BRITISH STANDARD

BS EN 409:2009

Timber structures — Test methods — Determination of the yield moment of dowel type fasteners

ICS 91.080.20

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 409:2009. It supersedes BS EN 409:1993 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/518, Structural timber.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Structures en bois - Méthodes d'essais - Détermination du moment plastique des organes d'assemblage de type tige

Holzbauwerke - Prüfverfahren - Bestimmung des Fließmoments von stiftförmigen Verbindungsmitteln

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Foreword

This document (EN 409:2009) has been prepared by Technical Committee CEN/TC 124 “Timber structures”, the secretariat of which is held by SFS.

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of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by October 2009.

This document supersedes EN 409:1993.

The following changes have been introduced in this version of EN 409:

- references added in Clause 2;

- symbols added in 4;

- text of 6.5 modified and extended;

- Figure 4 added;

- items added in 6.7.

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1 Scope

This European Standard specifies a method for determining the yield moment of dowel type fasteners.

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 14592, *Timber structures — Dowel-type fasteners — Requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
dowel type fastener
fasteners specified in EN 14592

3.2
yield moment
bending moment when the specimen is deformed through a prescribed rotation angle

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

d nominal dowel type diameter according to EN 14592, in millimetres

F_1, F_3 maximum support loads on the dowel type fastener, in newtons

F_2, F_4 test loads applied to the dowel type fastener, in newtons

l_1, l_3 distances between loading points and the nearest support, in millimetres, see Figure 1

l_2 free length of the nail in millimetres, see Figure 1

M_y yield moment of the dowel type fastener, in newton millimetres

α, α_1, α_2 rotation angle, in degrees

ρ_k is the characteristic density of the timber, in kg/m^3

f_t is the tensile strength of the fastener, N/mm^2

5 Requirements

The requirements for dowel type fasteners as given in EN 14592 apply.

6 Test methods

6.1 Principle

The principle of the test involves the loading of the dowel type fastener under test as shown in Figure 1 in such a manner that the loading points do not move along the dowel type fastener and the loads remain normal to the axis of the dowel type fastener during the test. The dimensions l_1 and l_3 shall be at least $2d$. The free length of the dowel type fastener, l_2, shall be between d and $3d$.

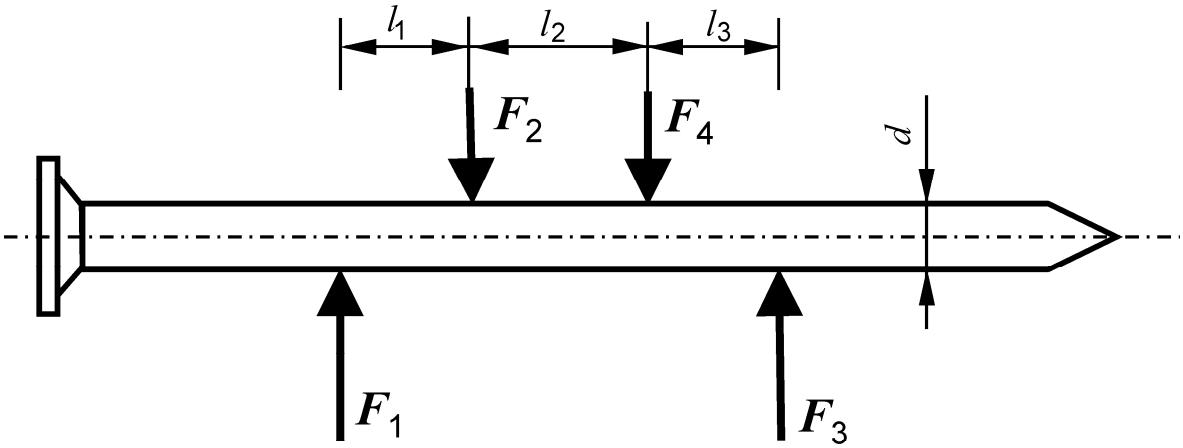


Figure 1 — Example of loading principle for nails

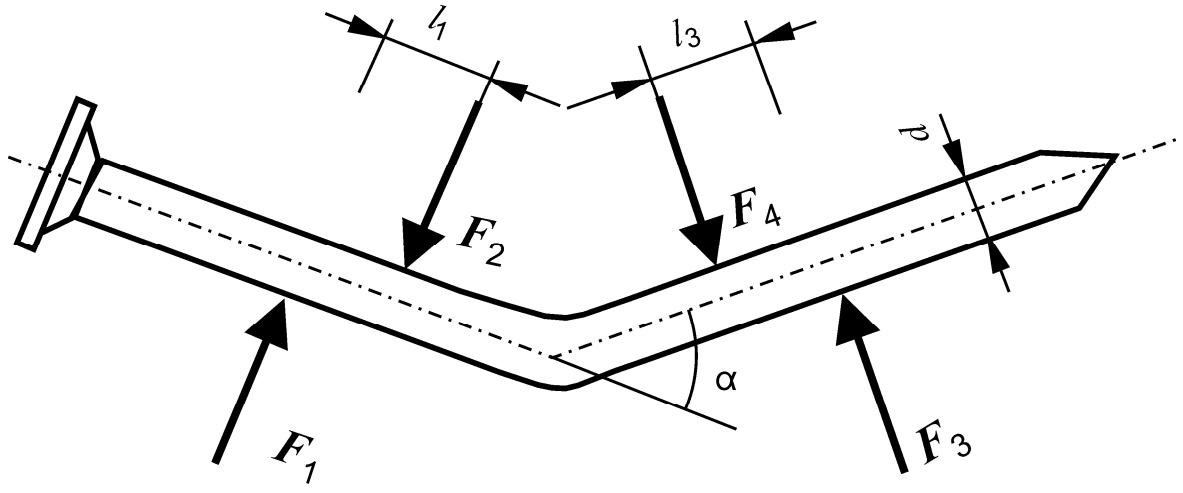


Figure 2 — Example of nail deformation

6.2 Materials

EN 14592 applies.

6.3 Apparatus

The apparatus used for the test shall be such that the loads F_2 and F_4 (see Figures 1 and 2) do not deviate by more than 5 % from each other. The bending moment diagram for the resulting yield moment M_y is shown in Figure 3.

NOTE A test apparatus, which has been found to be suitable for this test, is shown in Annex A.

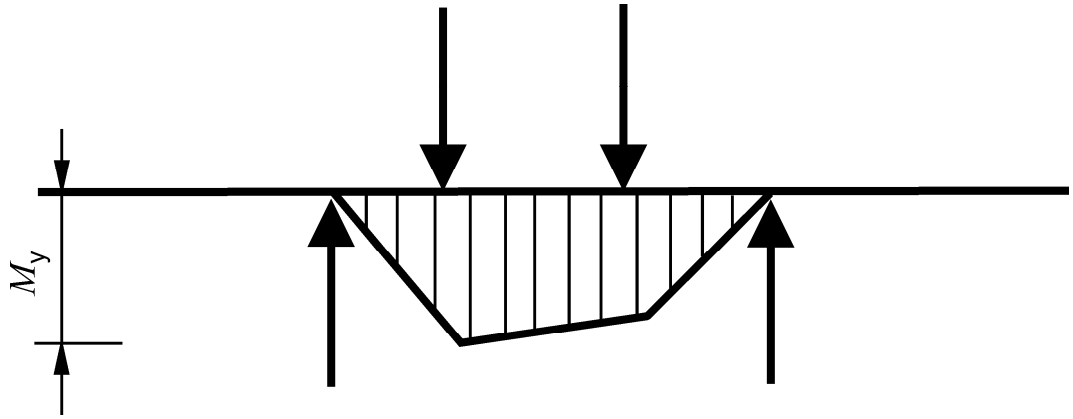


Figure 3 — Yield moment M_y on the dowel type fastener

6.4 Preparation of the specimen

The nail shall be tested about its weakest axis.

6.5 Loading procedure

6.5.1 General

The load shall be applied to the dowel type fastener as shown in Figure 1, and shall be increased at such a rate that at least the rotation angle according to 6.5.2 is reached in 10 s ± 5 s. Record the loads and the corresponding values of the rotation angle during the test.

The load shall be determined to an accuracy of 1 %.

6.5.2 Rotation angle

For nails and staples the rotation angle shall be 45°.

For screws, dowels or bolts used in wood based products the rotation angle is 110/d degree.

For screws, dowels or bolts with a tensile strength of 1 000 N/mm^2 used in timber with a characteristic density of 360 kg/m^3 the rotation angle is given in Figure 4.

For different tensile strength values or/and different characteristic timber density the rotation angle is:

$$\alpha = \alpha_1 \left(\frac{2{,}78\rho_k}{f_t} \right)^{0{,}44} + \alpha_2 \qquad (1)$$

where

α is the rotation angle to be used in the determination of the yield moment, in degrees;

α_1 is the rotation angle according to Figure 4, in degrees;

α_2 is 10° for nails, staples and screws and 0° for dowels and bolts;

ρ_k is the characteristic density of the timber where fastener is to be applied, kg/m^3;

f_t is the tensile strength of the fastener, N/mm^2.

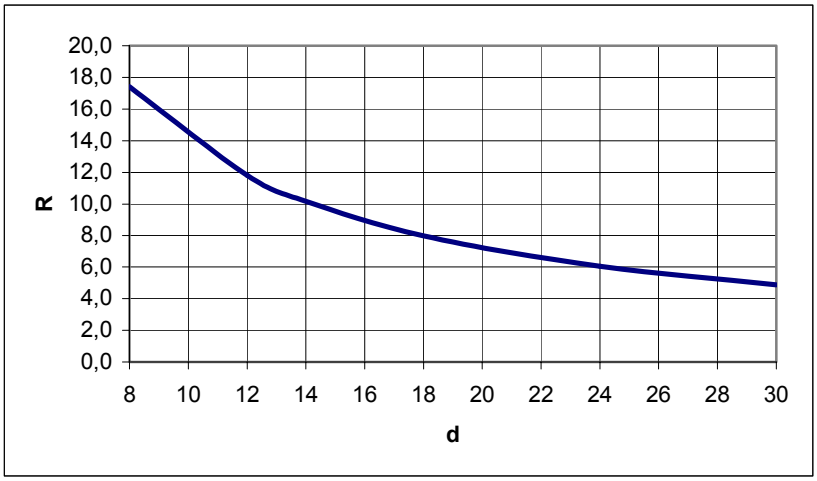
6.6 Results

Determine the load, F_1 and F_3, at the rotation angle α according to 6.5.2.

The yield moment, M_y, shall be calculated as given by:

$$M_y = \max \begin{cases} F_1 \mathrm{x}\, l_1 \\ F_3 \mathrm{x}\, l_3 \end{cases} \qquad (2)$$

and shall be determined to an accuracy of 1 %.



Key

R rotation angle, α_1, in degrees

d diameter of the dowel type fastener, in mm

Figure 4 — Rotation angle versus fastener diameter

6.7 Test report

The test report shall include the following information:

a) description of the dowel type fastener;

b) description of the test apparatus;

c) location of the free length, l_2, along the shank of the dowel type fastener in the test;

d) tensile strength of the steel;

e) characteristic wood density;

f) graphs plotting the values of the rotation angle and load;

g) rotation angle used for calculating the yield moment;

h) value of the yield moment;

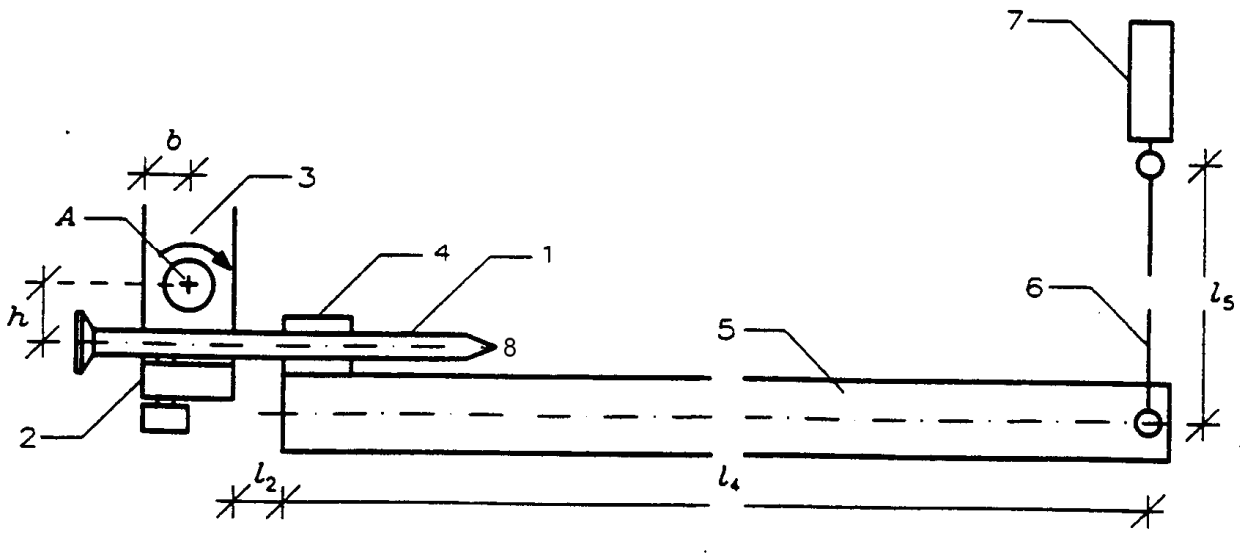
i) failure mode of the fastener at the rotation given by Equation (1).

j) reference to this European Standard, i.e. EN 409:2009

Annex A
(informative)

Bending apparatus

A.1 Apparatus



Key
1) fastener
2) loose fitting bushing
3) arm
4) loose fitting bushing
5) lever
6) rod
7) load gauge
8) nail
A) rotation point

Figure A.1 — Example of loading apparatus for nails

A bending apparatus suitable for nails is shown in Figure A.1 and consists of the following:

a) the nail under test (1) is held at one end in a loose fitting bushing (2) fixed to an arm (3) that can be rotated about point A;

b) the other end of the nail is put into a loose fitting bushing (4) which is fixed to a lever (5);

c) the lever (5) is suspended on a load gauge (7) by a rod (6) having freely rotating joints at both ends and having its axis perpendicular to the lever.

The dimensions:

h from the axis of rotation, point A in Figure A.1, to the axis of the nail and

b between the axis of rotation A and the leading edge of arm (3)

shall be so small in relation to the lengths of the lever 14 and of the rod 15 that the right angle between the rod and lever does not change by more than 0,1 rad during testing.

The lever shall be stiff compared to the nail.

With the arm (3) resting on the nail and the load gauge (7) set to zero the test shall be commenced by rotating arm (3) about axis A until the condition of yield within the free length ~ is reached. The length of bushings (2) and (4) shall not differ by more than 5 %.

A.2 Expression of results

$$M_y = \max \left\{ \begin{array}{l} F_{\max} x\ l_4 \\ F_{\max} \left[l_4 + \left(1 - \frac{G_{lev.}}{2F_{\max}} \right) x\, l_2 \right] \end{array} \right\} \qquad (3)$$

where

F_{rnax} is the maximum load on the gauge, in newtons;

G_{tev} is the self weight of the lever, in newtons;

l_2 is the free length of the nail, in millimetres;

l_4 is the length of the lever, in millimetres.

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