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Timber structures — Laminated veneer lumber — Structural properties

Structures en bois — Lamibois — Propriétés structurelles

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO 22390:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the specimen dimension measurement accuracy in 4.3 and

— routine update of the standard.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Laminated veneer lumber (LVL) is being produced in many countries under different national standards and these products are being exported from one country to another. While the national standards have many similarities, there are also many areas of dissimilarity. Thus, there is a need for the development of this International Standard to establish consistency between these standards in order to ensure the suitability of LVL for structural end-use applications, regardless of the country of manufacture or end use. It is valuable for the industry, consumers, governments and distributors.

Timber structures — Laminated veneer lumber — Structural properties

1 Scope

This document specifies requirements for establishing the characteristic properties of structural laminated veneer lumber (LVL), including 5th percentile strength values, stiffness characteristics and other performance characteristics, related to its end use as a structural product for dry use (service class 1). It is applicable to members used in flatwise or edgewise bending orientations.

It does not cover the assessment of formaldehyde requirements, biological durability, fire performance or manufacturing, such as quality control and marking.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10033-1, *Laminated Veneer Lumber (LVL) — Bonding quality — Part 1: Test methods*

ISO 10033-2, *Laminated Veneer Lumber (LVL) — Bonding quality — Part 2: Requirements*

ISO 13910, *Timber structures — Strength graded timber — Test methods for structural properties*

ISO 16572, *Timber structures — Wood-based panels — Test methods for structural properties*

ISO 16979, *Wood-based panels — Determination of moisture content*

EN 408, *Timber structures — Structural timber and glued laminated timber — Determination of some physical and mechanical properties*

ASTM D143, *Standard Test Methods for Small Clear Specimens of Timber*

ASTM D198, *Standard Test Methods of Static Tests of Lumber in Structural Sizes*

ASTM D4761, *Standard Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Material*

ASTM D5456, *Standard Specification for Evaluation of Structural Composite Lumber Products*

ASTM D6815, *Standard Specification for Evaluation of Duration of Load and Creep Effects of Wood and Wood-Based Products*

NOTIFICATION No MAFF 701 (Revised 2016), *Japanese Agricultural Standard for Laminated Veneer Lumber*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
laminated veneer lumber
LVL
composite of wood veneer sheet elements manufactured from one or more species, either separately or mixed, with wood fibres primarily oriented along the length of the member

Note 1 to entry: This does not exclude laminated veneer lumber with cross-laminated veneers.

3.2
characteristic value for strength
estimate of the 5th percentile values based on a statistical distribution obtained from results of tests on the defined properties with the test duration between 60 s and 300 s

Note 1 to entry: The characteristic values used for 3.2 are an estimate of the 5th percentile value of the sample as determined from ISO 12122-1 and ISO 12122-4.

Note 2 to entry: The defined properties are in accordance with Clauses 5 and 6.

3.3
characteristic value for stiffness
estimate of the mean property from results of tests on the defined properties with the test duration between 60 s and 300 s

Note 1 to entry: The characteristic values used for 3.3 are an estimate of the mean value of the sample as determined from ISO 12122-1 and ISO 12122-4.

Note 2 to entry: The defined properties are in accordance with Clauses 5 and 6.

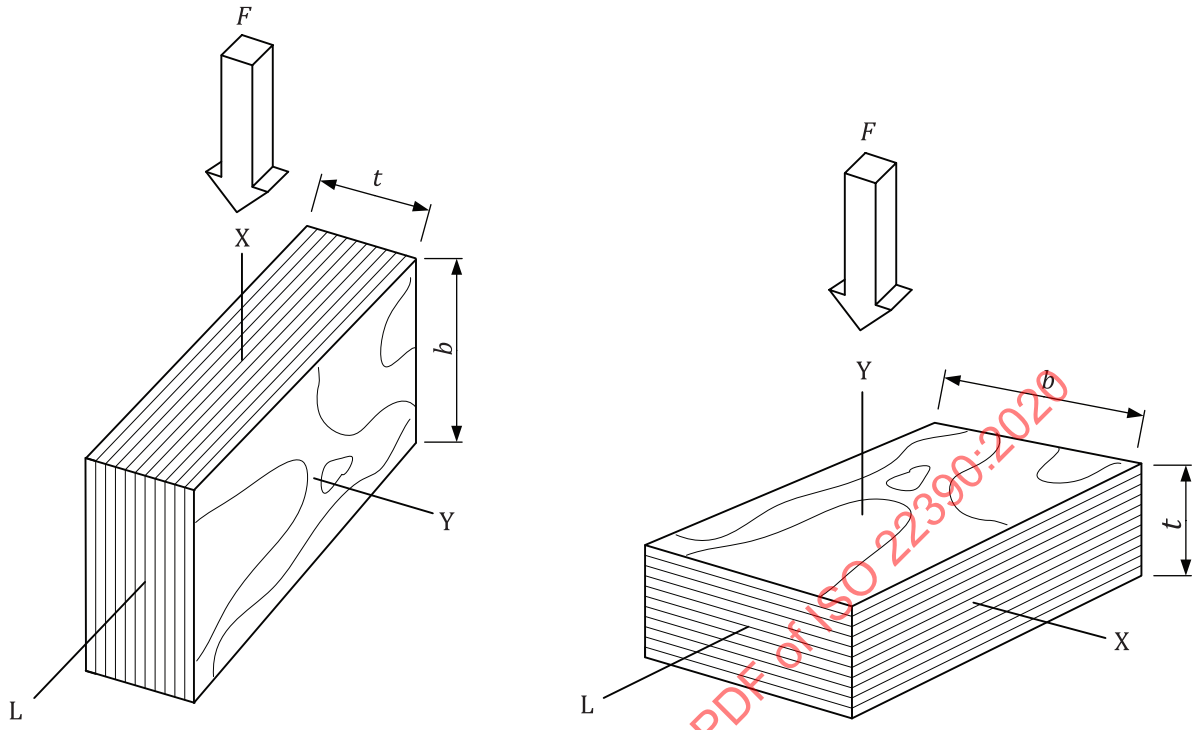
3.4
test specimen
specimen cut from random locations within the pieces of the LVL samples

3.5
thickness
t
dimension of a cross-section, which is perpendicular to the plane of the veneers, and measured in the Y-direction

Note 1 to entry: See Figure 1.

3.6
width
b
dimension of a cross-section, which is perpendicular to the thickness (or parallel to the plane of the veneers) and measured in the X-direction

Note 1 to entry: See Figure 1.



a) Cross-section related to edgewise (Joist) bending

b) Cross-section related to flatwise (Plank) bending

Key

F applied load

t thickness of the LVL

b width of the LVL

Figure 1 — Cross-section of laminated veneer lumber

4 Requirements

4.1 Veneers

The minimum number of veneers in the cross-section shall be five. The maximum thickness of each veneer shall be 6 mm.

4.2 Bonding quality

The LVL shall utilize a structural adhesive suitable for dry service (service class 1) and the bonding quality and adhesive qualification shall be determined in accordance with ISO 10033-1 and ISO 10033-2.

NOTE 1 Attention is drawn to national standards which can be applicable.

NOTE 2 Examples of applicable national standards include EN 314-1, ASTM D5456 and MAFF Notification No. 701.

NOTE 3 Additional testing to cover more severe bonding service conditions (service classes 2 and 3) can be considered as a manufacturer's option and can be required by some national standards.

4.3 Specimen dimension measurement accuracy

The dimensions of the test specimens shall be measured to the following accuracy:

a) for thickness (t): ±0,03 mm;

b) for width (b): ±0,03 mm;

c) for length (L): ±2 mm.

All measurements shall be made after the test pieces have been conditioned in accordance with Clause 5. Width and thickness measurements (see Figure 1) shall be the average of three measurements taken at three different positions within the middle third of the specimen. Where possible, the measurements should not be taken within 150 mm of the ends of the test piece.

Local thickness deviations related to discontinuities of the veneers, e.g., knotholes and veneer joints, are allowed, but should be avoided in the measurement of section properties.

NOTE Dimension tolerances for LVL are specified in ISO 18776.

The angle of the cross-section, α, shall not deviate by more than 1:50 (about 1,1°) from a right angle. See Figure 2, where α is the angle between the vertical axis and the sloped edge.

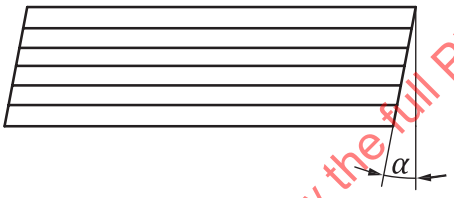


Figure 2 — Example of an angle, α, of a cross-section of laminated veneer lumber

5 Test methods

5.1 General

Characteristic strength values for edgewise and flatwise bending, tension parallel to the grain, compression parallel to the grain, edgewise and flatwise longitudinal shear and the mean compression perpendicular to grain strength shall be determined for laminated veneer lumber, as required by the product end-use application in accordance with 3.2 and the following requirements using the test methods in this clause.

All test specimens shall be conditioned to an equilibrium moisture content resulting from a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %. A test piece is considered to be conditioned when it attains constant mass. Constant mass is deemed to have been attained when the results of two successive weighings, carried out at intervals of not less than 6 h, do not differ by more than 1 %.

If test pieces cannot be conditioned due to their sizes, the moisture content at the time of test shall be reported and shall be within ±2 % of the moisture content of a subsample of the same product and grade conditioned in accordance with 7.2, or the provisions of ASTM D5456 may be used for developing a moisture content correlation for applications to large specimens.

If other conditions, such as tropical conditions, are used, they shall be permitted and reported. The data should be developed at the specific moisture content relative to those conditions.

NOTE Tropical interior conditions or protected exterior end use conditions may be characterized by a moisture content in the materials corresponding to a temperature regularly exceeding 30 °C and the relative humidity of the surrounding air regularly exceeding 85 % or where there is an occasional risk of wetting of the material (but excluding submerging or hosing), or prolonged exposure to weather leading to equilibrium moisture content of 18 % or higher.

For tests conducted in 5.2 to 5.8, the mode of failure and growth characteristics, such as excessive knots on the veneers and any unusual manufacturing characteristics or defects, at the failure section of each test piece shall be recorded.

5.2 Edgewise bending strength

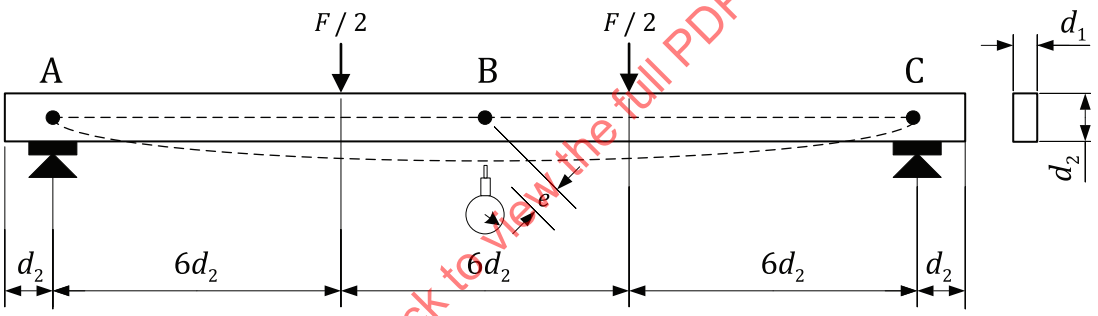
The edgewise bending strength test shall be carried out using a symmetric third-point load set-up as given in ISO 13910 (see Figure 3). The test span shall be at least 18 times dimension d_2 in Figure 3. In addition, the minimum size of the specimen shall not be less than the minimum structural size manufactured.

NOTE 1 The test results can be adjusted to a common size or value based on national codes.

NOTE 2 The provisions of ASTM D5456 provide an example of a methodology to adjust for size effects.

5.3 Flatwise bending strength

The flatwise bending strength tests shall be carried out using a symmetric third-point load set-up as given in ISO 13910 (see Figure 3). The test span of the specimen shall be at least 18 times the depth of the cross-section (dimension d_2 in Figure 3). The minimum size of the specimen shall not be less than the minimum structural size manufactured.



Key

A and C	centreline of bearing
B	mid-span
d_1	width of the test specimen (t for edgewise bending and b for flatwise bending)
d_2	depth of the specimen (b for edgewise bending and t for flatwise bending)
e	centrepoint deflection of the centreline of the specimen relative to the position of the centreline at the ends of the specimen

NOTE For illustrative purposes, Figure 3 is shown for edgewise bending only.

Figure 3 — Configuration for one third-point loading for determination of bending strength and stiffness

5.4 Tension strength parallel to the grain

The tension strength tests parallel to the grain shall be carried out using gripping devices which permit as far as possible the application of a tensile load without inducing bending. The gripping devices and loading conditions actually used shall be reported. The length of the specimen between the testing machine grips shall be at least 900 mm or at least 8 times the larger cross-sectional dimension and the minimum size of the specimen shall not be less than the minimum structural size manufactured.

If the length of the specimen between the testing machine grips is different than the reference length of 900 mm, the test results may need to be adjusted to a common size or value based on national codes. A failure in the grips of the test machine invalidates the results and a new test shall be required.

NOTE The provisions of ASTM D5456 provide an example of a methodology that can be used to adjust for length effects.

5.5 Compression strength parallel to the grain

The compression strength tests parallel to the grain shall be carried out such that the test piece is loaded concentrically using spherically seated loading-heads or other devices, which permit the application of a compressive load without inducing bending as given in ASTM D198. The bearing blocks and loading conditions actually used shall be reported. The length of the specimen shall be such that:

$$15 \leq \frac{L}{r} \leq 17$$

where

L is the unsupported length;

r is the least radius of gyration.

The end surfaces shall be accurately prepared to ensure that they are plane and parallel to one another and the load shall be applied in a direction generally parallel to the longitudinal axis of the test piece. The minimum size of the specimen shall not be less than the minimum structural size manufactured.

5.6 Shear strength (edge) related to edgewise bending

Tests used to determine edgewise shear include a centre point single span test or the double span (five-point load test) as specified in ISO 13910. When evaluating the effects of systematic manufacturing characteristics that can affect horizontal shear strength, the structural size horizontal shear test method given in ASTM D5456 or ASTM D198 may be used.

NOTE Specific test results can be different and can be adjusted according to applicable national standards.

5.7 Shear strength (flat) related to flatwise bending

The shear strength tests related to flatwise bending shall be carried out in accordance with the planar shear test method given in ISO 16572 or the block shear test given in ASTM D5456 or ASTM D143 or the short span bending test given in MAFF notification No. 701. The thickness of the specimen [dimension t in Figure 1 b)] shall be at least 25 mm.

NOTE Specific test results can be different and can be adjusted according to applicable national standards.

5.8 Compression strength perpendicular to the grain

The compression strength tests perpendicular to the grain shall be carried out in accordance with the principle of ASTM D143 except that references to placement of growth rings are not applicable and the minimum specimen size is as indicated below for flatwise and edgewise orientations.

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. The test piece shall be loaded concentrically using spherically seated loading heads and the load shall be applied at a constant rate of cross head movement throughout the test.

Depending on the product end use, compression perpendicular to grain values can be required for both the edgewise and flatwise orientations of the veneers. For flatwise orientation, the minimum cross-

