BS EN 1075:2014

BSI Standards Publication

Timber structures — Test methods — Joints made with punched metal plate fasteners

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National foreword

This British Standard is the UK implementation of EN 1075:2014. It supersedes BS EN 1075:2000 which is withdrawn.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'essai - Assemblages réalisés avec des connecteurs métalliques à plaque emboutie

Holzbauwerke - Prüfverfahren - Verbindungen mit Nagelplatten

This European Standard was approved by CEN on 7 November 2014.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 1075:2014) has been prepared by Technical Committee CEN/TC 124 “Timber Structures”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by June 2015 and conflicting national standards shall be withdrawn at the latest by June 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1075:1999.

Compared to EN 1075:1999, the following changes have been made:

a) replacement of EN 28970 by EN ISO 8970;

b) modification of definition in 3.5 for density;

c) modification of the formula in 6.6.1 for anchorage capacity;

d) improvement of figures.

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

1 Scope

This European Standard specifies the test methods for determining the strength capacity and stiffness of joints made with punched metal plate fasteners in load bearing timber structures, being used to join two or more pieces of timber of the same thickness in the same plane.

The properties measured are:

— load-slip characteristics and maximum load resulting from the lateral resistance of the embedded projections, at various angles between the direction of the applied force and

  — the axis of the fastener (load-fastener angle α),

  — the direction of the grain of the timber (load-grain angle β),

— the tension capacity of the fastener at various angles α,

— the compression capacity of the fastener at various angles α,

— the shear capacity of the fastener at various angles α.

A nail root test method is shown in Annex A.

2 Normative references

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

EN 336, *Structural timber — Sizes, permitted deviations*

EN 14358, *Timber structures — Calculation of characteristic 5-percentile values and acceptance criteria for a sample*

EN 26891:1991 *Timber structures — Joints made with mechanical fasteners — General principles for the determination of strength and deformation characteristics (ISO 6891:1983)*

EN ISO 8970, *Timber structures — Testing of joints made with mechanical fasteners — Requirements for wood density (ISO 8970)*

3 Terms and definitions

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

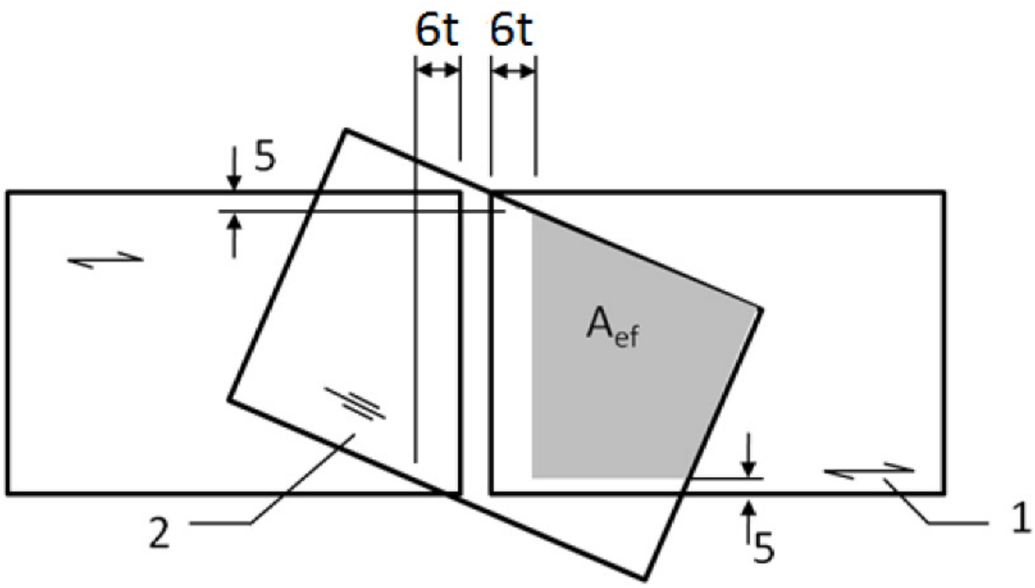
3.1
punched metal plate
fastener made of metal plate of nominal thickness not less than 0,9 mm and not more than 3,0 mm, having integral projections punched out in one direction and bent perpendicular to the base of the metal plate

3.2
major axis of fastener
direction giving the highest tension capacity per unit width of the fastener

Note 1 to entry: In many cases the punching pattern of the fastener gives rise to two main directions, perpendicular to each other, with different capacity properties.

3.3
effective area of fastener
area of the total contact surface between the plate and the timber, reduced by 5 mm from the edges of the timber and by a distance in the grain direction from the end of timber equal to 6 times the fastener's nominal thickness, see Figure 1

Dimensions in millimetres



Key

1 direction of the grain

2 major axis of the fastener

Figure 1 — Definition of effective area of fastener

3.4
anchorage capacity per unit area
maximum load resisted by the joint per effective unit area of the fastener

3.5
mean density
population 50-percentile value with the mass and volume corresponding to equilibrium moisture content at a temperature of 20 °C and a relative humidity of 65 %

3.6
design core thickness of the fastener
nominal thickness of the fastener, reduced by the thickness of the coating and further reduced by the minus tolerance of the core thickness

4 Symbols and abbreviations

A_{ef} effective area of fastener, in square millimetres

b width of fastener perpendicular to the major axis of the fastener, in millimetres

$f_{a,\alpha,\beta}$ fastener anchorage capacity, in newtons per square millimetre

$f_{c,\alpha}$ fastener compression capacity, in newtons per millimetre

$f_{t,\alpha}$ fastener tension capacity, in newtons per millimetre

$f_{t,act}$ actual tension strength of the fastener material, in newtons per square millimetre

$f_{t,k}$ characteristic tension strength of the fastener material, in newtons per square millimetre

$f_{v,\alpha}$ fastener shear capacity, in newtons per millimetre

$f_{y,act}$ actual yield stress of the fastener material in newtons per square millimetre

$f_{y,k}$ characteristic yield stress of the fastener material in newtons per square millimetre

F load, in newtons

F_{max} maximum load, in newtons

$F_{max,est}$ estimated maximum load, in newtons

h depth of timber, in millimetres

l length of fastener parallel to the major axis of the fastener, in millimetres

l_1, l_2 lengths of area covered by the fastener (see Figure 3), in millimetres

l_j length of the fastener in the joint line, in millimetres

t thickness of timber test piece, in millimetres

$t_{cor,d}$ design core thickness of fastener, in millimetres

t_{act} actual core thickness of fastener, in millimetres

α angle between the direction of the applied force and the major axis of the fastener, in degrees

β angle between the direction of the applied force and the direction of the grain of the timber, in degrees

θ angle between the gap line and the line through the load point and the centre point of the fastener (see Figure 6), in degrees

ρ density of the timber member in which the failure took place, in kilogram's per cubic metre.

5 Materials

5.1 Timber

The timber shall be selected in accordance with EN ISO 8970.

5.2 Fasteners

The fastener specification, including the relevant characteristic mechanical properties (e.g. tensile strength, yield stress and elongation) of the steel used to manufacture the fasteners, determined using standard test procedures, shall be recorded. For the purpose of verifying such records, material shall be available which has been taken from the coil used in the manufacture of the fasteners.

The ductility of the fasteners at the root position of the projections shall be determined in accordance with Annex A.

The sizes (length and width) of fastener to be used for the various tests should be selected in such a way that capacity values for the complete range of sizes normally produced by the fastener manufacturer shall be obtained.

6 Test methods

6.1 General

For the determination of the fastener tension capacity, the timber shall be sufficiently strong for failure to occur in the fastener. The timber used shall have a target size, see EN 336, of not less than 35 mm or twice the length of the projections plus 5 mm, whichever is the greater.

In the tests specified in 6.4.1 and 6.4.2 the minimum timber thickness should be limited to that proposed for use in service.

Test data of anchorage capacity should not be applied to joints with members thinner than those tested, but may be applied to joints with thicker members.

NOTE Examples of properly located transducers are given in Annex C (informative).

If there are no special requirements, the timber shall be planed; the difference in thickness between adjoining pieces shall not exceed 0,5 mm. For each test piece, the two individual members to be joined shall be cut from adjacent positions on the same plank to ensure a test piece of balanced density. In each group of similar test pieces, the timber for each test piece shall be cut from a different plank.

Timber members for the test pieces shall be cut so that the areas to which the fasteners are embedded are free from knots, local grain disturbance, fissures and wane. Elsewhere the members shall be free from characteristics which could lead to premature failure in the timber.

The moisture content of the timber and its density shall be determined.

6.2 Conditioning

The test pieces shall be manufactured with the timber at an equilibrium moisture content corresponding to (20 ± 2) °C and (85 ± 5) % relative humidity and shall afterwards be conditioned for at least one week at (20 ± 2) °C and (65 ± 5) % relative humidity. The timber material is conditioned when it attains constant mass. Constant mass is considered to be attained when the results of two successive weightings, carried out at an interval of 6 h, do not differ by more than 0,1 % of the mass of the timber material. For certain investigations other moisture conditioning may be appropriate, and shall be reported.

NOTE For some hardwoods a much longer conditioning period may be necessary.

6.3 Fabrication of test pieces

Test pieces shall be made with two fasteners positioned parallel to each other and symmetrically on opposite faces of the joint. The size and geometry of the test pieces will depend upon fastener size and the property being measured. The test pieces shall be assembled using the method (e.g. press or roller) normally used with the particular fasteners in the commercial production of structural timber components and the projections of the fastener shall be fully embedded in the timber so that the contact surface of the fastener is flush with the surface of the timber. If complementary nails are used to locate fasteners during the assembly of joints, such nails shall either be omitted from the test pieces or withdrawn prior to the test. The fasteners shall not be modified by the removal of any projections or by notching.

In the case of the testing of fastener compression capacity (see 6.4.4), the test piece shall be fabricated so that the pieces of timber in the test piece are separated by a gap of not less than 4 mm.

In the case of the other test series, the test piece shall be fabricated so that the pieces of timber in the test piece are separated by a gap of not less than 2 mm.

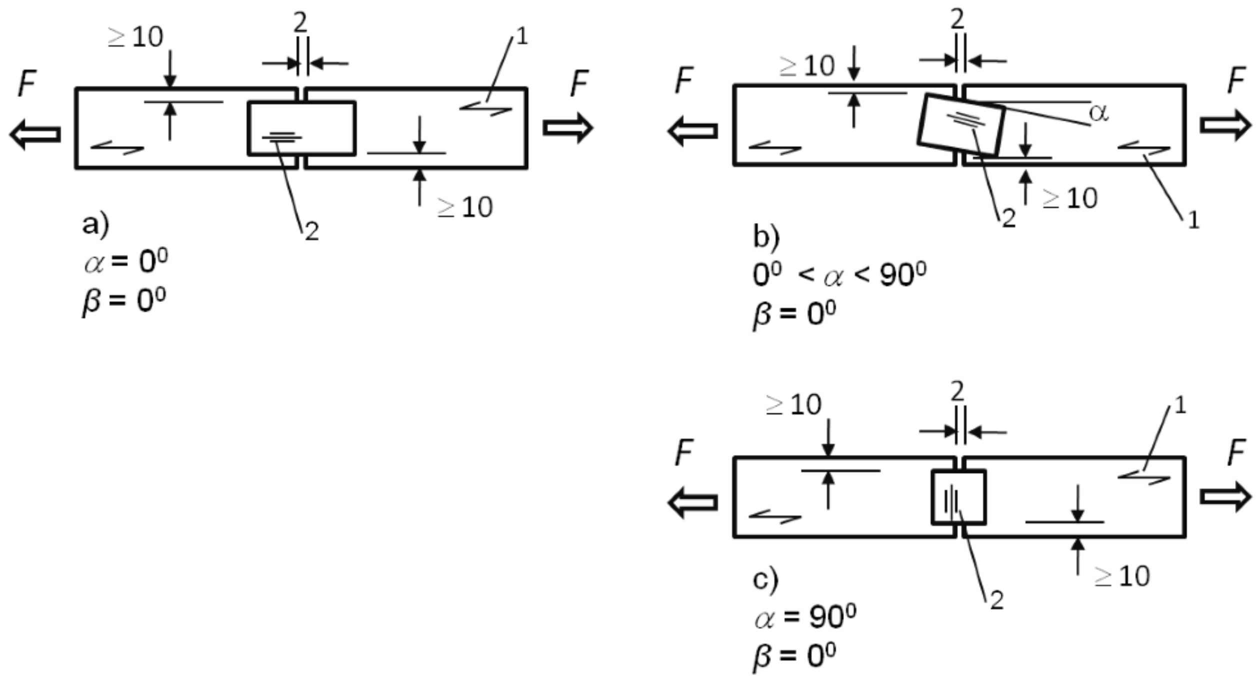
The fastener size should be chosen so that no anchorage failure occurs in the determination of the tension, compression and shear capacity of the fastener. However, in testing for shear capacity, some buckling of the edge of the fastener may occur locally and this should be acceptable.

6.4 Preparation of test pieces

6.4.1 Anchorage capacity and load-slip characteristics of contact surface and timber: load parallel to grain

The maximum load due to the lateral resistance of the fastener projections and the load-slip characteristics, with the load applied in the direction parallel to the grain of the timber, shall be determined using the test piece shown in Figure 2.

Dimensions in millimetres



Key

1 direction of the grain

2 major axis of the fastener

Figure 2 — Test pieces for anchorage capacity and load-slip characteristics of contact surface: load parallel to grain

The length of the test piece shall be such that the ends of the test machine grips shall be not less than 200 mm from the ends of the fasteners. Where necessary, the ends of the test piece may be reinforced to avoid premature failure at the grips.

Generally, fasteners have multiple projections in a modular arrangement and it will be sufficient to test one size of fastener at each value of the angle α. The size of the fastener shall be such that its dimension in the direction of the applied force is the largest for which failure at the embedded projections will occur.

NOTE The selection of the appropriate size of fastener may often be made on the basis of experience with similar fasteners. However, preliminary tests may sometimes be required.

The fasteners shall be positioned on the members so as to minimize the effects of moment rotation. The corners of the fastener may cross the edges of timber members.

With the results of the anchorage test and the shear test, the rotational stiffness of the contact surface of the fastener with the timber at various angles *α* may be derived by calculation as shown in Annex B.

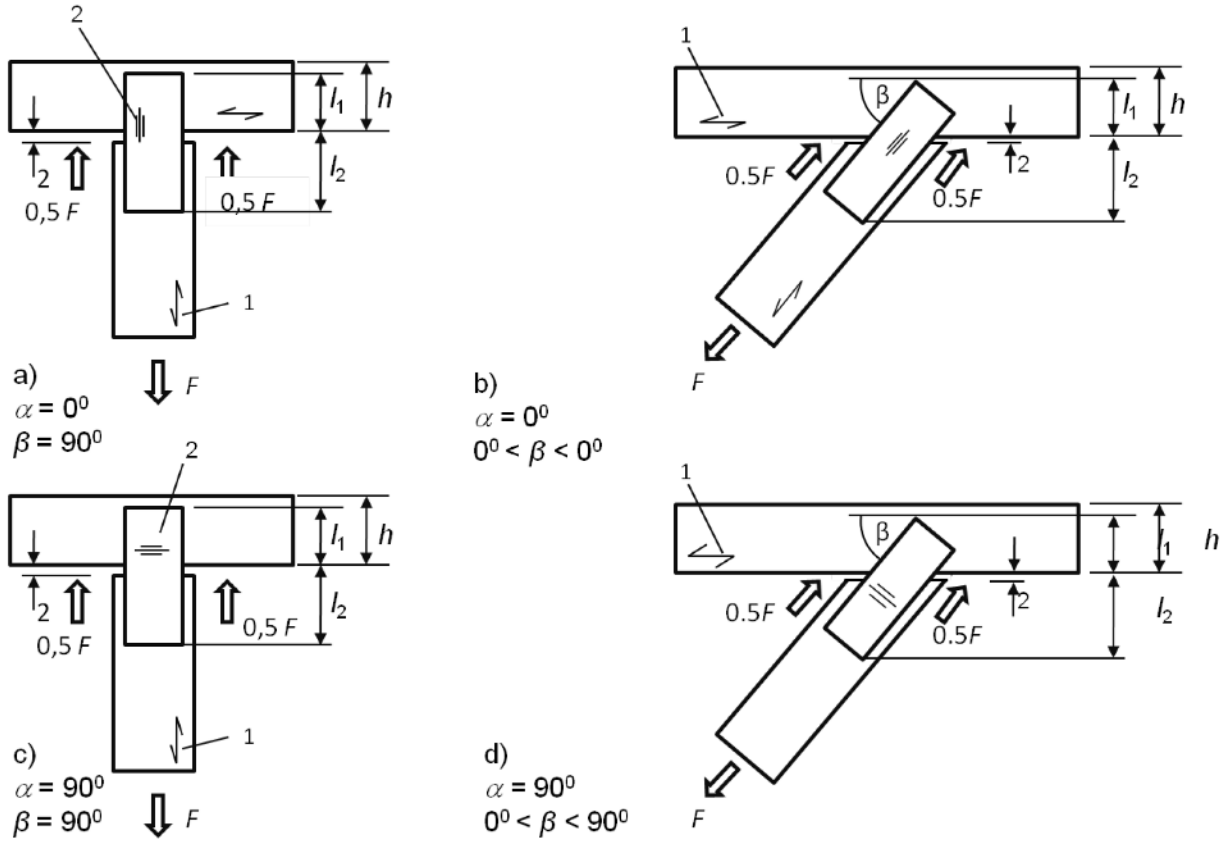
6.4.2 Anchorage capacity and load-slip characteristics of contact surface of fastener and timber: load not parallel to grain

The maximum load due to the lateral resistance of the fastener projections and the load slip characteristics, with the load applied other than parallel to the grain of the timber, shall be determined using the test piece shown in Figure 3.

The length of the abutting timber loaded in tension shall be such that the end of the test machine grip shall be not less than 200 mm from the ends of the fasteners.

The distance between the edge of the fastener and the edge of the support should be in the range *h*/4 to *h*.

Dimensions in millimetres



Key

1 direction of the grain

2 major axis of the fastener

Figure 3 — Test piece for anchorage capacity and load-slip characteristics of contact surface: load not parallel to grain

The fasteners shall be positioned to favour failure at the fastener projections embedded in the member loaded not parallel to the grain of the member, i.e. in the cross member.

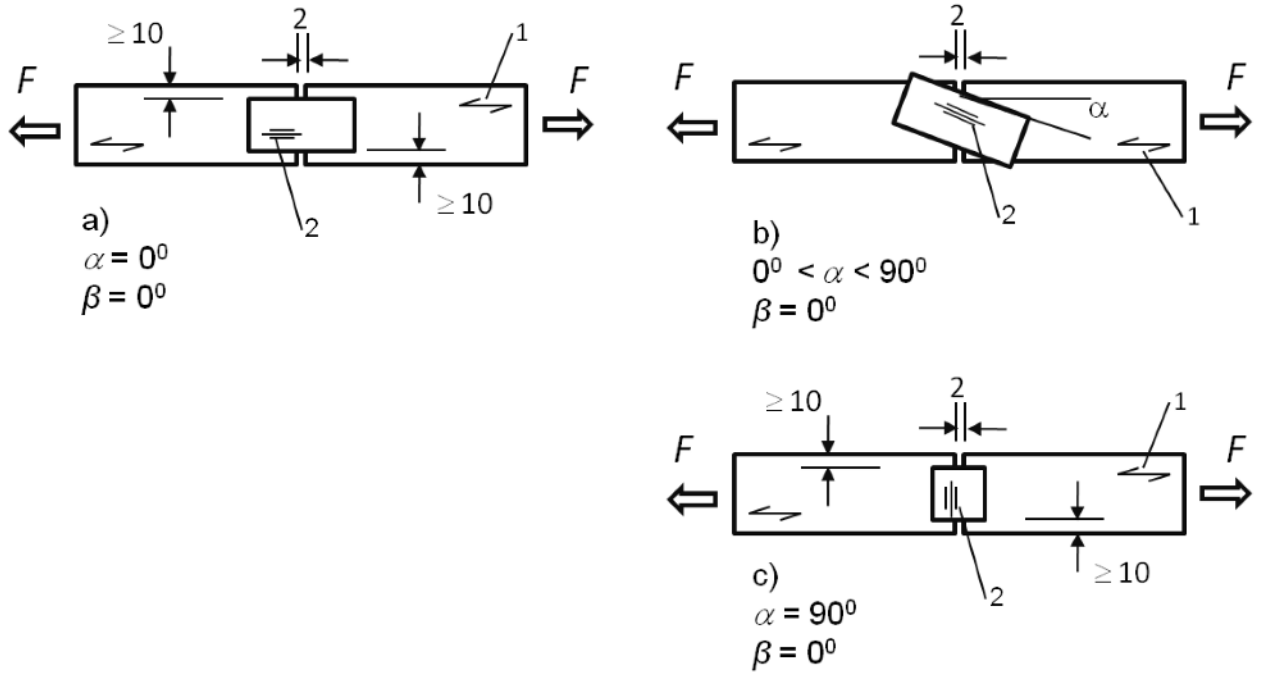
NOTE 1 This will normally occur when $l_1 < l_2$ and $l_1 \geq 0{,}7\ h$.

NOTE 2 The selection of the appropriate size of fastener may be made on the basis of experience with similar fasteners. However, preliminary tests may sometimes be required.

6.4.3 Fastener tension capacity

Fastener tension capacity shall be determined using the test piece shown in Figure 4.

Dimensions in millimetres



Key

1 direction of the grain

2 major axis of the fastener

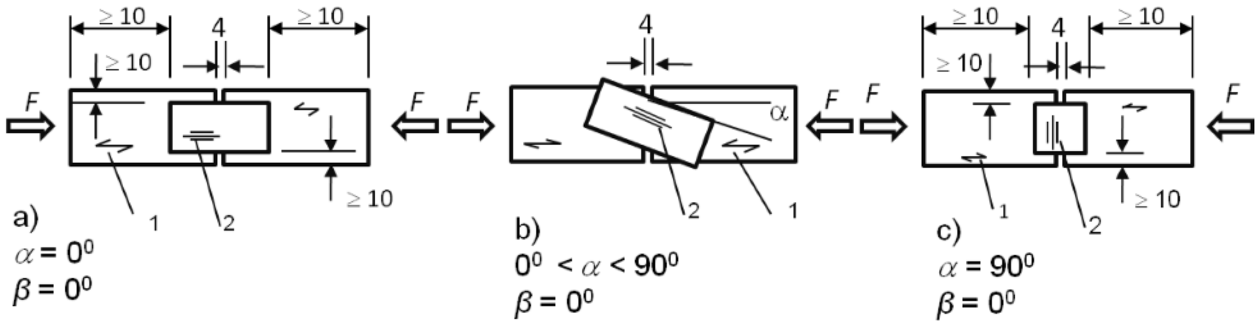
Figure 4 — Test piece for fastener tension capacity

The length of the fastener and the cross-section dimensions of the timber shall be chosen on the basis of the results found from testing the test pieces described in 6.4.1 to ensure that failure occurs in the fastener. The weakest cross-section near the fastener centreline shall be over the gap between the timber members of the joint.

6.4.4 Fastener compression capacity

Fastener compression capacity shall be determined using the test piece shown in Figure 5.

Dimensions in millimetres



Key

1 direction of the grain

2 major axis of the fastener

Figure 5 — Test piece for fastener compression capacity

The length of the fastener and the cross-section dimensions of the timber shall be chosen on the basis of the results found from testing the test pieces described in 6.4.1 to ensure that failure occurs in the fastener. The weakest cross-section near the fastener centreline shall be over the gap between the timber members of the joint.

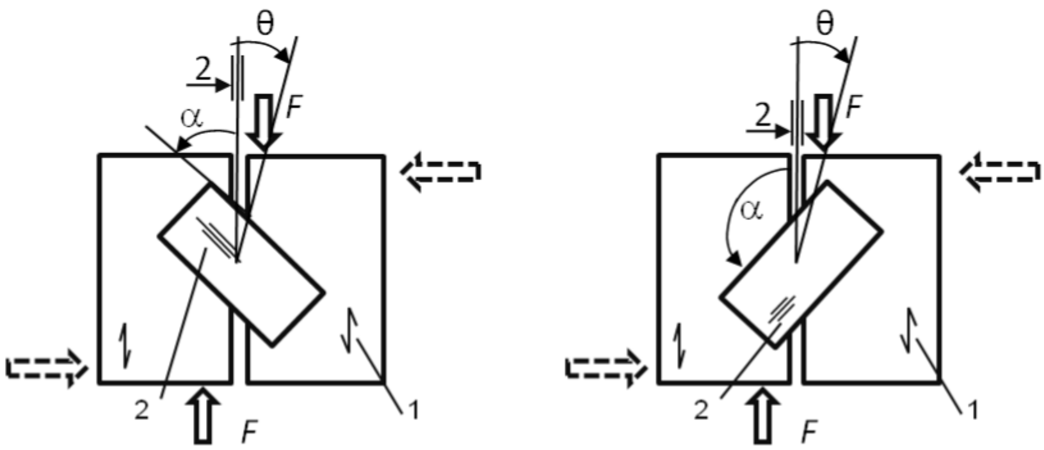
The loaded surfaces shall be accurately prepared to ensure that they are plane and parallel to each other and perpendicular to the test piece axis. This preparation shall be carried out after conditioning.

NOTE The failure of the fastener will be facilitated if the overall length of the test piece is in the range of 5 times to 6 times *t*.

6.4.5 Fastener shear capacity

The fastener shear capacity and the load-slip characteristics shall be determined using the statical principle shown in Figure 6. The load shall be applied to the test piece so that the angle θ, between the gap line and the line drawn through the load point and centre point of the fastener in the joint line does not exceed 10°.

Dimensions in millimetres



a) Tension shear, $\alpha \leq 90°$ **b) Compression shear, $90° < \alpha < 180°$**

Key

1 direction of the grain

2 major axis of the fastener

Figure 6 — Test piece for fastener shear capacity

NOTE Examples of loading arrangements are shown in Annex D. The load shown in Figure D.2 can also be applied to the test piece in tension.

The weakest cross-section near the fastener centreline shall be over the gap between the timber members of the joint. The thickness of the timber members and the size of the fasteners shall be chosen so that failure will occur in the fastener.

With the results of the anchorage test and the shear test, the rotational stiffness of the contact surface of the fastener with the timber at various angles α may be derived by calculation as shown in Annex B.

6.5 Procedure

6.5.1 Estimation of maximum load

The estimated maximum load $F_{max,est}$ for the type of joint to be tested shall be determined on the basis of experience, or by calculation or from preliminary tests, and shall be adjusted as required by the loading procedure.

6.5.2 Loading procedure

The loading procedure given in EN 26891:1991, Clause 8, shall be followed, with the following exceptions:

— the separation of the fasteners, in combination with pulling out the projections shall not be hindered by the loading equipment;

— tension test piece shall be loaded using gripping devices which will permit as far as possible the application of load without inducing bending;

— compression test pieces shall be loaded between clamped parallel platens.

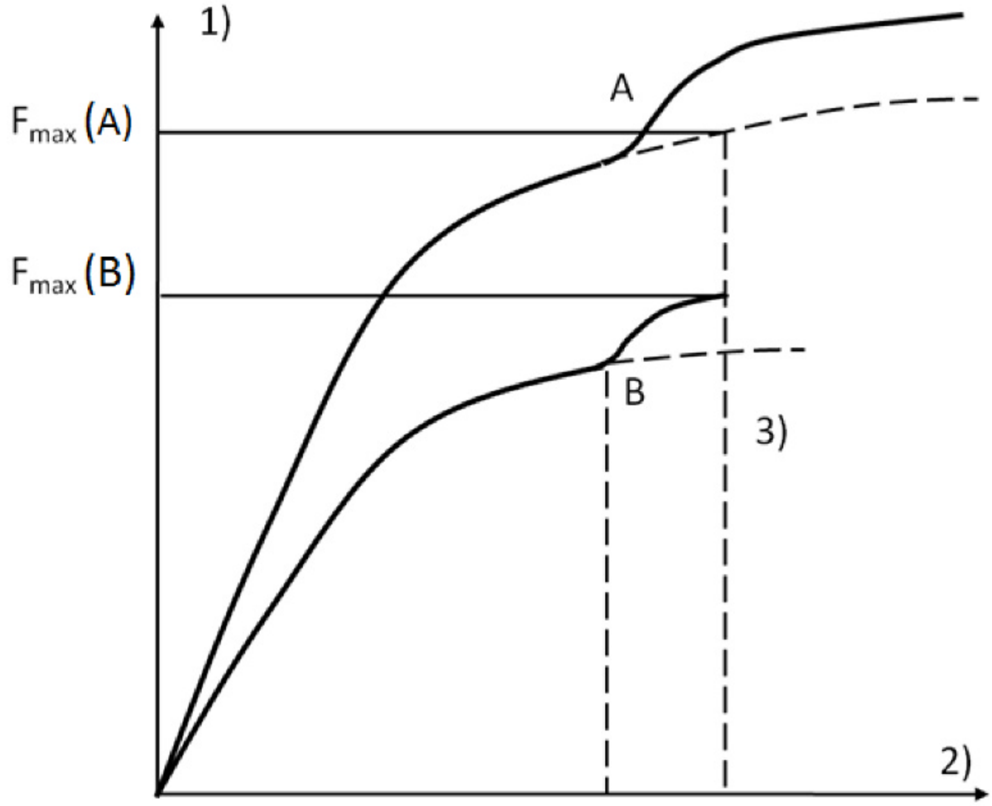
The pre-load cycle at the beginning of the loading sequence may be omitted for fastener tension capacity and fastener compression capacity tests.

6.5.3 Maximum load

For fastener compression capacity, the capacity shall be taken as the highest load required to close the gap between the timber members. For fastener shear capacity the maximum load shall be taken as the highest loads reached for a slip between joint members less than 6 mm or six times the fastener nominal thickness, whichever is the larger.

The closing of the gap is observed through the load deformation curve and visual inspection.

However, if a distinct 'yield point' occurs, the subsequent rise in load shall be ignored, and the load-slip curve shall be extrapolated in a smooth curve to the appropriate slip limit, and the load value at this point taken as the maximum load. This adjustment is shown in Figure 7.



Key

1 load

2 slip

3 limiting slip

Figure 7 — Load-slip curves for shear tests and definition of maximum load

The curves are extrapolated from yield to give assumed values of maximum load: Case A where the maximum load F_{max}(A) is not recorded before the appropriate limiting slip is reached and Case B where the test maximum load F_{max} (B) is recorded at a slip less than the limiting value.

6.6 Expression of results

6.6.1 Anchorage capacity

The fastener anchorage capacity for angles α and β shall be calculated from the following formula:

$$f_{a,\alpha,\beta} = \frac{F_{a,\alpha,\beta,max}}{2 \times A_{ef}} \quad N/mm^2 \tag{1}$$

where

$F_{a,\alpha,\beta,max}$ maximum load on the fastener, in newtons

The other symbols are as given in Clause 4.

The anchorage capacity shall be calculated to three significant figures.

6.6.2 Fastener tension capacity

The fastener tension capacity for any angle α shall be calculated from the following formula

$$f_{t,\alpha} = \frac{F_{t,\alpha,max}}{2 \times l_j} \cdot \frac{t_{cor,d}}{t_{act}} \cdot \frac{f_{t,k}}{f_{t,act}} \tag{2}$$

where

$F_{t,\alpha,max}$ maximum load, in newtons

The other symbols are as given in Clause 4.

NOTE The value of $f_{t,k}$ is the value given as R_m in EN 10346.

The tension capacity shall be calculated to three significant figures.

6.6.3 Fastener compression capacity

The fastener compression capacity for any angle α shall be calculated from the following formula

$$f_{c,\alpha} = \frac{F_{c,\alpha,max}}{2 \times l_j} \cdot \frac{t_{cor,d}}{t_{act}} \cdot \frac{f_{y,k}}{f_{y,act}} \tag{3}$$

where

$F_{c,\alpha,max}$ maximum load, in newtons

The other symbols are as given in Clause 4.

NOTE The value of $f_{y,k}$ is the value given as R_{eH} in EN 10346.

The compression capacity shall be calculated to three significant figures.

6.6.4 Fastener shear capacity

The fastener shear capacity for any angle α shall be calculated from the following formula

$$f_{v,\alpha} = \frac{F_{v,\alpha,max}}{2 \times l_j} \cdot \frac{t_{cor,d}}{t_{act}} \cdot \frac{f_{y,k}}{f_{y,act}} \qquad (4)$$

where

$F_{v,\alpha,max}$ maximum load, in newtons

The other symbols are as given in Clause 4.

NOTE The value of $f_{y,k}$ is the value given as $R_{p0,2}$ in EN 10346.

The shear capacity shall be calculated to three significant figures.

6.7 Determination of characteristic values

Characteristic values shall be determined using EN 14358.

6.8 Test report

The test report shall include the following information:

— species, density and moisture content of the timber;

— method for selecting timber density, by reference to EN ISO 8970;

— dimensions of the joints, size of the fasteners, details of gaps between the members;

— conditioning of the timber and test pieces before and after manufacture;

— the loading procedure used, and a statement of any deviations from the procedures given in 6.5.2 above;

— fastener specification, including the dimensions, coating thickness and relevant characteristic mechanical properties (e.g. tension strength, yield stress and elongation) of the steel used to manufacture the fasteners;

— method of installation of the fastener;

— result of nail root tests, see Annex A;

— individual test results of anchorage capacity, fastener tension capacity, fastener compression capacity, fastener shear capacity including all values of F_{max}, A_{ef}, ρ, l_j and t_{act}, and any relevant information regarding adjustments; descriptions of the modes of failure; density of timber in which failure took place in anchorage capacity test;

— initial slip and slip modulus according to EN 26891, and load-slip curve.

Annex A
(normative)

Nail root test

A.1 Scope

Method for determining the properties of fasteners at the root position of the projections by means of a bend test.

A.2 Symbols

a dimension between the bending device and the contact surface of the fastener, see Figure A.1.

A.3 Test piece

This shall consist of one projection of a fastener.

A.4 Test method

Place a suitable close fitting tool over one projection of the fastener. The tool shall be fitted on to the projection until the dimension *a* is between 0,5 mm and 1 mm.

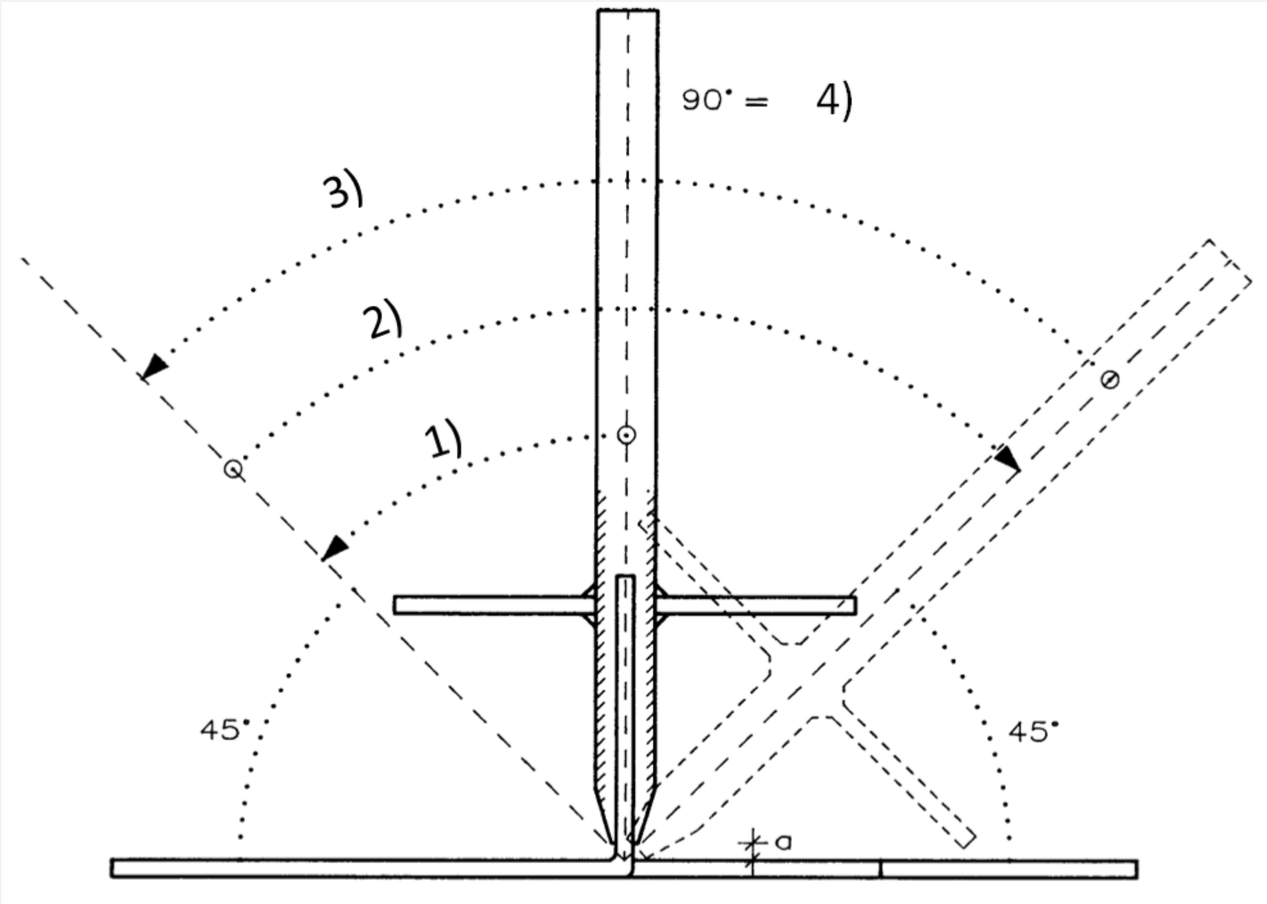
Initial bend: In a period of 1 s, bend the projection to an angle of 45°, see Figure A.1.

Next bend: In a period of 2 s, bend the projection through an angle of 90° from its initial bend position. This shall be numbered bend number 1.

From this bend number 1 position the projection shall be bent through an angle of 90° and subsequent bends shall be repeated without interruption, each in a period of 2 s. These bends shall be numbered 2, 3, 4, 5, 6, etc. Repeat the bending procedure until the projection snaps off the fastener.

A.5 Test results

The test result shall consist of the number of the 90° bends completed before the projection snapped off the fastener.



Key

1 initial bend

2 bend N°1,3,5, etc.

3 bend N°2,4,6, etc.

4 one bend

a dimension between the bending device and the contact surface of the fastener

Figure A.1 — nail root test (showing a form of tool for carrying out this test)

Annex B
(informative)

Derivation of rotational stiffness of the contact surface of the fastener and timber

B.1 General

This is a method for calculating the rotational stiffness of the contact surface of the fastener and timber in which the calculations are based on the results of the anchorage test, see 6.4.1, and the shear test, see 6.4.5. It is assumed that the fasteners size and specification and the timber are the same in the anchorage and shear tests. An example of an appropriate shape of fastener is one which is square and of 100 mm length of side.

B.2 Background to the calculations

The rotational stiffness moduli may be calculated from the measurements of the total shear deformations of the joint line (see the loading arrangements in Figure D.1). The measured total slip δ is composed of

— the slip component δ_s caused by the force and;

— the slip component δ_M caused by the moment as shown in Figure B.1.

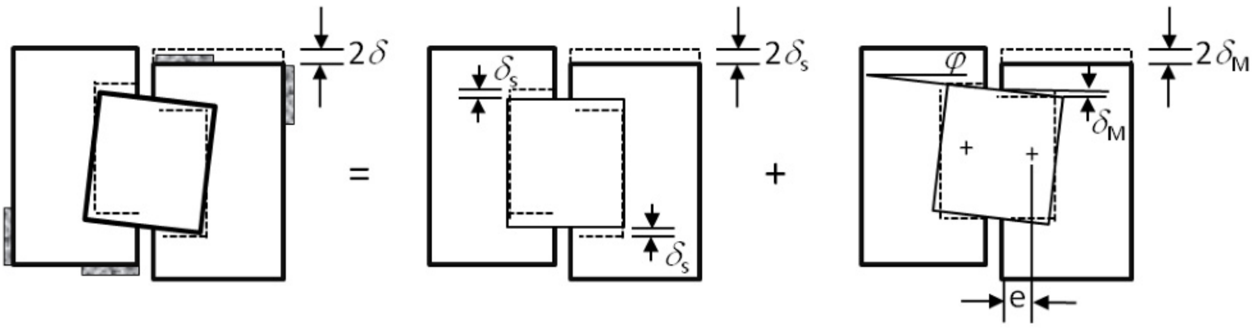


Figure B.1 — Dividing of measured total shear slip δ to force δ_s and moment δ_M slip component

The slip component δ_s may be calculated by the slip modulus k_s, see EN 26891, which has been determined by the anchorage tests (see 6.4.1).

The tests should be carried out with angles α = 0 and 90°; β = 0°.

B.3 Calculations

Calculation of modified initial deformation of shear test:

$$\delta_{i,mod} = \frac{4}{3}\left(\delta_{04} - \delta_{01}\right) \tag{B1}$$

where

δ_{04} and δ_{01} are the measured total shear slips at force levels 0,4 F_{est} and 0,1 F_{est} (at initial loading phase).

Calculation of the slip, δ_s:

$$\delta_{s} = \frac{0{,}4F_{est}}{(2A_{ef}.\ k_{s,ser})} \qquad (B2)$$

where

$k_{s,ser}$ is the slip modulus [N/mm^3] which has been determined by anchorage capacity tests.

Calculation of the slip, δ_M:

$$\delta_{M} = \frac{\delta_{i,mod}}{2} - \delta_{s} \qquad (B3)$$

Calculation of the 'rotation' angle, $\varphi_{i,mod}$:

$$\varphi_{i,mod} = \delta_{M} / e \text{ radians} \qquad (B4)$$

where

e is the eccentricity between the joint line and the centre of gravity of the area A_{ef}.

Calculation of the 'rotation' modulus, $k\varphi_{,ser}$:

$$k_{\varphi,ser} = \frac{M_{A}}{\varphi_{i,mod}.I_{p}} \qquad (B5)$$

where

$M_A = 0{,}4\ F_{est}.e/\ 2$

I_p is the polar moment of inertia of the area of the contact surface, $A_{ef.}$

Annex C
(informative)

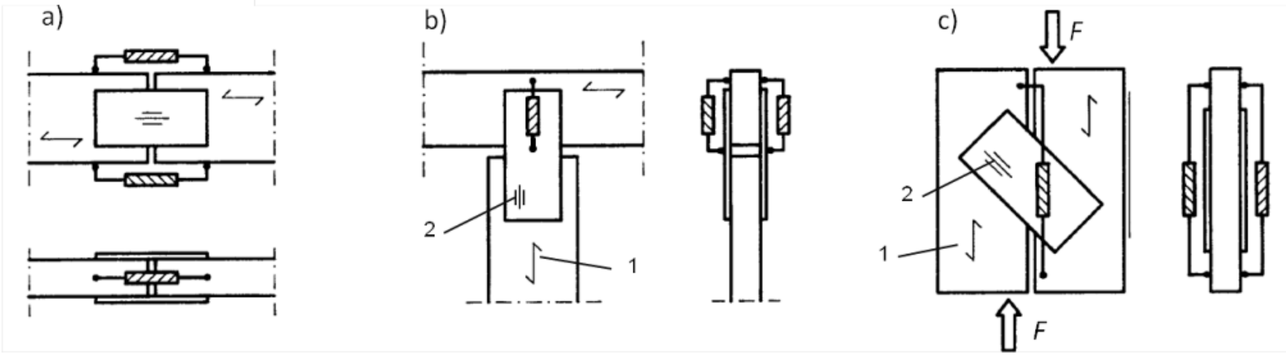
Examples of properly located transducers

Generally the slip measurements should be recorded as the displacements between the timber members in the centre of the joint line in the direction of the applied force. To minimize the effect of distortions normally two transducers should be used. On account of local splitting of the wood material during testing it is necessary to fasten transducers some distance from the joint line. In this case the influence of the deformations in the timber members can normally be neglected compared to the slip between the timber members.

In the joints of unsymmetrical type the slip shall be recorded as the displacement between one of the timber members and the fastener (one on each side) in the centre of the joint line.

Examples of properly located transducers are shown in Figure C.1.

Dimensions in millimetres



Key

1 direction of the grain

2 major axis of the fastener

Figure C.1 — Examples of location of transducers

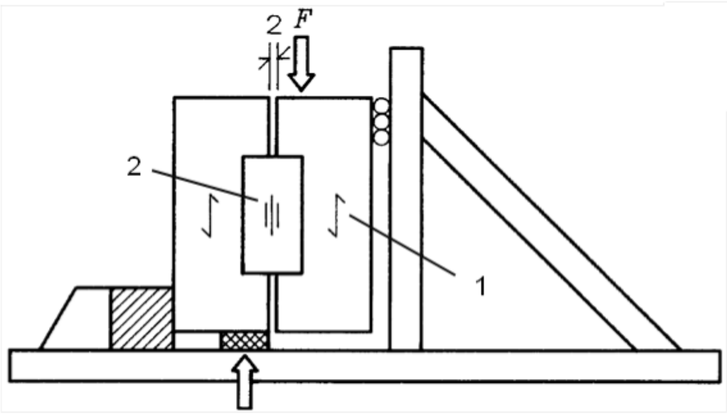
Annex D
(informative)

Examples of loading arrangement

D.1 Fastener shear capacity

Forms of loading arrangement for fastener shear capacity determination are shown in Figures D.1 and D.2.

Dimensions in millimetres



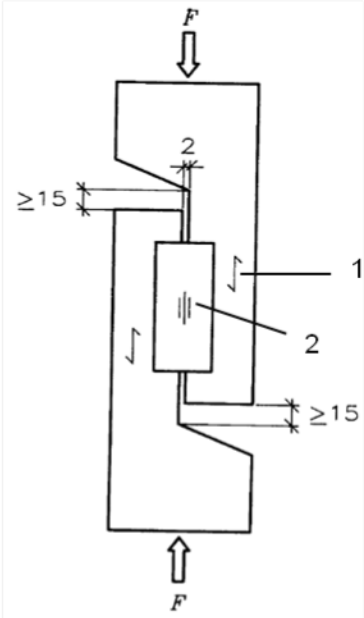
Key

1 direction of the grain

2 major axis of the fastener

Figure D.1 — Test piece for shear capacity - example of loading arrangement – rectangular test piece

Dimensions in millimetres



Key

1 direction of the grain

2 major axis of the fastener

Figure D.2 — Test piece for shear capacity - example of loading arrangement - “boot” test piece

D.2 Fastener anchorage capacity: load not parallel to grain, (see 6.4.2).

Forms of loading arrangement for fastener anchorage capacity determination are shown in Figure D.3.

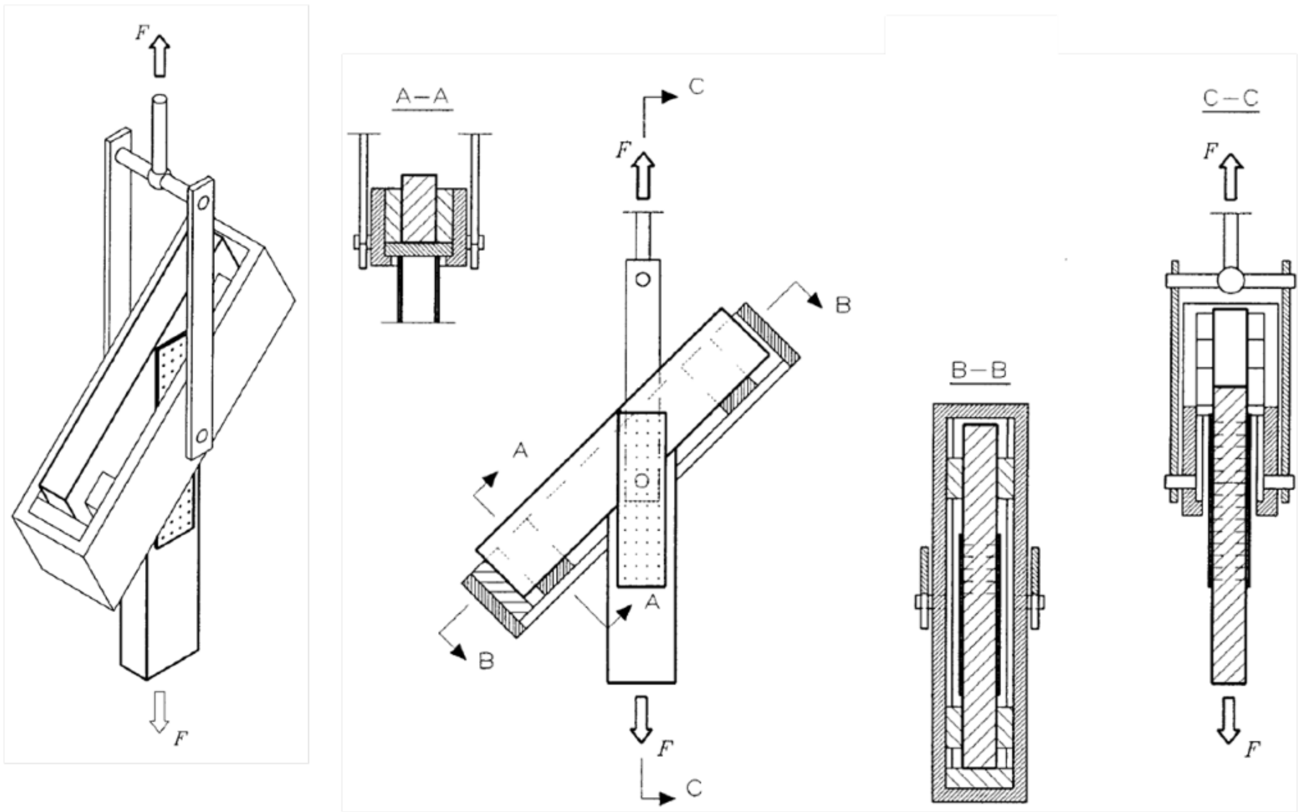


Figure D.3 — Loading arrangement for fastener anchorage capacity: load not parallel to grain

Bibliography

[1] EN 10346, *Continuously hot-dip coated steel flat products — Technical delivery conditions*

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