BRITISH STANDARD

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1881:2006

Products and systems for the protection and repair of concrete structures — Test methods — Testing of anchoring products by the pull-out method

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ICS 91.100.30

BSI
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National foreword

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A list of organizations represented on B/517/8 can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Prüfung von Verankerungsprodukten mit der Ausziehprüfung

This European Standard was approved by CEN on 7 September 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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Foreword

This document (EN 1881:2006) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2007, and conflicting national standards shall be withdrawn at the latest by December 2008.

It has been prepared by Sub-committee SC 8 "Protection and repair of concrete structures", the secretariat of which is held by AFNOR.

This European Standard is one of a series dealing with products and systems for the protection and repair of concrete structures. It describes a method of test for determining the pull out resistance offered by a bonding grout or mortar used to anchor reinforcing bar.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies the conditions for carrying out a pull-out test on a reinforcing steel bar (rebar) anchored in a concrete block.

The test applies to products based on hydraulic binders or synthetic resins or mixtures of these. It does not include those products intended to be used as grout around tendons used for the prestressing of concrete.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 206-1, *Concrete — Part 1: Specification, performance, production and conformity*

EN 1766, *Products and systems for the protection and repair of concrete structures — Test methods — Reference concretes for testing*

EN 10080, *Steel for the reinforcement of concrete - Weldable reinforcing steel - General*

EN 12390-2, *Testing hardened concrete – Part 2: Making and curing specimens for strength tests*

3 Test principle

A tensile load is applied to a rebar anchored in a concrete test-piece with the product to be tested. The force and displacement of the rebar relative to the test-piece are measured.

The test is performed on concrete, type C (0,40) in accordance with EN 1766.

The test shall be carried out on dry and/or wet concrete, as described in 5.4.1 and 5.4.2, and the product may be applied vertically, horizontally or overhead, or in any combination, as requested by the manufacturer.

NOTE If a bar is tested after being installed overhead it is not necessary to carry out additional tests in the other orientations.

4 Apparatus

The following apparatus is required.

4.1 One mixer for concrete.

4.2 One mixer for the product to be tested.

4.3 Moulds for the preparation of concrete blocks of minimum dimensions (400 × 400 × 250) mm.

4.4 One concrete vibrator, 25 mm diameter (EN 12390-2).

4.5 One rotary percussive drill or one diamond drill, or both, as specified by the manufacturer.

4.6 Three ribbed steel bars type B500B, diameter 16 mm, with a related rib area of 0.075 to 0.085 in accordance with EN 10080 for each test.

4.7 Devices for centring and maintaining alignment of the rebars during anchoring.

4.8 One thermometer accurate to within ± 1 °C.

4.9 One room or chamber controlled to standard laboratory climate of (21 ± 2) °C and (60 ± 10) % RH.

4.10 A tensile testing machine of adequate capacity, capable of measuring load to an accuracy of ± 2 %, and fitted with a load pacer to control the rate of load increase, or deformation controlled.

4.11 A device, interlocked with the rebar and one or more displacement sensors, capable of measuring relative movement between the anchored bar and a fixed reference point on the test block to an accuracy of ± 0,01 mm.

5 Preparing for the test

5.1 Composition of the concrete test blocks

The concrete test blocks shall be cast from concrete type C (0,40) as specified in EN 1766.

5.2 Preparation of moulds

Test blocks shall be produced in a room or chamber maintained at (21 ± 2) °C.

Moulds shall be non-deformable and of minimum dimensions (400 × 400 × 250) mm for a single test, or in multiples of the 400 mm dimensions for more than one test. Before filling the mould the inner surface of the mould should be covered with a thin film of non reactive release material to prevent the concrete from adhering to the mould.

5.3 Preparation of concrete test blocks

The concrete shall be placed and immediately compacted in three layers of approximately equal thickness and vibrated using a 25 mm diameter concrete vibrator in such a way as to produce full compaction of the concrete with neither excessive segregation nor laitance. For a block for a single test the vibratory operation shall be carried out at four points, each position being equidistant and at about 125 mm from the two adjacent faces. For larger blocks with dimensions greater than (400 × 400 × 250) mm vibration shall be carried out at the same four positions, and also at intermediate points on a square grid pattern of approximately 150 mm.

The vibration should be applied for the minimum time necessary for the full compaction of the concrete. The vibrator should be in a vertical position and not allowed to touch the sides or bottom of the mould.

The concrete specimens shall be cured in the moulds for at least 72 h after casting at (21 ± 2) °C, either under polyethylene sheeting or at not less than 95 % relative humidity, then demoulded and cured until at least 28 days after casting. During curing the test blocks shall be stored at (21 ± 2) °C, either under water for wet testing or, for dry testing, in air at a relative humidity of not less than 95 %, in accordance with EN 206-1.

5.4 Preparing the concrete test blocks for anchoring

5.4.1 Pull-out from wet concrete

At least one day before the intended anchoring operation, each concrete block is removed from the water and a hole drilled by a rotary percussive or diamond drill, as specified by the manufacturer, in the centre of the cast (400 × 400) mm face of the block. For larger blocks (for multiple tests) holes are drilled at a minimum distance of 200 mm from any edge and at least 400 mm from any other hole. Holes shall be drilled to a depth of (150 ± 3) mm. The hole diameter shall be 20 mm for reactive resin products and 30 mm for hydraulic cement products, unless specified otherwise by the manufacturer.

Immediately after the drilling operation, the hole(s) shall be cleaned in accordance with the manufacturer's instructions and filled with water for at least 24 h. The water shall then be drained and the test block shall then be placed in its required orientation in a room or chamber maintained at (21 ± 2) °C and (60 ± 10) % relative humidity for one hour, after which time the anchoring operation shall be undertaken.

5.4.2 Pull-out from dry concrete

Seven days before carrying out the anchoring operation, each concrete test-piece shall be removed from the humidity chamber or room and then stored in a chamber or room maintained at (21 ± 2) °C and (60 ± 10) % relative humidity.

On the day of the intended anchoring operation, a hole shall be drilled by a rotary percussive or diamond drill, as specified by the manufacturer, in the centre of the cast (400 × 400) mm face of the block. For larger blocks (for multiple tests) holes are drilled at a minimum distance of 200 mm from any edge and at least 400 mm from any other hole.

Holes shall be drilled to a depth of (150 ± 3) mm. The hole diameter shall be 20 mm for reactive resin products and 30 mm for hydraulic cement products, unless specified otherwise by the manufacturer.

Immediately after the drilling operation the hole(s) shall be cleaned in accordance with manufacturers instructions and the test block shall then be placed in its required orientation and the anchoring operation may be undertaken.

6 Procedure

6.1 Carrying out the anchoring operation

Before use the rebars shall be prepared in accordance with manufacturers instructions; the prepared rebars, the product, and the equipment and tools required for mixing and placing shall be stored for at least 24 h in a room or chamber maintained at (21 ± 2) °C and (60 ± 10) % relative humidity.

The product shall be mixed and placed, and the rebars installed, strictly in accordance with the manufacturer's instructions. It should be noted that the efficacy of the product is dependent on the care exercised during use, and therefore the manufacturer's recommendations shall be followed.

Each rebar, set to the base of its hole, shall be located and supported along the centre line of the hole by the centering devices.

6.2 Storage of test-pieces after carrying out the anchoring operation

The test pieces shall be stored undisturbed for the minimum curing time recommended by the manufacturer, and then up to the time of the test, at (21 ± 2) °C and (60 ±10) % relative humidity.

6.3 Carrying out the test

The pullout test consists of applying a tensile force to the free end of the rebar, Figure 1 gives details of a typical test rig.

Before load is applied the displacement measuring device is attached to the rebar as closely as possible to the surface plane of the test block, with the sensor(s) being in contact with the surface at a distance of at least 150 mm from the rebar.

Increasing tensile load is applied to the rebar, at the rate of (1,6 ± 0,1) kN/s, until failure.

The applied force and the displacement shall be measured continuously.

NOTE When testing test pieces of different orientations the test piece can be rotated to a position where the pull-out test is easier to carry out.

For each test, the load/displacement behaviour and the maximum load are recorded.

7 Test report

The test report shall include the following information:

a) identification of the product;

b) date and place of the test;

c) the temperature and relative humidity of the room or chamber during the test;

d) the conditions for preparing the product;

e) the batch number and pack size of product;

f) the quantity of mixture prepared;

g) the method used for mixing the constituents and the time taken;

h) the time between mixing the constituents and installing the anchor;

i) the exact technique used to prepare the hole;

j) the diameter and the measured depth of the hole;

k) the surface condition – wet or dry;

l) the method used to place the anchor (pouring, pumping, ramming, etc.) and the anchor orientation (vertically downwards, horizontally, overhead);

m) the time taken to place the product and install the anchors, and any difficulties encountered;

n) the time period between mixing the product and testing;

o) the progressive load displacement and the value of the displacement at a load of 75 kN for each test piece;

p) a description of the type of failure, or combination of failure types, for each test-piece, as follows:

   1) type 1: failure of the rebar;

   2) type 2: extraction of the rebar from the anchoring product;

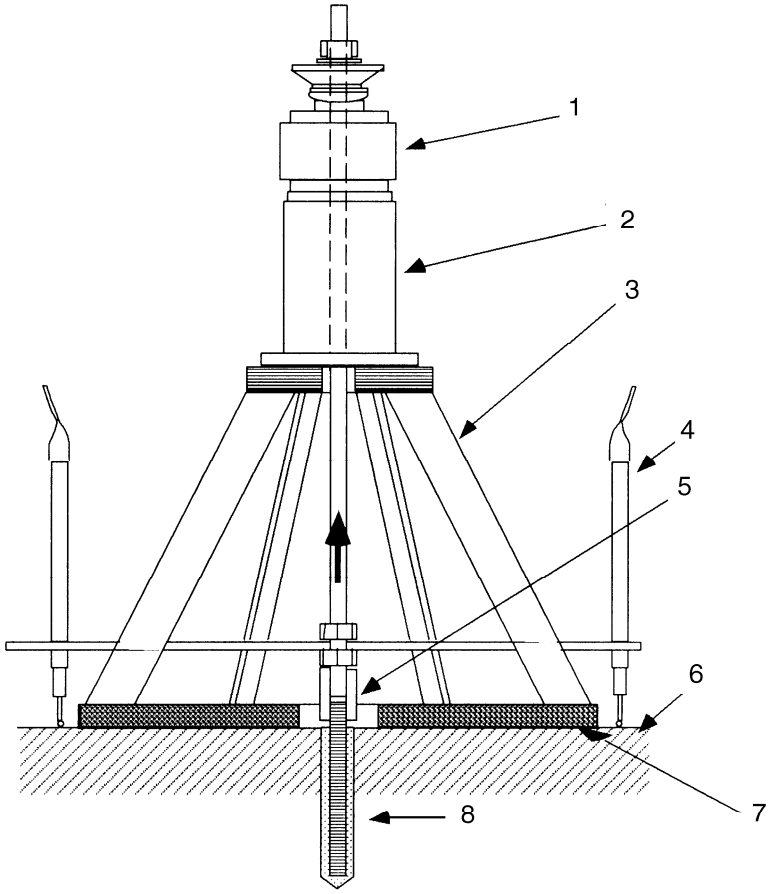
   3) type 3: extraction of the rebar and anchoring product from the concrete;

   4) type 4: failure within the anchoring product itself;

q) any incident liable to have affected the results;

r) any deviation from the conditions specified in this standard;

s) reference to this standard.



Key

1 load cell
2 load cylinder
3 support
4 displacement transducer
5 socket
6 concrete test
7 confinement plate
8 bonded rebar

Figure 1 — A typical pull out test rig

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