INTERNATIONAL STANDARD

ISO 8969

Second edition
2011-11-01

Timber structures — Testing of punched metal plate fasteners and joints

Structures en bois — Essai des connecteurs à plaque métallique emboutie et des assemblages

Reference number
ISO 8969:2011(E)

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Normative references 1
3 Terms and definitions 1
4 Symbols 2
5 Materials 3
5.1 Timber 3
5.2 Plates 4
6 Test specimens 4
6.1 General 4
6.2 Tensile strength of the solid metal control specimens 5
6.3 Load-slip characteristics of plate and timber 6
6.4 Plate tensile strength 8
6.5 Plate compression strength 10
6.6 Plate shear strength 11
7 Test procedure 12
7.1 General 12
7.2 Loading 12
7.3 Maximum load 12
8 Test results 14
9 Test report 14
Annex A (normative) Test of nail root in alternate bending 16
Annex B (informative) Interpretation of plate shear strength results 17
Bibliography 21

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 8969 was prepared by Technical Committee ISO/TC 165, *Timber structures*.

This second edition cancels and replaces the first edition (ISO 8969:1990), which has been technically revised.

Introduction

The first edition of this International Standard was based on the recommendations of the joint committee RILEM/CIB 3TT (Working Commission W 18, *Timber structures,* of the International Council for Building Research, Studies and Documentation, and Commission 3TT, *Testing methods for timber,* of the International Union of Testing and Research Laboratories for Materials and Structures respectively) published (in English and French) in *Materiaux et Constructions,* Vol. 15, No. 88, 1982.

Timber structures — Testing of punched metal plate fasteners and joints

1 Scope

This International Standard specifies test methods for determining the strength and stiffness of joints made with punched metal plate fasteners in load-bearing timber structures, as follows:

a) 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 plate (load-plate angle, α),

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

b) the tensile strength of the plate at various angles, α;

c) the compression strength of the plate at various angles, α (optional test);

d) the shear strength of the plate at various angles, α.

This International Standard is linked to ISO 6891, which gives general test requirements.

In addition, a method for testing the nail root in alternate bending is specified in Annex A.

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.

ISO 3130, *Wood — Determination of moisture content for physical and mechanical tests*

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

ISO 6891, *Timber structures — Joints made with mechanical fasteners — General principles for the determination of strength and deformation characteristics*

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

ASTM E8/E8M, *Standard Test Methods for Tension Testing of Metallic Materials*

3 Terms and definitions

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

3.1
punched metal plate fastener
fastener made of metal plate of thickness not less than 0,9 mm and not more than 2,5 mm, having integral projections punched out in one direction and bent perpendicular to the plane of the plate, being used as a splice plate to join two or more pieces of timber of the same thickness

NOTE For this purpose, the projections of the plate are fully embedded in the timber, using a press or roller, so that the contact surface of the plate is flush with the surface of the timber.

3.2
major axis of plate
direction giving the highest tensile strength of the plate

NOTE In many cases the punching pattern of the plate gives rise to two main directions perpendicular to each other with different strength properties.

3.3
keeper nails
nails driven through the metal plate fasteners, during assembly of joints, to hold its location on the timber members before pressing

4 Symbols

The following symbols are used in this International Standard.

A_{gc} cross-sectional area

A_{gp} average gross cross-sectional area

F force, expressed in newtons

F_{cc} ultimate compression strength

F_{sc} ultimate shear stress

F_{sp} ultimate shear strength

F_{tc} ultimate tensile strength

L_p length of the plate in the direction parallel to the long dimension of the tooth slots, expressed in millimetres

l length covered by plate at the interface of the two pieces of timber measured parallel to the timber grain direction (see Figure 6), expressed in millimetres

l' plate dimension parallel to the loading direction for test specimens used to develop lateral resistance strength of metal connector plate teeth

P_{cc} maximum compression load

P_{sp} maximum shear load

P_{tc} maximum tensile load

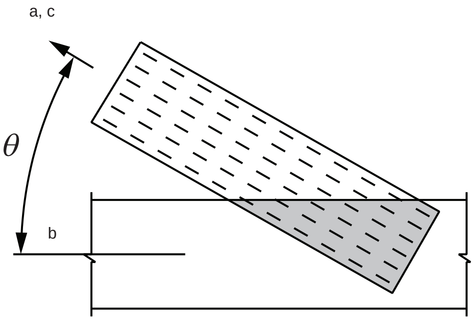
R_s shear resistance effectiveness ratio

t_{net} minimum thickness

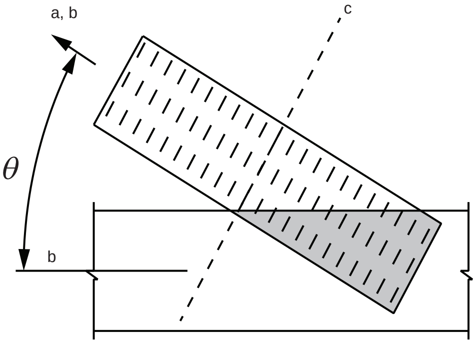
W_p width of the plate in the direction perpendicular to the long dimension of the tooth slots, expressed in millimetres

α angle between the direction of the applied force and the major axis of the plate [see Figure 1 c)]

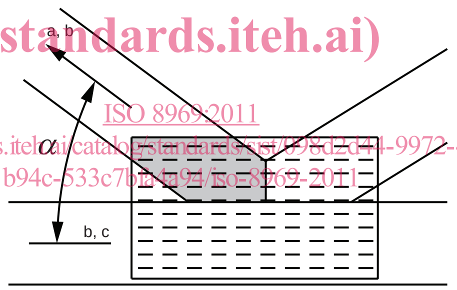
θ angle between the direction of the applied force and the direction of the grain of the timber [see Figures 1 a) and b)]



a) Tooth slot direction parallel to load



b) Tooth slot direction perpendicular to load



c) Tooth slot direction at angle to load

a Load direction.
b Grain direction.
c Tooth slot direction.

Figure 1 — Relationship between the loading direction and the major axis of the plate or the timber grain direction

5 Materials

5.1 Timber

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

5.1.2 For determination of the tensile strength, compression strength and shear strength of the plate, the timber shall be sufficiently strong for failure to occur in the plate.

5.1.3 The timber shall have a thickness consistent with the timber being used in production.

5.1.4 For each specimen, the two individual members being joined shall be cut from the same plank to ensure a specimen of balanced density. In each group of similar specimens, the timber for each specimen shall be cut from a different plank. The number of timber members selected shall be sufficient to fabricate a minimum of five joints for each combination of plate type, plate/timber orientation, timber face width, species combination and fabrication method tested.

5.1.5 Timber members for the specimens shall be cut so that the areas into which the fasteners are embedded are free from knots, local grain disturbance, fissures (such as shakes, checks and splits) and wane. Elsewhere, the members shall be free from major defects that can lead to premature failure in the timber.

5.1.6 If there are no special requirements, the timber shall be planed; the difference in thickness between adjoining pieces shall not exceed 0,5 mm.

5.1.7 The moisture content of the timber shall be determined in accordance with ISO 3130, and its density in accordance with ISO 3131.

5.1.8 The identity of the species shall, if necessary, be confirmed by botanical examination.

5.1.9 A minimum period of seven days shall elapse between assembly and testing of the test specimens to allow for fibre relaxation.

5.2 Plates

5.2.1 The sizes of plate used for the various tests shall be selected from the range of sizes produced by the plate manufacturer in such a way that the strength values for all sizes can be obtained by interpolation or extrapolation when judged to be of adequate reliability. Appropriate regression shall be used and reported.

5.2.2 The mechanical properties (tensile strength, yield stress, elongation and hardness) of the test coil metal shall meet the requirements for the specified structural grade of steel for plate manufacture.

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

5.2.4 The number of plates selected shall be sufficient to fabricate a minimum of five joints for each combination of plate type, plate/timber orientation, timber face width, species combination and fabrication method tested.

5.2.5 If the plates are to be free of oil or any substance that can alter the plate performance in service, then they shall be washed in solvent before they are used in the tests.

5.2.6 The metal plate fasteners shall be of sufficient length to induce failure in the plate metal, rather than failure by tooth withdrawal. Where necessary, it shall be permitted to clamp the metal plates, or otherwise firmly fasten them, a minimum of 50 mm from the joint to prevent withdrawal.

6 Test specimens

6.1 General

6.1.1 The specimens 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.

Metal plate fasteners shall be embedded in clear wood of the timber members, and shall be installed so that the teeth are fully embedded in the timber member and no gaps remain between the metal plate fastener and the timber member. Over-pressing shall be avoided, so that the metal plate fasteners do not embed into the timber member more than half the steel thickness.

6.1.2 If keeper nails, or any supplemental fasteners, are used in normal production to locate fasteners during assembly of the joints, and are not an integral part of the joint design method, such nails shall be omitted from the test specimens or withdrawn prior to the test. Where keeper nails are an integral part of the joint design method, are used in the manufacturing process and are intended for use in normal production of the joints, they shall be installed in the test specimens in the same proportions and with the same distribution as those intended for use in production.

6.1.3 Except as allowed in 6.3.1, the plates shall be embedded without removal of any teeth.

6.1.4 The test specimens shall be manufactured and tested with the timber at moisture content of 11 % or greater for solid-sawn timber, and 7 % or greater for structural composite timber. For certain investigations, other moisture conditions can be appropriate.

6.1.5 There shall be a sufficient number of test specimens to permit statistical treatment of the results.

In determining the number of test specimens for each type, consideration should be given to the variability of the wood substrate materials (see ISO 8970). For plate strength (tension, compression and shear), a minimum of three specimens of each type should be used, provided all achieve the same mode of failure as stated in 5.1.4 and 5.2.4. As tooth withdrawal can be expected to be a more variable property than steel strength, testing of more than three specimens should be considered as per 6.3.3.

6.2 Tensile strength of the solid metal control specimens

6.2.1 Conduct ultimate tensile strength tests on the solid metal control specimens in accordance with procedures in ASTM E8/E8M.

6.2.2 Metal connector plates selected for test specimen fabrication shall be typical of production. Test-coil metal shall be sampled from the production inventories of the metal connector plate manufacturers that are procured with a specified minimum yield or grade. Where such samples are found to exceed the specified minimum yield by more than 48 MPa, the lateral resistance strength shall be multiplied by the adjustment factor, R_Y, to account for steel yield as given in Equation (1):

$$R_Y = (F_{y,spec}/F_{y,test})^{(1,2G - 0,4)} \leq 1,0 \qquad (1)$$

where

$F_{y,spec}$ is the specified minimum steel yield strength, expressed in MPa;

$F_{y,test}$ is the average measured steel yield strength of test plates, expressed in MPa;

G is the average measured specific gravity (oven-dry basis) of timber used in test joints.

Where the metal thickness of the test coil metal exceeds the minimum specified thickness by more than 5 %, the lateral resistance strength shall be multiplied by the adjustment factor, R_T, to account for steel thickness as given in Equation (2):

$$R_T = (t_{spec}/t_{test})^{0,7} \leq 1,0 \qquad (2)$$

where

t_{spec} is the specified minimum steel thickness, expressed in millimetres;

t_{test} is the average measured steel thickness of the test plates, expressed in millimetres.