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Timber structures — Determination of characteristic values —

Part 4: Engineered wood products

Structures en bois — Détermination des valeurs caractéristiques —

Partie 4: Produits bois reconstitués

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 165, *Timber structures*.

A list of all the parts in the ISO 12122 series can be found on the ISO website.

Introduction

This document sets out a framework for establishing characteristic values from test results on a sample drawn from a clearly defined reference population of engineered wood products. The characteristic value is an estimate of the property of the reference population with a consistent level of confidence prescribed in the standard.

This document is intended to be used in conjunction with ISO 12122-1.

This document permits the evaluation of characteristic values on testing on commercial engineered wood products.

In some cases, characteristic values determined in accordance with this document may be modified to become a design value.

The document has the following annexes:

— Annex A presents a commentary on this document;

— Annex B presents information on methods for calculating characteristic values from component properties.

Timber structures — Determination of characteristic values —

Part 4: Engineered wood products

1 Scope

This document gives methods of determination of characteristic values for a defined population of engineered wood products calculated from test values.

This document presents methods for the determination of

a) characteristic value of material properties, where the determined property is multiplied by a geometric parameter to give a component capacity or component stiffness, or

b) characteristic value of component properties directly, where the determined property is a component capacity or component stiffness.

This document presents methods for determination of

a) characteristic value of mean-based properties, and

b) characteristic value of 5th percentile-based properties.

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 12122-1:2014, *Timber structures — Determination of characteristic values — Part 1: Basic requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12122-1 and the following apply.

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

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

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

3.1
engineered wood product
item manufactured from wood, namely plywood, oriented strand board, I beams, laminated veneer lumber or structural insulated panel walls

Note 1 to entry: These products that are defined in ISO 12465, ISO 16894, ISO 22389-1, ISO 22390 and ISO 22452.

4 Symbols

Symbols defined in the relevant ISO product or test standard shall be used. Other symbols are defined in ISO 12122-1.

5 Reference population

In addition to the requirements for definition of the reference population in ISO 12122-1, the following attributes of engineered wood products may be described:

a) sources of raw material;

b) seasoning method (if seasoned);

c) grading or production method for components of the engineered wood product where it is made of previously graded components (including lamellae);

d) specification of adhesives, method of application and method of curing adhesives;

e) quality control measures;

f) secondary processing, such as preservative treatment, fire retardant treatment, profiling, etc.;

g) variations in the configuration of the product (if any).

6 Sampling

6.1 Sampling method

The sampling method shall comply with the performance objective of sampling defined in ISO 12122-1.

Representation of each of the variants in the sample shall approximate the representation of the same variants in the reference population.

See Clause 10 and ISO 12122-1 for reporting requirements on the sampling method. The report should indicate a response to each of the identified attributes of the reference population listed in compliance with Clause 5 or otherwise important to the description of the reference population.

6.2 Sample size

The sample size shall comply with requirements of ISO 12122-1 and shall take into account the coefficient of variation (V) expected for the sawn timber in the reference population.

NOTE 1 See notes under the relevant clause in ISO 12122-1.

Engineered wood products' properties generally have lower population coefficients of variation (V) in structural properties and should therefore have a smaller sample size.

NOTE 2 ISO 12122-1 gives some guidance on selecting sample size.

7 Sample conditioning

The sample storage and testing environment shall reflect conditioning in accordance with the definition of the reference population as indicated in ISO 12122-1.

8 Test data

8.1 Test method

The test data shall be obtained from

a) tests in accordance with the ISO test standard relevant to the product, or

b) a standard test method appropriate for the reference population, provided equivalency factors with the relevant ISO test standard can be established.

NOTE See notes under the relevant clause in ISO 12122-1.

Test methods involve many variables that will affect results including loading configuration and rates, specimen positioning and measurement methods. The level of precision of these variables should be appropriate to the objectives of the testing and the adjustments required in 8.2.

8.2 Test data compatible with product description

Where the characteristic value is applicable to a standard size or moisture content, adjustments to the test data may be required. Any adjustment shall be in accordance with ISO 12122-1 and shall be detailed in the report.

NOTE These adjustments include those required to pool data from different test programs as outlined in ISO 12122-1.

8.3 Failure modes

The failure modes obtained in the tests shall be recorded.

The data shall only be included in the analysis if it comes from a test in which the failure mode appropriate to the property was obtained.

NOTE The same test method may produce different failure modes on different products. The characteristic value may be underestimated by tests that produce failure modes that are different to the ones that the test method was intended to produce.

9 Evaluation of characteristic values for structural properties

9.1 Structural properties

For engineered wood products, either material properties or component properties shall be evaluated.

NOTE 1 Annex A gives guidance on the type of property that is appropriate for some common engineered wood products.

NOTE 2 Where component properties are reported, they are in general specific to a given size of product. Different sized products will have different component properties.

Determination of the characteristic values for structural properties shall be in accordance with ISO 12122-1 unless specifically specified in the reference product standard.

9.2 Characteristic values of material properties

9.2.1 Characteristic modulus of elasticity and shear modulus

The characteristic modulus of elasticity and shear modulus shall be the mean value, taken as the average of the test values evaluated in accordance with ISO 12122-1.

9.2.2 Characteristic bearing strength

The characteristic values for bearing strength, both parallel and perpendicular to grain, shall be the mean property obtained from results of tests.

9.2.3 Other characteristic values for strength based on the 5th percentile test value

The 75 % lower single-sided confidence limit of the test 5th percentile value shall be evaluated. Suitable methods for evaluating the 5th percentile value of the test data and estimating the 75 % lower single-sided confidence limit are presented in ISO 12122-1.

9.3 Characteristic values of component properties

9.3.1 Characteristic stiffness

The characteristic stiffness shall be the mean value, taken as the average of the test values evaluated in accordance with ISO 12122-1.

9.3.2 Characteristic bearing strength

The characteristic values for bearing strength evaluated in accordance with 9.2.2, both parallel and perpendicular to grain, shall be the mean property obtained from results of tests.

NOTE Even though other properties are component properties, bearing strengths are generally reported as material properties. Further guidance is given in Annex A.

9.3.3 Other characteristic capacities for strength based on the 5th percentile test value

The 75 % lower single-sided confidence limit of the test 5th percentile value shall be evaluated. Suitable methods for evaluating the 5th percentile value of the test data and estimating the 75 % lower single-sided confidence limit are presented in ISO 12122-1.

10 Report

The report shall comply with the requirements of ISO 12122-1.

Annex A
(informative)

Commentary

A.1 Commentary on scope

This document presents methods for determining characteristic values for engineered wood products. It is to be used in conjunction with ISO 12122-1.

This document presents a uniform methodology for the evaluation of characteristic values that are consistent with the characteristic values found for other structural timber products.

This document does not establish methods for the determination of design values, which may be determined based on characteristic values from test data by incorporating safety factors to account for any or all of the following factors.

— Expected changes in product or product properties over a long period. These changes could be due to variations in timber resource quality, production methods or changes in other raw materials.

— The complexity of the reference population. For example, where the reference population has a large number of producers who draw their resources over a large area or use different production parameters, then the sampling may not effectively reflect all possible combinations of resource quality and production methods. In this way, the sample may not be truly representative and a safety factor may be applied to allow for that.

— Variations in time of the assembly used for the engineered wood product. These variations may include end-joint treatment of elements, element specification, curing and holding times.

— Anticipated variations in quality control across the reference population in the future.

Characteristic values presented in this document relate only to the determination of characteristic values from the results of tests on full-scale engineered wood products. The ISO 12122- series has this common basis. However, in many cases, the characteristic properties for engineered wood products are found from calculation using models that relate the properties of the individual elements to the properties of the composite products. The scope of this document does not cover these methods, but Annex B contains information linking to some commonly accepted models for these calculations. This document can be used to verify such models using tests on full-scale engineered wood products.

A.2 Commentary on normative references

No commentary.

A.3 Commentary on terms and definitions

No commentary. (See ISO 12122-1.)

A.4 Commentary on symbols

No commentary. (See ISO 12122-1.)

A.5 Commentary on reference population

Characteristic values can be taken to represent the properties of the material from which the sample was taken. The reference population is the definition of the parent population to which the characteristic properties are said to apply. ISO 12122-1 presents some general requirements for definition of the reference population, but some other features are known to influence the structural properties of engineered wood products.

— The properties of the wood that is the raw material for the engineered wood product may affect the properties of the final product. This means that the definition of the reference population should include all possible sources of wood for the product. This also will require sampling across the full range of raw material sources to ensure that the test sample is truly a representative of the reference population.

— Temperature of seasoning may also have an influence on the structural properties of seasoned wood materials. Range of seasoning temperatures and method of seasoning, which may relate to the speed of moisture removal, should be declared.

— Grading of raw material and production methods employed may also have a significant influence on the properties of the completed engineered wood products. In some cases, relatively small changes in grading (e.g. variation of wood material density limits) may significantly affect some properties. Likewise some manufacturing details may be critical to some product properties. These may include sharpness of cutters for profiling some products or holding pressures and times for some glued products. Where a reference population may be drawn from plants that use a range of manufacturing processes, they should all be represented in the test sample.

— Most engineered wood products employ adhesives and the behaviour of the adhesive under applied load is often crucial to its performance. Hence any factor that may influence the strength of the adhesive should be linked to the reference population. Where a range of adhesive specifications, handling and application methods or curing methods may be present in the reference population, these variations should be declared and care should be taken to ensure that they are all included in the representative sample.

— Quality control measures are often used to maintain various aspects of production that can affect structural properties. Specification of the quality control processes is an important consideration in defining the reference population. Ideally, all producers included in the reference population should have the same quality control measures, but where there are variations, these should all be included in the specification of the reference population.

— Secondary processing, such as preservative treatment, fire retardant treatment, profiling, etc., may affect the material properties and should be kept consistent for the same referenced population under evaluation.

— Where some products are restricted in their application, they should generally be regarded as a separate product to similar unrestricted application products. Restrictions in application may lead to differences in manufacturing processes or testing for some properties.

Where the characteristic values are to be product properties (e.g. bending strength, f_m), it is possible that the reference population can include a range of sizes as the capacity of the different sized products can be evaluated using the different geometric parameters for each size. However, for characteristic values of component properties, the reference population can only refer to a single size product. Different sized cross-sections will have different capacities and stiffness.

ISO 12122-1 refers to the period over which the product was manufactured. In some climates, the time of year can affect the properties of the raw materials or manufacturing processes in use.

The lists in ISO 12122-1 and this document are examples, but the intent of the clause is that anything in the manufacture of the product that may affect the structural properties should be included in the description.

A.6 Commentary on sampling

Where the reference population of the engineered wood products includes a number of different manufacturers or processes, care should be taken to ensure that all variations in raw material and production methods are included in the representative sample. While engineered wood products often have lower coefficients of variation (V) within a product specification compared with other timber products, variations in raw material or production methods may contribute to higher V for a whole reference population compared with product from a single manufacturer.

The list of features to be described in the reference population (from ISO 12122-1:2014, Clause 5 and A.5) can be used to derive a sampling program that will include all of the variations in the reference population.

Tests on engineered wood products with lower coefficients of variation than sawn timber can use smaller sample sizes. Guidance on sample size can be found in ISO 12122-1.

A.7 Commentary on sample conditioning

Most engineered wood products are seasoned. Samples should be stored so that the moisture content remains within the requirements for the seasoned product.

Otherwise, the requirements of ISO 12122-1 apply.

A.8 Commentary on testing

A.8.1 Commentary on test method

Each engineered wood product has separate testing requirements designed to fully explore the failure modes possible with the product. The test method should be compatible with the product specification. ISO test methods for each product are the reference test methods, but where other test methods have demonstrated that they capture all possible failure modes and are compatible with the relevant ISO test method, they can also be used.

The key point in this clause is that the test method is the appropriate test method for the particular type of engineered wood product described in the reference population.

A.8.2 Commentary on test data compatible with product description

Where adjustment of the test data to a reference size, moisture content or temperature is required, it should comply with the requirements of ISO 12122-1.

A.8.3 Commentary on failure modes

Where tests are aimed at a particular structural property, but a different failure mode has occurred, then the intended property may be underestimated by the test data.

An example is tests for shear capacity of I-beams may be performed, but if bearing failures limit the test, then the calculated shear capacity from the test is a lower bound on the true shear capacity of the product.

Where the failure mode obtained in the test involved glue failures, this may indicate that the glue lines are not stronger than the timber and as a result, calculation methods for the determination of characteristic values may not be valid as the product does not comply with the relevant ISO product standard.

A.9 Commentary on evaluation of characteristic values for structural properties

A.9.1 Commentary on structural properties

The method of presentation of the structural properties for engineered wood products depends on the geometric form of the product:

— In general, products with a rectangular cross-section and are manufactured entirely of elements with similar properties (e.g. plywood and LVL) will give material properties (see A.9.2) and capacities. Stiffness is calculated when the material properties are multiplied by geometric parameters.

— In general, products with a non-rectangular cross-section or made with elements that have very different properties (e.g. I-beams and structural insulated panels) will give component properties (see A.9.3). The characteristic values will be the capacities and stiffness of the whole component.

Table A.1 — Classification of characteristic values for engineered wood products

Characteristic value Characteristic properties	Basis	Typical units
Bending strength, f_m	5th percentile	MPa
Tension strength, $f_{t,0}$, parallel to grain	5th percentile	MPa
Compression strength, $f_{c,0}$, parallel to grain	5th percentile	MPa
Shear strength, f_s	5th percentile	MPa
Compression strength, $f_{c,90}$, perpendicular to grain	Mean (5th percentile)[a]	MPa
Tension strength, $f_{t,90}$, perpendicular to grain	5th percentile	MPa
Modulus of elasticity, E	Mean (5th percentile)[a]	MPa or GPa
Shear modulus, G	Mean (5th percentile)[a]	MPa

[a] Indicates that for some products, a 5th percentile value may be required in addition to the normal mean-based value.

A.9.2 Commentary on characteristic values of material properties

Material properties include modulus of elasticity and strength values as indicated in Table A.1. All of these properties will have the units of GPa or MPa.

A.9.2.1 Commentary on characteristic modulus of elasticity and shear modulus

No commentary. (See ISO 12122-1.)

A.9.2.2 Commentary on characteristic bearing strength

No commentary. (See ISO 12122-1.)

A.9.2.3 Commentary on other characteristic values for strength based on the 5th percentile test value

No commentary. (See ISO 12122-1.)

A.9.3 Commentary on characteristic values of component properties

Component properties include flexural stiffness and capacity values with typical units as indicated in Table A.2.

Table A.2 — Typical units for characteristic capacity values for structural component properties

Characteristic value Characteristic capacity properties	Basis	Typical units
Bending capacity, M	5th percentile	kN·m
Tension capacity, $N_{t,0}$, parallel to grain	5th percentile	kN
Compression capacity, $N_{c,0}$, parallel to grain	5th percentile	kN
Shear strength, V	5th percentile	kN
Compression strength, $N_{c,90}$, perpendicular to grain	Mean (5th percentile)[a]	kN
Tension strength, $T_{t,90}$, perpendicular to grain	5th percentile	kN
Flexural stiffness, EI	Mean (5th percentile)[a]	kN·m^2
Axial stiffness, EA	Mean (5th percentile)[a]	kN
Shear stiffness, GA	Mean (5th percentile)[a]	kN

[a] Indicates that for some products, a 5th percentile value may be required in addition to the normal mean-based value.

NOTE Bearing capacity can only be calculated from a bearing area and bearing strength. The bearing strength is generally limited by the wood components intended to be in contact with the bearing. (See A.9.3.2.)

A.9.3.1 Commentary on characteristic stiffness

As indicated in Table A.2, a number of different stiffness may be required. Flexural stiffness will be different to the axial stiffness reported. This will require different testing and analysis.

A.9.3.2 Commentary on characteristic bearing strength

Strengths perpendicular to grain should still be evaluated as strengths rather than capacity. Bearing capacity is a function of the size of the bearing and its area. The bearing capacity can be found in individual design situations by multiplying the bearing strength, $f_{c,90}$, by the bearing area.

A.9.3.3 Commentary on other characteristic capacities for strength based on the 5th percentile test value

No commentary. (See ISO 12122-1.)

A.10 Commentary on report

No commentary. (See ISO 12122-1.)

Annex B
(informative)

Analytical models for determining characteristic properties of engineered wood products

B.1 General

In some cases, the characteristic values of engineered wood products can be calculated from the characteristic properties of the individual elements from which it is assembled. These models are statistically based and rely on the sharing of strength between the elements. These models are generally founded on the following principles.

— The glue joint may be required to be as strong as the timber in the engineered wood products through the in-plant process control. Otherwise, the model should consider the strength of the glue joint in addition to the strength of the timber component.

— The properties of engineered wood products are enhanced by the placement of components in different location or orientation based on the principle of engineering mechanics.

B.2 Models

Several analytical models that have been successfully used in modelling selected mechanical properties of engineered wood products are available from different countries or regions. For example, ISO 22389-1 contains an analytical model in determining the characteristic moment capacity of prefabricated wood I-beams. While some models are stochastic and the others are deterministic in nature, most models are capable of predicting the characteristic property values of engineered wood products compatible with this document.

Bibliography

[1] ISO 12465, *Plywood — Specifications*

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

[3] ISO 16894, *Wood-based panels — Oriented strand board (OSB) — Definitions, classification and specifications*

[4] ISO 22389-1, *Timber structures — Bending strength of I-beams — Part 1: Testing, evaluation and characterization*

[5] ISO 22390, *Timber structures — Laminated veneer lumber — Structural properties*

[6] ISO 22452, *Timber structures — Structural insulated panel walls — Test methods*

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