EOTA

ETAG 001

GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL
OF
METAL ANCHORS
FOR USE IN CONCRETE

Annex A: DETAILS OF TESTS
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ANNEX A

Details of Tests

1   TEST SAMPLES

Samples shall be chosen to be representative of normal production as supplied by the manufacturer, including screws, nuts and washers.

Anchors with inner threads may be supplied without the fixing elements such as screws or nuts, but the anchor manufacturer shall specify the screws or nuts to be used. If according to the chosen design method the characteristic resistance for concrete failure is needed, it may be necessary to use screws or bolts of higher strength than those specified, in order to achieve a concrete failure in tests; if higher strength screws or bolts are used, the functioning of the anchors shall not be influenced in any way.

Sometimes the tests are carried out with samples specially produced for the tests before issuing the ETA. If so, it shall be verified that the anchors subsequently produced conform in all respects, particularly suitability and bearing behaviour, with the anchors tested.

2   TEST MEMBERS

The test members shall be made in accordance with EN 206 [8] and comply with the following:

2.1 Aggregates

Aggregates shall be of medium hardness and with a grading curve falling within the boundaries given in Figure 2.1. The maximum aggregate size shall be 16 mm or 20 mm. The aggregate density shall be between 2.0 and 3.0 t/m^3 (see EN 206 [8] and ISO 6783 [9]).
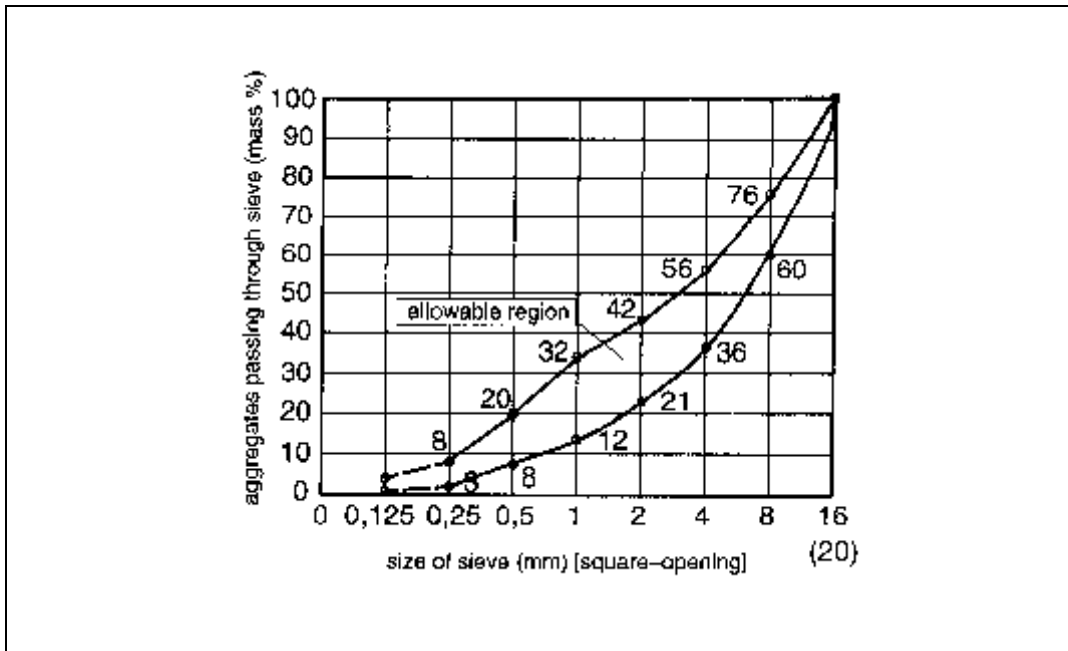

Figure 2.1 Admissible region for the grading curve

2.2 Cement

The concrete shall be produced using Portland cement Type CEM I or CEM II/A-LL, CEM II/B-LL (see EN 197-1 [10])

2.3 Water/cement ratio and cement content

The water/cement ratio shall not exceed 0,75 and the cement content shall be at least 240 kg/m^3.
No additives likely to change the concrete properties (e.g. fly ash, or silica fume, limestone powder or other powders) shall be included in the mix.

2.4 Concrete strength

Tests are carried out in concrete of two strengths: low strength (strength class C 20/25) and high strength (strength class C 50/60).

The following mean compressive strengths at the time of testing anchors shall be obtained for the two classes:

C 20/25: f_{cm} = 20-30 MPa (cylinder: diameter 150 mm, height 300 mm)
= 25-35 MPa (cube:150 x 150 x 150 mm)

C 50/60: f_{cm} = 50-60 MPa (cylinder: diameter 150 mm, height 300 mm)
= 60-70 MPa (cube:150 x 150 x 150 mm)

It is recommended to measure the concrete compressive strength either on cylinders diameter 150 mm, height 300 mm, or cubes 150 mm.
If this is not done in certain cases, the concrete compressive strength may be converted thus:

C 20/25: f_{cyl} $= \dfrac{1}{1.25} f_{cube\ 150}$ (2.1a)

C 50/60: $\qquad f_{cyl} \qquad = \dfrac{1}{1.20} \; f_{cube\,150}$ (2.1b)

Conversion factors for cubes of different sizes:

$$f_{cube\,100} \qquad = \dfrac{1}{0.95} \cdot f_{cube\,150}$$ (2.1c)

$$f_{cube\,150} \qquad = \dfrac{1}{0.95} \cdot f_{cube\,200}$$ (2.1d)

For every concreting operation, specimens (cylinder, cube) shall be prepared having the dimensions conventionally employed in the member country; the specimens being made and treated in the same way as the test members.

Generally, the concrete control specimens shall be tested on the same day as the anchors to which they relate. If a test series takes a number of days, the specimens shall be tested at a time giving the best representation of the concrete strength at the time of the anchor tests, e.g. at the beginning and at the end of the tests.

The concrete strength at a certain age shall be measured on at least 3 specimens, the mean value governs.

If, when evaluating the test results, there shall be doubts whether the strength of the control specimens represents the concrete strength of the test members, then at least three cores of 100 mm or 150 mm diameter shall be taken from the test members outside the zones where the concrete has been damaged in the tests, and tested in compression. The cores shall be cut to a height equal to their diameter, and the surfaces to which the compression loads are applied shall be ground or capped. The compressive strength measured on these cores may be converted into the strength of cubes by Equation (2.1e):

$$f_{c,cube\,200} = 0,95 \; f_{c,cube\,150} \quad = f_{c,core\,100} = f_{c,core\,150}$$ (2.1e)

2.5 Dimensions of test members

The specification and dimensions of the test members shall conform to the following:

(a) Tests in cracked concrete
   The tests are carried out on test members with unidirectional cracks, the crack width shall be approximately constant throughout the member thickness. The thickness of the test member shall be $h \geq 2\,h_{ef}$ but at least 100 mm. For bonded anchors see Part 5, for anchors for lightweight systems see Part 6. To control cracking, so-called 'crack-formers' may be built into the member, provided they are not situated near the anchorage zone. An example for a test member is given in Figure 2.2.
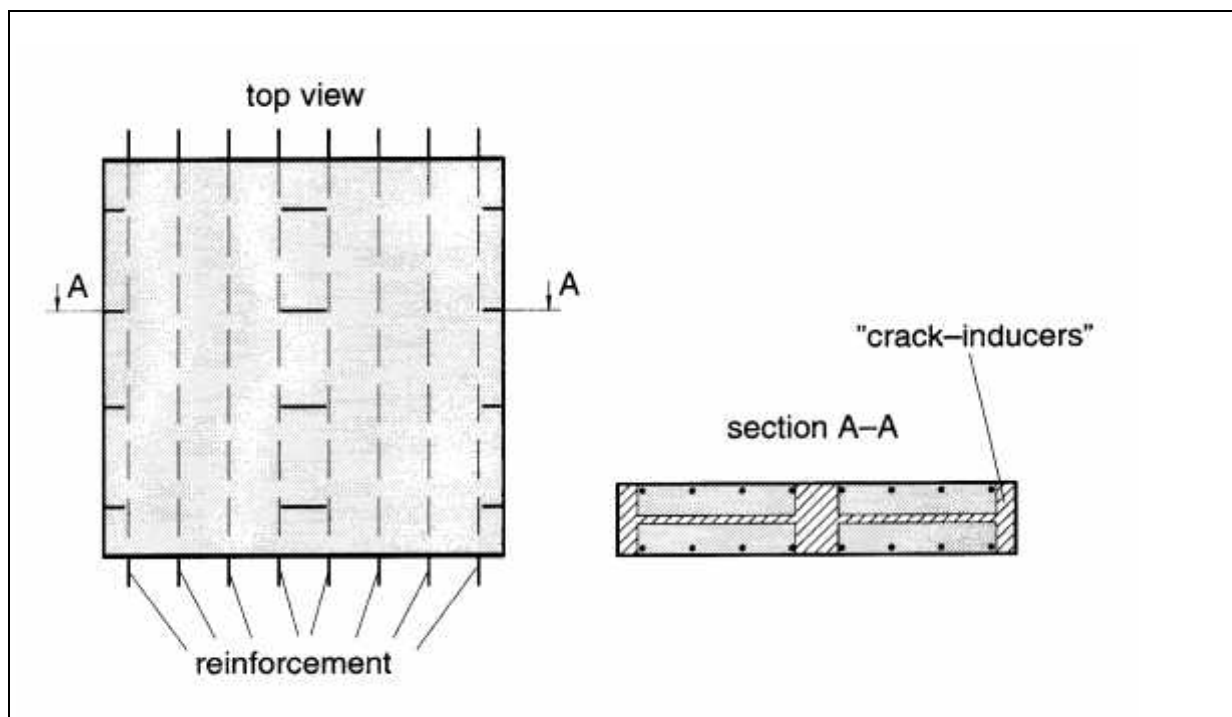
Figure 2.2   Example of a test member for anchors tested in cracked concrete

When using a test member according to Figure 2.2, the reinforcement ratio and/or the member depth shall be sufficiently large to allow for a small increase in crack width during loading of the anchor (see 5.1). In the test with crack movements (see 5.5), the reinforcement ratio (top and bottom reinforcement) shall be $\mu = A_s / (b \cdot h) \sim 0,01$ and the spacing of the bars ≤ 250 mm.

For tests with anchors in contact with reinforcement (see 5.8) the specimen shall be reinforced with smooth bars (bar diameter $\varnothing = 25$ mm, spacing ≥ 150 mm). The concrete cover shall correspond to the value $h_{ef} - \varnothing / 2$ (so that the effective embedment depth is at the same depth as the axis of the bar).

(b)   Tests in non-cracked concrete
Generally, the tests are carried out on unreinforced test members. Only in the tests according to 5.9 the member may be provided with an edge reinforcement. This edge reinforcement used in the tests shall be stated in the ETA as a minimum requirement. The reinforcement bars shall be straight and have a concrete cover on both sides of 15 mm.

In cases where the test member contains reinforcement to allow handling or for the distribution of loads transmitted by the test equipment, the reinforcement shall be positioned such as to ensure that the loading capacity of the tested anchors is not affected. This requirement will be met if the reinforcement is located outside the zone of concrete cones having a vertex angle of 120°.

For tests with anchors in contact with reinforcement, the requirements for test members described in (a) above apply.

The thickness of the members shall correspond to the minimum member thickness applied by the manufacturer which will be given in the ETA (generally h = 2 h_{ef}, but at least 100 mm). For bonded anchors see Part 5, for anchors for lightweight systems see Part 6.
Only in tension, shear and combined tension and shear tests with single anchors without edge and spacing effects, tension tests with quadruple anchors groups, shear tests to measure pryout failure load and shear tests with single anchors and anchors groups at the edge (Options 1, 2, 7 and 8 only, compare Part 1, Table 5.4, lines 16 to 19) the member thickness may be larger.

2.6   Casting and curing of test members and specimens

The test members shall be cast horizontally. They may also be cast vertically if the maximum height is 1.5 m and complete compaction is ensured.

Test members and concrete specimens (cylinders, cubes) shall be cured and stored indoors for seven days. Thereafter they may be stored outside provided they are protected such that frost, rain and direct sun does not cause a deterioration of the concrete compression and tension strength. When testing the anchors the concrete shall be at least 21 days old.

3   ANCHOR INSTALLATION

The tested anchors shall be installed in a concrete surface that has been cast against a form of the test member. Exceptions see 5.9.

The anchors shall be installed in accordance with the standard instructions supplied by the manufacturer. Torque moments, where appropriate, shall be applied to the anchor by a torque wrench having calibration traceable. The measuring error shall not exceed 5 % of the applied torque throughout the whole measurement range.

After about 10 minutes of torquing the anchors with the torque moment T_{inst} required by the manufacturer, the torque moment shall be reduced to 0,5 T_{inst} to account for relaxation of the prestressing force with time.

Anchors not needing the application of a defined torque moment for suitability (e.g. deformation-controlled expansion anchors, many types of undercut anchors and bonded anchors) shall not be torqued before testing.

With anchors which need to be torqued, the test results can be influenced by the roughness of the fixture. Therefore the washer shall not turn relative to the fixture. To ensure defined test conditions, e.g. double-sided abrasive material may be inserted between washer and fixture (see Figure 4.4).

For the installation safety tests only special conditions appropriate for the anchor types concerned are specified in the appropriate Parts of this Guideline.

When testing in cracked concrete, anchors are placed in the middle of hairline cracks. If it is established that the cracks will run through the axis of the anchors, the initial anchorage may be made in non-cracked concrete.

The holes for anchors shall be perpendicular to the surface of the concrete member.

In the tests the drilling tools specified by the manufacturer for the anchors shall be used. If hard metal hammer-drill bits are required, these bits should meet the requirements laid down in ISO 5468 with regard to dimensional accuracy, symmetry, symmetry of insert tip, height of tip and tolerance on concentricity.

The diameter of the cutting edges as a function of the nominal drill bit diameter is given in Figure 3.1.

For the suitability tests the cutting diameter of drill bits shall conform to the requirements given in Table 5.1 and 5.2 of the subsequent parts.

In all tests for admissible service conditions the cylindrical hole is drilled with a medium diameter ($d_{cut,m}$) of the drill bit.

The diameter of the drill bit shall be checked every 10 drilling operations to ensure continued compliance.

If special drilling bits like stop-drills or diamond core drill bits are required no standards on the specification of these products are available. In which case the anchor manufacturer has to specify the dimensions and tolerances of the bits and tests shall be performed with bits within the specifications. The definition of a medium diameter ($d_{cut,m}$)shall be laid down by the Approval Body.
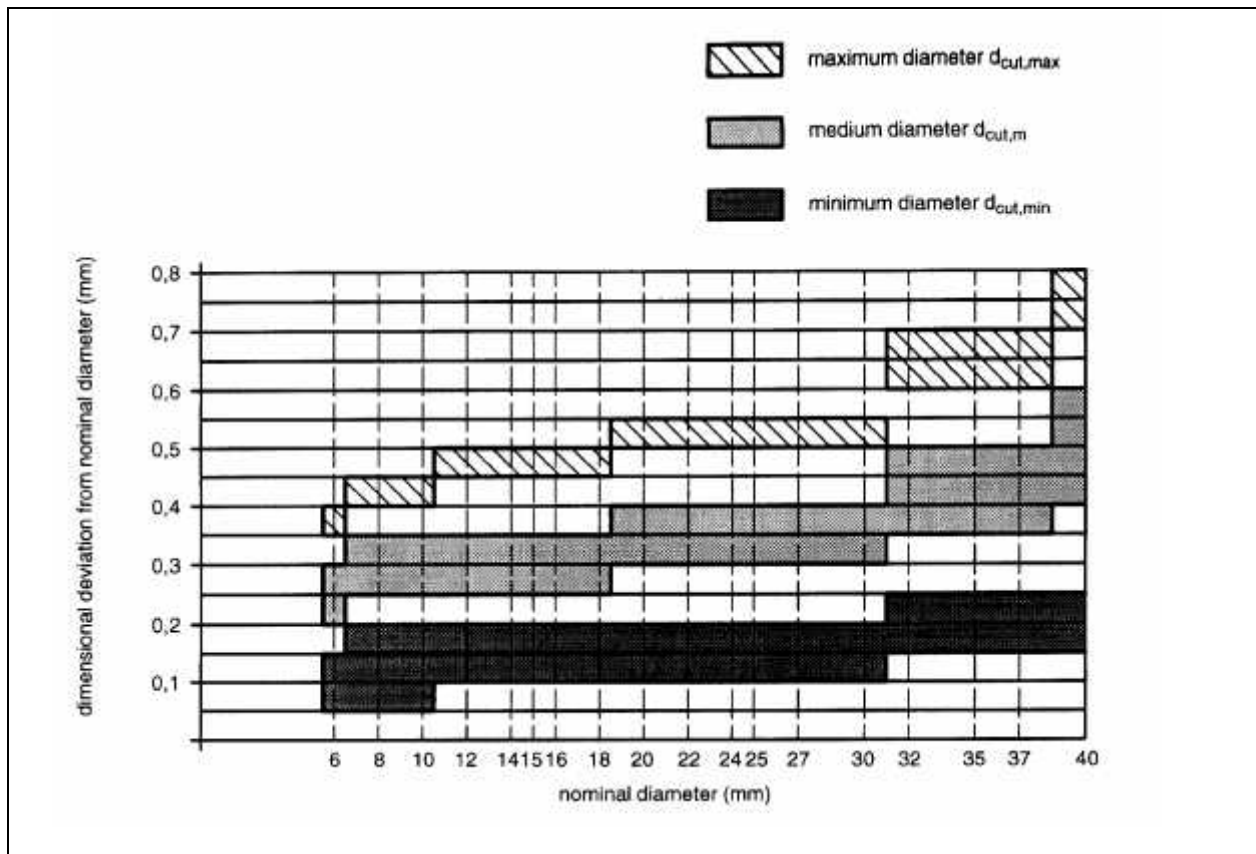
Figure 3.1   Cutting diameter of hard metal hammer-drill bits

4   TEST EQUIPMENT

Tests shall be carried out using measuring equipment having calibration traceable to internationsal standards. The load application equipment shall be designed to avoid sudden increase in load especially at the beginning of the test. The measuring error of the load shall not exceed 2 % throughout the whole measuring range.

Displacements shall be recorded continuously (e.g. by means of displacement electrical transducers) with a measuring error not greater than 0,02 mm.

The test rigs shall allow the formation of an unrestricted rupture cone. For this reason the clear distance between the support reaction and an anchor (single anchor) or an outer anchor (anchor group) respectively shall be at least 2 h_{ef} (tension test) or 2 c_1 (shear test at the edge with load applied towards the edge) (c_1 = edge distance in load direction). Only in shear tests without edge influence where steel failure is expected the clear distance may be less than 2 c_1.

During all tests, the load shall be applied to the anchor by a fixture representing the conditions found in practice.

In tests on single anchors without edge and spacing influences the centre-to-centre distance and the distances from free edges shall be large enough to allow the formation of an unrestricted rupture cone of vertex angle 120° in the concrete.

During tension tests (see 5.2), the load shall be applied concentrically to the anchor. To achieve this, hinges shall be incorporated between the loading device and the anchor. The diameter of the clearance hole provided in the fixture shall be in accordance with the values given in Table 4.1. These values correspond approximately to 'medium' holes according to ISO 273 [13] and Eurocode N° 3 [14]. An example of tension test rig is illustrated in Figure 4.1.

In shear tests (see 5.3), the load shall be applied parallel to the concrete surface. A plate with interchangeable sleeves may be used for testing the different sizes of anchors (see Figure 4.2). The sleeves shall be made of quenched steel and have radiused edges (0,4 mm) where in contact with the anchor. The height of the sleeves shall be approximately equal to the outside diameter of the anchor. The inner diameter of the sleeve shall

correspond to the sizes given in Table 4.1. To reduce friction, smooth sheets (e.g. PTFE) with a maximum thickness of 2 mm shall be placed between the plate with sleeve and the test member.

An example of a shear test rig is illustrated in Figure 4.3a and 4.3b. As there is a lever arm between the applied load and the support reaction, the test member is stressed by a torsion moment. This shall be taken up by additional reaction forces placed sufficiently far away from the anchor.

In combined tension and shear tests (see 5.4) the axis of the load shall pass through a point coincident with the axis of the anchor and the concrete surface. The load direction shall be kept constant throughout the test. In all other aspects the provisions for tension and shear tests apply.

In sustained load tests (see 5.7) the permanent load can be applied by a hydraulic jack, by springs or by dead load, e.g. applied by a lever arm.
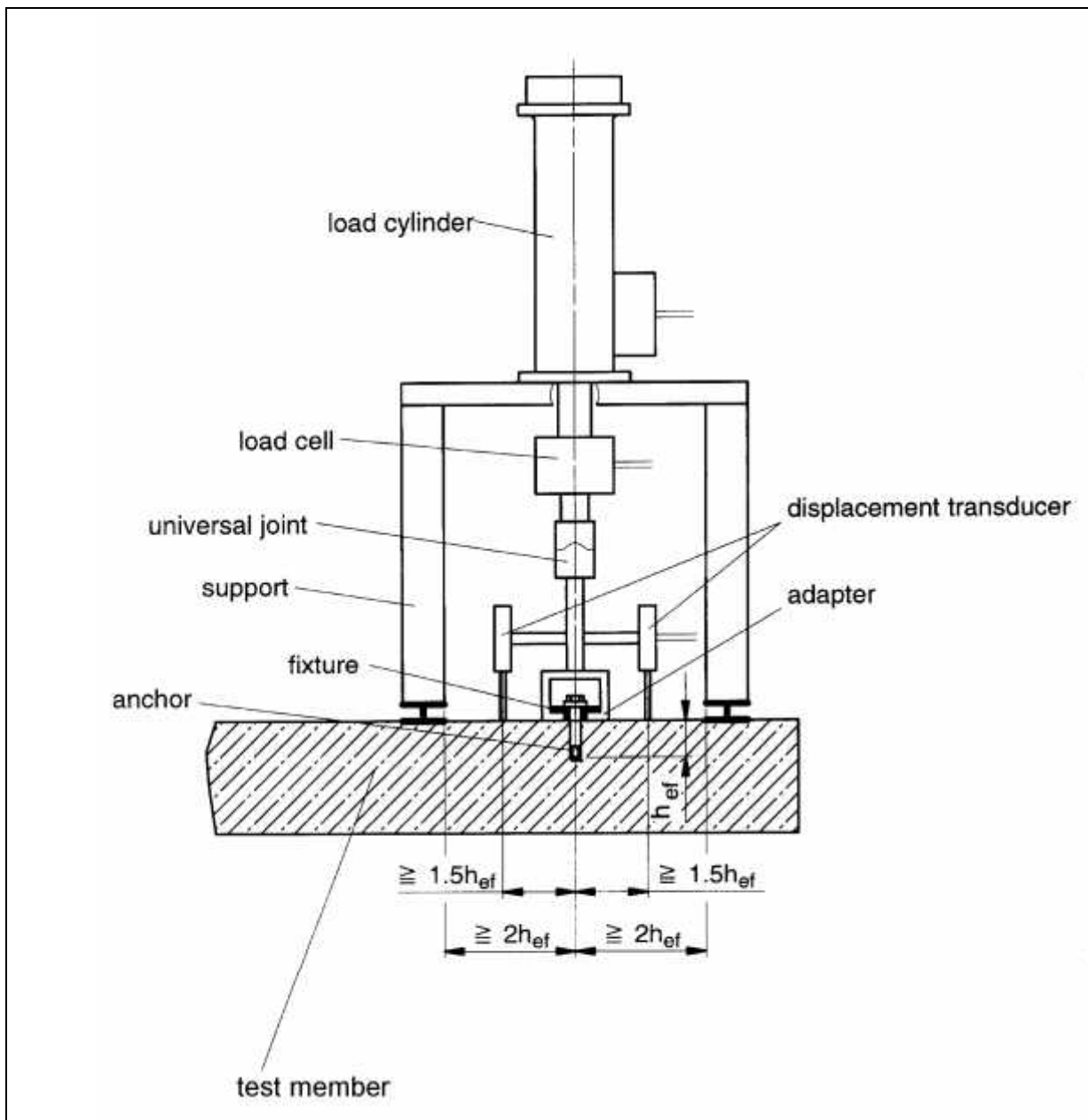

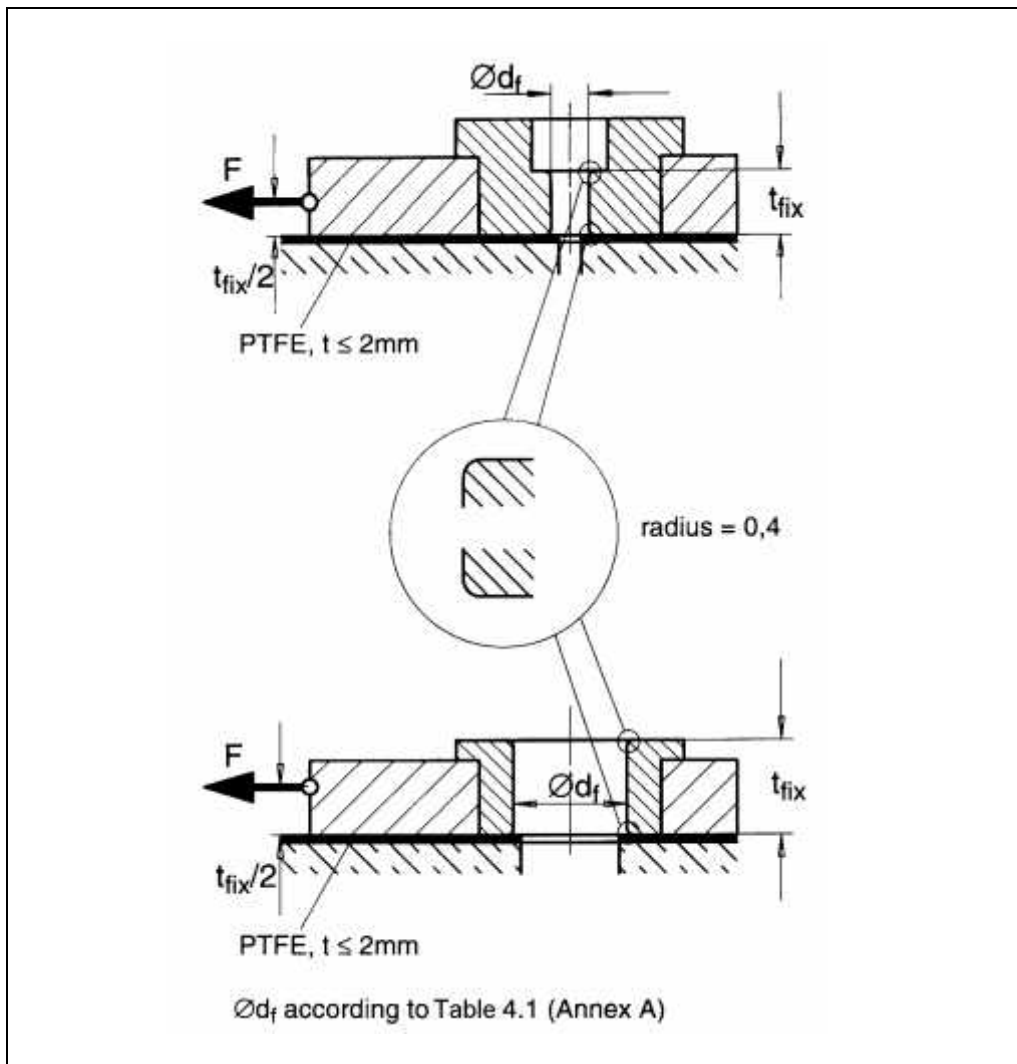**Figure 4.1**   Example of a tension test rig

Figure 4.2   Examples of shear test sleeves

Table 4.1   Diameter of clearance hole in the fixture

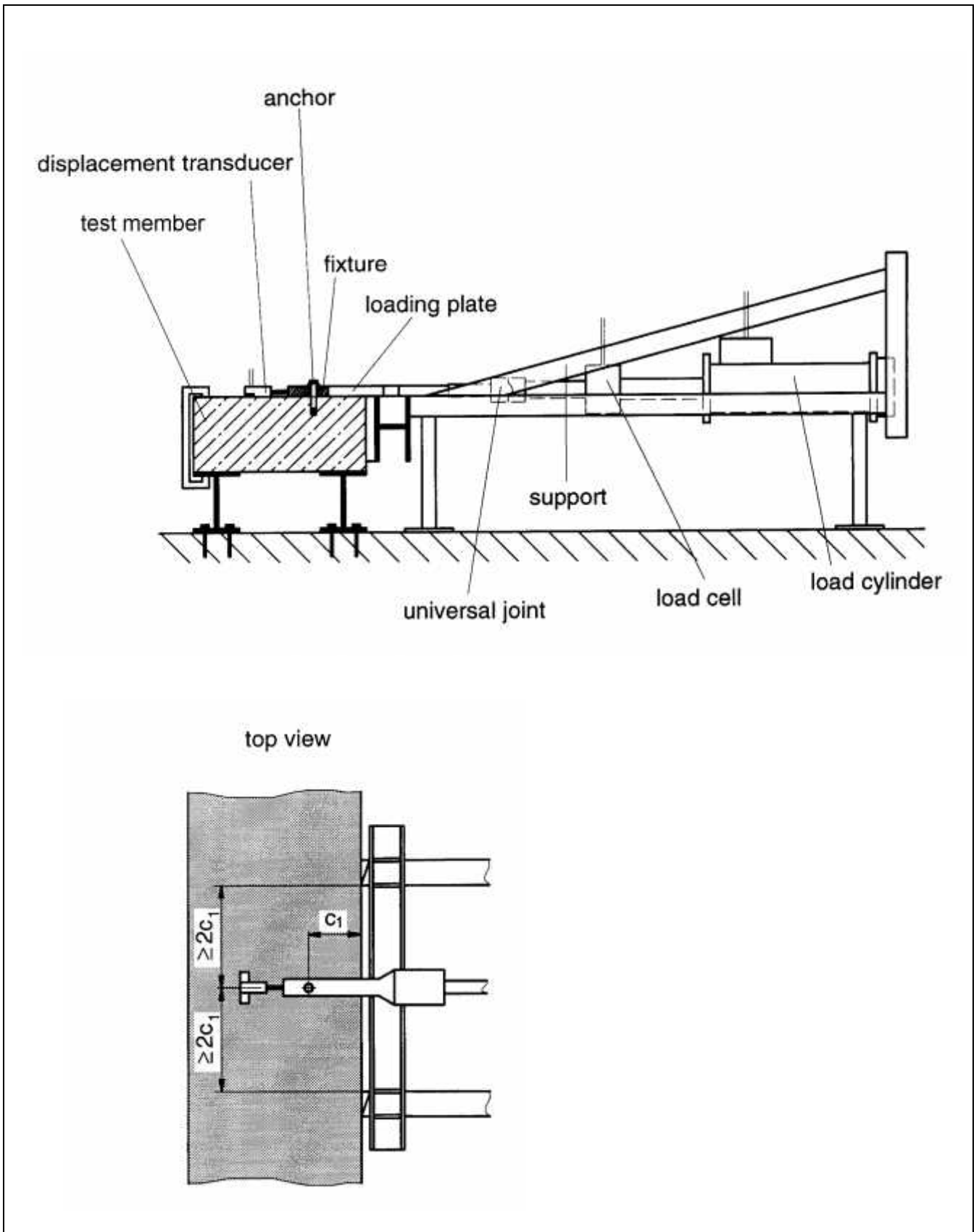| external diameter d or d_{nom} (mm)	6	8	10	12	14	16	18	20	22	24	27	30
diameter d_f of clearance hole in the fixture (mm)	7	9	12	14	16	18	20	22	24	26	30	33

Figure 4.3a   Example of a shear test rig

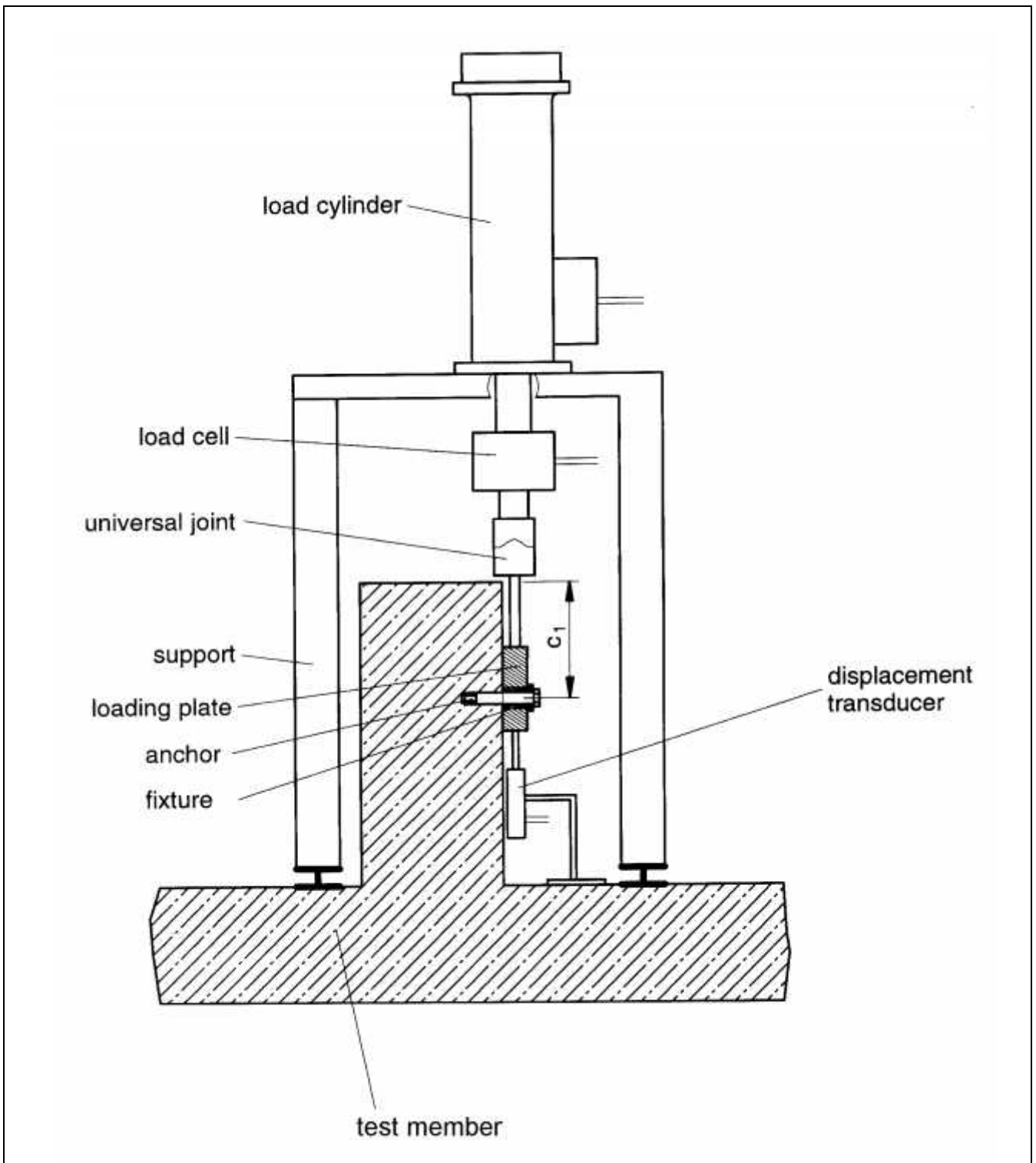**Figure 4.3b**   Example of a shear test rig

In torque tests (see 5.10), the relation between the applied torque moment and the tension force in the bolt is measured. For this, a calibrated load cell with a measuring error $\leq$ 3 % throughout the whole measuring range is used as a fixture (Figure 4.4). The anchor shall be installed in non-cracked concrete with strength class of C50/60 (Figure 4.4).
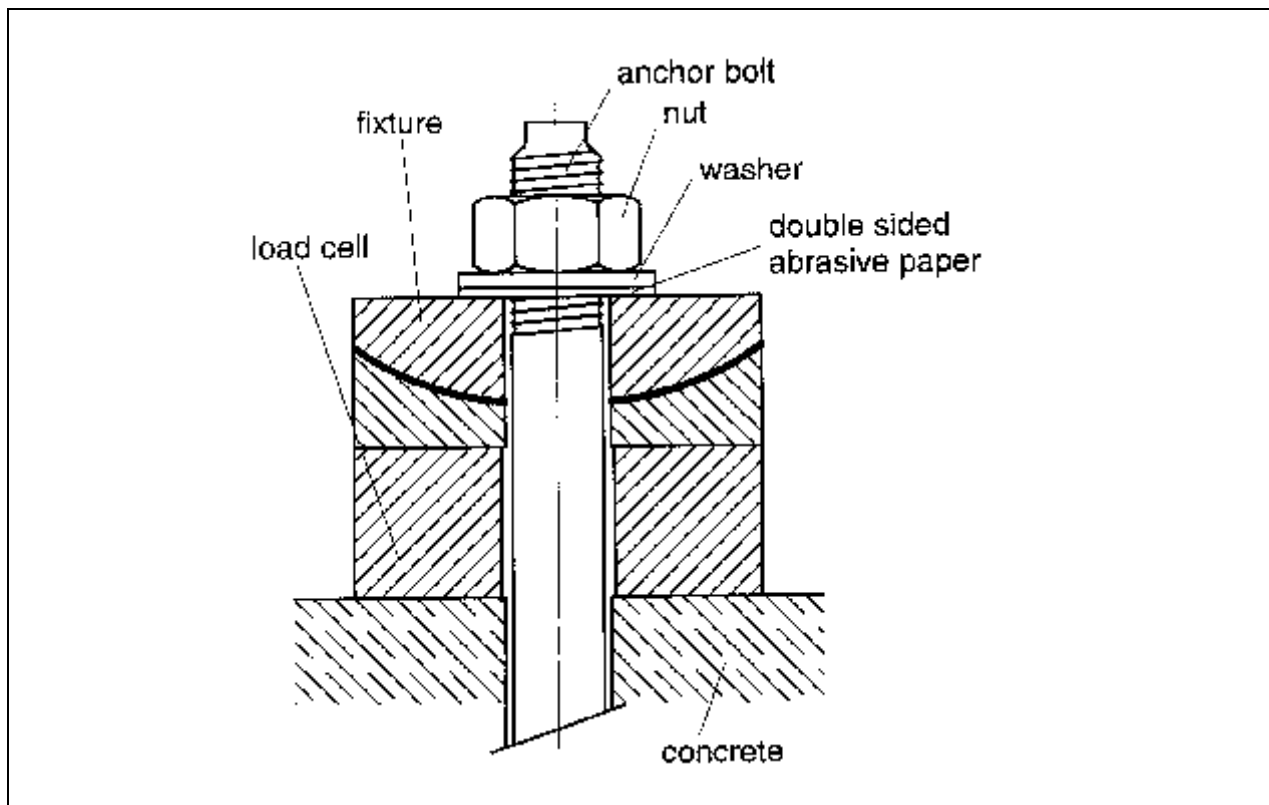
Figure 4.4   Example for torque test (schematic)
(Any rotation of the spherical part of the fixture shall be prevented.)

5   TEST PROCEDURE

5.1   General

The anchors shall be installed in accordance with the standard instructions supplied by the manufacturer, except where special conditions are specified in the tests.

The tests in cracked concrete are undertaken in unidirectional cracks (compare Introductory Notes). The crack width Δw is given in Part 1, Table 5.1 (suitability tests) and Table 5.4 (tests for admissible service conditions). Δw is the difference between the crack width when loading the anchor and the crack width at anchor installation. After installation of the anchor (see 3) the crack is widened to the appropriate crack width while the anchor is unloaded. The initial crack width shall be set to within $\pm$ 10 % of the specified value. However, the mean value of a series shall reflect the specified value.

Then the anchor is subjected to load while the crack width is controlled, either:

(a)   at a constant width, for example, by means of a servo system, or

(b)   limited to a width close to the initial value by means of appropriate reinforcement and depth of the test member.

In both cases the crack width at the face opposite to that through which the anchor is installed be maintained close to the specified value.

The load shall increase in such a way that the peak load occurs after 1 to 3 minutes from commencement. Load and displacement be recorded either continuously or at least in about 100 intervals. The tests may be carried out with load or displacement control. In case of displacement control, then the test be continued up to at least 75 % of the maximum load to be measured (to allow the drop of the load/displacement curve).

5.2 Tension test

5.2.1 Single anchor

After installation, the anchor is connected to the test rig and loaded to failure. The displacements of the anchor relative to the concrete surface at a distance of $\geq 1.5\,h_{ef}$ from the anchor shall be measured by use of either one displacement transducer on the head of the anchor or at least two displacement transducers on either side; the mean value shall be recorded in the latter case.

When testing anchors at the corner of a non-cracked test member, then the test rig shall be placed such that an unrestricted concrete failure towards the corner is possible (see Figure 5.1). It may be necessary to support the test rig outside the test member.

When testing in cracked concrete, the crack width shall be regularly measured during the test on both sides of the anchor at a distance of approximately $1.0\,h_{ef}$ and at least on the face of the test member in which the anchors are installed.
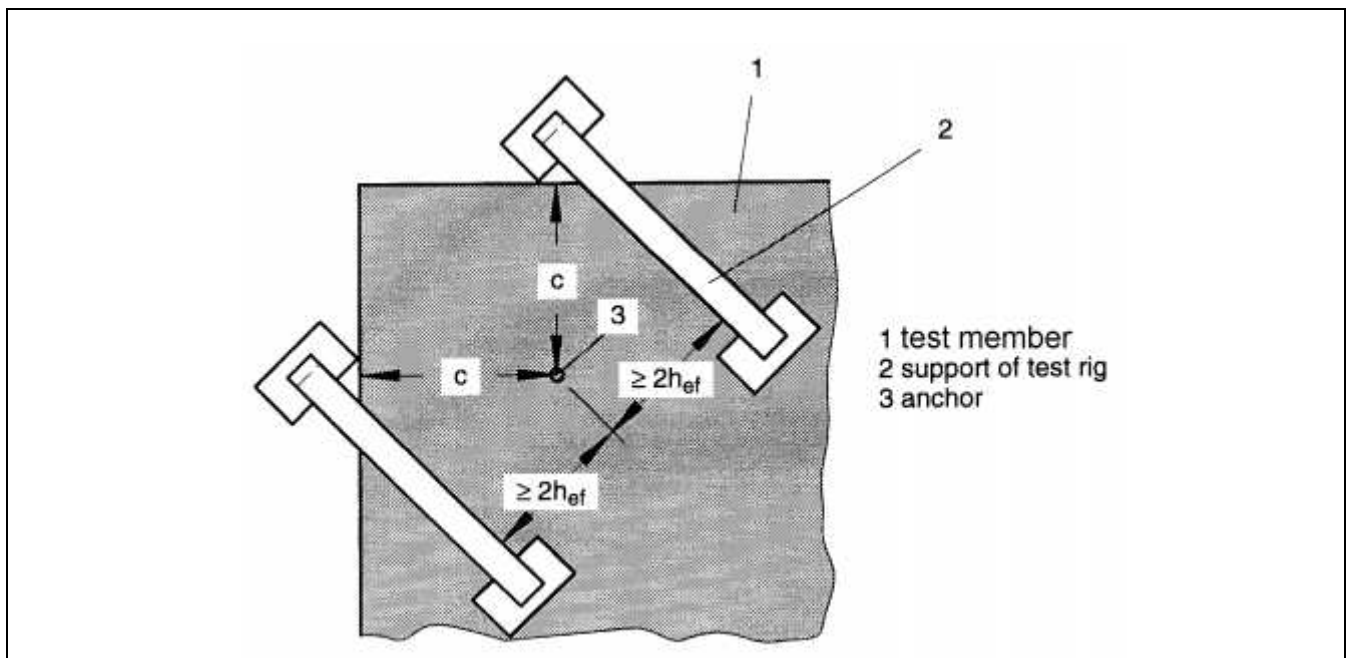

Figure 5.1   Example of the test rig for tension tests on anchors at a corner

5.2.2 Quadruple anchor group

The tests are performed in non-cracked concrete. The anchors of a quadruple anchor group shall be connected by a rigid fixture. The tension load shall be applied centrally to the fixture. The connection between the fixture and the load jack shall be hinged to permit differential anchor displacement to occur.

The mean displacement of the anchor group relative to the concrete surface at a distance of $\geq 1.5\,h_{ef}$ of the outermost anchors shall be measured, for example by use of transducers measuring the displacement of the fixture at the corners.

5.2.3 Double anchor group

In certain cases, tension tests on double anchor groups close to the edge are necessary (see Part 2, 5.1.3). The tests are performed in non-cracked concrete. The two anchors are installed parallel to the edge of the test member at a spacing $s = s_{min}$ and an edge distance $c = c_{min}$. The test procedure follows 5.2.2.

5.3 Shear test

5.3.1 Single anchor

After installation, the anchor is connected to the test rig without gap between the anchor and the interchangeable sleeve in the loading plate; it is then loaded to failure. The displacements of the anchor relative to the concrete

shall be measured in the direction of the load application, eg by use of a displacement transducer fixed behind the anchor (seen from the direction of load application) on the concrete (see Figure 4.3a).

When testing anchors at a corner, the test rig shall be arranged such that an unrestricted concrete corner failure may occur.

When testing in cracked concrete, 5.1 applies. However, the crack widths shall be measured at a distance of approximately h_{ef} behind the anchor. The load shall be applied in the direction of the crack towards the edge.

5.3.2   Double anchor group

The test is performed in non-cracked concrete. The two anchors shall be installed parallel to the edge and connected by a rigid fixture and the shear load shall be applied at the centre. The test arrangement shall simulate a hinged connection, so that the two anchors are loaded equally.

The total load on the anchor group and the mean displacement of the fixture relative to the concrete outside the failure cone shall be measured (see 5.3.1).

5.3.3   Quadruple anchor group

After installation, the 4 anchors shall be connected by a rigid fixture with the dimension given in Figure 5.2.
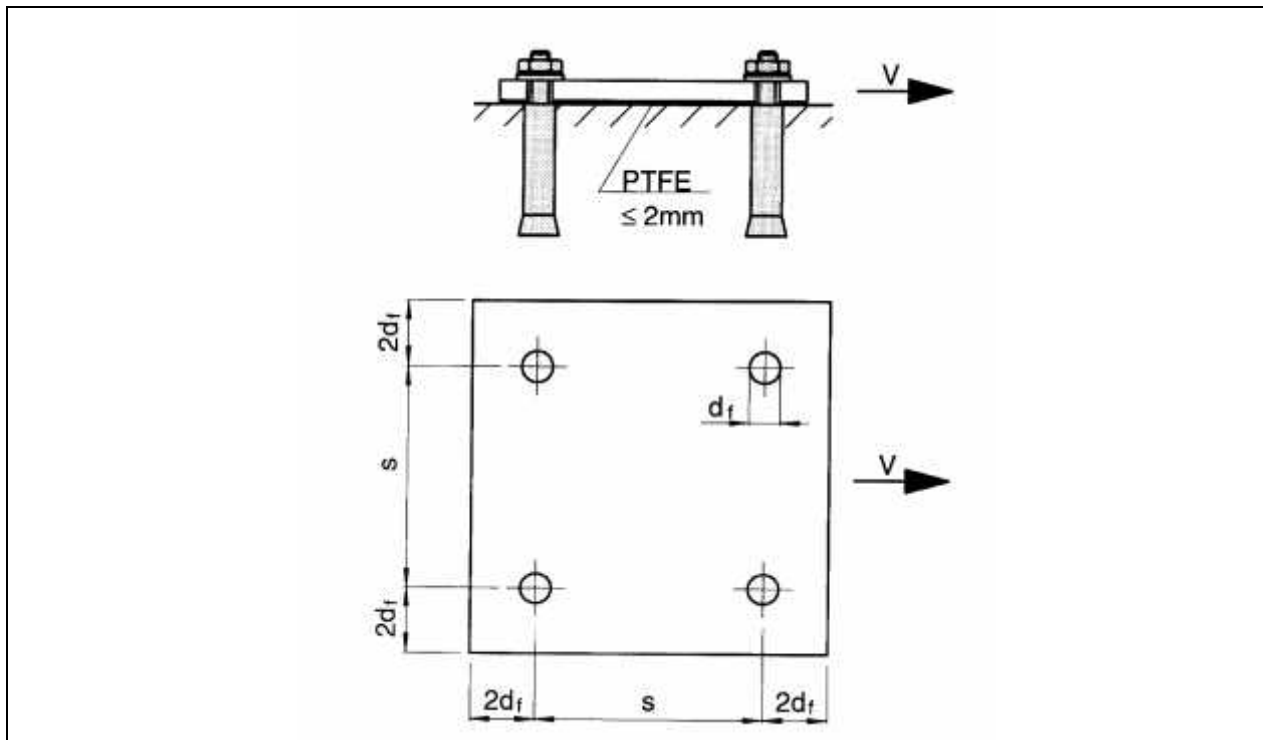

Figure 5.2   Dimensions of fixture
Below the fixture, a sheet of PTFE (e.g. Teflon) with a maximum thickness of 2 mm shall be placed. The test arrangement shall simulate a hinged connection so that the 4 anchors are loaded equally. The shear force may be applied to the front or back side of the fixture.

The load on the anchor group and the shear mean displacement of the fixture relative to the concrete outside the rupture cone shall be measured (see 5.3.1).

5.4   Combined tension and shear test

In a combined tension and shear (oblique tension) test the load may be applied by either one jack acting at the specified angle to the anchor axis or using two jacks under servo control applying an axial tension and shear load, respectively. During the test the intended angle of load application shall be kept constant with a tolerance of $\pm$ 2 degrees. The anchor displacements may be measured in either the direction of the load or, alternatively, both directions (see 5.2.1 and 5.3.1).

When testing in cracked concrete, the provisions given in 5.2.1 and 5.3.1 apply.

5.5   Crack movement test

After anchor installation the maximum (max N_s) and minimum (min N_s) loads applied to the test member shall be determined such that the crack width under max N_s is $\Delta w_1 = 0,3$ mm and under min N_s is $\Delta w_2 = 0,1$ mm. To stabilize crack formation, up to 10 load changes varying between max N_s and min N_s may be applied. Then a tensile load N_p [Equation (5.1)] is applied to the anchor after opening the crack to $\Delta w_1 = 0,3$ mm.

$$N_P = \quad 0,,9\, N_{Rk} / \gamma_{Mc} \tag{5.1}$$

   where:

   N_{Rk} = characteristic tensile resistance in cracked concrete C20/25 evaluated according to Part 1, 6.1.2.2 from the tests according to Part 1, 5.1.3.

   γ_{Mc} = according Annex C (≥ 1.8)

N_p shall remain constant during the test (variation $\pm$ 5%). Then the crack is opened and closed 1000 times (frequency approximately 0,2 Hz). During opening of the cracks, the crack width Δw_1 is kept approximately constant (see Figure 5.3); for this purpose the load max N_s applied to the test member may have to be reduced. The load min N_s is kept constant. Therefore, the crack width Δw_2 may increase during the test (see Figure 5.3). The crack width difference $\Delta w_1 - \Delta w_2$, however, shall be $\geq 0,1$ mm during the 1000 movements of the crack. If this condition cannot be fulfilled with $\Delta w_1 = 0,3$ mm, then either min N_s hall be reduced or Δw_1 hall be increased accordingly.

The load/displacement behaviour shall be measured up to the load N_p. Afterwards under N_p, the displacements of the anchor and the crack widths Δw_1 and Δw_2 shall be measured either continuously or at least after 1, 2, 5, 10, 20, 50, 100, 200, 500 and 1000 crack movements.

After completion of the crack movements the anchor shall be unloaded, the displacement measured and a tension test to failure according to 5.2.1 performed with $\Delta w = 0,3$ mm.
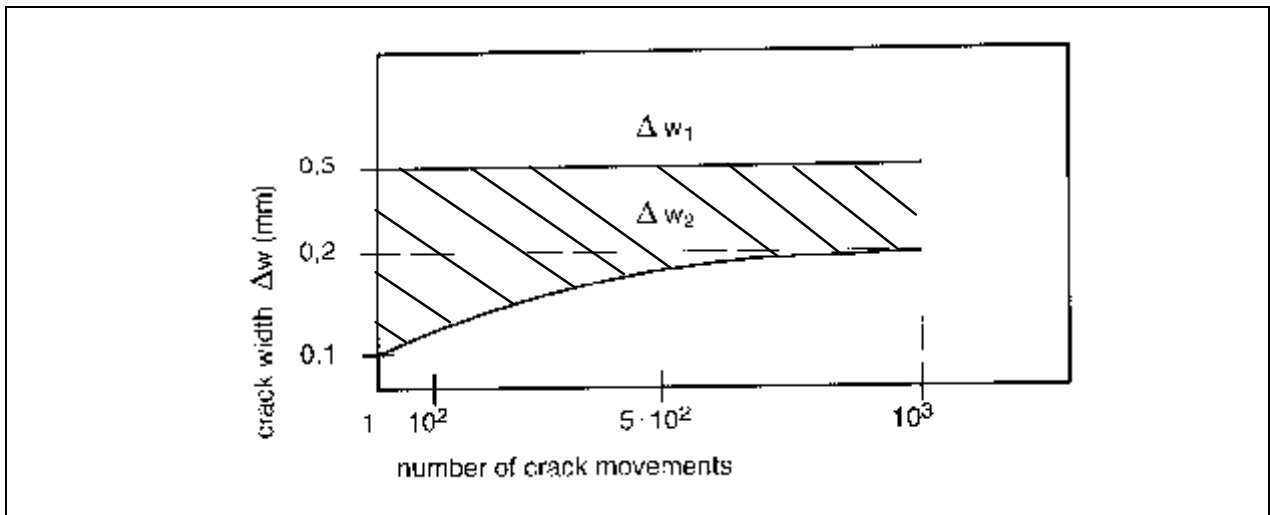
Figure 5.3 Allowable crack opening variations during the crack movement test

5.6 Repeated load test

The test is performed in non-cracked concrete. The anchor is subjected to 10^5 load cycles with a maximum frequency of approximately 6 Hz. During each cycle the load shall change as a sine curve between max N and min N according to Equations (5.2) and (5.3), respectively. The displacements shall be measured during the first loading up to max N and then either continuously or at least after 1, 10, 10^2, 10^3, 10^4 and 10^5 load cycles.

$$max\ N = \text{smaller value of } 0{,}6\ N_{Rk} \text{ and } 0{,}8 \cdot A_s \cdot f_{yk} \qquad (5.2)$$
$$min\ N = \text{higher value of } 0{,}25\ N_{Rk} \text{ and } max\ N - A_s \cdot \Delta\sigma_s \qquad (5.3)$$

where:

N_{Rk} = characteristic anchor failure load in tension in non-cracked concrete for the concrete strength of the test member. N_{Rk} is calculated either according to Annex B if the anchor conforms to current experience, or otherwise from the results of tension tests according to Part 1, 5.1.3 on single anchors without edge and spacing effects.

A_s = stressed anchor cross-section

$\Delta\sigma_s$ = 120 N/mm^2

After completion of the load cycles the anchor shall be unloaded, the displacement measured and a tension test to failure performed according to 5.2.1.

5.7 Sustained load test

The test is performed in non-cracked concrete. The anchor is subjected to a load according to Equation (5.2) and kept constant (variation within ± 5 %). The test will generally last for six months unless the displacements appear to have stabilized earlier. The minimum duration is three months.

After completion of the sustained load test the anchor shall be unloaded, the displacement measured and a tension test to failure performed according to 5.2.1.

5.8 Test with the anchor in contact with reinforcement

When drilling the cylindrical hole, the drilling tool shall be mounted in a drilling stand and positioned such that the reinforcing bar is clearly cut. On an mean the depth of the notch cut hall be about 1 mm. Apart from the contact with reinforcement the anchor shall be correctly installed. Then a tension test according to 5.2.1 is performed.

An anchor after installation in contact with reinforcement is shown in Figure 5.4.
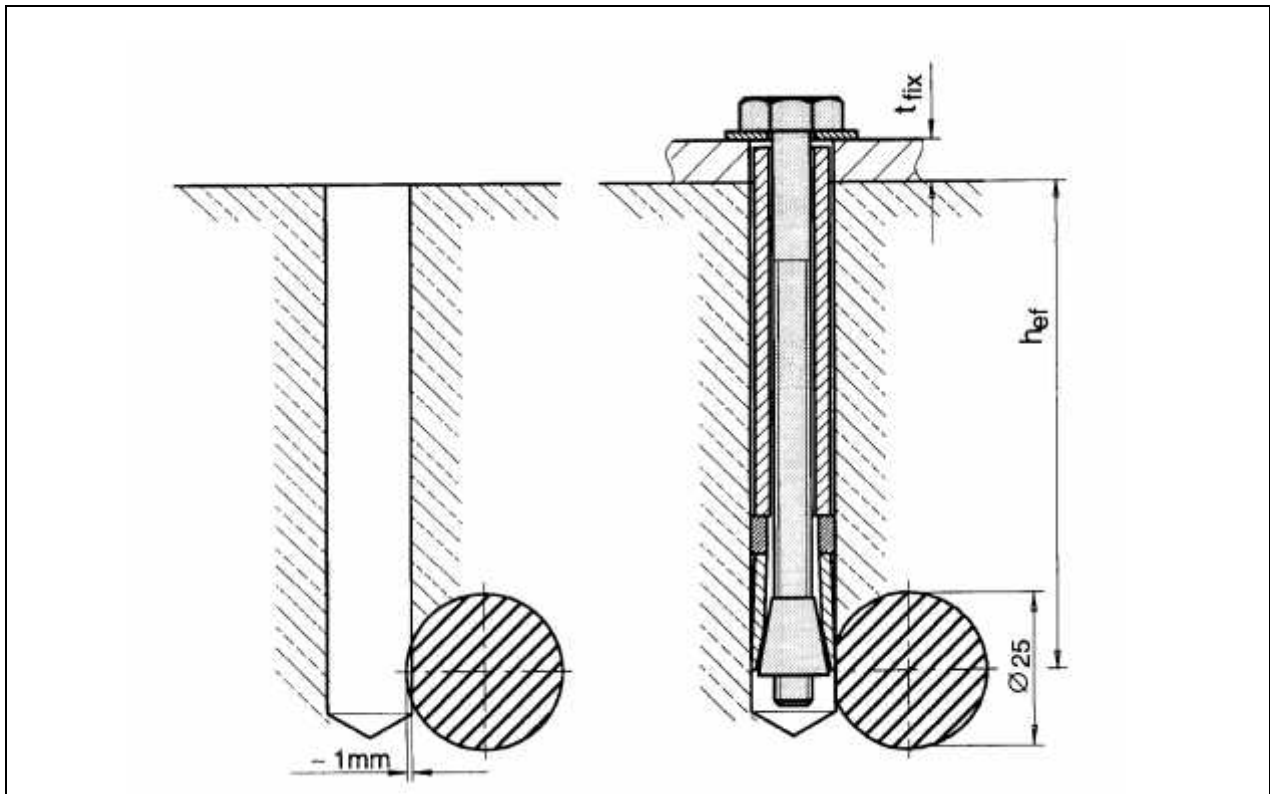
Figure 5.4   Position of anchor when tested in contact with reinforcement

5.9   Test for determining minimum spacing and edge distance

The tests are carried out with double anchors with a spacing $s = s_{min}$ and an edge distance $c = c_{min}$. The double anchors are placed on an uncast side of a concrete test member (see Part 1, Table 5.4) with a distance $a \geq 3\ h_{ef}$ between neighbouring groups. The diameter d_f of the clearance holes in the fixture shall correspond to the values given in Table 4.1. The dimensions of the fixture shall be width = 3 d_f, length = s_{min} + 3 d_f and thickness $\cong d_f$.

The anchors shall be torqued alternately in steps of 0,2 T_{inst}. After each load step the concrete surface shall be inspected for cracks. The test is stopped when the torque moment cannot be increased further.

The number of revolutions per load step shall be measured for both anchors. Furthermore, the torque moment at the formation of the first hairline crack at one or both anchors and the maximum torque moment that can be applied to the two anchors, shall be recorded.

5.10   Torque test

The diameter of the clearance hole in the fixture shall correspond to the values given in Table 4.1.

The torque moment is applied with a calibrated torque wrench until it cannot be increased further or at least to 1.3 T_{inst} respectively.

The tension force in the bolt or screw shall be measured as a function of the applied torque moment.

6   TEST REPORT

As a minimum requirement, the report shall include at least the following information:

General

- Description and type of anchor
- Anchor identification (dimensions, materials, coating, production method)
- Name and address of manufacturer

- Name and address of test laboratory
- Date of tests
- Name of person responsible for test
- Type of test (eg tension, shear, oblique tension, short-term or repeated load test)
- Number of tests
- Test rigs, illustrated by sketches or photographs
- Particulars concerning support of test rig on the test member

Test members

- Composition of concrete. Properties of fresh concrete (consistency, density)
- Date of manufacture
- Dimensions of control specimens, and/or cores (if applicable) measured value of compression strength at the time of testing (individual results and mean value)
- Dimensions of test member
- Nature and positioning of any reinforcement
- Whether cast horizontally or vertically

Anchor installation

- Information on the positioning of the anchor (e.g. placed on the uncast face or cast face of the test member)
- Distances of anchors from edges of test member and between adjacent anchors
- Tools employed for anchor installation, e.g. impact drilling tool, drilling hammer, other equipment, e.g. torque wrench
- Type of drill bit, manufacturer's mark and measured drill bit dimensions, particularly the effective diameter, d_{cut}, of the hard metal insert
- Information on the direction of drilling
- Information on cleaning of the hole
- Depth of drill hole
- Width of crack when installing the anchor (where applicable)
- Depth of anchorage
- Tightening torque or other parameters for control of installation, e.g. penetration depth of the expansion element of displacement controlled anchors
- Displacement of anchor at the applied torque moment (if measured)
- Quality and type of screws and nuts employed
- Length of thread engagement (where applicable)

Measured values

- Parameters of load application (e.g. rate of increase of load or of size of load increase steps.)
- Displacements measured as a function of the applied load
- Any special observations concerning application of the load
- Width of crack during the loading of the anchor (where applicable)
- Failure load
- Cause(s) of rupture or failure
- Radius (maximum radius, minimum radius) and height of a concrete cone produced in the test (where applicable)
- Particulars of tests with crack movements
    - constant load on anchor and method of applying it
    - frequency of crack openings
    - anchor displacements and crack width Δw_1, Δw_2 as a function of the number of crack openings
- Particulars of repeated load tests
    - minimum and maximum load
    - frequency of cycles
    - number of cycles
    - displacements as function of the number of cycles
- Particulars of sustained load tests
    - constant load on anchor and method of applying it
    - anchor displacement as a function of time
- Particulars of group tests
    - any special observation, e.g. one anchor fails and load is redistributed to other anchors
    - eventual cracking between anchors

- Particulars of tests with anchor in contact with reinforcement
  - positioning of the anchor with respect to reinforcement bars
  - dimensions of notch cut
- Particulars of test for determining the minimum spacing and edge distance
  - increment of torque
  - number of revolutions
  - torque moment at the forming of a hairline crack at each anchor
  - maximum torque moment applied to each anchor
- Particulars of torque test
  - increment of torque
  - tension force as a function of the applied torque moment

The above measurements shall be recorded for each test.

- Particulars of identification tests
  - dimensions of the parts of the anchor and the drilling- and installation tools
  - properties (e.g. tensile strength, elastic limit, elongation at rupture, hardness and surface conditions of anchor cone and sleeve, if applicable)