have the following mix proportions, compaction and curing treatments.

- a) Ordinary Portland cement (complying with BS 12):100 kg.
- b) Total aggregate (complying with BS 882):510 kg (dry weight) composed as follows.
 - 1) Coarse aggregate: flint gravel graded 20 mm to 5 mm.
 - 2) Fine aggregate: natural sand as a proportion of the total aggregate content of one of the following:
 - i) Type C: 40 %; or
 - ii) Type M: 35 %; or
 - iii) Type F: 30 %.
- c) Water content: the water content of each batch shall be adjusted to give a concrete of medium workability, equivalent to a slump of 25 mm to 75 mm when determined in accordance with BS 1881-102.
- d) Compaction: mechanical vibration (applied externally or internally) shall be used to compact the concrete.
- e) Curing: the specimen(s) shall be stored in moist air of at least 90 % r.h. and 20 °C for the first 2 days after casting.

NOTE 1 The quantities and proportions of materials given will produce approximately 0.28 m³ of fully compacted concrete. The batch weights should be calculated to suit the size of the mixer and the actual quantity of concrete required.

NOTE 2 This concrete mix complies with the C25P ordinary prescribed mix of BS 5328.

Any reinforcement in the standard specimen shall be so positioned as to offer no additional strength in the zone of interaction between the concrete and the fixings.

The density and compressive strength of the concrete from each batch shall be determined at the time of testing in accordance with BS 1881-114 and BS 1881-116 respectively.

5.1.3 Specimen size. It shall be acceptable for a single specimen to be used for the installation and testing of any number of fixings, provided that it complies with the dimensional conditions specified in 1) to 3), which are based on characteristic dimension *A* of the fixing, defined as follows.

- a) *expanding and undercut anchors* [see Figure 4(a)]: *A* = the hole diameter or one-quarter of the embedded depth, whichever is greater.
- b) *bonded fixings* [see Figure 4(b)]: *A* = the maximum diameter of the fixing or one-quarter of the embedded depth, whichever is the greater.
- c) *cast-in fixings* [see Figure 4(c)]: *A* = the maximum dimension perpendicular to the axis or one-quarter of the maximum embedded depth, whichever is the greater.
- d) *channel inserts* [see Figure 4(d)]: the dimensions of the specimen shall, as far as possible, comply with the criteria for other fixings and allowance shall be made for projecting ties or lugs.

NOTE It is not practicable to define a characteristic dimension *A* for channel inserts.

The dimensions of the specimen shall comply with the following.

- 1) There shall be a minimum of 4*A* below the embedded depth of the fixing, *D*.
- 2) There shall be a minimum of 8*A* between the centre of any fixing and a free edge.
- 3) There shall be a minimum of 4*A* between the centres of any two fixings when the applied direction of shear force is at right angles to a line between the fixings. Where the direction of applied shear force is parallel to the line the minimum spacing shall be 8*A* (see Figure 3). Where fixings of two different sizes are considered their distances shall be taken as the sum of 2*A* (right angle loading direction) and 4*A* (parallel loading direction) for each fixing.

5.2 Other base materials

Where the test is to be carried out on a base material other than the standard specimen, a description of the base material shall be included in the test report.