

English Version

## Timber structures - Test methods - Load bearing nails, screws, dowels and bolts

Structures en bois - Méthode d'essai - Pointes, tire-fonds,  
broches et boulons porteurs

Holzbauwerke - Prüfverfahren - Tragende  
Nagelverbindungen

This European Standard was approved by CEN on 2 November 2006.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
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## Foreword

This document (EN 1380:2009) 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of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by October 2009.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 1380:1999.

The first version of this European Standard was published in September 1999 and considered only connections with nails. When the product standard for dowel type fasteners EN 14592 became available the scope of EN 1380 was expanded. Therefore, this revised version covers dowel type fasteners as nails, screws, dowels and bolts.

Connections with load bearing staples are considered in EN 1381:1999.

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, 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 test methods for determining the strength and deformation characteristics of laterally loaded connections with nail, screws, dowels and bolts in load-bearing timber structures.

The methods assess connections with members of timber (solid timber or glued laminated timber) or wood-based products or metal plates (but not punched metal plate fasteners) in the combination proposed for use in service.

The methods are used to determine load-slip characteristics and maximum load of connections where various angles between the applied force and the timber grain direction, or the main direction of the wood-based products, respectively, are possible.

## 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 322, *Wood-based panels — Determination of moisture content*

EN 323, *Wood-based panels — Determination of density*

EN 13183-2, *Moisture content of a piece of sawn timber — Part 2: Estimation by electrical resistance method*

EN 14080, *Timber structures — Glued laminated timber — Requirements*

EN 14081-1, *Timber structures — Strength graded structural timber with rectangular cross section — Part 1: General requirements*

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

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

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

EN 28970, *Timber structures — Testing of joints made with mechanical fasteners — Requirements for wood density (ISO 8970:1989)*

ISO 3131, *Wood — Determination of density for physical and mechanical tests*

### 3 Terms and definitions

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

#### 3.1

##### **deformation of the connection**

mean value of the measurements of the relative displacements of the members

#### 3.2

##### **dowel type fasteners**

elements such as nails, screws, dowels and bolts as defined by EN 14592

### 4 Symbols and abbreviations

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

$b$  width of member cross-section, in millimetres

$F$  load, in newtons

$t$  member thickness, in millimetres

### 5 Requirements

#### 5.1 Timber

The timber (solid timber or glued laminated timber) shall satisfy the requirements of EN 14080, EN 14081-1 and shall be selected in accordance with either of the methods given in EN 28970.

For each test piece, the individual members to be joined shall be selected to ensure a test piece of balanced density. For a group of similar test pieces, separate planks shall be used for each test piece.

NOTE The members should be free from major defects, which could lead to premature failure in the area away from the fasteners.

#### 5.2 Wood-based products

The specification of the wood based products shall be established. The products used for the individual members of the test pieces shall be representative of the class or range of product to which they belong and the relevant properties shall be declared.

One unique grade shall be used to make the test pieces. For each test piece, the individual members in the connection shall be selected from separate pieces of material.

#### 5.3 Metal plates and dowel type fasteners

The specification of the metal plates shall be established.

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



## 6 Test methods

### 6.1 General

The moisture content and density of the timber or wood-based products members at test shall be determined as specified in EN 13183-2, ISO 3131, EN 322 and EN 323 as appropriate.

### 6.2 Conditioning

The test pieces shall be manufactured with the timber or wood-based products at an equilibrium moisture content corresponding to  $(20 \pm 2) ^\circ\text{C}$  and  $(85 \pm 5) \%$  relative humidity. The 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 material.

After manufacture but prior to testing the test pieces shall be stored for at least one week at  $(20 \pm 2) ^\circ\text{C}$  and  $(65 \pm 5) \%$  relative humidity.

For certain investigations other moisture conditioning can be appropriate, and shall be reported.

NOTE For some hardwoods a much longer storing period can be necessary or the test pieces should be made with appropriate gaps between the members.

### 6.3 Fabrication of the test pieces

If there are no special requirements, timber members shall be planed. Test pieces shall be fabricated with the fasteners perpendicular to the member surface. The insertion of the dowel type fasteners shall follow normal preparation (e.g. pre-boring) and practice, which shall be reported. The number of fasteners shall reflect the actual use in practice.

In principle the connection is symmetrical with respect to the direction of the load comprising the geometry of the timber members and number and penetration depth of the fasteners.

For nails and screws the depth of the fastener head indentation will have an influence on the test result, particularly for connections loaded in double shear. Therefore, if the fabrication technique permits the fastener heads shall protrude above the surface.

### 6.4 Preparation of the test pieces

#### 6.4.1 Load parallel to grain

For connections with fasteners that do not pass fully through all members:

- consisting solely of timber or wood-based products (or combinations thereof) the test pieces shall be fabricated either as

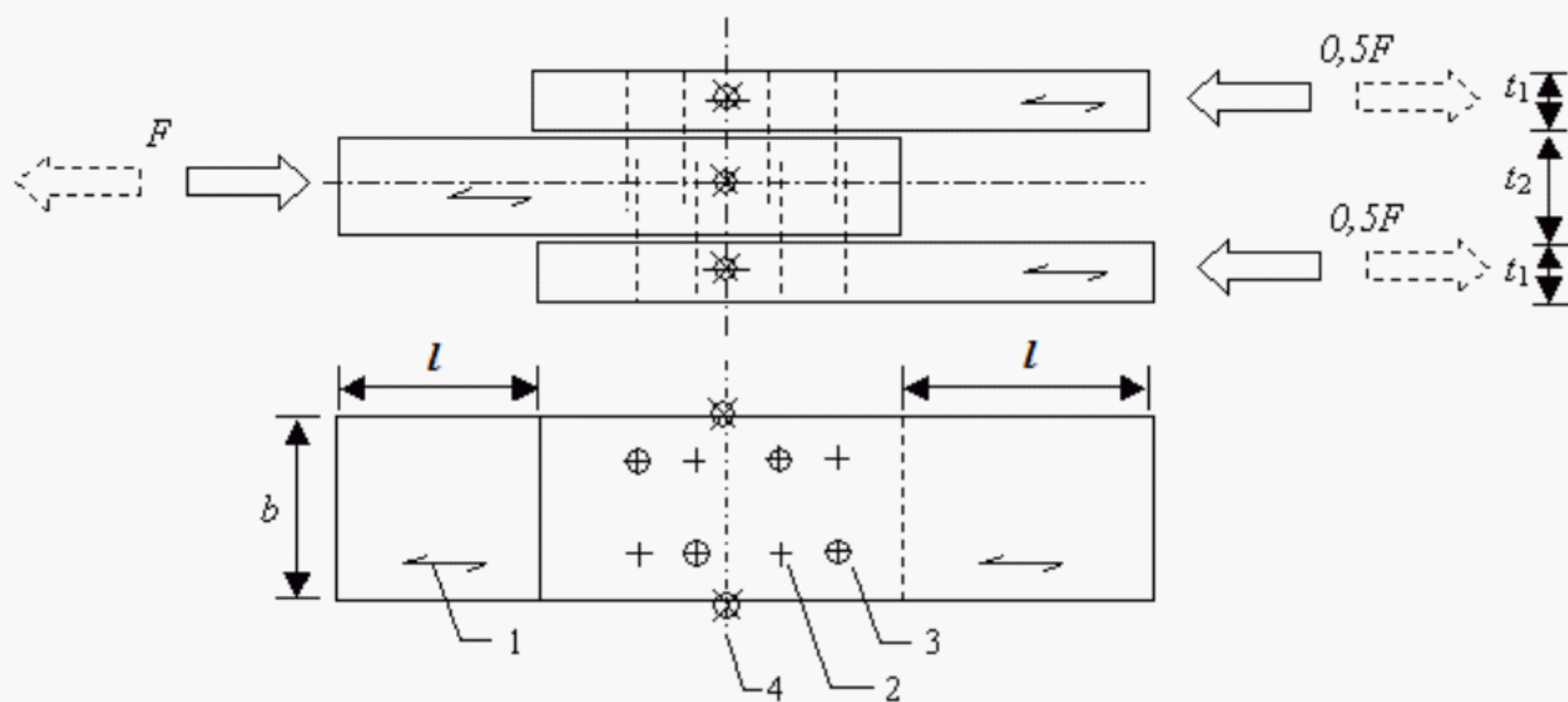
a) three-member connections with dowel type fasteners from each side, loaded in single shear, see Figure 1, or

b) three-member connections with dowel type fasteners from each side, loaded in double shear, see Figure 2.

The minimum end length  $l$  is 50 mm as shown in Figures 1 and 2 may not be appropriate to thin timber or wood-based products subjected to compression loads.

- with metal plates connected with dowel type fasteners to timber or wood-based products members, the test pieces shall be fabricated either as

- a) single shear test pieces with dowel type fasteners from each side and with the side members of metal plates, or
- b) double shear test pieces with dowel type fasteners from each side and with the metal plate as central member.



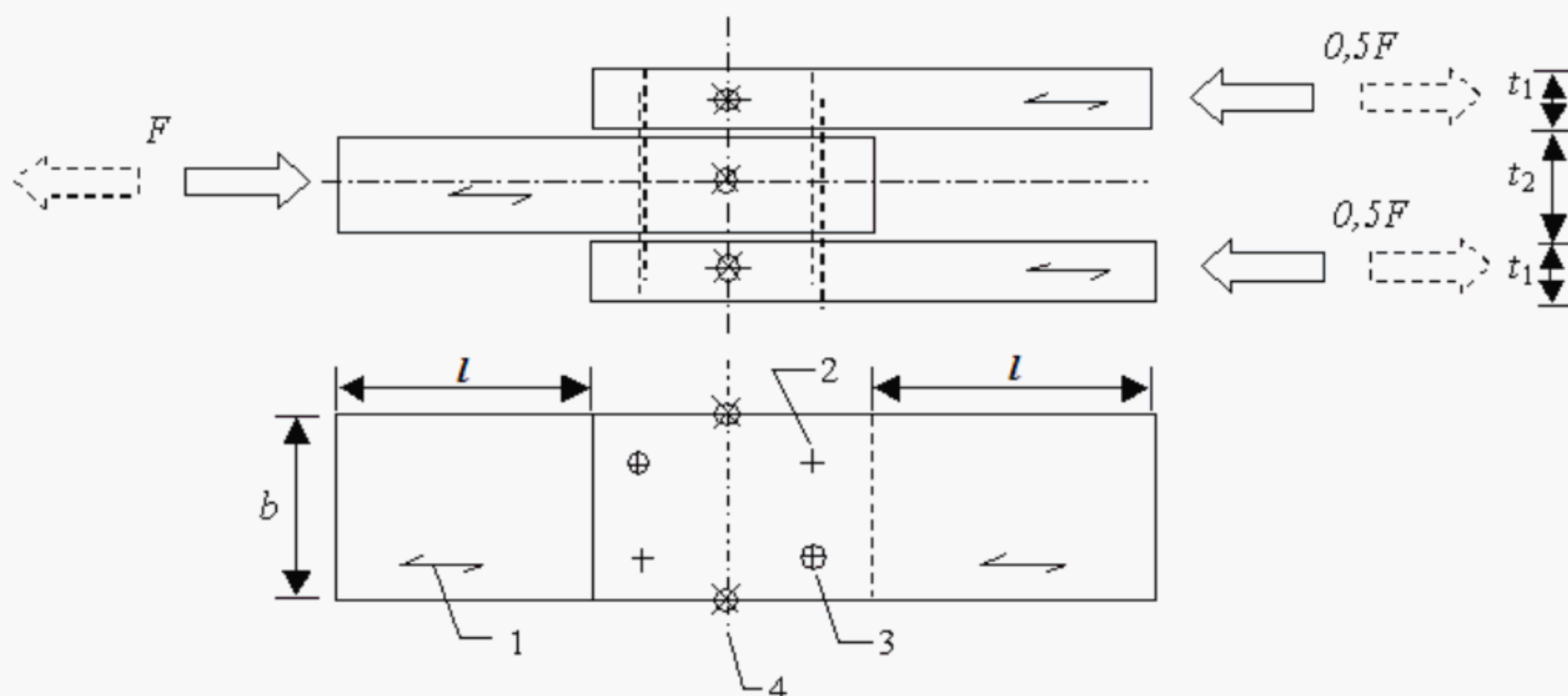
Key

- 1 grain direction
- 2 not protruding end
- 3 protruding end
- 4 ⊗ displacement pick-up points
- / free length
- $t_1$  side member width
- $t_2$  middle member

NOTE Dowels and bolts will usually protrude at the outer faces of the side members.

Figure 1 — Example of a three timber member connection with not fully penetrating dowel type fasteners loaded in single shear and with the positions of displacement pick up points





### Key

- 1 grain direction
- 2 not protruding end
- 3 protruding end
- 4 ⊗ displacement pick-up points
- $l$  free length
- $t_1$  side member width
- $t_2$  middle member

NOTE Dowels and bolts will usually protrude at the outer faces of the side members.

**Figure 2 — Example of a three timber member connection with not fully penetrating dowel type fasteners, loaded in double shear and with the position of displacement pick up points**

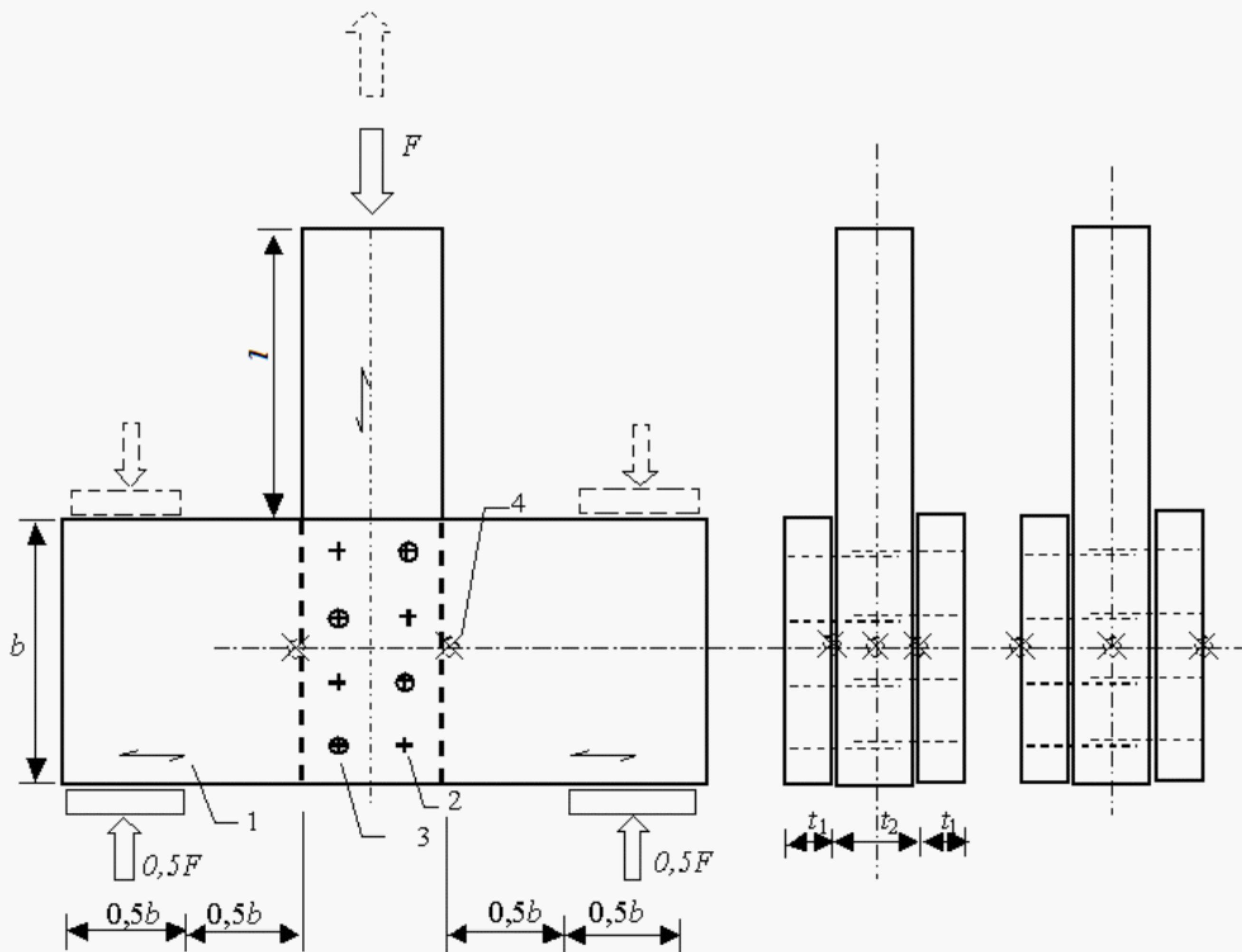
### 6.4.2 Load perpendicular to grain

For connections with fasteners that do not fully pass through all members:

- consisting solely of timber or wood-based products (or combinations thereof) the test pieces shall be fabricated either as

- a) three-member connections with dowel type fasteners from each side, loaded in single shear, see Figures 3 and 4, or
- b) three-member connections with dowel type fasteners from each side, loaded in double shear, see Figures 5 and 6.

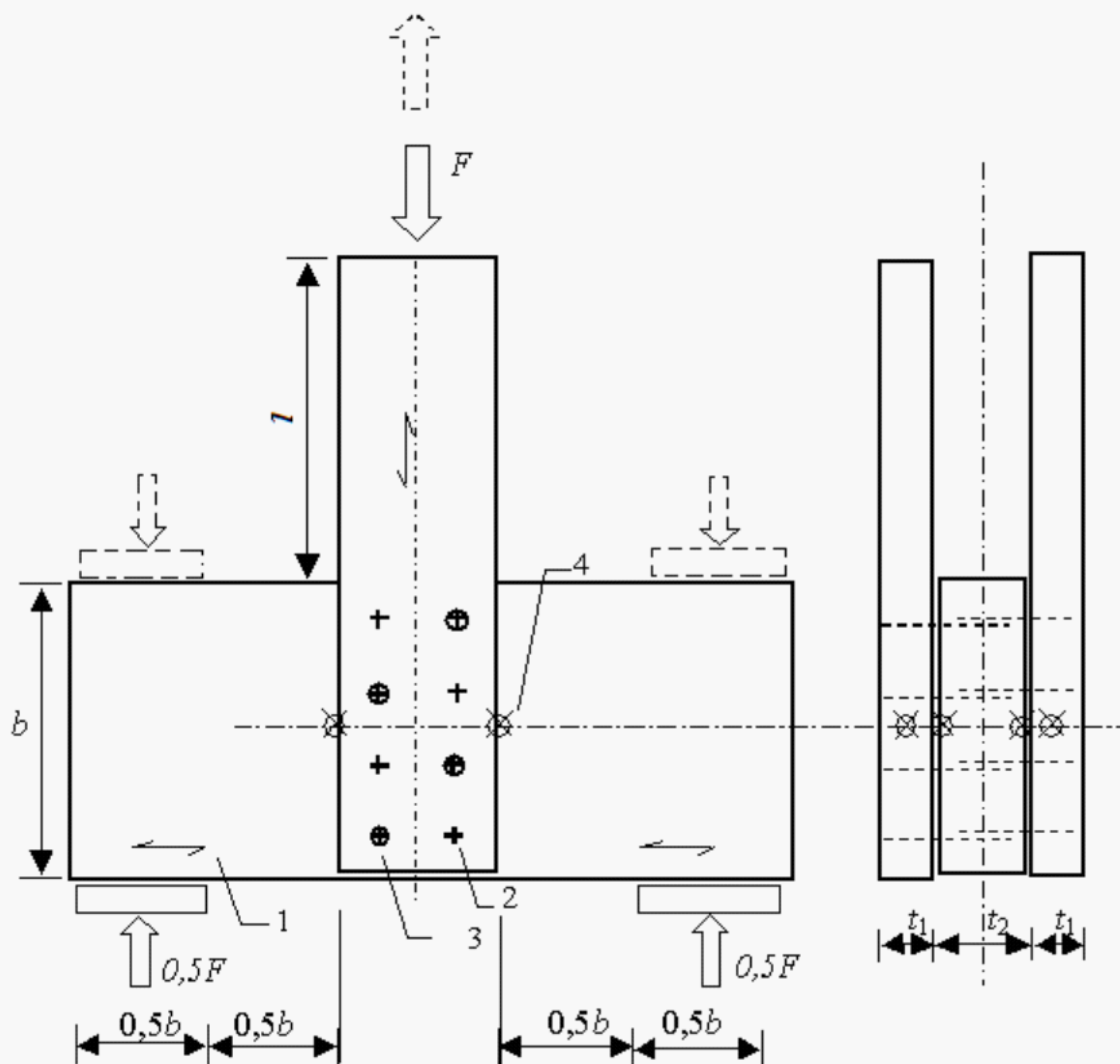
The minimum end length  $l = 50$  mm as shown in Figures 3 to 6 may not be appropriate to thin timber or wood-based products subjected to compression loads.



- Key**
- 1 grain direction
  - 2 not protruding end
  - 3 protruding end
  - 4 ⊗ displacement pick-up points
  - $l$  free length
  - $t_1$  side member width
  - $t_2$  middle member

**Figure 3 — Example of a three timber member connection with not fully penetrating dowel type fasteners loaded single shear, side members loaded perpendicular to grain and with the positions of displacement pick up points**





### Key

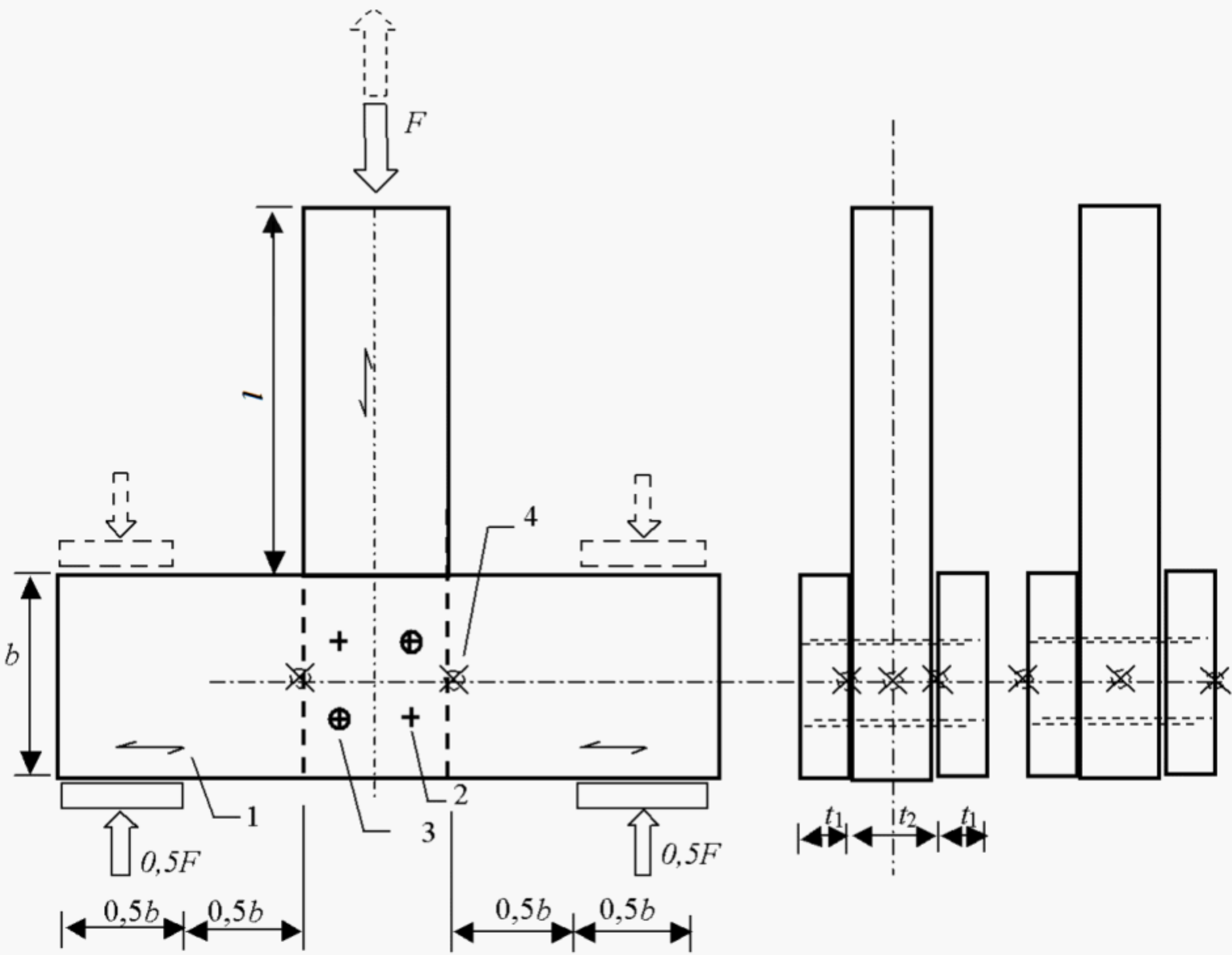
- 1 grain direction
- 2 not protruding end
- 3 protruding end
- 4 ⊗ displacement pick-up points
- $l$  free length
- $t_1$  side member width
- $t_2$  middle member

**Figure 4 — Example of a three timber member connection with not fully penetrating dowel type fasteners loaded single shear with a central member loaded perpendicular to grain and the position of displacement pick up points**

- with metal plates to timber or wood based products members, the test pieces shall be fabricated either as

- a) single shear test pieces with dowel type fasteners from each side and with the side members of metal plates, or

b) double shear test pieces with dowel type fasteners from each side and with the metal plate as central member.

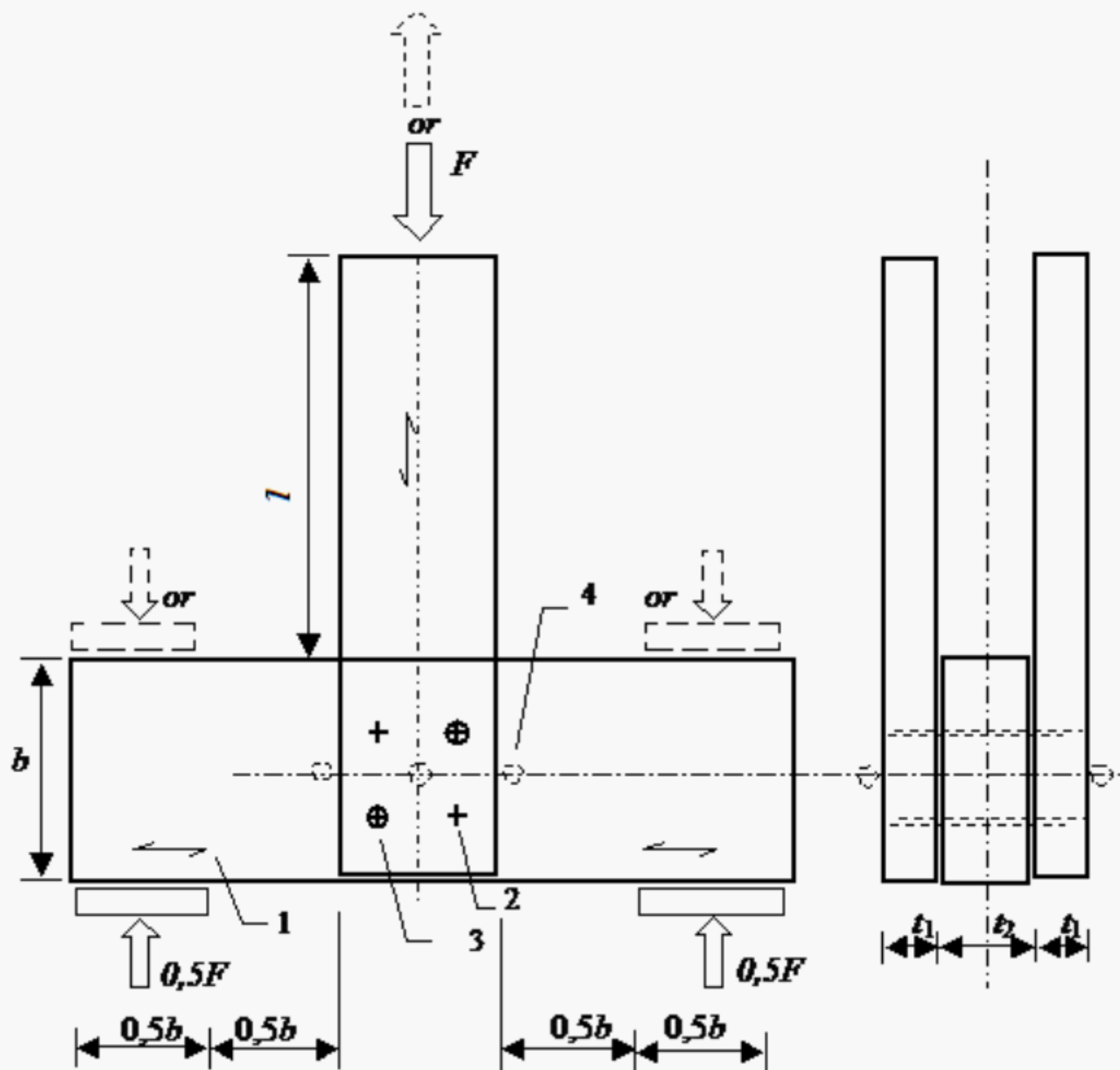


Key

- 1 grain direction
- 2 not protruding end
- 3 protruding end
- 4 ⊗ displacement pick-up points
- $l$  free length
- $t_1$  side member width
- $t_2$  middle member

Figure 5 — Example of a three timber member connection with not fully penetrating dowel type fasteners loaded double shear with side members loaded perpendicular to grain with the position of displacement load pick-up points





### Key

- 1 grain direction
- 2 not protruding end
- 3 protruding end
- 4 ⊕ displacement pick-up points
- $l$  free length
- $t_1$  side member width
- $t_2$  middle member

**Figure 6 — Example of a three timber member connection with not fully penetrating fasteners loaded in double shear and a central member loaded perpendicular to grain with the position of displacement load pick-up points**

### **6.4.3 Determination of relative displacements**

The mean relative displacement of the members shall be measured to determine the slip related parameters according to EN 26891.

The displacement shall be measured to an accuracy of 1 %.

The displacement pick-up points to determination of the relative displacement of the members in the direction of the load shall in principle be located at the level of the centre of the fastener area. Displacement pick-up points are shown in Figures 1 and 2 for parallel to grain loading and in Figures 3 to 6 for perpendicular to grain loading. If for practical reasons the pick-up points differ from the indicated position they shall be located on the unstressed part of the specimen. The position of the pick-up points shall be reported. The mean of the readings shall be calculated to the nearest 0,01 mm.

## **6.5 Test procedure**

The test shall be carried out in accordance with Clauses 7 and 8 of EN 26891:1991 with the following additions:

- a) if compression test pieces are used, instability of members shall be prevented and
- b) the separation of the side members in combination with pulling out the dowel type fasteners shall not be hindered by the loading equipment.

## **6.6 Test results**

The test results shall be determined in accordance with 8.5 of EN 26891:1991 and evaluated in accordance with EN 14358.

If splitting failure of the members loaded perpendicular to the grain occurs prior to an appreciable relative displacement of the connection members the test result will be reported but discarded in the evaluation of the results.

## **6.7 Test report**

The test report shall contain the following information:

- a) species, density and other relevant properties of timber and/or wood-based products;
- b) quality, strength properties and surface finish of the materials of the dowel type fasteners, including anti-corrosive protection;
- c) dimensions of the connections, size and number of the dowel type fasteners, details of gaps between members;
- d) mode of insertion of the nails and screws (e.g. shot, hammered) and any pre-boring;
- e) spacing of the dowel type fasteners, and end and edge distances;
- f) main direction (in the case of wood-based products);
- g) depth of point penetration, if applicable;
- h) depth of head indentation, if any;
- i) conditioning of materials of the test specimens before and after manufacture, moisture content of the materials at manufacture and at test, fissures etc.;



- j) loading procedure used, including whether in compression or tension, and a statement of any deviations;
- k) displacement transducers, type, accuracy, and the pick-up points on the specimen members;
- l) individual test results, load slip curves and any other relevant information regarding adjustments, mean values and standard deviations, and descriptions of the modes of failure;
- m) reference to this European Standard, i.e. EN 1380:2009.