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Structural timber — Visual strength grading — Basic principles

Bois de structure — Classement visuelle selon la résistance — Principes de base

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Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Symbols and abbreviated terms ... **4**

5 General ... **4**
5.1 Visual strength-graded timber ... 4
5.2 Visual strength-grading operations ... 4
5.3 Visual strength-grading principles of quality control ... 4

6 Resource and sawn timber input requirements ... **4**
6.1 General ... 4
6.2 Input requirements ... 5
6.2.1 Resource ... 5
6.2.2 Sawn timber ... 5
6.3 Control of inputs ... 5
6.4 Reprocessing of previously graded material ... 5

7 Visual strength-grading requirements ... **5**
7.1 Grader requirements ... 5
7.2 Grading process ... 5
7.2.1 General ... 5
7.3 Grading to satisfy structural requirements ... 6
7.3.1 Structural features ... 6
7.3.2 Measurement of structural features ... 6
7.3.3 Framework for structural requirements ... 7
7.4 Grading to satisfy the utility requirements ... 7
7.4.1 Utility features ... 7
7.4.2 Measurement of utility features ... 7
7.5 Check on visual grading process ... 10

8 Visual graded timber structural properties ... **11**
8.1 General ... 11
8.2 Initial evaluation ... 11

9 Product identification ... **11**

10 Documentation ... **11**

Annex A (informative) **Example of a visual strength-grading timber standard — based on the need for design values where a degree of certainty of structural properties is required** ... **13**

Annex B (informative) **Example of a visual strength-grading timber standard based on the need for design values where a high degree of certainty of structural properties is *not* required** ... **21**

Annex C (informative) **Example of a framework for structural grading provisions** ... **25**

Annex D (informative) **Example of visual strength grading for tropical hardwood timber** ... **29**

Annex E (informative) **Training, supervision and oversight of grading** ... **38**

Bibliography ... **39**

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.

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

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

This second edition cancels and replaces the first edition (ISO 9709:2005), which has been technically revised. The main changes compared to the previous edition are as follows:

— general grading provisions have been moved to the main body from the annexes;

— Clause 7 has been technically revised;

— Annexes C and E have been added to provide additional guidance on the grading framework;

— a new Annex D on grading tropical hardwood timber has been added.

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

The general principle of this document is that any type of visual strength-grading procedure is acceptable, provided it is defined, controlled, and documented to the extent required to reflect the degree of certainty of structural properties intended for the structural application of the product. The body of this document specifies the essential features common to all visual strength-grading operations. The requirements are minimal so as to ensure maximum scope and flexibility in the application of a standard to the visual strength-grading process for timber. The annexes provide a detailed example of a conformance standard resulting in strength properties having a high degree of engineering reliability and a simple standard resulting in strength properties where a high degree of engineering reliability is not required, as well as a tropical timber example.

This document was based initially on the European Standard EN 518 and modified to bring it into conformance with ISO procedures and requirements.

The bibliography lists a number of additional standards referenced during the development of this document.

Structural timber — Visual strength grading — Basic principles

1 Scope

This document establishes the basic principles for rules and procedures governing the visual sorting of timber for use in structural applications.

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

ISO 12122-2, *Timber structures — Determination of characteristic values — Part 2: Sawn timber*

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

ISO 24294, *Timber — Round and sawn timber — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13910 and ISO 24294 and the following 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
air dried timber
timber that has been dried by exposure to air without any artificial heating above 50 °C and has a moisture content in approximate equilibrium with the surrounding natural atmospheric conditions

3.2
compression wood
abnormal wood that forms on the underside of leaning and crooked coniferous trees

3.3
density
mass per unit volume expressed as kg/m^3 at a moisture content of 12 %

3.4
fissure
separation of the wood occurring at various locations in a piece of timber, classified in terms of its type, size and location

EXAMPLE Shake, check or split.

3.5
fungal decay
disintegration of the wood substance due to action of wood-destroying fungi

3.6
grade
population of timber derived from a specified resource and by applying a specified sorting procedure

3.7
heartwood
inner core of the tree, in some species with a different colour from the sapwood

Note 1 to entry: Boxed heart means heartwood is enclosed within the four surfaces of a piece of sawn timber at both ends.

3.8
insect damage
damage including pinholes and larger bore holes caused by insects

3.9
kiln dried timber
sawn timber that has been dried in a closed chamber in which the required moisture content is obtained by artificial heat and humidity control

3.10
knot
portion of a branch or limb that has become incorporated in a piece of timber, classified in terms of its type, size and location

EXAMPLE Sound, unsound or other types.

3.11
moisture condition
classification of timber wetness, based on measurement of the weight of water in wood expressed as a percentage of the weight of the oven-dry wood

3.12
pith
small soft core in the structural centre of a log

3.13
pocket
well-defined opening between the rings of annual growth which develops during the growth of the tree and typically contains resin or bark

3.14
rate of growth
classification of timber growth rings, expressed as the number of rings per unit width

3.15
sapstain
natural variation from the colour of the sapwood

3.16
sapwood
outer layer of wood between the bark and the heartwood

3.17
seasoned timber
dry timber
timber with moisture content of 19 % or less

3.18
slope of grain
deviation of the wood fibre direction from a line parallel to the edges of a piece of timber, expressed as the ratio of unit deviation to the unit of length over which it occurs

3.19
sound wood
wood that is free of decay

3.20
strength group
strength class
classification of timber based on particular characteristic values such as bending strength, density and mean modulus of elasticity parallel to the grain

3.21
structural requirements
grade requirements that affect the structural properties of the timber

Note 1 to entry: Structural features are: knots, slope of grain, fissures, and any other features that may cause a decrease in strength properties to an amount which threatens the serviceability of the piece.

3.22
thickness
lesser dimension perpendicular to the longitudinal axis of a piece of timber

3.23
unseasoned timber
timber with moisture content greater than 19 %

3.24
utility requirements
grade requirements that do not affect the structural properties of the timber to an extent that jeopardizes the serviceability of the piece

3.25
visual graded timber
sawn wood that has been sorted into structural or non-structural grades according to visual criteria

Note 1 to entry: The visual criteria identify visible physical features that affect timber strength, utility of the product and/or the visual quality of the product.

3.26
wane
lack of wood on any face or edge of a piece of sawn timber, including or not including bark

3.27
warping
any deviation from a true or plane surface including bow, crook, cupping or spring, twisting, or any combination thereof

EXAMPLE Bow, crook, cup or spring, twist.

3.28
white speck
white or brown pit or spot in wood caused by the “Fomes Pini” fungus that only develops in the living tree and does not develop further in service

3.29
width
greater dimension perpendicular to the longitudinal axis of a piece of timber

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 13910 apply.

5 General

5.1 Visual strength-graded timber

Visual strength-graded timber is sawn wood that has been sorted into structural or non-structural grades according to visual criteria. The visual criteria identify physical features that can affect timber strength.

5.2 Visual strength-grading operations

A typical visual strength-grading operation shall be comprised of a visual grader who sorts an input resource into one or more output grades (see Figure 1). A visual-grading machine shall be permitted to be used in place of the visual grader.

In addition to the structural requirements, any relevant non-structural or utility requirements shall also be specified.

NOTE Some of the timber might not meet the requirements of the minimum specified grade.

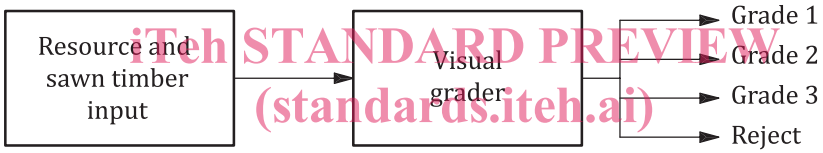

Figure 1 — Schematic of visual strength-grading operation

5.3 Visual strength-grading principles of quality control

Visual grading is one element of quality control operations. This document requires that the quality control related to the visual grading operation is undertaken by placing checks on the three components of the grading operation: 1) the resource and sawn timber inputs; 2) the visual sorting process; and 3) the graded timber output (see Figure 1).

NOTE In theory it is possible to control quality either

a) by control on the resource input and the visual sorting operation, or

b) by checks of the visual sorting operation and of the quality of the output grades.

However, in practice it is not feasible to rely solely on the checks on the output grades because of the high variability and complexity of timber, and because of the large sample sizes that are required to reliably measure the 5-percentile strength values.

6 Resource and sawn timber input requirements

6.1 General

The input resources shall be identified in terms of all parameters that can affect the output of the visual grade sorting operation.

6.2 Input requirements

6.2.1 Resource

The parameter that shall be identified is the timber species or mixture of species.

Other relevant parameters shall be identified, such as the following:

a) silvicultural practices used;

b) log source;

c) log size;

d) cutting pattern used to manufacture sawn timber from logs;

e) any other parameters deemed to be important.

6.2.2 Sawn timber

Parameters that shall be specified are:

a) condition (such as seasoned, unseasoned, etc.);

b) moisture content and moisture content range;

c) any other parameters deemed to be important.

6.3 Control of inputs

A periodic check on the resource and sawn timber inputs shall be defined and specified.

NOTE See ISO 12122-1 and ISO 12122-2 for information about the determination of structural properties.

6.4 Reprocessing of previously graded material

If major reprocessing of previously graded material is permitted, then any requirements for re-grading of the material shall be specified.

7 Visual strength-grading requirements

7.1 Grader requirements

The grader shall be qualified to grade timber accurately at the necessary operational speeds and to evaluate the visual quality of all grades and sizes that the grader will encounter in commercial visual grading operations.

7.2 Grading process

7.2.1 General

The grading process shall be specified. During grading, methods shall be in place to ensure that the timber species and the timber moisture content comply with the requirements specified.

The framework for the grading system shall be supported by evidence that it can provide a stable basis for delivering graded products that achieve key characteristic properties.

NOTE The detail required in the standard is directly related to the reliability of the stated structural properties. Annex A provides a detailed example of a conformance standard resulting in strength properties having a moderate to high degree of engineering reliability. Annex B provides an example of a conformance standard resulting in strength properties where a high degree of engineering reliability is not required. Annex D provides an example for tropical hardwoods.

7.3 Grading to satisfy structural requirements

7.3.1 Structural features

To ensure adequate structural properties, limitations shall be specified on one or more of the following features:

a) knots (type, size and location);

b) slope of grain;

c) rate of growth;

d) fissures (shake, checks, and/or splits);

e) moisture condition;

f) any other features that are deemed to be important.

7.3.2 Measurement of structural features

7.3.2.1 Knots

Knots shall be measured in a manner consistent with grading provisions.

NOTE Examples of knot measurement are shown in Annexes A, B and D.

7.3.2.2 Slope of grain

The slope of grain (see Figure 2) is assessed over a distance sufficiently great so as to avoid the influence of local deviations.

7.3.2.3 Rate of growth

To assess rate of growth, measurements shall be made on one end of the piece, and expressed as the average ring width in millimetres along a straight line 75 mm long normal to the growth rings, passing through the centre of the end of the pieces [see Figure 3 a]; or commencing 25 mm from the pith when it is present [see Figure 3 b]. When a line 75 mm in length is unobtainable, the measurements are to be made on the longest possible line normal to the growth rings and passing through the centre of the piece.

7.3.2.4 Fissures

Fissures shall be measured as illustrated in Figure 4.

7.3.2.5 Moisture condition

Moisture condition shall be determined in accordance with a specified standard.

7.3.2.6 Combinations of defects

Each of the defects listed will reduce the strength of a piece to the lowest permissible if present to the maximum extent allowed, even if no other type of defects is present. Where two or more defects, each of a size smaller than the maximum permitted, are present at the same place in a piece, the timber grader shall use his discretion to reject any piece that he believes will be weakened to a greater extent than would be caused by a single defect of the maximum size.

7.3.3 Framework for structural requirements

The provisions identified in 7.3.1 and 7.3.2 shall be supported by testing of samples from at least two reference grades containing a random selection of the permitted features, resulting in data on the mean modulus of elasticity and the 5th percentile of at least one strength property. This data shall be permitted to be used to formulate the structural grade model including other grades and sizes, provided it shows a consistent relationship for the reference grades.

NOTE The intent is to select reference grades and sample sizes that will serve best to represent the grades in the system, reflecting both the range and frequency of features that could appear in these grades and demonstrating that the grading system is robust enough to differentiate properties for the timber population. Annex C provides an example of a framework to support structural requirements.

7.4 Grading to satisfy the utility requirements

7.4.1 Utility features

To ensure adequate visual quality, limitations shall be specified on all relevant features, such as:

a) crookedness;

b) dimensions and tolerances;

c) fungal decay;

d) insect damage;

e) sapstain;

f) squareness;

g) white speck;

h) any other features that are deemed to be important.

7.4.2 Measurement of utility features

7.4.2.1 Crookedness

Bow, spring (or crook) and twist shall be assessed the entire length (see Figure 6). Longitudinal curvature in square section pieces shall be assessed using the limits for bow. Measurement shall be taken at the time of grading. Cupping shall be assessed across the width (see Figure 7).