BS EN 16351:2015

BSI Standards Publication

Timber structures — Cross laminated timber — Requirements

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 16351:2015.

The UK participation in its preparation was entrusted to Technical Committee B/518, Structural timber.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2015

ISBN 978 0 580 76677 0

ICS 79.060.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2015.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16351

October 2015

ICS 79.060.10

English Version

Timber structures - Cross laminated timber - Requirements

Structures en bois - Bois lamellé croisé - Exigences

Holzbauwerke - Brettsperrholz - Anforderungen

This European Standard was approved by CEN on 29 August 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 16351:2015 E

Contents

Page

European foreword ... 6

Introduction ... 7

1 Scope ... 8

2 Normative references ... 9

3 Terms and definitions ... 10

4 Symbols ... 14
4.1 Main symbols ... 14
4.2 Subscripts ... 15

5 Components and product characteristics, testing and assessment methods ... 16
5.1 Components characteristics ... 16
5.1.1 Timber to be used in laminations ... 16
5.1.2 Laminations ... 16
5.1.3 Timber layers ... 17
5.1.4 Wood-based panel layers ... 17
5.1.5 Species ... 17
5.1.6 Adhesives for the production of cross laminated timber ... 18
5.2 Characteristics of cross laminated timber ... 20
5.2.1 General ... 20
5.2.2 Geometrical data ... 20
5.2.3 Strength and stiffness properties of cross laminated timber ... 24
5.2.4 Strength and stiffness properties of cross laminated timber with large finger joints ... 25
5.2.5 Bonding strength ... 26
5.2.6 Resistance to fire ... 27
5.2.7 Reaction to fire ... 27
5.2.8 Dimensional stability ... 29
5.2.9 Release of dangerous substances ... 29
5.2.10 Durability ... 30

6 Assessment and Verification of Constancy of Performance (AVCP) ... 31
6.1 General ... 31
6.2 Type testing ... 31
6.2.1 General ... 31
6.2.2 Test samples, testing and compliance criteria ... 32
6.2.3 Test reports ... 36
6.2.4 Shared other party results ... 36
6.2.5 Cascading determination of the product type results ... 37
6.3 Factory production control (FPC) ... 38
6.3.1 General ... 38
6.3.2 Requirements ... 39
6.3.3 Product specific requirements ... 45
6.3.4 Initial inspection of factory and of FPC ... 45
6.3.5 Continuous surveillance of FPC ... 46
6.3.6 Procedure for modifications ... 46

7 Marking and labelling ... 46

7.1 General **46**
7.2 Cross laminated timber **47**

Annex A (normative) **Release of Formaldehyde** **48**
A.1 General **48**
A.2 Classification **48**
A.2.1 Cross laminated timber **48**
A.2.2 Cross laminated timber with large finger joints **49**

Annex B (normative) **Additional test methods and requirements for adhesives** **50**
B.1 General **50**
B.2 Long-term sustained load test at cyclic climate conditions with specimens loaded perpendicular to the glue line for moisture curing one-component polyurethane and emulsion polymer isocyanate adhesives (glass house test) **50**
B.2.1 General description **50**
B.2.2 Production of the specimens **50**
B.2.3 Test procedure and climate conditions **51**
B.2.4 Requirements **52**
B.2.5 Test report **52**

Annex C (normative) **Delamination test of glue lines between layers** **53**
C.1 Principle **53**
C.2 Apparatus **53**
C.2.1 Pressure vessel **53**
C.2.2 Drying duct **53**
C.2.3 Balance **53**
C.2.4 Metal wedge and hammer **53**
C.3 Sampling and preparation of test pieces **53**
C.4 Procedures **54**
C.4.1 General **54**
C.4.2 Measurement and evaluation of delamination **54**
C.4.3 Test cycle **55**
C.5 Results **55**
C.5.1 General **55**
C.5.2 Total delamination **55**
C.5.3 Maximum delamination **56**
C.5.4 Wood failure percentage **56**
C.6 Test report **56**

Annex D (normative) **Shear tests** **57**
D.1 Principle **57**
D.2 Apparatus **57**
D.2.1 Testing machine **57**
D.2.2 Shearing tool **57**
D.3 Test pieces **58**
D.3.1 General **58**
D.3.2 Test pieces for edge bonds in timber layers **58**
D.3.3 Test pieces for glue lines between layers **58**
D.3.4 Test pieces for testing single glue lines within cross laminated timber **60**
D.3.5 Sampling of test pieces **60**
D.3.6 Marking of test pieces **61**
D.4 Procedure **61**
D.5 Results **61**
D.6 Test report **62**

Annex E (normative) **Tests with laminations with or without finger joints (including compliance criteria)** **63**
E.1 Sampling **63**
E.1.1 General **63**
E.1.2 For type testing **63**
E.1.3 For factory production control **63**
E.2 Testing **63**
E.2.1 General **63**
E.2.2 Additional requirements for type testing **63**
E.2.3 Additional requirements for factory production control **63**
E.3 Compliance criteria of finger joints in laminations **64**
E.3.1 For type testing **64**
E.3.2 For factory production control **64**
E.4 Report of tests with finger joints in laminations **64**
E.5 Tests with laminations without finger joints **65**

Annex F (normative) **Determination of strength, stiffness and density properties of cross laminated timber** **66**
F.1 Indices **66**
F.2 General **69**
F.2.1 Sampling **69**
F.2.2 Specimens **69**
F.2.3 Testing **69**
F.2.4 Analysis of test results **70**
F.2.5 Test reports **70**
F.3 Characteristics determined by tests with loads perpendicular to the plane **70**
F.3.1 Bending test **70**
F.3.2 (Rolling) shear strength and stiffness derived from bending tests **71**
F.3.3 (Rolling) shear strength and stiffness derived from shear test (alternative test method) **72**
F.3.4 Compression perpendicular to the plane **74**
F.3.5 Large finger joint - Bending test **74**
F.4 Characteristics determined by tests with in-plane loads **75**
F.4.1 Bending **75**
F.4.2 Shear values within a layer – net cross section **76**
F.4.3 Shear values for glue lines between layers – torsional shear **77**
F.4.4 Shear stiffness for cross laminated timber in plane by bending test **78**
F.4.5 Large finger joint - Bending test **79**

Annex G (normative) **Measurement of moisture content** **80**
G.1 General **80**
G.2 Measurement of moisture content of boards during production **80**
G.3 Mean moisture content of cross laminated timber made from timber laminations **80**

Annex H (normative) **Separation tests with finger joints in laminations produced with contact-free application of adhesive** **81**

Annex I (normative) **Minimum production requirements** **82**
I.1 Personnel **82**
I.2 Production and storage facilities **82**
I.2.1 General **82**
I.2.2 Facilities for drying and storage of timber **82**
I.2.3 Facilities for processing and storage of adhesives **82**
I.2.4 Facilities for production and curing **82**
I.3 Equipment **83**
I.4 Finger joints in laminations **83**

I.4.1 Wane and edge damages **83**
I.4.2 Finger joint geometry **84**
I.4.3 Knots and local grain deviation **84**
I.4.4 Moisture content at bonding **85**
I.4.5 Bonding surface and application of the adhesive **85**
I.4.6 Time between cutting and adhesive application **86**
I.4.7 Pressure **86**
I.4.8 Curing **86**
I.5 Bonding of laminations and layers **87**
I.5.1 General **87**
I.5.2 Moisture content at bonding **87**
I.5.3 Bonding surfaces and adhesive application **87**
I.5.4 Cramping **87**
I.5.5 Glue line thickness **87**
I.5.6 Curing **88**
I.6 Cross laminated timber with large finger joints **88**
I.6.1 Cross laminated timber to be jointed **88**
I.6.2 Moisture content at bonding **88**
I.6.3 Finger joint geometry **88**
I.6.4 Machining of the fingers **88**
I.6.5 Adhesive, bonding surface and adhesive application **88**
I.6.6 Cramping **89**
I.6.7 Glue line thickness **89**
I.6.8 Curing **89**

Annex ZA (informative) **Clauses of this European Standard addressing the requirements of the EU Construction Products Regulation** **90**

Bibliography **102**

European foreword

This document (EN 16351:2015) has been prepared by Technical Committee CEN/TC 124 "Timber structures", the secretariat of which is held by AFNOR.

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 April 2016, and conflicting national standards shall be withdrawn at the latest by July 2017.

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

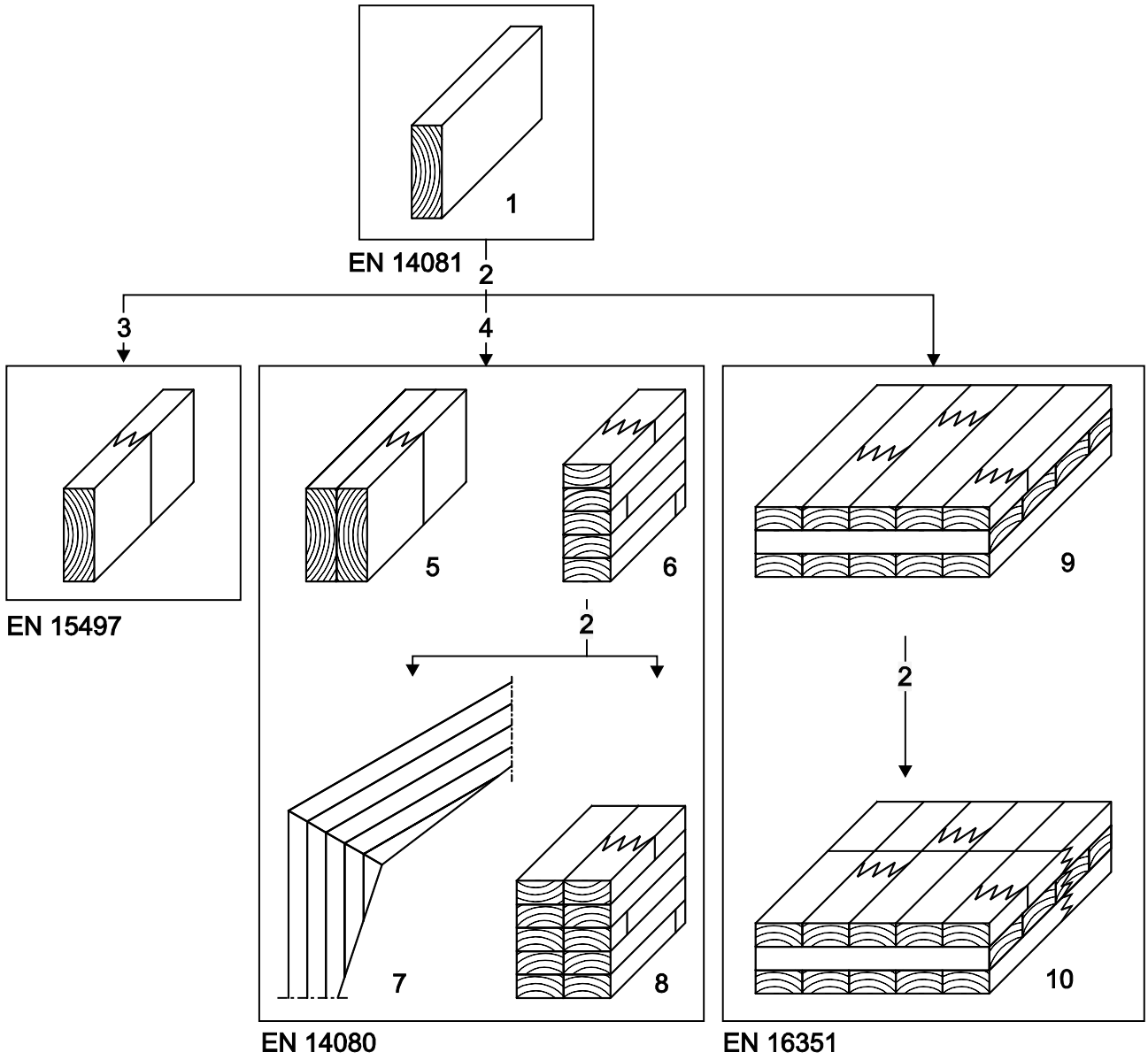
This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports basic work requirements of Regulation (EU) No 305/2011.

For relationship with the EU Regulations, see informative Annex ZA, which is an integral part of this document.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Figure 1 shows the relation of European Standards prepared by CEN/TC 124.



Key

1	boards	6	glued laminated timber (glulam)
2	is a component for	7	glulam with large finger joints
3	structural finger jointed timber	8	block glued glulam
4	glued laminated products	9	cross laminated timber (X-Lam)
5	glued solid timber	10	cross laminated timber (X-Lam) with large finger joints

Figure 1 — Relation of European Standards prepared by CEN/TC 124

1 Scope

This European Standard sets out provisions regarding the performance characteristics for straight and curved structural cross laminated timber (X-Lam) both without and with large finger joints as a material for the manufacture of structural elements to be used in buildings and bridges.

This European Standard applies to cross laminated timber:

— to be used in service class 1 or 2 according to EN 1995-1-1;

— made of coniferous species and poplar listed in 5.1.5 of this standard;

— built up of at least three orthogonally bonded layers (at least two of them timber layers);

— having, depending on the number of layers, adjacent layers which may be bonded parallel to the grain;

— made of timber layers which are made of strength graded timber according to EN 14081-1;

— made of timber layers having thicknesses between 6 mm and 60 mm (including) taking into account the layup requirements given in this European standard;

— made of timber layers which may be edge bonded or which are not bonded and have spacing less than 6 mm between adjacent laminations;

— which may comprise wood based panel layers made of structural wood based panels specified in this European standard, fulfilling the requirements for use in service class 2 or 3 according to EN 1995-1-1, having no structural joints between the single panels and having thicknesses between 6 mm and 45 mm (including);

— bonded with adhesives, fulfilling the requirements given in this European standard;

— having overall thicknesses up to 500 mm;

— which is not made from reused timber or wood based panels comprising reused timber.

This European Standard also applies to cross laminated timber with large finger joints:

— made from cross laminated timber pieces having the same cross section and layup;

— made from cross laminated timber pieces having cross sectional thicknesses from 51 mm up to 345 mm (inclusive) and minimum thicknesses of the outermost layers not less than 17 mm.

— made from cross laminated timber pieces solely comprising timber layers;

— made from plane cross laminated timber pieces jointed so that no regular change between the grain directions of the layers occurs;

— with finger joints having a finger length of at least 45 mm and fingers which are visible at the two narrow sides of the components.

This European Standard applies to cross laminated timber treated against biological attack. Cross laminated timber treated with fire retardants is not covered.

It also sets out minimum production requirements and procedures for Assessment and Verification of Constancy of Performance.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 301:2013, *Adhesives, phenolic and aminoplastic, for load-bearing timber structures — Classification and performance requirements*

EN 302-1, *Adhesives for load-bearing timber structures — Test methods — Part 1: Determination of longitudinal tensile shear strength*

EN 302-2:2013, *Adhesives for load-bearing timber structures — Test methods — Part 2: Determination of resistance to delamination*

EN 302-3:2013, *Adhesives for load-bearing timber structures — Test methods — Part 3: Determination of the effect of acid damage to wood fibres by temperature and humidity cycling on the transverse tensile strength*

EN 302-4, *Adhesives for load-bearing timber structures — Test methods — Part 4: Determination of the effects of wood shrinkage on the shear strength*

EN 302-6, *Adhesives for load-bearing timber structures — Test methods —- Part 6: Determination of the minimum pressing time under referenced conditions*

EN 338, *Structural timber - Strength classes*

EN 350-1, *Durability of wood and wood-based products — Natural durability of solid wood — Part 1: Guide to the principles of testing and classification of the natural durability of wood*

EN 350-2, *Durability of wood and wood-based products — Natural durability of solid wood — Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe*

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

EN 717-1, *Wood-based panels — Determination of formaldehyde release — Part 1: Formaldehyde emission by the chamber method*

EN 789:2004, *Timber structures — Test methods — Determination of mechanical properties of wood based panels*

EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*

EN 13183-1, *Moisture content of a piece of sawn timber — Part 1: Determination by oven dry method*

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

EN 13183-3, *Moisture content of a piece of sawn timber — Part 3: Estimation by capacitance method*

EN 13238, *Reaction to fire tests for building products — Conditioning procedures and general rules for selection of substrates*

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*

EN 13986, *Wood-based panels for use in construction — Characteristics, evaluation of conformity and marking*

EN 14081-1:2005+A1:2011, *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 14374, *Timber structures — Structural laminated veneer lumber — Requirements*

EN 15228:2009, *Structural timber — Structural timber preservative treated against biological attack*

EN 15416-3, *Adhesives for load bearing timber structures other than phenolic and aminoplastic — Test methods — Part 3: Creep deformation test at cyclic climate conditions with specimens loaded in bending shear*

EN 15416-5, *Adhesives for load bearing timber structures other than phenolic and aminoplastic — Test methods — Part 5: Determination of conventional pressing time*

EN 15425:2008, *Adhesives — One component polyurethane for load bearing timber structures — Classification and performance requirements*

3 Terms and definitions

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

3.1
actual size
measured size of a cross laminated timber at a related measured/estimated moisture content

3.2
bonding strength
structural effectiveness of adhesives between timber pieces when subjected to stresses

3.3
corrected size
size of a cross laminated timber corrected by calculation from its actual size to its size at the reference moisture content

3.4
cross laminated timber
X-Lam
structural timber consisting of at least three layers of which a minimum of three are orthogonally bonded, which always comprise timber layers and may also comprise wood-based panel layers

Note 1 to entry: See also 5.2.2.7.

Note 2 to entry: Cross laminated timber in accordance with EN 16351 and multilayer solid wood panels in accordance with EN 13353 may have the same layup but the timber to be used in laminations is strength graded according to EN 14081–1 and the adhesives are tested according to 5.1.6 of this European Standard.

3.5
curved cross laminated timber
cross laminated timber having a precamber greater than 1% of the respective span

3.6
edge bonds
bonds between adjacent laminations within a timber layer

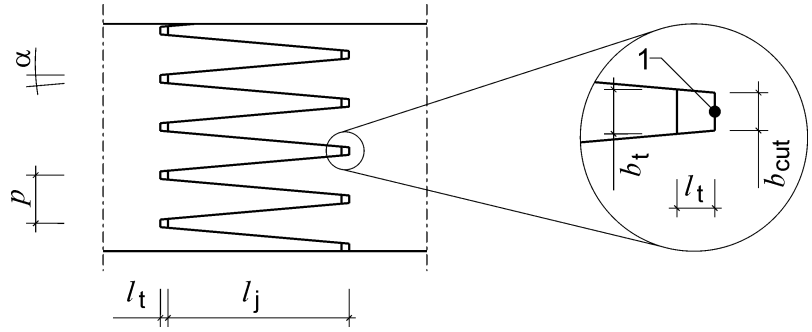
3.7
edge bonded layer
timber layer comprising structural edge bonds

3.8
finger angle
inclination α of each side of the fingers of a finger joint

Note 1 to entry: See Figure 2.

3.9
finger joint
interlocking end joint formed by machining a number of similar, tapered, symmetrical fingers in the ends of timber components using a finger joint cutter and then bonded together

Note 1 to entry: In this European Standard the term finger joint is used for finger joints in laminations whereas finger joints between cross laminated timber are defined as large finger joints (see 3.13).



Key

l_j finger length

p pitch

α finger angle

l_t tip gap

b_{cut} tip width of the cutter

b_t tip width

1 slot base

Figure 2 — Typical profile of a finger joint

3.10
finger length
distance l_j between the finger base and the tip of the finger, measured along the centre line of the finger

Note 1 to entry: See Figure 2.

3.11
finished thickness
thickness after planing

3.12
laminations
structural timber boards, finger jointed unless the length of a single board matches the lamination length, being part of timber layers in cross laminated timber

3.13
large finger joint
finger joint through the full cross sectional area of two cross laminated timber pieces

Note 1 to entry: See Figure 3.

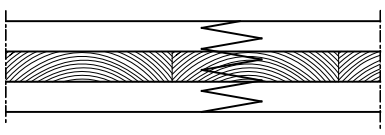


Figure 3 — Cross laminated timber with large finger joints

3.14
layup
cross sectional arrangement of timber layers or wood-based panel layers in which each layer may be made of different species and may have different strength classes, manufacturer specific strength classes or technical classes

3.15
manufacturer specific strength class
set of characteristic strength, stiffness and density properties not tabulated in a standard

3.16
maximum delamination length
largest delamination length in any single glue line measured around the circumference of the test piece

3.17
mean moisture content
mean value of the moisture content of cross laminated timber calculated from at least two measurements

Note 1 to entry: See G.3.

3.18
minimum mean density
required density at reference moisture content, estimated as the weighted mean of the mean densities of the layers, if necessary

Note 1 to entry: Minimum mean density is used for the classification of the reaction to fire.

3.19
pitch
distance between centres of adjacent finger tips

Note 1 to entry: See Figure 2.

3.20
ratio of resin to hardener
proportion of resin to hardener by mass with the resin set at 100 parts

3.21
reduction factor
ratio between tip width and pitch

Note 1 to entry: See Figure 2.

3.22
reference moisture content
moisture content at which target sizes are established

3.23
relative tip gap
ratio between tip gap and finger length

Note 1 to entry: See Figure 2.

3.24
rolling shear
shear stress for which both complementary stress components are perpendicular to the grain

3.25
target size
size specified (at the reference moisture content) to which deviations are to be related

3.26
timber layer
layer made of edge bonded or non-edge bonded timber laminations

3.27
tip gap
distance between finger-tip and slot base in a bonded finger joint

Note 1 to entry: See Figure 2.

3.28
tip width
distance between finger faces, measured at the tip of the finger

Note 1 to entry: See Figure 2.

3.29
total delamination length
sum of delamination lengths of all glue lines measured around the circumference of the test piece

3.30
wood-based panels
structural plywood, structural laminated veneer lumber (LVL) and structural solid wood panels according to EN 13986 and structural LVL according to EN 14374

3.31
wood-based panel layer
layer made of one type and technical class of wood-based panels

3.32
wood failure
rupture in or between wood fibres

3.33
wood failure percentage
percentage of the wood failure area in relation to the total sheared or split area

4 Symbols

4.1 Main symbols

A area, in mm^2;

A_w area of wane, in mm^2 (see Figure I.1);

a_w length of the diagonal of wane, in mm (see Figure I.1);

b	width, in mm;
b_{cut}	tip width of the cutter (see Figure 2);
b_t	tip width, in mm (see Figure 2);
C	compression force in N (for indices see also Figures F.1 and F.2 and Tables F.1 to F.3);
d	diameter, in mm;
$Delam_{max}$	maximum delamination, in %;
$Delam_{tot}$	total delamination, in %;
e	relative tip gap;
f	strength, in N/mm^2;
G	shear modulus, in N/mm^2;
k	moisture deformation factor;
k_{15}	statistical factor;
l	length, in mm;
l_j	finger length, in mm (see Figure 2);
l_t	tip gap, in mm (see Figure 2);
p	pitch, in mm (see Figure 2);
M	Moment, in Nmm (for indices see also Figures F.1 and F.2 and Tables F.1 to F.3);
r	radius of curvature, in mm;
R	Resistance to forces in N or to moments in Nm (for indices see also Figures F.1 and F.2 and Tables F.1 to F.3);
t	thickness, in mm;
T	Tension force in N (for indices see also Figures F.1 and F.2 and Tables F.1 to F.3);
u	moisture content, in %;
V	Shear force in N (for indices see also Figures F.1 and F.2 and Tables F.1 to F.3);
w	deflection, in mm;
α	finger angle, in degree (see Figure 2);
ρ	density, in kg/m^3;
v	reduction factor of a finger joint.

4.2 Subscripts

a	actual;
c	compression;
cor	corrected;
dc	declared value;
j	properties of finger joints in laminations;
k	characteristic;
l	properties of laminations;

lay	properties of layers;
lfj	properties of large finger joints;
local	referring to local axis or plane;
m	bending;
mean	mean value;
ref	reference;
t	tension;
v	shear;
w	property of wane;
x	global axis parallel to the fibre direction of the outermost layers, (see Figure F.1 and F.2);
xlam	properties of cross laminated timber;
y	global axis orthogonal to the fibre direction of the outermost layers, (see Figure F.1 and F.2);
z	global axis perpendicular to the plane of the cross laminated timber, (see Figure F.1 and F.2);
0	local axis parallel to the grain;
90	local axis perpendicular to the grain (both tangential and radial);
090	local plane spanned by local axis 0 and axis 90 (e.g. shear in a plane spanned by axes parallel and perpendicular to the fibre direction);
9090	local plane spanned by local axis 90 and axis 90 (e.g. shear in a plane spanned by axes perpendicular to the fibre direction).

5 Components and product characteristics, testing and assessment methods

5.1 Components characteristics

5.1.1 Timber to be used in laminations

Timber boards used in laminations shall be strength graded or tested according to EN 14081-1 and declared as tabulated strength class in accordance with EN 338, manufacturer specific strength class or as individual values.

For the determination of characteristic strengths the height factor given in EN 384 may be disregarded. The requirements of EN 14081-1 also apply to the grading of boards having thicknesses from 6 mm up to 22 mm.

Used wood is not permitted.

5.1.2 Laminations

If either the characteristic tensile strength or the characteristic bending strength of the finger joints in laminations, tested in accordance with Annex E, fulfils the requirements given in Formula (1) or (2), respectively, the properties of the laminations shall be taken as those of the timber boards:

$$f_{t,j,k} \geq f_{t,0,l,k} + 5 \text{ N/mm}^2 \quad (1)$$

$$f_{m,j,k} \geq 1{,}4\, f_{t,0,l,k} + 8 \text{ N/mm}^2 \quad (2)$$

where:

$f_{t,j,k}$ is the characteristic tensile strength of the finger joint in N/mm²;

$f_{m,j,k}$ is the characteristic bending strength of the finger joint in flatwise bending in N/mm² and;

$f_{t,0,l,k}$ is the characteristic tensile strength of the timber in N/mm².

If it is intended to manufacture preservative treated cross laminated timber, testing shall be done with finger joints in treated timber.

5.1.3 Timber layers

Each timber layer shall be made of laminations of one strength class or manufacturer specific strength class.

Each timber layer may be produced from laminations made of mixed species, if these species have similar technical properties, especially regarding swelling and shrinking.

The properties of the timber layers shall be taken as the properties of the laminations from which they are made of.

5.1.4 Wood-based panel layers

Only wood-based panels which fulfil the requirements for the use in service class 2 or 3 according to EN 1995-1-1 shall be used.

The strength of butt joints and glued joints between wood-based panels in a layer shall be regarded as zero.

Wood-based panels comprising used wood are not permitted.

The material properties of wood based panel layers shall be taken as the material properties of the wood based panels from which they are made of.

5.1.5 Species

This European Standard covers cross laminated timber made with timber laminations and wood-based panels from the following species:

Norway Spruce (*Picea abies*, PCAB), Fir (*Abies alba*, ABAL), Scots pine redwood (*Pinus sylvestris*, PNSY), Douglas fir (*Pseudotsuga menziesii*, PSMN), Western Hemlock (*Tsuga heterophylla*, TSHT), Corsican pine (*Pinus nigra Arnold subsp. laricio*, PNNL), Austrian pine (*Pinus nigra Arnold subsp. nigro*, PNNL), European Larch (*Larix decidua*, LADC), Siberian larch (*Larix sibirica*, LASI), Dahurian larch (*Larix gmelinii (Rupr.) Kuzen*.), Poplar (Applicable clones: Populus x euramericana cv “Robusta”, ”Dorskamp”, “I214” and “I4551”, POAL), Maritime pine (*Pinus pinaster*, PNPN), Radiata-Pine (*Pinus radiata*, PNRD), Sitka-spruce (*Picea sitchensis*, PCST), Southern Yellow pine (*Pinus palustris*, PNPL), Western Red Cedar (*Thuja plicata*, THPL), Yellow Cedar (*Chamaecyparis nootkatensis*, CHNT).

Norway spruce and Fir may be considered as one species.

NOTE 1 Letter codes according to EN 13556, if available, are given after the botanical name.

NOTE 2 Not all of the species listed above have a national grade related to a European strength class in EN 1912.

5.1.6 Adhesives for the production of cross laminated timber

5.1.6.1 General

Adhesives shall provide durable bonds in cross laminated timber.

Adhesives shall be assigned to an adhesive type (including subclasses, if relevant) according to EN 301:2013, Table 1 or EN 15425:2008, Table 1.

Taking into account the restrictions given in the referred subclauses, the following adhesive families are applicable:

a) phenolic and aminoplastic adhesives (e.g. MF, MUF, PRF, UF) in accordance with 5.1.6.2;

b) moisture curing one-component polyurethane adhesives (PUR) in accordance with 5.1.6.3;

c) emulsion polymer isocyanate adhesives (EPI) in accordance with 5.1.6.4.

If a preservative treatment is done before the bonding of the laminations or layers it shall be documented that the requirements are fulfilled for the combination of the preservative and adhesive.

The applicability of an adhesive for a cross laminated timber or its components covered by this European Standard shall be taken from Table 1.

Table 1 — Applicability of adhesives for cross laminated timber and its components

	Relevant requirements for the application of:		
	Phenolic and aminoplastic adhesives	**Moisture curing one-component polyurethane adhesives**	**Emulsion polymer isocyanate adhesives**
Finger joints in laminations	5.1.6.2	5.1.6.3	5.1.6.4
Structural edge bonds between laminations	5.1.6.2	5.1.6.3	5.1.6.4
Bonds between layers	5.1.6.2	5.1.6.3	5.1.6.4
Large finger joints	5.1.6.2	5.1.6.3	Not applicable

The applicability of adhesives may be further limited by national requirements valid at the place of use.

5.1.6.2 Phenolic and aminoplastic adhesives

Phenolic and aminoplastic adhesives shall fulfil the requirements of EN 301 and shall, if required, be tested and declared according to EN 302-6.

For phenolic and aminoplastic adhesives to be used for large finger joints separate application of resin and hardener is not allowed.

5.1.6.3 Moisture curing one component polyurethane adhesives

Moisture curing one component polyurethane adhesives shall fulfil the requirements of EN 15425 and B.2 taking into account the conditions given in B.1.

The requirements given in EN 302-2:2013, 5.1, 2nd paragraph apply. For moisture curing one component polyurethane adhesives to be used in finger joints in larch wood the delamination test

according to EN 302-2 may be replaced by tests according to EN 301:2013, Annex A, with larch wood species.

Moisture curing one component polyurethane adhesives to be used for large finger joints shall fulfil the requirements of EN 15425 for glue line thicknesses up to 0,3 mm.

If required, the influence of the climate on the minimum pressing time shall be tested and declared in accordance with EN 15416-5.

5.1.6.4 Emulsion polymer isocyanate adhesives

5.1.6.4.1 General

Emulsion polymer isocyanate adhesives shall fulfil the requirements of EN 15425 and B.2 taking into account the conditions given in B.1.

If required the influence of the climate on the minimum pressing time shall be tested and declared in accordance with EN 15416-5. If the maximum glue line thickness in use is 0,2 mm these tests shall be performed with specimens having a glue line thickness of 0,2 mm.

5.1.6.4.2 Systems tested with a maximum glue line thickness of 0,3 mm

Testing according to EN 15425 and B.1 and B.2 may be done with a maximum glue line thickness of 0,3 mm instead of 0,5 mm if the glue line thicknesses in the finished cross laminated timber do not exceed 0,2 mm.

For tests with a maximum glue line thickness of 0,3 mm the requirements given in EN 15425 shall apply with the following exceptions:

— For bonding strength in longitudinal tensile strength tests according to EN 302-1 with a glue line thickness of 0,3 mm, the requirements given in Table 2 shall be met;

— For creep deformation tests with specimens loaded in bending shear according to EN 15416-3, the specimens shall have a glue line thickness of 0,2 mm.

Table 2 — Required mean shear strength in N/mm² for lap shear tests according to EN 15425 for samples glued with EPI having a glue line thickness of 0,3 mm

	Adhesive type	
Treatment	Type I	Type II
A1	9,5	9,5
A2	5,5	5,5
A3	7,6	7,6
A4	5,5	NR [a]
A5	7,6	NR [a]
A6	NR [a]	8,3
A7	7,2	NR [a]
[a] Treatment cycle not required (NR).		

5.2 Characteristics of cross laminated timber

5.2.1 General

If required, characteristics of cross laminated timber shall be obtained either by testing or by determining the characteristics of the components (proxy characteristics), and declared accordingly.

For one and the same cross laminated timber some characteristics may be determined by means of proxy characteristics and others by testing.

5.2.2 Geometrical data

5.2.2.1 General

The relevant geometrical data (cross sectional sizes, layup, layer thickness and orientations, presence of grooves, presence of edge bonds and ratio of lamination width to lamination thickness shall be determined and declared.

5.2.2.2 Cross sectional sizes

The overall thickness of the cross laminated timber shall not exceed 500 mm.

5.2.2.3 Layer thickness

The finished thickness t_l of any layer shall be greater than or equal to 6 mm and less than or equal to 45 mm, except for three layered cross laminated timber where the inner timber layer may have a finished thickness up to 60 mm.

For curved cross laminated timber the maximum finished thickness t_l of the lamination is also governed by the radius r of curvature of the lamination with the smallest radius within the cross laminated timber and the characteristic bending strength of the end joints. The finished thickness t_l shall comply with Formula (3):

$$t_l \leq \frac{r}{250}\left(1+\frac{f_{\mathrm{m,j,dc,k}}}{80}\right) \tag{3}$$

where:

t_l is the finished lamination thickness (in mm);

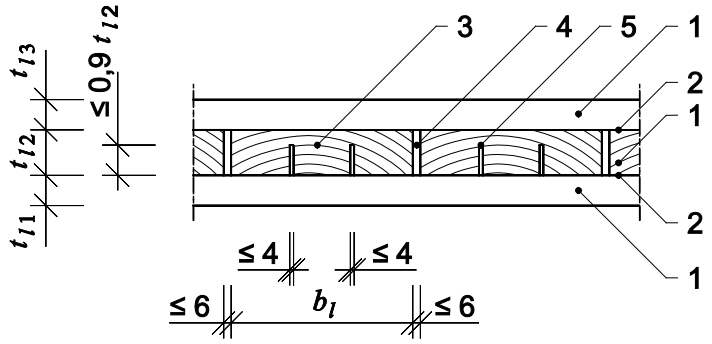
r is the radius of the lamination with the smallest radius (in mm);

$f_{\mathrm{m,j,dc,k}}$ is the declared characteristic bending strength of the finger joints (in N/mm^2).

5.2.2.4 Grooves and edge bonds

In order to reduce cupping and cracking, laminations may be grooved. Grooves may have a maximum depth of 90 % of the thickness of the lamination and a maximum width of 4 mm, see Figure 4.

Dimensions in millimetres



Key

1 timber layers

2 bondline between layers

3 lamination

4 gap between laminations

5 grooves in laminations

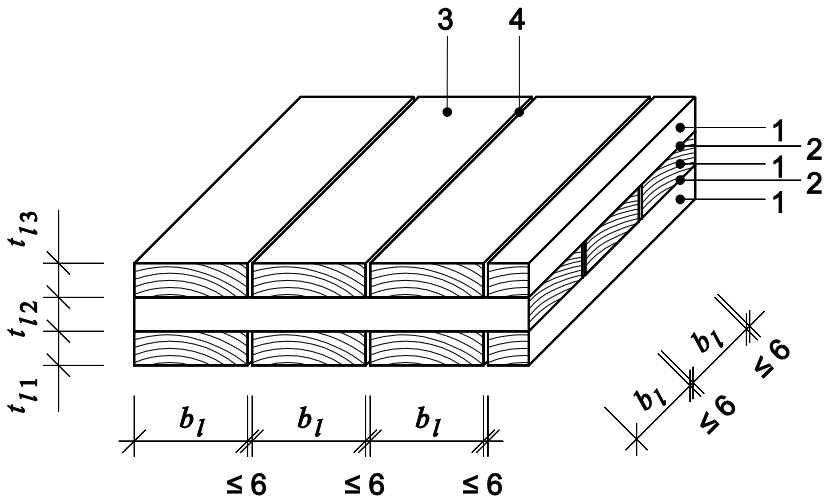
Figure 4 — Permissible geometry of grooves

Adjacent laminations may be edge bonded or non edge bonded. The width of gaps between adjacent laminations within a timber layer shall be less than or equal to 6 mm, see Figure 4.

The finished width b_l of any lamination in a non edge bonded layer, the spacings between adjacent grooves in lamellas and the distances between grooves and edges of laminations shall be greater than or equal to 40 mm. The finished width b_l of any lamination shall be less than or equal to 300 mm, see Figure 5.

If it is intended, to declare rolling shear strength according to 5.2.3.2, further limitations on the ratio of lamination width to lamination thickness apply.

Dimensions in millimetres



Key

1	timber layer	$6 \le t_{l,3} \le 45$	$6 \le t_{l,2} \le 60$	$40 \le b_l \le 300$
2	bondline between layers			
3	lamination			
4	gap between lamination			

Figure 5 — Example for a layup made of three timber layers

5.2.2.5 Maximum acceptable deviations

The corrected thickness of the cross section (see 5.2.2.6) shall not deviate from the nominal thickness by more than ± 2 mm or 2 % of the nominal thickness whichever is greater.

The corrected thickness of the single layers shall not deviate from the nominal thickness by more than ± 1 mm.

5.2.2.6 Corrected sizes and moisture deformation factor

The actual sizes of cross laminated timber are influenced by swelling and shrinkage due to changes of moisture content.

The swelling and shrinkage ratios of a certain species can be regarded as constant values in the perpendicular to grain and parallel to grain directions of the timber.

If the actual moisture content differs from the reference moisture content, a corrected size is calculated from the actual size by Formula (4):

$$a_{cor} = a_a \left(1 + k_{cor,\alpha} \left(u_{ref} - u_a\right)\right) \quad (4)$$

where

a_{cor} is the corrected size, in mm;

a_a is the actual size, in mm;

$k_{cor,\alpha}$ is the moisture deformation factor perpendicular to the grain for a change in moisture content of 1 % for moisture contents from 6 % up to 25 % (inclusive);

u_{ref} = 12 % is the reference moisture content, in %;

u_a is the actual moisture content, in %, measured according to Annex G.

Unless taken from the respective design code the moisture deformation factor for unhindered moisture induced deformations and for species listed in 5.1.5 may be taken as:

$k_{cor,90}$ = 0,002 4 for deformations perpendicular to the plane;

$k_{cor,0}$ = 0,000 2 for deformations in plane.

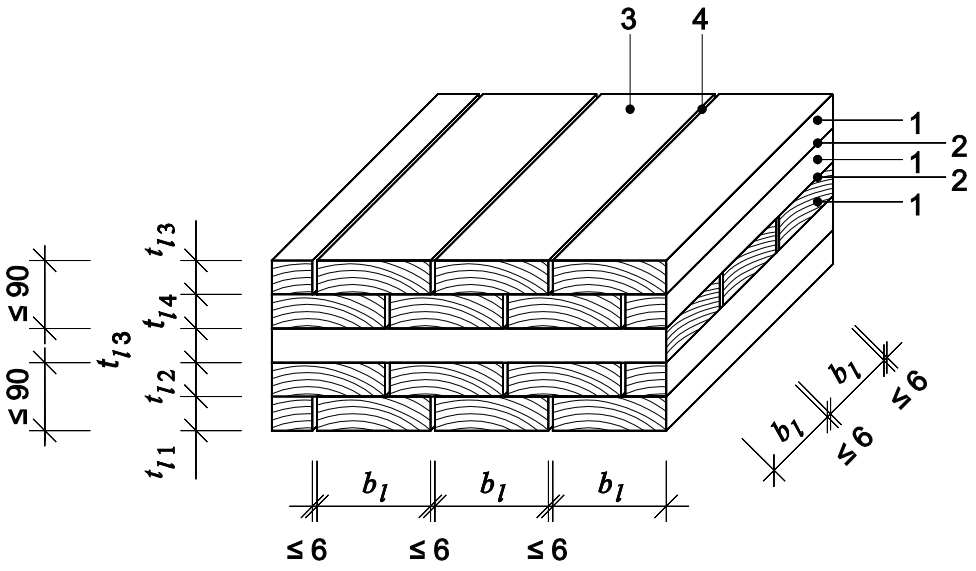
5.2.2.7 Layup (including layer orientation)

Each layup shall comprise at least three layers, at least two of them made of timber laminations. An example for a layup made of three layers is given in Figure 5.

Layers made of laminations or solid wood panels shall be orthogonally arranged, unless the following conditions are met: Within cross laminated timber made of four or more layers, up to three adjacent layers having a total thickness of not more than 90 mm may be glued parallel to the grain in the direction of one of the main axes of the cross laminated timber, see Figure 6.

The sum of the thicknesses of all wood based panel layers in a cross laminated timber may be up to 50 % of the overall thickness of the cross laminated timber, see Figure 7. Wood-based panel layers may be bonded to layers made of laminations in one of the main axis of the wood-based panels.

Dimensions in millimetres

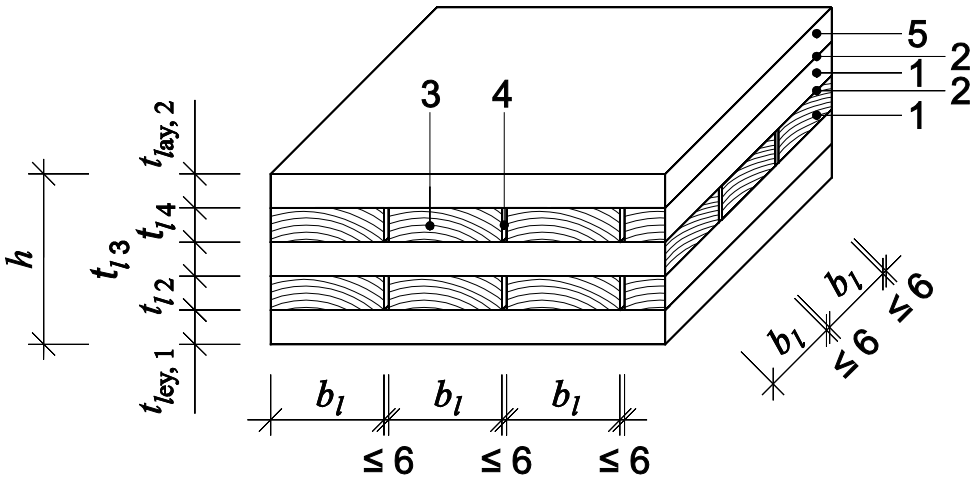


Key

1	timber layer	$6 \le t_l \le 45$ $40 \le b_l \le 300$
2	bondline between layers	
3	lamination	
4	gap between lamination	

Figure 6 — Example for a layup with five timber layers outermost layers bonded parallel to the grain

Dimensions in millimetres



Key

1	timber layer	$6 \le t_l \le 45$	$40 \le b_l \le 300$
2	bondline between layers		
3	lamination		
4	gap between lamination		
5	wood-based panel layer	$t_{lay} \le 45$	$\sum_i t_{lay} \le 0{,}5\,h$

Figure 7 — Example for a layup including wood-based panels

5.2.3 Strength and stiffness properties of cross laminated timber

5.2.3.1 General

For the purpose of this standard, modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength of cross laminated timber are treated as "Strength and stiffness properties of cross laminated timber" and shall be obtained either:

— by determination and declaration of geometrical data and relevant properties of the layers (proxy characteristics) according to 5.2.3.2;

— by testing of cross laminated timber and declaration of geometrical data and relevant recalculated properties of the layers determined from tests (proxy characteristics) according to 5.2.3.3.

NOTE Resistances and stiffnesses of cross laminated timber can be calculated later under a structural design for a specific end-use situation, using calculation method(s) applicable in the market where it is intended to be used.

For one cross laminated timber some properties may be verified by determination and others by testing.

5.2.3.2 Determination from geometrical data and layer's properties

If the strength and stiffness properties of the cross laminated timber are expressed as geometrical data and layer's properties the following information shall be given:

— geometrical data (cross sectional sizes, layer thicknesses and orientations, grooves (if relevant), presence of edge bonds (if relevant) and ratio of lamination width to lamination thickness according to 5.2.2);

— strength, stiffness and density properties of timber layers according to 5.1.3 and wood based panel layers according to 5.1.4, if relevant, and;

— bending strength(s) of the large finger joints according to 5.2.4, if relevant.

For cross laminated timber either

— made of edge bonded timber layers, or

— made of timber layers, which have a thickness of up to 45 mm (including), which are not edge bonded and comprise laminations having a ratio of lamination width to lamination thickness greater than or equal to four,

the characteristic rolling shear strength $f_{v,9090,k}$ may be taken as $f_{v,9090,k}$ = 1,1 N/mm² without testing. Grooves in laminations shall be regarded as free (non bonded) edges.

If a ratio of lamination width to lamination thickness is not limited in a non edge bonded timber layer having a thickness of up to 45 mm (including) the characteristic rolling shear strength $f_{v,9090,k}$ may be taken as $f_{v,9090,k}$ = 0,7 N/mm², without testing.

If the characteristic compression strength perpendicular to the grain of a cross laminated timber only made from timber layers is not determined by tests, it may be taken as $f_{c,90,xlam,k}$ = 3 N/mm².

The characteristic density of the cross laminated timber may be taken as $\rho_{xlam,k} = 1{,}1\ \rho_{lay,k}$ where $\rho_{lay,k}$ is the characteristic density of the lowest declared timber grade of a timber layer within the cross laminated timber. The mean density of the cross laminated timber shall be taken as $\rho_{xlam,mean} = \rho_{lay,mean}$ where $\rho_{lay,mean}$ is the mean density of the lowest declared timber grade of a timber layer within the cross laminated timber.

5.2.3.3 Determination from tests with cross laminated timber

If the strength and stiffness properties of the cross laminated timber are determined from tests, these tests shall be done and evaluated according to Annex F. The strength and stiffness properties of the cross laminated timber shall be expressed as:

— geometrical data (cross sectional sizes, layer thicknesses and orientations, grooves (if relevant), presence of edge bonds (if relevant), and ratio of lamination width to lamination thickness according to 5.2.2);

— strength, stiffness and density properties of timber and wood based panel layers, if relevant, calculated from test results and;

— bending strength(s) of the large finger joints according to 5.2.4, if relevant.

5.2.4 Strength and stiffness properties of cross laminated timber with large finger joints

For cross laminated timber with large finger joints the characteristic bending strength(s) $f_{m,lfj,k}$ of the large finger joints shall also be tested and declared in accordance with F.3.5 and F.4.5 in the directions (flat- or edgewise) relevant for the intended use.

5.2.5 Bonding strength

5.2.5.1 General

Bonds may be considered durable and reliable satisfied if the respective minimum production requirements given in Annex I and the requirements given in 5.2.2.3, 5.2.2.4 and 5.2.2.7 are fulfilled.

Bonding strength is defined by

— bonding strength of finger joints in laminations according to 5.2.5.2 tested for bending or tension strength of finger joints according to 5.1.2 and declared as bending strength of timber;

— bonding strength of glue lines between layers, tested and declared according to 5.2.5.4;

— bonding strength of edge bonds between laminations, tested and declared according to 5.2.5.3, if relevant; and

— bonding strength of large finger joints, tested according to 5.2.5.5, and declared as bending strength(s) of large finger joints according to 5.2.4, if relevant.

5.2.5.2 Bonding strength of finger joints in laminations

Finger joints in laminations may be considered durable and reliable if the respective minimum production requirements given in I.4 are fulfilled.

Bonding strength of finger joints in laminations shall be verified by bending or tension strength tests according to 5.1.2.

5.2.5.3 Bonding strength of bonds in edge bonded timber layers (shear test)

The bonding strength of edge bonds between laminations shall be verified by shear tests according to Annex D, if these glue lines are declared as load bearing glue lines, and declared as “Pass Shear”.

The bonding strength of edge bonds is proved to be sufficient, if the characteristic shear strength of the edge bonds $f_{v,k}$ derived from tests is $f_{v,k} \geq 3{,}5$ N/mm^2. If a single tested glue line has a shear strength of $f_v < 2$ N/mm^2 the wood failure percentage in this glue line shall be 100 %.

5.2.5.4 Bonding strength of glue lines between layers

5.2.5.4.1 General

Bonds between laminations may be considered durable and reliable if the respective minimum production requirements given in I.5 are fulfilled.

The bonding strength of glue lines between layers shall be verified either by delamination test according to 5.2.5.4.2 or by shear test according to 5.2.5.4.3. The shear test according to 5.2.5.4.3 is the reference test method. No correlation between delamination test and shear test results is given.

5.2.5.4.2 Bonding strength of glue lines between layers (delamination test)

The glue line integrity of glue lines between layers shall be verified by delamination test according to Annex C and declared as test method “Pass Delam”.

The bonding strength of glue lines between layers is proved to be sufficient, if the maximum delamination length does not exceed 40 % of the total length of a single glue line and the total delamination length does not exceed 10 % of the sum of all glue lines. Where the maximum delamination length or the total delamination length exceeds the limits given above or if the delamination lengths cannot be estimated due to the inadequate surface quality of the end grain

surfaces each glue line shall be split. The minimum wood failure percentage of each split glued area shall be not less than 50 %, the minimum wood failure percentage of the sum of all split glued areas shall be not less than 70 %.

5.2.5.4.3 Bonding strength of glue lines between layers (shear test)

The bonding strength of glue lines between layers shall be verified by shear tests according to Annex D and declared as test method "Pass Shear",

The bonding strength of glue lines between crosswise bonded layers is proved to be sufficient, if the characteristic shear strength $f_{v,k}$ derived from tests is $f_{v,k} \geq 1{,}25$ N/mm² and the shear strength f_v of each glue line is at least 1 N/mm².

The bonding strength of glue lines between parallel bonded layers is proved to be sufficient, if the characteristic shear strength $f_{v,k}$ derived from tests is $f_{v,k} \geq 3{,}5$ N/mm², If a tested glue line has a shear strength of $f_v < 2$ N/mm² the wood failure percentage in this glue line shall be 100 %.

5.2.5.5 Bonding strength of large finger joints

Large finger joints may be considered durable and reliable if the respective minimum production requirements given in I.6 are fulfilled.

Bonding strength of large finger joints shall be verified by bending strength tests according to 5.2.4 and declared as bending strength of large finger joints according to 5.2.4.

5.2.6 Resistance to fire

When required, resistance to fire of cross laminated timber shall be declared as the following proxy parameters:

— geometrical data (e.g. cross sectional sizes and layup), in accordance with 5.2.2 and;

— charring rate (of layers), assessed on the basis of the species used, as given in 5.1.5; and the characteristic density expressed as strength class of timber layer, in accordance with 5.1.3 or technical class according to 5.1.4 or as single value.

NOTE Resistance to fire of cross laminated timber can be calculated later under a fire engineering design for specific end-use situation taking into account additional parameters, e.g. charring rates, given in the respective fire design code.

5.2.7 Reaction to fire

5.2.7.1 General

When required, the class of reaction to fire performance (including the additional classification on smoke production and flaming droplets/particles, if any) of cross laminated timber, both preservative treated against biological attack or not, shall be either:

— declared as the reaction to fire class of the timber layers according to 5.2.7.2 or;

— tested and declared according to 5.2.7.3.

5.2.7.2 Declaration as reaction to fire class of layers

The reaction to fire performance of cross laminated timber may be taken as the reaction to fire performance(s) of its layers. The reaction to fire performance of timber layers shall be determined according to EN 14081-1 and the reaction to fire performance of wood based panel layers according to EN 13986.

Either the reaction to fire classes of all layers or the class of the layer having the lowest reaction to fire class shall be declared.

5.2.7.3 Declaration on the basis of tests

5.2.7.3.1 General

The cross laminated timber shall be tested and classified according to EN 13501-1 and the standards referred therein for the corresponding reaction to fire classes.

Tests may be done without conditioning according to EN 13238 with specimens having a moisture content of $u \leq 15$ %. The moisture content shall be reported.

Unless the reaction to fire performance is determined from tests, the influence of a preservative treatment against biological attack on the performance of reaction to fire shall be taken into account as laid down in EN 15228:2009, 4.4.

Reaction to fire class of cross laminated timber with large finger joints shall be considered as the reaction to fire class of the cross laminated timber components.

5.2.7.3.2 Mounting and fixing conditions

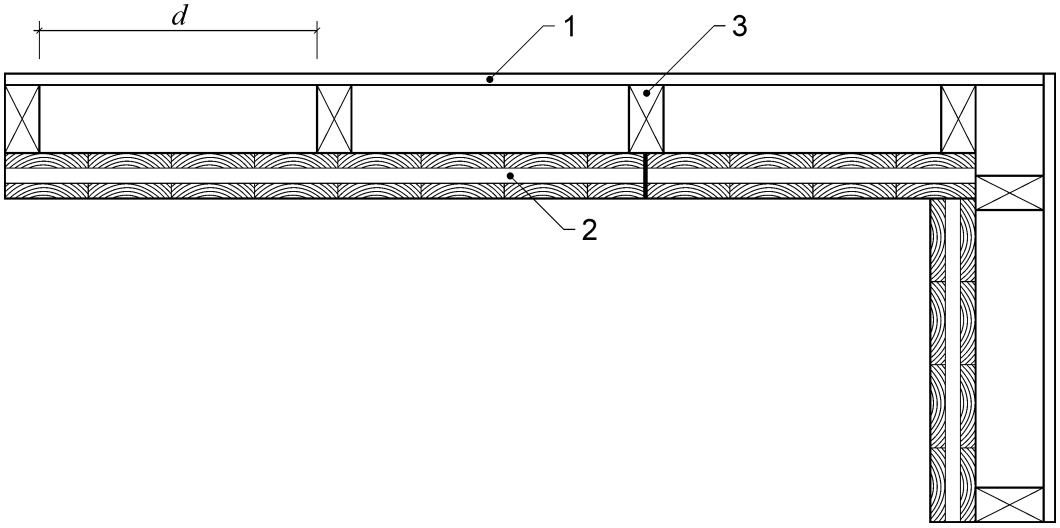
For tests according to EN 13823 (SBI test) specimens of cross laminated timber shall be mounted and fixed as follows:

— the whole area of both wings in the SBI apparatus shall be covered with pieces of the cross laminated timber concerned, mounted edge to edge (butt jointed), without jointing or bonding and orientated horizontally or vertically;

— supported by battens of the cross laminated timber concerned of a size minimum (40 × 80) mm, fixed to the test backing boards at 400 mm to 600 mm centres horizontally or vertically (perpendicular to the orientation of the cross laminated timber pieces), so that the resulting spacing between backing board and cross laminated timber is 80 mm;

— see also Figure 8.

Test results are valid for cross laminated timber having at least the densities and the minimum overall thickness of the specimens tested.



Key

400 mm ≤ *d* ≤ 600 mm

1 backing board

2 cross laminated timber

3 batten (cross section of 40 mm x 80 mm)

Figure 8 — Top view of fixing system for reaction to fire test according to EN 13823

5.2.8 Dimensional stability

The sizes of timber change by swelling and shrinkage due to changes of moisture content (for moisture contents below fibre saturation point which can be taken as 25 % for coniferous species). Changes in sizes due to changes of moisture content are determined according to 5.2.2.6. The moisture deformation factor depends on the species.

Dimensional stability shall be declared either as moisture deformation factor according to 5.2.2.6 or as species.

5.2.9 Release of dangerous substances

5.2.9.1 Formaldehyde emission

If required, the release of formaldehyde shall be tested according to Annex A and declared as either Class E1 or class E2 given in that Annex.

NOTE Cross laminated timber of class E2 may be banned in some member states.

5.2.9.2 Release/content of other dangerous substances

National regulations on dangerous substances may require verification and declaration on release and sometimes on content of other dangerous substances in addition to those dealt with in other clauses when construction materials covered by this Standard are placed on those markets.

In the absence of European harmonized test methods, verification and declaration on release/content should be done taking into account national provisions in the place of use.

NOTE An informative database covering European and national requirements on dangerous substances is available at the Construction website on EUROPA accessed through: http://ec.europa.eu/growth/tools-databases/cp-ds/index_en.htm.

5.2.10 Durability

5.2.10.1 Durability of bonding strength

Durability of bonding strength shall be expressed as:

— species according to 5.1.5;

— adhesive type and adhesive family according to 5.1.6;

— and declaration of minimum pressing time according to 5.1.6.2 or 5.1.6.3 or 5.1.6.4.1, if required at the place of intended use.

5.2.10.2 Durability against biological attack

5.2.10.2.1 General

If the cross laminated timber is solely built up of timber layers the durability against biological attack shall be declared as the durability of the timber. If the cross section is built up of different species or of treated and untreated layers only the natural durability or the preservative treatment of the layer with the lowest durability needs to be declared.

If the cross laminated timber comprises wood-based panel layers the technical class of these wood-based panels, where applicable, shall be declared additionally. If the cross section comprises different types of wood-based panels only the technical class of the wood-based panel with the lowest durability needs to be declared.

5.2.10.2.2 Timber layers without preservative treatment

The natural durability of cross laminated timber shall be taken as the natural durability according to EN 350-2 of the timber from which they are made. For species not listed in EN 350-2, the natural durability shall be verified according to EN 350-1.

5.2.10.2.3 Timber layers with preservative treatment

Only treatments according to EN 15228:2009, 4.5, which do not affect the strength, stiffness and density properties shall be used.

If either the preservative treated timber is used for the layers of the cross laminated timber, or the cross laminated timber itself is preservative treated, the information given in EN 15228:2009, Clause 6, shall be declared.

Requirements according to EN 15228 apply to the cross laminated timber as supplied, e.g. planing needs to be taken into account regarding retention and penetration depth.

NOTE The use of timber preservatives may be restricted by requirements valid in the place of use.

5.2.10.2.4 Wood-based panels

The technical class of wood-based panels according to EN 13986 shall be declared.

The durability of LVL according to EN 14374 shall be declared as the natural durability according to EN 350-2 of the timber from which it is made of. For species not listed in EN 350-2, the natural durability shall be verified according to EN 350-1.

6 Assessment and Verification of Constancy of Performance (AVCP)

6.1 General

The compliance of cross laminated timber with the requirements of this standard and with the performances declared by the manufacturer in the Declaration of Performance (DoP) shall be demonstrated by:

— determination of the product-type on the basis of type testing;

— factory production control by the manufacturer, including product assessment.

The manufacturer shall always retain the overall control and shall have the necessary means to take responsibility for the conformity of the product with its declared performance(s).

6.2 Type testing

6.2.1 General

All performances related to characteristics of 5.2 of this standard shall be determined when the manufacturer intends to declare the respective performances unless the standard gives requirements for declaring them without performing tests. (e.g. use of previously existing data, CWFT and conventionally accepted performance).

Assessments previously performed in accordance with the requirements of this standard may be taken into account provided that they were made to the same or a more rigorous test method, under the same AVCP system on the same product or products of similar design, construction and functionality, such that the results are applicable to the product in question.

NOTE 1 Same AVCP system means testing by an independent third party, under the responsibility of a notified product certification body.

Reference to the assessment method standards should be made to allow the selection of a suitable representative sample.

For the purposes of assessment, the manufacturer's products may be grouped into families, where it is considered that the results for one or more characteristics from any one product within the family are representative of the same characteristics for all products within that same family.

Products may be grouped in different families for different characteristics.

In addition, the determination of the product-type shall be performed for all characteristics included in the standard for which the manufacturer declares the performance:

— at the beginning of the production of a new or modified cross laminated timber (unless a member of the same product range), or

— at the beginning of a new or modified method of production (where this may affect the stated properties); or

— they shall be repeated for the appropriate characteristic(s), whenever a change occurs in the cross laminated timber design, in the raw material or in the supplier of the components, or in the method of production (subject to the definition of a family, e.g. production on a new production line), which would affect significantly one or more of the characteristics.

NOTE 2 In this context "design" means "product design".

Where components are used whose characteristics have already been determined, by the component manufacturer, on the basis of assessment methods of other product standards, these characteristics need not be re-assessed. The specifications of these components shall be documented.

Products bearing regulatory marking in accordance with appropriate harmonized European specifications may be presumed to have the performances declared in the DoP, although this does not replace the responsibility on the cross laminated timber manufacturer to ensure that the cross laminated timber as a whole is correctly manufactured and its component have the declared performance values.

6.2.2 Test samples, testing and compliance criteria

The number of samples to be tested/assessed shall be in accordance with Table 3.

Table 3 — Number of samples to be tested and compliance criteria[a]

Characteristic	Clause	Assessment method	No. of samples	Compliance criteria
Modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength of cross laminated timber with or without large finger joints according to 5.2.3 and 5.2.4 as				
Strength and stiffness properties of timber layers[b]	According to 5.1.3 expressed as Strength and stiffness properties of timber according to 5.1.1 and	EN 14081–1 (assess, check or test)	For timber graded by the manufacturer of the cross laminated timber: as indicated in EN 14081-1:2005+A1:2011, 6.2	Assess or test according to EN 14081-1:2005+A1:2011, 6.2
			For timber not graded by the manufacturer of the cross laminated timber: -	Check labelling of timber according to EN 14081-1:2005+A1:2011, Clause 7
		EN 408 and EN 14358 (test)	For cross laminated timber for which mechanical resistance has been derived from full scale tests: For each grade and species 30 boards shall be tested according to EN 408 and $f_{m,k,l,dc}$ shall be determined according to EN 14358	Test according to EN 14081-1:2005+A1:2011, 6.2
	Bending or tension strength of finger joints in laminations according to 5.1.2	Annex E (test)	For each combination of species, adhesive, strength class or manufacturer specific strength class and finger joint press: 20 finger joints in laminations	5.1.2
Strength and stiffness properties of wood-based panel layers, if relevant	5.1.4	5.1.4 (check)	-	Technical class or strength and stiffness properties for wood-based panels according to EN 13986 or strength and stiffness properties for LVL according to

Characteristic	**Clause**	**Assessment method**	**No. of samples**	**Compliance criteria**
				EN 14374
Geometrical data	5.2.2	5.2.2 (measurement)	3	5.2.2
Bending strength(s) of large finger joints, if relevant	5.2.4	Annex F (test)	According to Annex F	Characteristic bending strength(s) of large finger joint for the relevant load direction(s)
Bonding strength of cross laminated timber with or without large finger joints according to 5.2.5 expressed as				
Bonding strength of finger joints in timber	According to 5.2.5.2 expressed as Bending strength of finger joints in laminations according to 5.1.2	As for modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength of cross laminated timber with or without large finger joints		
	Moisture of timber to be jointed according to 5.2.5.2[c]	G.1 (test)	100 timber pieces for each species	G.1
Bonding strength of glue lines between layers	5.2.5.4	Annex C (test) or	For each combination of species and adhesive 10 full cross sectional specimens or test bars from 10 full cross sectional specimens 5 of the 10 specimens shall have layups which comprise the maximum number of glue lines between the adjacent parallel timber layers to be produced, if relevant	5.2.5.4.2
		Annex D (test)		5.2.5.4.3
Bonding strength of edge bonds between laminations	5.2.5.3	Annex D (test)	6 specimens comprising at least 2 glue lines	5.2.5.3
Bonding strength of large finger joints	5.2.5.5 expressed as bending strength(s) of large finger joints according to 5.2.4	As for modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength of cross laminated timber with or without large finger joints		
Resistance to fire of cross laminated timber with or without large finger joints according to 5.2.6 expressed as				
Geometrical data	5.2.2	5.2.2 (measurement)	3	5.2.2
Density of	5.1.1	EN 14081–1 (assess, check	For timber graded by the manufacturer of the cross	Assess or test according to

Characteristic	**Clause**	**Assessment method**	**No. of samples**	**Compliance criteria**
timber		or test)	laminated timber: EN 14081-1:2005+A1:2011, 6.2	EN 14081-1:2005+A1:2011, 6.2
			For timber not graded by the manufacturer of the cross laminated timber: -	Check labelling of timber according to EN 14081-1:2005+A1:2011, Clause 7
Density of wood-based panels, if relevant[d]	5.1.4	5.1.4 (check)	-	Technical class or characteristic density for wood-based panels according to EN 13986 or characteristic density properties for LVL according to EN 14374
Species[e]	5.1.5	5.1.5 (check)	-	5.1.5
Reaction to fire of cross laminated timber with or without large finger joints according to 5.2.7				
Reaction to fire	5.2.7.2	Declared as reaction to fire class(s) of timber layers and	EN 14081–1	EN 14081–1
		Reaction to fire class(s) of wood based panel layers, if relevant	EN 13986 (structural plywood, LVL, solid wood panels) or EN 14374 structural LVL)	EN 13986 (structural plywood, LVL, solid wood panels) or EN 14374 structural LVL)
	or 5.2.7.3	or tested acc. To methods referred in EN 13501–1	EN 13501–1	Classes according to EN 13501–1
Dimensional stability of cross laminated timber with or without large finger joints according to 5.2.8 expressed as				
Moisture deformation factor or species	5.2.2.6	5.1.5 (check)	-	Check that species according to 5.1.5 are used
Release/content of dangerous substances from cross laminated timber with or without large finger joints				
Formaldehyde emission	5.2.9.1	Annex A	Annex A	Class E1 or E2
Release / content of other dangerous substances	5.2.9.2	As relevant, according to 5.2.9.2		

Characteristic	Clause	Assessment method	No. of samples	Compliance criteria
Durability of bonding strength of cross laminated timber with or without large finger joints according to 5.2.10.1 expressed as				
Species	5.1.5	5.1.5 (check)	-	5.1.5
Adhesive characteristics	5.1.6.1 and 5.1.6.2 phenolic and amino-plastic adhesives[c]	EN 301 and EN 302–6 (test)	EN 302–1, –2, –3, –4 and –6	The requirements for the respective adhesive type class and subclass given in EN 301 shall be fulfilled If required, the minimum pressing time according to EN 302–6 shall be declared
	5.1.6.1 and 5.1.6.3 Moisture curing one-component polyurethane adhesives[c]	EN 15425 (test)	EN 15425	EN 15425
		and B.2 (test)	80	B.2
		and EN 302–2:2013, 5.1, 2nd para. (test) or	EN 302–2:2013, 5.1, 2nd para.	EN 302–2:2013, 5.1, 2nd para.
		For adhesives only to be used for finger joints in larch laminations: EN 301:2013, 5.7	EN 301:2013, 5.7	EN 301:2013, 5.7
		and EN 15416–5 (test)	EN 15416–5	If required, the minimum pressing time according to EN 15416–5 shall be declared
	5.1.6.1 and 5.1.6.4 Emulsion polymer isocyanate adhesives[c]	EN 15425 (test)	EN 15425	5.1.6.4
		and B.2 (test)	80	B.2
		and EN 302–6 (test)	EN 302–6	If required, the minimum pressing time according to EN 302–6 shall be declared
Durability against biological attack of cross laminated timber with or without large finger joints according to 5.2.10.2 expressed as durability against biological attack of				
Timber layers without preservative treatment	5.2.10.2.1 and 5.2.10.2.2	5.2.10.2.2 (check)	-	Requirements for the declared durability class according to EN 350–2 shall be

Characteristic	Clause	Assessment method	No. of samples	Compliance criteria
				fulfilled
Timber layers with preservative treatment	5.2.10.2.1 and 5.2.10.2.3	5.2.10.2.3 (test)	EN 15228:2009, 5.2	EN 15228
Wood based panel layers	5.2.10.2.1 and 5.2.10.2.4	5.2.10.2.4 (check)	EN 13986 and EN 14374	Requirements for the declared technical class for wood based panels according to EN 13986 shall be fulfilled. Requirements for the declared durability class according to EN 350–2 for LVL according to EN 14374 shall be fulfilled

[a] Where further references to Annex I are made in Clause 5 the corresponding requirements shall also be included into the type testing.

[b] The boards within a width of at least 90 % of the total width of the layer shall comply with the declared grade. The boards within a width of up to 10 % of the total width of the layer may deviate from the declared strengths parallel to the grain by not more than 35 %.

[c] The manufacturer of the adhesive or the moisture meter, respectively, usually provides the manufacturer of the structural finger jointed timber with some documentations on tests previously performed by notified product certification bodies (shared other party results, see 6.2.4).

[d] As for mechanical resistance.

[e] As for durability of bonding strength.

6.2.3 Test reports

The results of the determination of the product-type shall be documented in test reports. All test reports shall be retained by the manufacturer for at least 10 years after the last date of production of the cross laminated timber to which they relate.

6.2.4 Shared other party results

A manufacturer may use the results of the product-type determination obtained by someone else (e.g. by another manufacturer, as a common service to manufacturers, or by a product developer), to justify his own declaration of performance regarding a product that is manufactured according to the same design (e.g. dimensions) and with raw materials, constituents and manufacturing methods of the same kind, provided that:

a) the results are known to be valid for products with the same essential characteristics relevant for the product performance;

b) in addition to any information essential for confirming that the product has such same performances related to specific essential characteristics, the other party who has carried out the determination of the product-type concerned or has had it carried out, has expressly accepted[1)] to transmit to the manufacturer the results and the test report to be used for the latter's product-type determination, as well as information regarding production facilities and the production control process that can be taken into account for factory production control (FPC);

c) the manufacturer using other party results accepts to remain responsible for the product having the declared performances and he also:

   1) ensures that the product has the same characteristics relevant for performance as the one that has been subjected to the determination of the product-type, and that there are no significant differences with regard to production facilities and the production control process compared to that used for the product that was subjected to the determination of the product-type; and

   2) keeps available a copy of the determination of the product-type report that also contains the information needed for verifying that the product is manufactured according to the same design and with raw materials, constituents and manufacturing methods of the same kind.

6.2.5 Cascading determination of the product type results

For some construction products, there are companies (often called "system houses") which supply or ensure the supply of, on the basis of an agreement[2)], some or all of the components (e.g. in case of windows: profiles, gaskets, weather strips)[3)] to an assembler who then manufactures the finished product (referred to below as the "assembler") in his factory.

Provided that the activities for which such a system house is legally established include manufacturing/assembling of products as the assembled one, the system house may take the responsibility for the determination of the product type regarding one or several essential characteristics of an end product which is subsequently manufactured and/or assembled by other firms in their own factory.

When doing so, the system house shall submit an "assembled product" using components manufactured by it or by others, to the determination of the product type and then make the determination of the product type report available to the assemblers, i.e. the actual manufacturer of the product placed on the market.

To take into account such a situation, the concept of cascading determination of the product type might be taken into consideration in the technical specification, provided that this concerns characteristics for which either a notified product certification body or a notified test laboratory intervene, as presented below.

The determination of the product type report that the system house has obtained with regard to tests carried out by a notified body, and which is supplied to the assemblers, may be used for the regulatory marking purposes without the assembler having to involve again a notified body to undertake the determination of the product type of the essential characteristic(s) that were already tested, provided that:

---

1) The formulation of such an agreement can be done by licence, contract, or any other type of written consent.

2) This can be, for instance, a contract, license or whatever kind of written agreement, which should also contain clear requirements with regard to responsibility and liability of the component producer (system house, on the one hand, and the assembler of the finished product, on the other hand.

3) These companies may produce components but they are not required to do so.

— the assembler manufactures a product which uses the same combination of components (components with the same characteristics), and in the same way, as that for which the system house has obtained the determination of the product type report. If this report is based on a combination of components not representing the final product as to be placed on the market, and/or is not assembled in accordance with the system house's instruction for assembling the components, the assembler needs to submit his finished product to the determination of the product type;

— the system house has notified to the manufacturer the instructions for manufacturing/assembling the product and installation guidance;

— the assembler (manufacturer) assumes the responsibility for the correct assembly of the product in accordance with the instructions for manufacturing/assembling the product and installation guidance notified to him by the system house;

— the instructions for manufacturing/assembling the product and installation guidance notified to the assembler (manufacturer) by the system house are an integral part of the assembler's factory production control system and are referred to in the determination of the product type report;

— the assembler is able to provide documented evidence that the combination of components he is using, and his way of manufacturing, correspond to the one for which the system house has obtained the determination of the product type report (he needs to keep a copy of the system house's determination of the product type report);

— regardless the possibility of referring, on the basis of the agreement signed with the system house, to the latter's responsibility and liability under private law, the assembler remains responsible for the product being in compliance with the declared performances, including both the design and the manufacture of the product, which is given when he affixes the regulatory marking on his product.

6.3 Factory production control (FPC)

6.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market comply with the declared performance of the essential characteristics.

The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

All the elements, requirements and requirements adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This FPC system documentation shall ensure a common understanding of the evaluation of the constancy of performance and enable the achievement of the required product performances and the effective operation of the production control system to be checked. FPC therefore brings together operational techniques and all measures allowing maintenance and control of the compliance of the product with the declared performances of the essential characteristics.

In case the manufacturer has used shared or cascading product-type results, the FPC shall also include the appropriate documentation as foreseen in 6.2.4 and 6.2.5.

6.3.2 Requirements

6.3.2.1 General

The manufacturer is responsible for organizing the effective implementation of the FPC system in line with the content of this product standard. Tasks and responsibilities in the production control organization shall be documented and this documentation shall be kept up-to-date.

The responsibility, authority and the relationship between personnel that manages, performs or verifies work affecting product constancy, shall be defined. This applies in particular to personnel that need to initiate actions preventing product non-constancies from occurring, actions in case of non-constancies and to identify and register product constancy problems.

Personnel performing work affecting the constancy of performance of the product shall be competent on the basis of appropriate education, training, skills and experience for which records shall be maintained.

In each factory the manufacturer may delegate the action to a person having the necessary authority to:

— identify procedures to demonstrate constancy of performance of the product at appropriate stages;

— identify and record any instance of non-constancy;

— identify procedures to correct instances of non-constancy.

The manufacturer shall draw up and keep up-to-date documents defining the FPC. The manufacturer's documentation and procedures should be appropriate to the product and manufacturing process. The FPC system should achieve an appropriate level of confidence in the constancy of performance of the product. This involves:

a) the preparation of documented procedures and instructions relating to FPC operations, in accordance with the requirements of the technical specification to which reference is made;

b) the effective implementation of these procedures and instructions;

c) the recording of these operations and their results;

d) the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-constancy of performance.

Where subcontracting takes place, the manufacturer shall retain the overall control of the product and ensure that he receives all the information that is necessary to fulfil his responsibilities according to this European standard.

If the manufacturer has part of the product designed, manufactured, assembled, packed, processed and/or labelled by subcontracting, the FPC of the subcontractor may be taken into account, where appropriate for the product in question.

The manufacturer who subcontracts all of his activities may in no circumstances pass the above responsibilities on to a subcontractor.

NOTE Manufacturers having an FPC system, which complies with EN ISO 9001 standard and which addresses the requirements of the present European standard are considered as satisfying the FPC requirements of the Regulation (EU) No 305/2011.

6.3.2.2 Equipment

6.3.2.2.1 Testing

All weighing, measuring and testing equipment shall be calibrated or verified and regularly inspected according to documented procedures, frequencies and criteria. The results shall be documented.

6.3.2.2.2 Manufacturing

All equipment used in the manufacturing process should be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

6.3.2.3 Raw materials and components

The specifications of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring their compliance.

6.3.2.4 Traceability and marking

Individual cross laminated timber shall be identifiable and traceable with regard to their production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes and/or markings are inspected regularly.

6.3.2.5 Controls during manufacturing process

The manufacturer shall plan and carry out production under controlled conditions.

The manufacturer's documentation, procedures and instructions shall be relevant to the production and process control of the products, and shall be adequately described in a works' quality manual, covering:

a) quality aims and organizational structure, responsibilities and powers of the management with regard to conformity of the cross laminated timber;

b) procedures for specifying and verifying the compliance of the timber and the bonding;

c) manufacturing, production control and other techniques, processes and systematic actions to be taken.

For the bonding processes the following shall be recorded:

1) production line;

2) date and number of production;

3) species and types of wood-based panels;

4) strength class or manufacturer specific strength class or technical class;

5) dimensions and layup of the cross laminated timber;

6) moisture content;

7) time for start of adhesive application;

8) time for start and end of cramping procedure;

9) cramping pressure;

10) adhesive, e.g. resin and hardener;

11) quantity of adhesive applied (g/m^2);

12) ratio of resin and hardener, if relevant;

13) information on preservative treatment in accordance with EN 15228 if the laminations have been treated with a preservative against biological attack of timber;

14) temperature and relative humidity for the timber storage facilities, the facilities for the production of the bonds and the facilities for the adhesive application and the curing;

15) adjustment of the moisture meter according to the specification of the moisture meter manufacturer;

16) name of the responsible member of the personnel.

All documentation shall be registered so that the raw materials and production conditions for the products are traceable, at least to the production week and year. The documentation of the different tests may kept separately. All documentation shall be kept for at least 10 years.

6.3.2.6 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of the characteristics he declares are maintained and the minimum production requirements in Annex I are fulfilled. The characteristics and the means of control shall be as given in Table 4.

Table 4 — Factory production control for cross laminated timber

Characteristic	**Clause, indicating the relevant test or evaluation method**	**Acceptance criteria for tests**	**Minimum frequency**
Modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength			
Strength, stiffness and density properties of timber layers according to 5.1.3 as	Strength, stiffness and density properties of timber according to 5.1.1[a]	For timber graded by the manufacturer of the cross laminated timber: EN 14081-1:2005+A1:2011, 6.3	As indicated in EN 14081-1:2005+A1:2011, 6.3
		For timber not graded by the manufacturer of the cross laminated timber: -	Check suppliers declaration according to EN 14081-1:2005+A1:2011, Clause 7, on receipt

Characteristic	**Clause, indicating the relevant test or evaluation method**	**Acceptance criteria for tests**	**Minimum frequency**
	Strength, stiffness and density properties of timber according to E.5	For cross laminated timber for which mechanical properties has been derived from full scale tests: $f_{m,k,l}$ determined according to E.5 shall be greater than or equal to $f_{m,k,l,dc}$ (determined within TT)	Annex E 2 boards per shift and line, layup, strength class or manufacturer specific strength class
	Bending or tension strength of finger joints in laminations according to 5.1.2	See Annex E and declared values according to 5.1.3	2 specimens per shift (e.g. 8 h) and line taken at random for each combination of strength class or manufacturer specific strength class, species and adhesive[b]
	Moisture content of timber to be jointed according to G.1	G.1	Measurement according to the quality manual of the manufacturer of the cross laminated timber
	and G.2, if relevant	G.2	At least one measurement per month
Strength, stiffness and density properties of wood based panel layers	5.1.4	5.1.4 (check)	Check the suppliers declaration on receipt
Geometrical data	5.2.2	5.2.2 (measurement)	Check at each change of layup
Bending strength(s) of large finger joints	Annex F	5.2.4	One per shift
	I.6.7	I.6.7 (measurement)	Check once per every 30 large finger joints
Bonding strength			
Bonding strength of finger joints in timber	5.2.5.2	As for mechanical resistance, see 5.1.2	
Bonding strength of glue lines between layers	Annex C or	5.2.5.4.2	2 full cross sectional specimens or test bars from 2 full cross sectional specimens in each shift in which gluing is carried out 1 of the 2 specimens shall comprise adjacent parallel timber layers, if produced during the shift
	Annex D	5.2.5.4.3	
Bonding strength of edge bonds between laminations	Annex D	5.2.5.3	2 in each shift in which gluing is carried out
Bonding strength of large finger joints	As for bending strength(s) of large finger joints		

Characteristic	**Clause, indicating the relevant test or evaluation method**	**Acceptance criteria for tests**	**Minimum frequency**
Resistance to fire			
Geometrical data	5.2.2	5.2.2 (measurement)	Check at each change of layup
Density of timber[c]	5.1.1	For timber graded by the manufacturer of the cross laminated timber: EN 14081-1:2005+A1:2011, 6.3	According to EN 14081-1:2005+A1:2011, 6.3
		For timber not graded by the manufacturer of the cross laminated timber: -	Check suppliers declaration according to EN 14081-1:2005+A1:2011, Clause 7, on receipt
Density of wood based panels[c]	5.1.4	5.1.4 (check)	Check the suppliers declaration on receipt
Species[d]	5.1.5	-	Check on receipt
Reaction to fire			
Reaction to fire	Declared as reaction to fire class(es) of layers according to 5.2.7.2		Control the minimum mean density, minimum overall thickness and preservative treatment (if any) of the layers at least once per shift.
	Declared by tests according to 5.2.73		Check on receipt that the relevant parameters of the tests are fulfilled at least once per shift.
Dimensional stability			
As moisture deformation factor	5.2.8	-	Check on receipt that only species according to 5.1.5 for values according to 5.2.2.6 apply are used
Release/content of dangerous substances			
Formaldehyde emission	5.2.9.1	Class E1 or E2	Check on receipt of adhesives that only adhesives for which an initial classification has been carried out within the type testing are used.
Release / content of other dangerous substances	As relevant, according to 5.2.9.2		
Durability of bonding strength			
Species	5.1.5	-	Check on receipt
Adhesive	5.1.6	-	Adhesives for the production of finger joints or edge bonds or glue lines between layers: Check the suppliers declaration on receipt Adhesives for large finger joints: Check the suppliers declaration at each shift in which large finger joints are produced

Characteristic	Clause, indicating the relevant test or evaluation method	Acceptance criteria for tests	Minimum frequency
Adhesive application for contact free adhesive application	I.4.5.4	I.4.5.4	for automated monitoring systems: 2 per shift, evenly distributed in time for visual monitoring: 1 per two h
Moisture content of timber to be jointed	G.1 (test)	G.1	Measurement according to the quality manual of the manufacturer of the cross laminated timber
	and G.2 (test, if relevant)	G.2	At least one measurement per month
Durability against biological attack			
Species or preservative treatment of timber or technical class of wood based panel	5.2.10.2	-	Check on receipt the species or declaration of wood-based panel or checking preservative treatment according to EN 15228:2009, 5.3
[a] The boards within a width of at least 90 % of the total width of the layer shall comply with the declared grade. The boards within a width of up to 10 % of the total width of the layer may deviate from the declared strengths parallel to the grain by not more than 35 %. [b] If all tests for a three months period satisfy the requirements the number of samples may be reduced to not less than half of the number prescribed above. [c] As for mechanical resistance. [d] As for durability of bonding strength.			

6.3.2.7 Non-complying products

The manufacturer shall have written procedures which specify how non-complying products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures.

Where the product fails to satisfy the acceptance criteria, the requirements for non-complying products shall apply, the necessary corrective action(s) shall immediately be taken and the products or batches not complying shall be isolated and properly identified.

Once the fault has been corrected, the test or verification in question shall be repeated.

The results of controls and tests shall be properly recorded. The product description, date of manufacture, test method adopted, test results and acceptance criteria shall be entered in the records under the signature of the person responsible for the control/test.

With regard to any control result not meeting the requirements of this European standard, the corrective measures taken to rectify the situation (e.g. a further test carried out, modification of manufacturing process, throwing away or putting right of product) shall be indicated in the records.

6.3.2.8 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence.

6.3.2.9 Handling, storage and packaging

The manufacturer shall have procedures providing methods of product handling and shall provide suitable storage areas preventing damage or deterioration.

6.3.3 Product specific requirements

The FPC system shall address this European Standard and ensure that the products placed on the market comply with the declaration of performance.

The FPC system shall include a product specific FPC, which identifies procedures to demonstrate compliance of the product at appropriate stages, i.e.:

a) the controls and tests to be carried out prior to and/or during manufacture according to a frequency laid down in the FPC test plan, and/or;

b) the verifications and tests to be carried out on finished products according to a frequency laid down in the FPC test plan.

If the manufacturer uses only finished products, the operations under b) shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

If the manufacturer carries out parts of the production himself, the operations under b) may be reduced and partly replaced by operations under a). Generally, the more parts of the production that are carried out by the manufacturer, the more operations under b) may be replaced by operations under a).

In any case the operation shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

NOTE Depending on the specific case, it can be necessary to carry out the operations referred to under a) and b), only the operations under a) or only those under b).

The operations under a) refer to the intermediate states of the product as on manufacturing machines and their adjustment, and measuring equipment, etc. These controls and tests and their frequency shall be chosen based on product-type and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters, etc.

The manufacturer shall establish and maintain records that provide evidence that the production has been sampled and tested. These records shall show clearly whether the production has satisfied the defined acceptance criteria and shall be available for at least three years.

6.3.4 Initial inspection of factory and of FPC

Initial inspection of factory and of FPC shall be carried out when the production process has been finalized and in operation. The factory and FPC documentation shall be assessed to verify that the requirements of 6.3.2 and 6.3.3 are fulfilled.

During the inspection it shall be verified:

a) that all resources necessary for the achievement of the product characteristics included in this European standard are in place and correctly implemented, and;

b) that the FPC-procedures in accordance with the FPC documentation are followed in practice, and that the product complies with the product-type samples, for which compliance of the product performance to the DoP has been verified.

All locations where final assembly or at least final testing of the relevant product is performed, shall be assessed to verify that the above conditions a) to b) are in place and implemented. If the FPC system covers more than one product, production line or production process, and it is verified that the general

requirements are fulfilled when assessing one product, production line or production process, then the assessment of the general requirements does not need to be repeated when assessing the FPC for another product, production line or production process.

All assessments and their results shall be documented in the initial inspection report.

6.3.5 Continuous surveillance of FPC

Surveillance of the FPC shall be undertaken twice per year. The surveillance of the FPC shall include a review of the FPC test plan(s) and production processes(s) for each product to determine if any changes have been made since the last assessment or surveillance. The significance of any changes shall be assessed.

Checks shall be made to ensure that the test plans are still correctly implemented and that the production equipment is still correctly maintained and calibrated at appropriate time intervals.

The records of tests and measurement made during the production process and to finished products shall be reviewed to ensure that the values obtained still correspond with those values for the samples submitted to the determination of the product-type and that the correct actions have been taken for non-compliant products.

6.3.6 Procedure for modifications

If modifications are made to the product, production process or FPC system that could affect any of the product characteristics declared according to this standard, then all the characteristics for which the manufacturer declares performance, which may be affected by the modification, shall be subject to the determination of the product-type, as described in 6.2.1.

Where relevant, a re-assessment of the factory and of the FPC system shall be performed for those aspects, which may be affected by the modification.

All assessments and their results shall be documented in a report.

7 Marking and labelling

7.1 General

Each cross laminated timber, which complies with this European Standard, shall be durably marked on its surface or on a durable label affixed on it, with the information as given below.

Where regulatory marking requirements require information on some or all items listed in 7.2, the requirements of this clause concerning those common items are deemed to be met and the information need not be repeated for the purpose of this clause.

Where the cross laminated timber is cut into parts each part shall be re-marked.

In exceptional cases, the end use may require marking to be omitted for aesthetic reasons. In such cases, when the customer specifically requests or orders the cross laminated timber to be free from marks, each delivery shall be dispatched under the cover of a document stating the following minimum information.

— customer’s name and address;

— customer’s purchase order number;

— dimensions and quantities of the delivered cross laminated timber.

7.2 Cross laminated timber

The following information shall be given for cross laminated timber:

a) identity of the manufacturer, logo or name;

b) modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength of the cross laminated timber as geometrical data (overall size, layup, grooves (if relevant), edge bonds (if relevant), ratio of lamination width to lamination thickness, strength and stiffness and density properties of layers and bending strength(s) of large finger joints, if relevant;

NOTE This is usually done by reference to a documented layup.

c) production week and year or traceability code;

d) adhesive types (without subclasses) according to EN 301 or EN 15425 and adhesive families according to 5.1.6;

e) "MPT" if the minimum pressing time under referenced conditions has been tested according to EN 302-6 or EN 15416-5;

f) bonding strength test method declared as "Pass Delam", if tested by delamination method according to Annex C or "Pass Shear", if tested by shear test according to Annex D;

g) "PT" for cross laminated timber treated against biological attack.

Annex A
(normative)

Release of Formaldehyde

A.1 General

Cross laminated timber may release formaldehyde.

A.2 Classification

A.2.1 Cross laminated timber

A.2.1.1 Requirements

Where formaldehyde containing adhesives are used, the following release of formaldehyde from cross laminated timber shall be:

— assessed by testing as specified in A.2.1.2 and the corresponding class according to Table A.1 declared;

— or classified as E2.

Cross laminated timber, produced with an adhesive not containing formaldehyde shall be assigned to class E1.

The evaluation of release of formaldehyde shall be carried out for each type of adhesive used.

The maximum steady-state emission values for cross laminated timber shall be used, when assessing the formaldehyde release as Classes E1 or E2 according to Table A.1.

Table A.1 — Release of formaldehyde classes

Formaldehyde release classes	**Maximum steady-state emission values** (in mg HCHO/m^3 air)
E1	≤ 0,124
E2	> 0,124

NOTE In certain Member States only cross laminated timber of class E1 are allowed.

A.2.1.2 Test procedure

A.2.1.2.1 General

The testing in a chamber shall be carried out according to EN 717-1 with a loading factor of 1 m^2/m^3.

Part of all cross sections of the specimens shall be sealed. The ratio of the unsealed surfaces of all cross sections to the overall surface of the cross sections shall be 1/9. All dimensions shall have a tolerance of ± 2 mm. The specimens shall comprise at least five layers. The layers shall have the minimum layer thickness t_l intended to be produced.

A.2.1.2.2 Additionally for cross laminated timber comprising wood-based panel layers

If it is intended to combine different types of wood-based panels within a cross laminated timber each combination of wood based panels shall be tested.

The specimens shall comprise the largest amount of wood-based panels to be used in practise.

If it is intended to produce layups in which the wood based panel layer is the outermost layer that layup shall be tested.

A.2.1.3 Test report

A test report according to EN 717-1 shall be given.

A.2.2 Cross laminated timber with large finger joints

Cross laminated timber with large finger joints shall be assigned to the formaldehyde emission class of the cross laminated timber components from which they are made.

Annex B
(normative)

Additional test methods and requirements for adhesives

B.1 General

The adhesives to be tested shall be ready for use and shall be, if the manufacturer of the cross laminated timber intends to mix them before application in the following production, mixed according to the instructions of the adhesive manufacturer. They shall have the viscosity in which they are used in practice. If no other specifications are given by the adhesive manufacturer the hardener shall be stirred in for 5 min using a stirring device.

B.2 Long-term sustained load test at cyclic climate conditions with specimens loaded perpendicular to the glue line for moisture curing one-component polyurethane and emulsion polymer isocyanate adhesives (glass house test)

B.2.1 General description

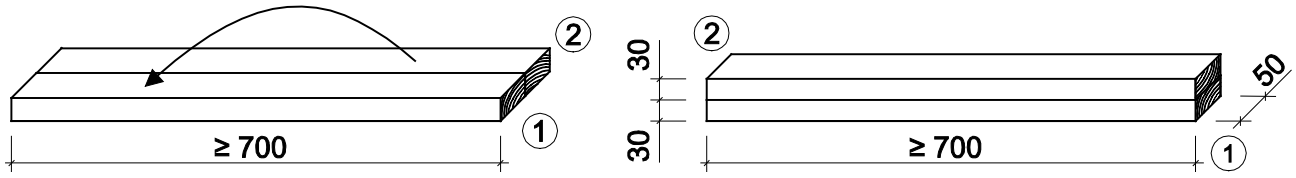
The tests shall be performed with specimens according to EN 302-3. As a divergence to EN 302-3, the specimens are made from beech wood with glue line thickness of 0,1 mm and 0,5 mm. The beech wood boards from which the specimens are cut shall be free from knots, straight grained and shall have a density larger than 650 kg/m^3 at 20 °C/65 % rh. The timber prior to specimen manufacture shall be conditioned in a climate chamber at storage conditions of (20 ± 2) °C and (65 ± 5) % rh. The moisture content shall be (12 ± 1) %.

B.2.2 Production of the specimens

In total, 5 sticks with a cross section of 50 mm × 60 mm and a length of at least 700 mm, enabling the cutting of 8 test specimens and 2 reserve specimens from each stick of the specimen type described in EN 302-3, shall be manufactured for each glue line thickness. The 10 specimens for each test are made up of two specimens (see Figure B.2) from each stick. Figure B.2 gives a view of the stick and of the cutting scheme for its subdivision into 10 specimens for the determination of the tensile strength perpendicular to the glue line. The manufacture and build-up of the sticks shall follow the scheme shown in Figure B.1a) and B.1b). The annual ring orientation of both components glued together shall be roughly co-linear and shall be in the range of 30° to 60°.

NOTE For details of cutting see EN 302–3:2013, Clause 5, and Figure B.1.

Dimensions in millimetres



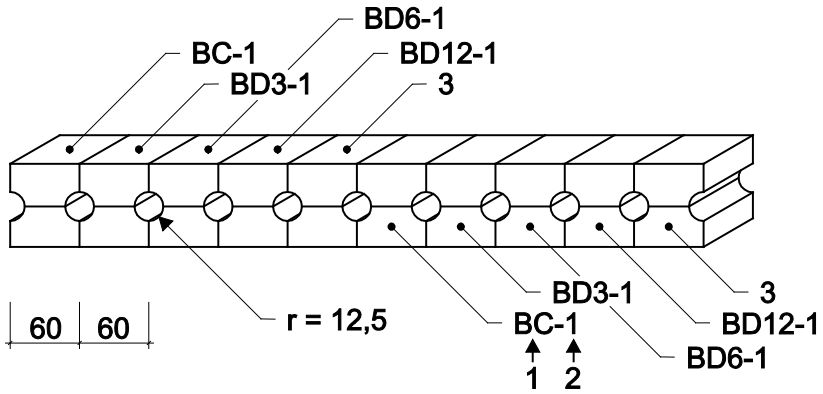
a) Dimensions before cutting **b) Dimensions after planing**

Key

1 and 2 positions of corners before cutting and after planing

Figure B.1 — Cutting scheme of the parts of the test sticks

Dimensions in millimetres



Key

1 test batch (BC = control batch, BD *x* = Batch for a test after a duration of *x* months)

2 current specimen number

3 reserve sample

Figure B.2 — Cutting scheme for test stick and numbering of specimens

B.2.3 Test procedure and climate conditions

The test procedure shall consist of the following test series:

a) short-term testing of a control batch BC of 10 specimens in ramp loading. The specimens are tested after 14 days of conditioning in (20 ± 2) °C and (65 ± 5) % rh subsequent to gluing;

b) long-term testing of 3 batches BD3, BD6, BD12, each with 10 specimens, whereby each batch shall be subjected to a different duration of loading time being 3, 6 and 12 months. All batches shall be subjected to the same constant stress level specified below. At the end of each loading period, all specimens of the respective batch not having failed shall be tested for residual tensile strength perpendicular to the glue line in ramp loading.

Constant stress equal in all 3 duration of load times shall be 1 N/mm^2 related to the net cross section of 25 mm × 50 mm.

The test climate shall be at natural outdoor conditions in Europe between latitude 45 and 60 degrees protected with light penetrable covering (glass house).

An alternative test procedure is to use a climate chamber with cyclically stepped climate varying stepwise with 24 h step length between two climates (10 ± 2)°C with (90 ± 5)%rh and (35 ± 2)°C with (40 ± 5)% rh.

The specimens tested for residual strength after removal of the constant long-term load shall be conditioned at least for 2 weeks in climate (20 ± 2)°C and (65 ± 5)%rh before ramp loading.

The climate shall be recorded.

B.2.4 Requirements

The mean tensile strength perpendicular to the grain of the control batch BC and of each of the batches BD3, BD6 and BD12 tested for residual strength after 3, 6 and 12 months of duration of load shall not be less than 5 N/mm^2. In each batch tested in long-term loading only one specimen may fail within each of the respective load duration periods. In case a specimen has failed in long-term loading, the mean value of the residual strength of the respective batch shall be calculated from the remaining 9 specimens.

B.2.5 Test report

A test report according to EN 302-3 and records of the climate during testing shall be given.

Annex C
(normative)

Delamination test of glue lines between layers

C.1 Principle

A gradient is introduced in the moisture content of the wood to build up internal stresses. This will result in tensile stresses perpendicular to the glue lines. Inadequate bonding quality will result in delamination of the glue lines.

C.2 Apparatus

C.2.1 Pressure vessel

A pressure vessel shall be used which safely withstands a pressure of at least 600 kPa (700 kPa absolute pressure) and a vacuum of at least 85 kPa (15 kPa absolute pressure) and is equipped with pumps or similar device capable of giving a pressure of at least 600 kPa (700 kPa absolute pressure) and of drawing a vacuum of at least 85 kPa (15 kPa absolute pressure).

NOTE 100 kPa is equal to 1 bar.

C.2.2 Drying duct

A drying duct shall be used where air is circulated at a velocity from 2 m/s up to 3 m/s, (inclusive), at a temperature from 65 °C up to 75 °C (inclusive) and a relative humidity from 8 % to 10 % (inclusive).

C.2.3 Balance

Balance shall be capable for determining mass with a tolerance of ± 5 g.

C.2.4 Metal wedge and hammer

Metal wedge and hammer shall be capable of splitting glue lines open.

C.3 Sampling and preparation of test pieces

The test pieces shall be prepared or selected in such a manner that they are representative of the production run.

They shall either be taken as drill cores from cross laminated timber having a minimum diameter of (95 ± 5) mm or as approximately quadratic cut outs having minimum lateral lengths of (100 ± 5) mm and a top view area of at least 10 000 mm^2. The thickness of the specimens shall comply with the thickness of the cross laminated timber they are taken from.

NOTE The delamination lengths can only be determined on end grain surfaces whose surfaces have been prepared properly, e.g. by sanding before delamination.

C.4 Procedures

C.4.1 General

Before subjecting the test pieces to the test cycles, measure the total length of the glue lines around the circumference of the test piece.

Subject the test pieces to the test cycles as described in C.4.3.

C.4.2 Measurement and evaluation of delamination

C.4.2.1 Measurement of delamination

The delamination measurement and the evaluation of the result shall take place not later than 1 h after the final drying treatment. The total glue line delamination on all end-grain surfaces shall be measured in millimetres.

The use of a magnifying glass with a tenfold magnification and strong lighting are recommended to determine whether the opening in the glue line is a valid delamination or not.

A feeler gauge 0,08 mm to 0,10 mm thick is convenient for probing into the joint to determine if separation in the glue line exists.

NOTE 1 C.4.2.2 and C.4.2.3 give information which openings are to be regarded or not to be regarded as delaminations.

Where the maximum delamination length or the total delamination length exceeds the limits given in 5.2.5.4.2 or if the delamination lengths cannot be estimated due to the inadequate surface quality of the end grain surfaces each glue line shall be split with a wedge and a hammer and the wood failure percentage of the split area shall be measured.

NOTE 2 C.4.2.4 gives information how to estimate the wood failure percentage of the split area.

C.4.2.2 Glue line openings to be regarded as delaminations

The following glue line openings shall be considered as being delaminations:

— a cohesive crack within the adhesive layer;

— a failure of the glue line precisely between the adhesive layer and the wood substrate. No wood fibres are left attached to the adhesive layer;

— a wood failure which is invariably within the first one or two layers of cells beyond the adhesive layer in which the fracture path is not influenced by the grain angle and the growth-ring structure. It is characterized by a fine, woolly appearance of the wood fibres, which border the interface between the wood surface and the adhesive layer.

C.4.2.3 Glue line openings not to be regarded as delaminations

The following glue line openings shall not be considered as being delaminations:

— a solid wood failure which is invariably more than two cell layers away from the adhesive layer, in which the fracture path is strongly influenced by the grain angle and the growth-ring structure;

— isolated openings in the glue line which are less than 2,5 mm long and more than 5 mm away from the nearest delamination;

— openings in the glue line which are found along knots or resin pockets which border the glue line, or openings in the glue line which are caused by hidden knots in the glue line. When the cause of an opening in the glue line due to the presence of a knot is suspected, the glue line shall be opened with a wedge and a hammer and be inspected for the presence of a concealed knot. Should the cause of a glue line opening be due to a concealed knot, the opening shall not be considered as delamination.

C.4.2.4 Criteria for glued areas after splitting

A solid wood failure is characterized by a crack which is invariably more than two cell layers away from the adhesive layer, in which the fracture area is strongly influenced by the grain angle and the growth-ring structure.

Openings in the glue area which are found along knots or resin pockets shall be taken as wood failure areas.

C.4.3 Test cycle

Place the test piece in the pressure vessel and weigh them down. Add water at a temperature of 10 °C to 20 °C in sufficient quantity so that the pieces are completely submerged. Separate the test pieces by stickers, wire screens, or other means in such a manner that all end-grain surfaces are freely exposed to the water. Draw a vacuum between 70 kPa and 85 kPa (i.e. an absolute pressure between 15 kPa and 30 kPa at sea level) and hold it for 30 min. Release the vacuum and apply a pressure between 500 kPa and 600 kPa (between 600 kPa and 700 kPa absolute pressure) for 2 h.

Dry the test pieces for a period of approximately 10 h to 15 h in a climate according to C.2.2 in the drying duct. During drying the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to the stream of air.

The actual time in the drying duct shall be controlled by the mass of the test pieces. Delamination shall be observed and recorded when the mass of the test pieces has returned to within 100 % to 110 % of the original mass. The drying time shall be recorded.

C.5 Results

C.5.1 General

For each test piece the delamination shall be calculated.

C.5.2 Total delamination

The total delamination $Delam_{tot}$ of a test piece shall be calculated from Formula (C.1):

$$Delam_{tot} = 100 \frac{l_{tot,delam}}{l_{tot,glue\ line}} \text{ in \%} \quad \text{(C.1)}$$

where:

$l_{tot,\ delam}$ is the total delamination length (in mm),

$l_{tot,\ glue\ line}$ is the sum of the perimeters of all glue lines in a delamination specimen (in mm).

C.5.3 Maximum delamination

The maximum delamination $Delam_{max}$ of a single glue line in a test piece shall be calculated from Formula (C.2):

$$Delam\ max = 100 \frac{l_{max,delam}}{l_{glue\ line}} \text{ in } \% \quad \text{(C.2)}$$

where:

$l_{max,\ delam}$ is the maximum delamination length (in mm),

$l_{glue\ line}$ is the perimeter of one glue line in a delamination specimen (in mm).

C.5.4 Wood failure percentage

The wood failure percentage of a split glue area shall be taken as the ratio of the area with wood failures according to C.4.2.4 and the glued area before splitting.

C.6 Test report

The following items shall be reported:

a) reference to this European Standard;

b) date of the test;

c) identification of test pieces and cross laminated timber from which they have been cut; any other relevant information, e.g. about preconditioning;

d) preservative treatment (if relevant);

e) species of timber and types of wood-based panels;

f) type of adhesive and trade name;

g) effective proportion of resin and hardener (if relevant);

h) sizes of the test piece;

i) the total delamination and the maximum delamination;

j) any relevant observation linked to the testing;

k) name of the person responsible for the testing.

Annex D
(normative)

Shear tests

D.1 Principle

Under ramp loading a shear stress is applied at the glue line until failure occurs.

D.2 Apparatus

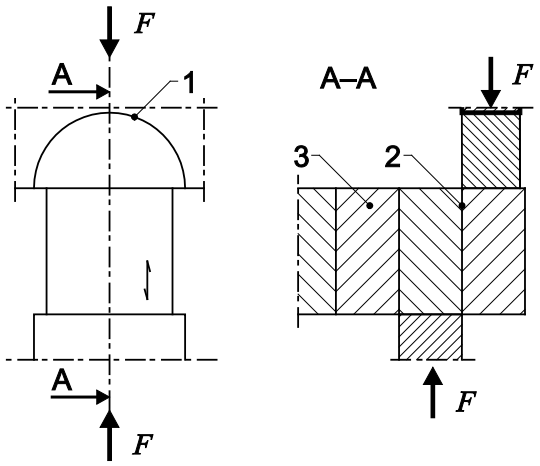
D.2.1 Testing machine

A testing machine shall be used which is checked and adjusted according to the information given by the manufacturer of the testing machine and capable of applying a compressive force to the shearing tool, see Figure D.1.

The accuracy of measuring the maximum load shall be better than ± 3 % of this load.

D.2.2 Shearing tool

A shearing tool as illustrated in Figure D.1 shall be used. The cylindrical bearing shall be self-aligning so that the test piece is loaded at the end-grain with a stress field uniform in the width direction.



Key

1 cylindrical bearing

2 sheared plane

3 test bar to be clamped as necessary

Figure D.1 — Shearing tool with a test bar inserted

D.3 Test pieces

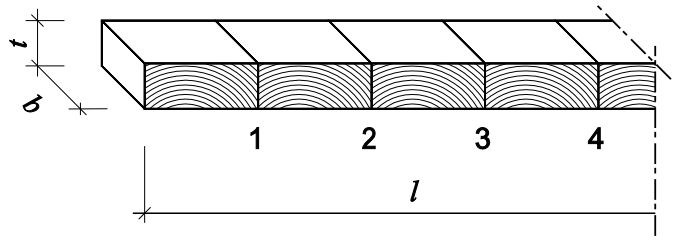
D.3.1 General

Special care shall be taken in preparing test pieces to ensure that the loaded surfaces are smooth and parallel to each other and perpendicular to the direction of the glue line.

Where drill cores have been taken the boreholes shall be filled durably and tightly with glued in wood having the same grain direction as the outermost layers of the cross laminated timber. For guidance of the drilling tool an appropriate support is recommended.

D.3.2 Test pieces for edge bonds in timber layers

The test pieces for tests with edge bonds shall be of the form shown in Figure D.2 or D5 b). That depicted in Figure D.2 shows the common test piece.



Key

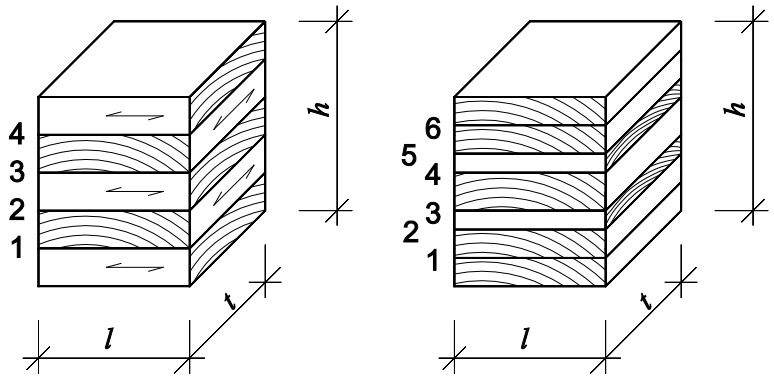
b	width, dimensions 40 mm to 50 mm
l	length
t	thickness of the timber layer
1 to *n*	number of edge bonds within the specimen

Figure D.2 — Test bar and numbering of the edge bonds from an edge bonded timber layer

D.3.3 Test pieces for glue lines between layers

Test samples shall be taken from end cuts or cut outs (for test samples according to Figure D.3) or from drill cores (for samples according to Figure D.4 or D.5).

The test pieces shall be of the form shown in either Figure D.3 or D.5. From the drill cores shown in Figure D.4, make a square test bar as shown in Figure D.3 giving a shear area of 40 mm x 40 mm. Test pieces depicted in Figure D.3 are the common test piece.



a) Test bar from cross laminated timber which comprises orthogonally bonded layers

b) Test bar from cross laminated timber which comprises layers bonded orthogonally and layers bonded parallel to the grain

Key

t width, dimension 40 mm

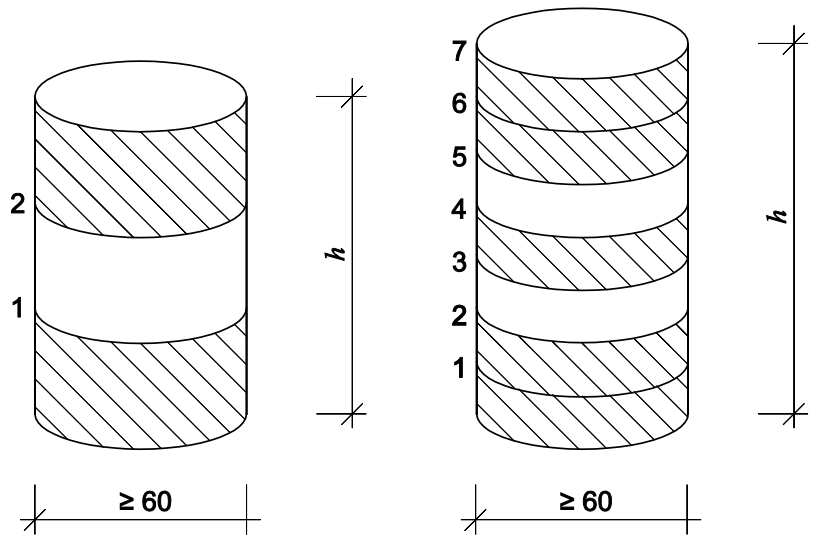
l length, dimension 40 mm

h height of element test bar

1 to *n* number of glue lines within the test specimen

Figure D.3 — Test bar and numbering of the glue lines

Dimensions in millimetres



a) A drill core sample from cross laminated timber with all layers glued crosswise

b) A drill core sample from cross laminated timber with two parallel layers on each side and the others glued crosswise

Key

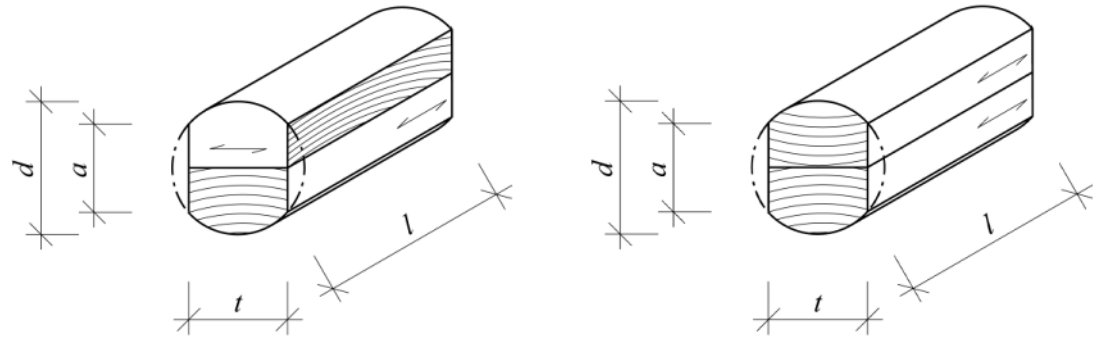
h height of drill core = element thickness

1 to *n* number of glue lines within the specimen

Figure D.4 — Drill core samples with glue line numbering

D.3.4 Test pieces for testing single glue lines within cross laminated timber

For tests with single glue lines within cross laminated timber small drill cores shall be cut out perpendicular to the face of the test pieces in such a way that the glue line to be tested is situated in the middle of the layer as shown in Figure D.5. The drill cores shall be machined at two faces perpendicular to the glue line as shown in Figure D.5 and divided lengthwise so that the test pieces have a rectangular shearing area.



a) Drill core sample with a glue line between crosswise layers

b) Drill core sample with a glue line between edge bonded panels or between layers bonded in the fibre direction

Key

a straight edges, (23 ± 5) mm

d diameter, (35 ± 5) mm

l length, 50 mm to 120 mm

t thickness, (26 ± 3) mm

Figure D.5 — Drill core with single glue lines with machined parallel plane surfaces

D.3.5 Sampling of test pieces

The specimens shall be representative for manufacture.

Test bars for tests with edge bonds shall have the full cross sectional depth of the timber layer. At least 2 glue lines in each timber layer shall be tested.

Test bars for tests with glue lines between layers shall include the full cross sectional depth of the cross laminated timber. All glue lines shall be tested. The number of test bars depends from the cross sectional width of the cross laminated timber and shall be as given in Table D.1.

Table D.1 — Number of test bars

	Number of test bars		
Width of full cross section (in mm)	$h \leq 600$	$600 < h \leq 1\,200$	$h > 1\,200$
Number of test bars	1	2	3

Test bars can be replaced by drill cores with single glue lines. Regarding the number of glue lines from which drill cores shall be taken, the 2nd and 3rd paragraph of this subsection applies.

D.3.6 Marking of test pieces

Every test bar shall be marked with a durable identification.

For test bars for tests with glue lines between layers the marking shall indicate the location of the test bar within the cross section of the cross laminated timber.

D.4 Procedure

Measure the moisture content of the test piece.

Measure the dimensions from which the sheared area is determined to the nearest of 0,5 mm. Use, for example, a sliding gauge.

Place the test piece in the shearing tool so that the timber at one side of the glue line is loaded in the direction of the grain for orthogonally bonded layers or the timber at both sides of the glue line is loaded in the direction of the grain in the case of parallel bonded layers and laminations. The glue line shall be positioned so that the distance between the shearing tool and the sheared plane nowhere exceeds 1 mm.

If the test piece includes gaps between laminations the shear force shall be applied in the direction of the gaps.

The loading shall be undertaken at a constant rate of deformation and so that failure occurs after no less than 20 s.

Express the wood failure to the nearest 5 % for every tested glue line as a percentage of the sheared area.

D.5 Results

The shear strength f_v shall be determined with two significant digits from Formula (D.1):

$$f_v = k\frac{F_u}{A} \tag{D.1}$$

where

F_u is the ultimate load (in N);

$A = b\,t$ is the sheared area (in mm^2);

b is the width (in mm);

k factor: $k = 0{,}78 + 0{,}004\,4\,t$;

NOTE The factor k modifies the shear strength for test pieces where the length in the grain direction of the sheared area is less than 50 mm.

l is the length (in mm);

t is the thickness (in mm).

For type testing the characteristic strength value $f_{v,k}$ shall be calculated according to EN 14358.

For factory production control the requirement on the bond strength may be verified by showing that not more than five test values from the last 100 bonds tested are below the required characteristic strength value $f_{v,k}$.

D.6 Test report

The following items shall be reported:

a) reference to this European Standard;

b) date of sampling and testing;

c) identification of test pieces and cross laminated timber from which they have been cut; any other relevant information, e.g. about preconditioning;

d) preservative treatment (if relevant);

e) species;

f) type of adhesive and trade name;

g) effective proportion of resin and hardener (if relevant);

h) sizes of the test piece;

i) ultimate load, shear strength and wood failure percentage for each glue line in each test piece;

j) any relevant observation made during or after testing;

k) name of the person responsible for the testing.

Annex E
(normative)

Tests with laminations with or without finger joints (including compliance criteria)

E.1 Sampling

E.1.1 General

The specimens shall be representative of the manufacture. The whole jointed cross section of the lamination shall be tested. The finger joints shall be in the middle of the specimens. If it is intended to manufacture preservative treated cross laminated timber, specimens from such preservative treated structural finger jointed timber shall be taken.

E.1.2 For type testing

The cross section of the specimens shall be equal to the typical size the manufacturer intends to finger joint.

E.1.3 For factory production control

The specimens taken in a shift shall, as far as possible, be taken evenly distributed in time and shall be representative for the lamination sizes produced during the shift.

E.2 Testing

E.2.1 General

Finger joints in cross laminated timber shall be tested in flat-wise or edge-wise bending according to EN 408, with the following exceptions:

— The knot free length of the joints shall bothway be at least 3 d, where d is the diameter of the knot. The knot free length shall bothway be at least 1,5 d, if an appropriate automated system according to I.4.3 is used;

— tension specimens shall be tested with the full width and a knot free length of at least 200 mm.

E.2.2 Additional requirements for type testing

For type testing the following additional requirements apply:

— the surface shall be planed on four sides;

— testing may be done without conditioning the specimens as described in EN 408. The specimens have a moisture content of $u \leq 15$ %. The moisture content shall be reported.

E.2.3 Additional requirements for factory production control

For factory production control the following additional requirements apply:

— the ultimate load should be reached within (60 ± 15) s;

— the accuracy of measuring the maximum load shall be better than ± 3 % of this load;

— testing may be done without conditioning the specimens as described in EN 408 and without measuring the moisture content;

— the density need not to be determined;

— bending tests may be done with a span of 15 h, where *h* is the cross sectional size in the direction of the load.

E.3 Compliance criteria of finger joints in laminations

E.3.1 For type testing

The characteristic strength value and the coefficient of variation shall be calculated according to EN 14358.

E.3.2 For factory production control

For each production line, declared strength value and shift, either the declared bending strength or the declared tensile strength, shall be acceptable if one of the following requirements a) or b) is met.

a) Of the last 100 joints tested, the values of the flat-wise bending strength $f_{m,j,k}$ or the tensile strength $f_{t,j,k}$ of each single joint shall relate to the threshold value $f_{m,k,j,dc}$ or $f_{t,0,k,j,dc}$ respectively:

   Not more than 5 shall be below the threshold value and

   No value shall fall below 80 % of the threshold value.

b) The characteristic strength k_{15} $f_{j,15,mean}$ of the last 15 finger joints tested in flat-wise bending or tension shall be higher than or equal to the declared characteristic strength $f_{j,dc,k}$.

   Where k_{15} is a statistical factor, taken from Table E.1 and $f_{j,15,mean}$ is the mean strength of the last 15 finger joints.

Table E.1 — Factor k_{15}

Coefficient of variation according to EN 14358	**≤ 0,10**	**0,15**	**0,20**	**0,25**	**0,30**
k_{15}	0,82	0,74	0,67	0,61	0,55

E.4 Report of tests with finger joints in laminations

The following items shall be reported:

— production line;

— reference to this European Standard;

— date of production;

— date of the test;

— species;

— strength class or manufacturer specific strength class;

— preservative treatment (if relevant);

— type and trade name of adhesive;

— effective proportion of resin and hardener (if relevant);

— density and moisture content (only for type testing);

— width and thickness of the lamination;

— finger joint profile;

— finger joint orientation;

— ultimate test load at failure;

— bending or tensile strength;

— description of the failure mode (wood failure percentage);

— mean bending strength of finger joints in laminations $f_{m,j,mean}$ or mean tension strength parallel to the grain of finger joints in laminations $f_{t,0,j,mean}$ and coefficient of variation (if relevant);

— name of the person responsible for the testing.

E.5 Tests with laminations without finger joints

For tests with laminations without finger joints the appropriate requirements from E.1 to E.4 apply.

Annex F
(normative)

Determination of strength, stiffness and density properties of cross laminated timber

F.1 Indices

The indices given in Table F.1 apply.

Table F.1 — Indices for forces, moments, resistances, strengths and moduli in cross laminated timber and its layers with loads perpendicular to the plane

		First index	Second index[a]	Third index[a]	Fourth index[a]
Moments[b]		axis to which the bending moment relates[c]	-	-	-
Forces[d]	Tension or compression forces	kind of force[e]	direction of force[c]	-	-
	Shear force	direction of force[c]	direction of stresses caused by related bending stresses[c]	-	-
Moduli[f]	of layers	direction of observed stress/strain related to local axes[g]	"lay"	-	-
	of cross laminated timber	direction of observed stress/strain related to global axes[c]	"xlam" or "lfj"	-	-
Resistances[h]		Moment and axis to which it relates or force to which strength refers[c,i]	direction of observed stress/strain[g]	"xlam"	-
Strengths[j]	of layers	Moment and axis to which it relates or force to which strength refers[c,i]	direction of observed stress/strain related to local axes[g]	Fibre direction to which strength belongs[g]	"lay"
	of cross laminated timber		direction of observed stress/strain related to global axes[c]	Fibre direction to which strength belongs[g]	"xlam" or "lfj"

[a] Index may be omitted, if selfevident

[b] *M* Moment, in Nmm

[c] *x* global axis parallel to the fibre direction of the outermost layers or
y global axis orthogonal to the fibre direction of the outermost layers or
z global axis perpendicular to the plane of the cross laminated timber

[d] *F* Compression or tension force in N or

V Shear force in N

[e] c Compression

t Tension

[f] E Modulus of elasticity in N/mm² or

G Shear modulus in N/mm²

[g] 0 local axis parallel to the grain or

90 local axis perpendicular to the grain (both tangential and radial) or

090 local plane spanned by local axis 0 and axis 90 (e.g. shear in a plane spanned by axes parallel and perpendicular to the fibre direction) or

9090 local plane spanned by local axis 90 and axis 90 (e.g. shear in a plane spanned by axes perpendicular to the fibre direction

[h] R Resistance to forces in N or to moments in Nm

[i] m bending

c compression

t tension

v shear

[j] f Strength in N/mm²

Table F.2 — Examples for indices in cross laminated timber with loads perpendicular to the plane

	Denomination for forces and moments	Denomination for resistances	Denomination for strengths	
Moment about *y*-axis	M_y	$R_{my,x,xlam}$	$f_{my,x,0,lay}$	for layers parallel to *x*-axis
			$f_{my,x,90,lay} = 0$	for cross layers with $E_{90} = 0$
Moment about *x*-axis	M_x	$R_{mx,y,xlam}$	$f_{mx,y,0,lay}$	for layers parallel to *y*-axis
			$f_{mx,y,90,lay} = 0$	for cross layers with $E_{90} = 0$
Shear perpendicular to the plane	$V_{z,x}$	$R_{v,zx,xlam}$	$f_{v,090}$	for layers parallel to *x*-axis
	$V_{z,y}$	$R_{v,zy,xlam}$	$f_{v,9090}$	for layers perpendicular to *x*- axis
			$f_{v,090}$	for layers parallel to *y*-axis
			$f_{v,9090}$	for layers perpendicular to *y*- axis
Compression perpendicular to the plane	$F_{c,z}$	$R_{c,z,xlam}$	$f_{c,90}$	for cross laminated timber in the direction of *z*-axis

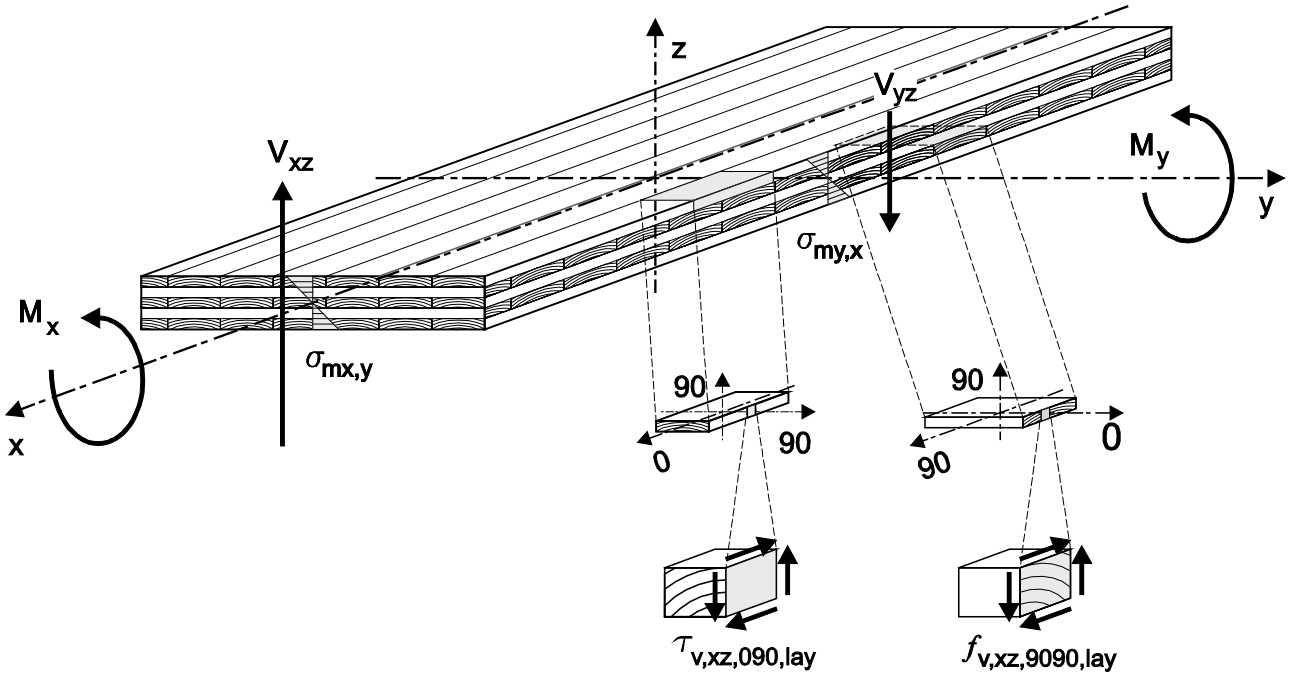


Figure F.1 — Indices for forces, moments, resistances and strengths in cross laminated timber with loads perpendicular to the plane

Table F.3 — Examples for indices in cross laminated timber with loads in plane

	Denomination for forces and moments	Denomination for resistances	Denomination for strengths	
Moment around *z*-axis	M_z	$R_{mz,y,xlam}$	$f_{mz,y,0,lay}$	for layers parallel to *y*-axis
			$f_{mz,y,90,lay}$	for layers perpendicular to *y*-axis
		$R_{mz,x,xlam}$	$f_{mz,x,0,lay}$	for layers parallel to *x*-axis
			$f_{mz,x,90,lay}$	for layers perpendicular to *x*-axis
Shear in plane	$V_{x,y}$	$R_{v,xy,xlam}$	$f_{v,090}$	
Compression or tension force in plane	$F_{c,x}$ or $F_{t,x}$	$R_{c,x,xlam}$ or $R_{t,x,xlam}$	$f_{c,x,lay}$ or $f_{tx,lay}$	
	$F_{c,y}$ or $F_{t,y}$	$R_{c,y,xlam}$ or $R_{t,y,xlam}$	$f_{c,y,lay}$ or $f_{ty,lay}$	

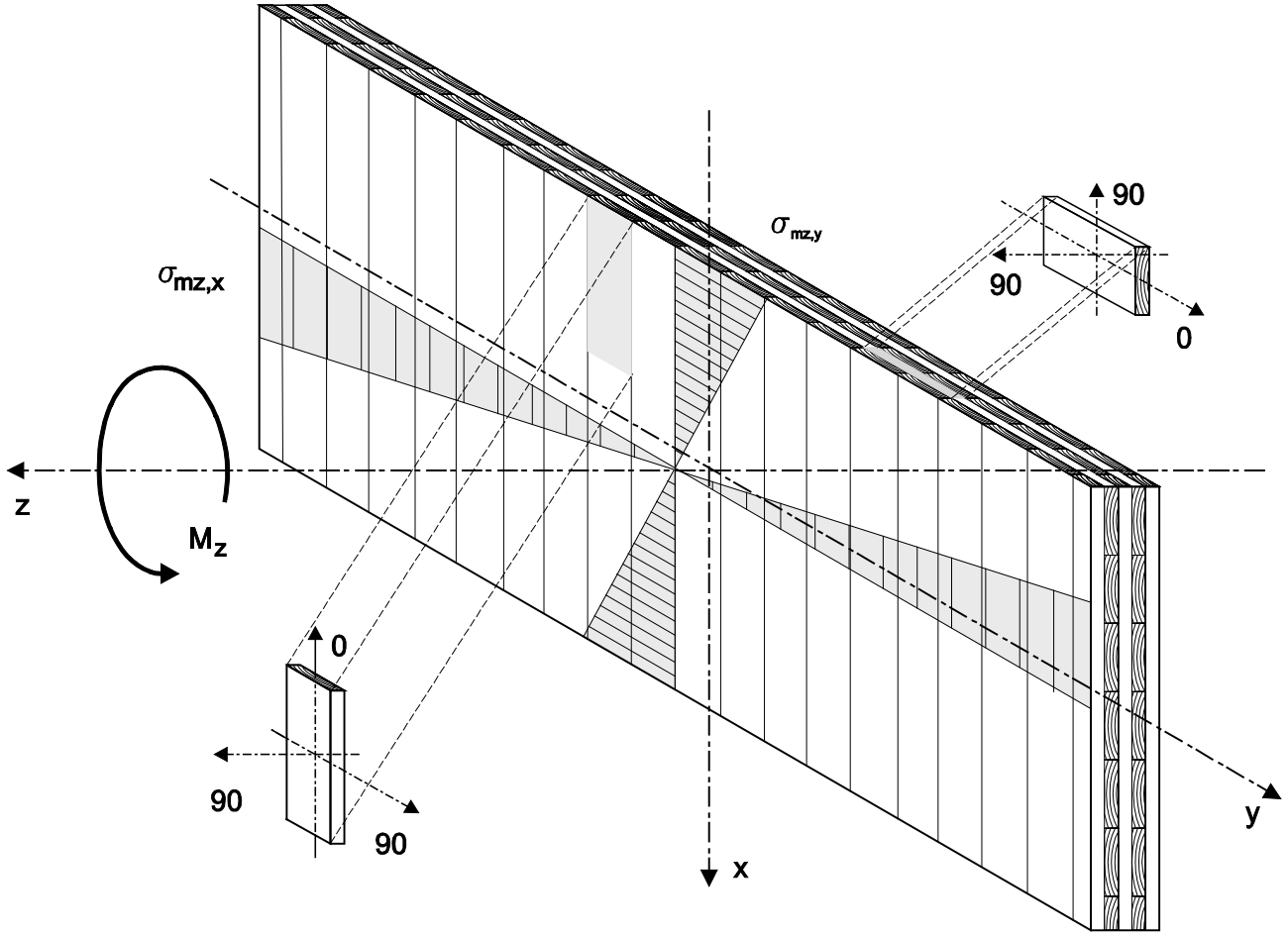


Figure F.2 — Indices for forces, moments, resistances, strengths in cross laminated timber with loads in plane

F.2 General

F.2.1 Sampling

The specimens shall be representative of the manufacture unless different requirements are given in the following paragraphs.

F.2.2 Specimens

The width of the specimens shall be at least 300 mm and timber layers parallel to the span of the specimens shall consist of at least two laminations unless different requirements are given in the following paragraphs.

F.2.3 Testing

EN 408 applies unless different requirements are given in the following paragraphs.

Testing may be done without conditioning the specimens as described in EN 408. If the specimens are not conditioned according to EN 408, they shall have a moisture content of u = (12 ± 3) %. The moisture content shall be reported.

F.2.4 Analysis of test results

The strength and stiffness properties shall be calculated according to EN 14358.

For analysis of test results the following assumptions shall apply:

— The bonds shall be taken as rigid;

— Linear elastic theory shall be taken into account;

— For layers made from timber laminations or single layered solid wood panels the mean value of modulus of elasticity perpendicular to the grain of the layers shall be taken as $E_{90,lay,mean}$ = 0 N/mm² and the mean value of shear modulus shall be taken as $G_{090,lay,mean}$ = 650 N/mm².

If layers in the span direction consist of different strength classes or technical classes, the ratios of layer stiffnesses shall be taken into account.

F.2.5 Test reports

A test report on the basis of EN 408 shall be given. The test report shall include all relevant information regarding layup of specimen, test setup, testing and analysis of results.

Any preservative treatment shall be documented additionally.

F.3 Characteristics determined by tests with loads perpendicular to the plane

F.3.1 Bending test

The number of specimens within type testing shall be as follows:

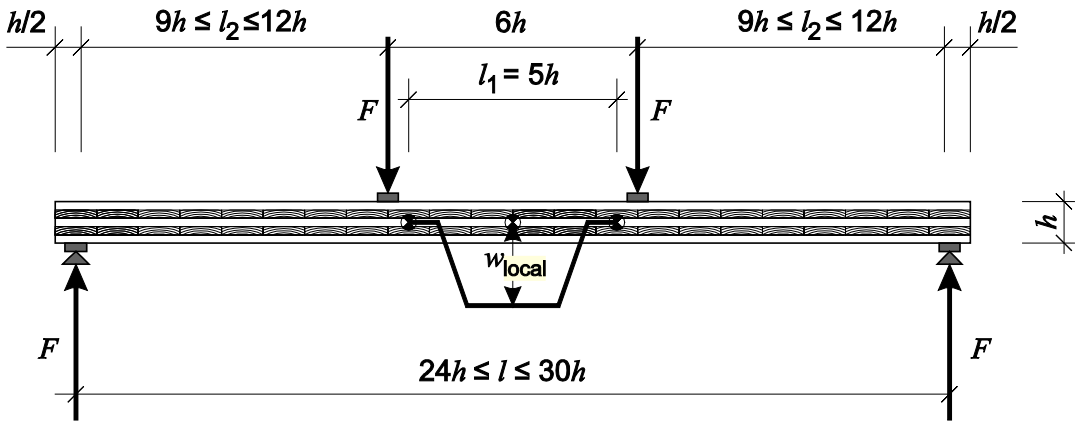
— 15 specimens per layup for widths up to 500 mm;

— 10 specimens per layup for widths up to 800 mm;

— 7 specimens per layup for widths larger than or equal to 800 mm.

The load configuration shall be taken from Figure F.3.

NOTE Cross laminated timber made of cross layers comprising laminations having a ratio of width b_l to thickness t_l of $b_l/t_l \geq 4$ usually fail in bending and therefore could also be tested with the load configuration given in EN 408, however for cross laminated timber made of cross layers comprising laminations having a ratio of width to thickness of $b_l/t_l \leq 4$ the load configuration given in Figure F.3 may be useful in order to prevent rolling shear failure.



Key

h height of the specimen

l span of specimen

l_1 gauge length for measuring w_{local}

w_{local} deflection measured over the length of the shear – stress free area

Figure F.3 — Bending test with cross laminated timber with loads perpendicular to the plane

The modulus of elasticity of the cross laminated timber shall be declared by the modulus of elasticity $E_{0,lay}$ in N/mm² of the layers in respective span direction and the layup.

The bending strength of the cross laminated timber shall be declared by the bending strength $f_{mx,0,lay}$ in N/mm² of the layers in respective span direction and the layup. The resistance to bending moments $R_{mx,xlam}$ in Nmm or $R_{my,xlam}$ in Nmm of the cross laminated timber shall also be given in the test report.

F.3.2 (Rolling) shear strength and stiffness derived from bending tests

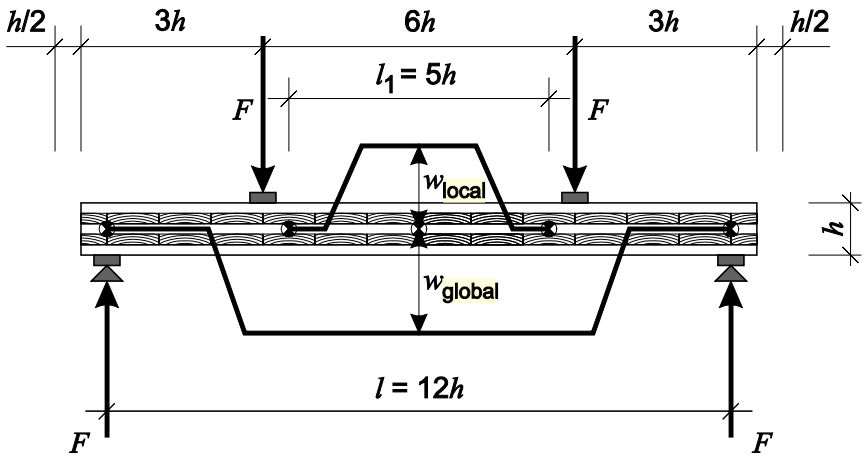
Regarding the number of specimens F.3.1 applies.

The load configuration shall be taken from Figure F.4 a) for determination of shear strength and stiffness or from Figure F.4 b) for determination only of shear strength.

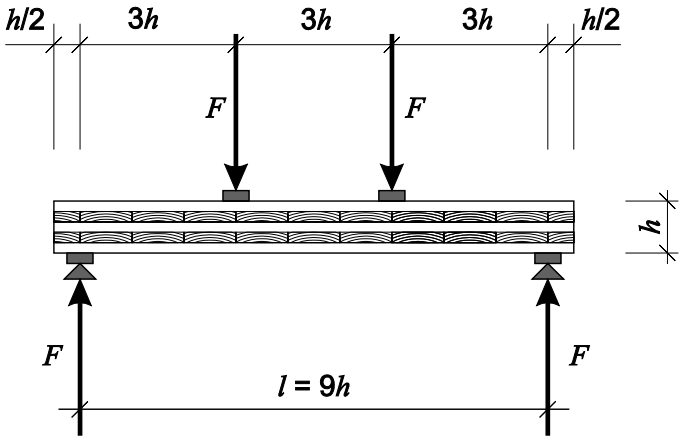
The (rolling) shear stiffness of the cross laminated timber shall be declared by the rolling shear modulus $G_{9090,lay}$ of the layers perpendicular to the span direction in N/mm² and the layup. The cross sectional shear stiffness $(G\,A)_{zx,xlam}$ or $(G\,A)_{yz,xlam}$ in Nmm² of the cross laminated timber shall also be given in the test report.

NOTE Determination of shear modulus $G_{090,lay}$ does not lead to reasonable results.

The (rolling) shear strength of the cross laminated timber shall be declared by the (rolling) shear strength $f_{v,9090}$ in N/mm² and the layup or by the resistance to (rolling) shear $R_{v,zx,xlam}$ or $R_{v,yz,xlam}$ in Nmm of the cross laminated timber.



a) For determination of rolling shear strength and stiffness



b) For determination of rolling shear strength only

Key

h = height of the specimen

l = span of specimen

l_1 = gauge length for measuring w_{local}

w_{local} = deflection measured over the length of the shear – stress free area

w_{global} = deflection measured over the entire span

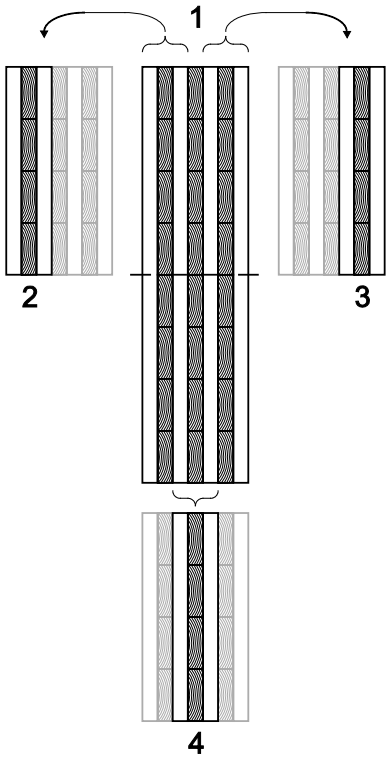
Figure F.4 — Bending test for determination of (rolling) shear strength and stiffness

F.3.3 (Rolling) shear strength and stiffness derived from shear test (alternative test method)

20 Specimens per layup shall be tested within type testing.

Alternatively to F.3.2 (rolling) shear values may be determined by tests according to EN 789:2004, 11.5, and the additional requirement of this section.

The width of the specimens shall be at least 100 mm. The cutting scheme for specimens given in Figure F.5 shall apply.



Key

1 full cross section to be tested

2 specimen 1 out of full cross section

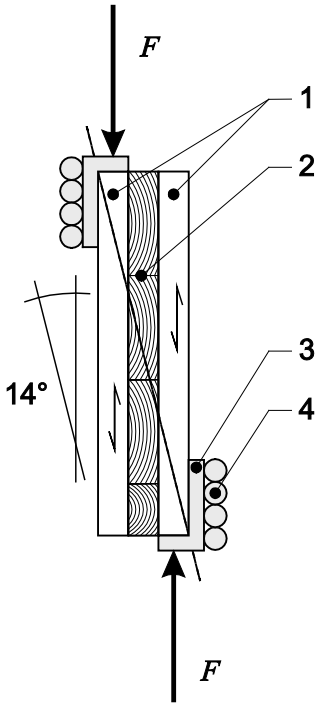
3 specimen 2 out of full cross section

4 specimen 3 out of full cross section

Figure F.5 — Cutting scheme for shear specimens from cross laminated timber comprising more than three layers

Alternatively to EN 789:2004, 11.3, a test configuration according to Figure F.6 may be taken.

NOTE In contrast to EN 789 the normal forces can be directly transferred from the outermost layers to the inner layer without glued on steel plates.



Key

1 longitudinal layers of specimen

2 cross layer of specimen

3 steel angles for load transmission

4 friction free support

Figure F.6 — Shear test with cross laminated timber

Each cross layer shall be tested separately. Layers bonded parallel to the grain shall be taken as one layer.

Shear stiffness and strength shall be calculated according to EN 789. The results from tests according to F.3.2 and F.3.3 may be considered equivalent.

F.3.4 Compression perpendicular to the plane

20 Specimens per layup shall be tested within type testing.

The height of the specimens shall be the overall thickness of the cross laminated timber.

F.3.5 Large finger joint - Bending test

Regarding the number of specimens F.3.1 applies.

The layup of the specimens shall have the maximum layer thickness of cross-layers intended to be jointed by the manufacturer. Specimens having the minimum and the maximum number of layers intended to be jointed by the manufacturer shall be taken.

The specimen shall have a minimum width of 300 mm and the full cross sectional thickness of the element from which they are taken. Specimens shall be taken from each side of an element.

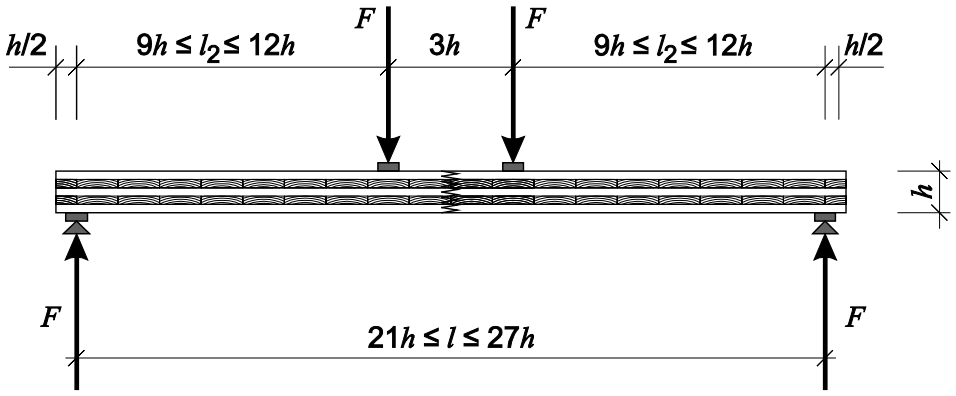
It is allowed to do the testing without conditioning the specimens as described in EN 408. The specimens shall have a moisture content of $u \leq 15$ %. The moisture content shall be reported.

The load configuration shall be taken from Figure F.7.

The large finger joint shall be placed in the middle of the specimen.

Each test result shall be equal or greater than the declared characteristic bending strength of the large finger joint.

The bending strength of large finger joints in cross laminated timber shall be declared as the bending strength of the outermost layer at the large finger joint $f_{my,0,lfj}$ in N/mm^2 and the layup.



Key

h height of the specimen

l span of specimen

Figure F.7 — Bending test with cross laminated timber containing large finger joint with loads perpendicular to the plane

F.4 Characteristics determined by tests with in-plane loads

F.4.1 Bending

The number of specimens within type testing shall be as follows:

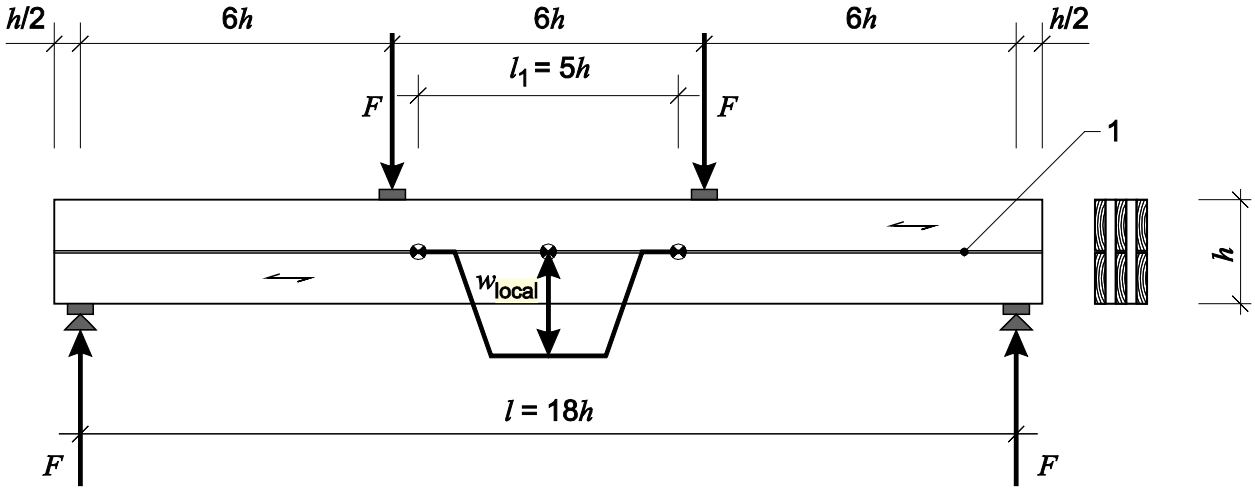
— 12 specimens for cross sections made from three or four layers;

— 10 specimens for cross sections made from five or six layers;

— 7 specimens for cross sections made from seven or more layers.

The load configuration shall be taken from Figure F.8 if cross laminated timber is built up from timber layers without edge bonds or from wood based panel layers with butt joints. The gaps of non-edge bonded layers or butt joints of wood based panels shall be positioned on the neutral axis of the specimens.

Test results shall be given either for gross cross section or for layers in span direction only (net cross section).



Key

1 gap

h height of specimen

l span of specimen

l_1 gauge length for measuring w_{local}

w_{local} deflection measured over the length of the shear – stress free area

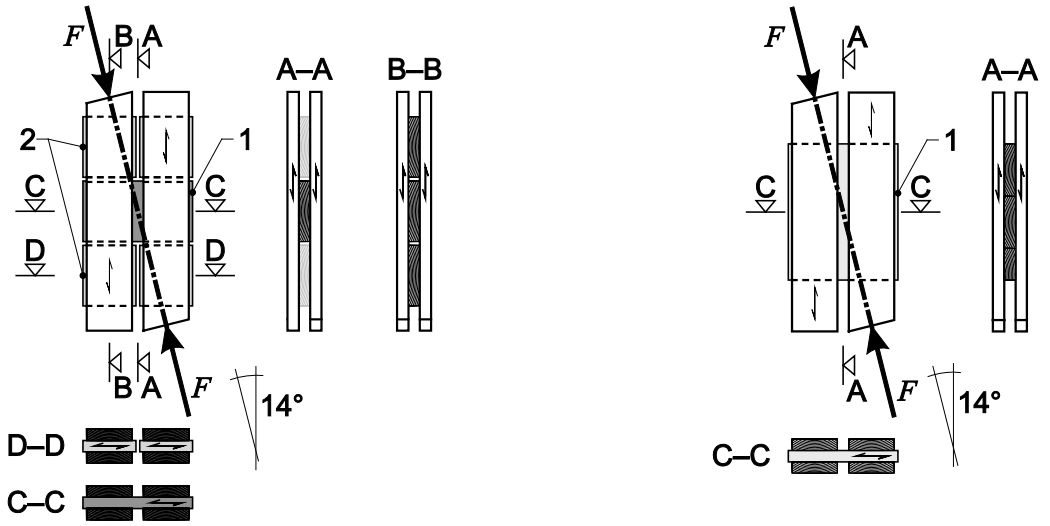
Figure F.8 — Bending test with cross laminated timber with loads in plane direction

F.4.2 Shear values within a layer – net cross section

For each combination of layer thickness, layer width and strength grade of laminations 20 specimens shall be tested within type testing.

Specimens and test configuration shall comply with Figure F.9.

Specimens shall comprise timber layers with the widest gaps between laminations and the smallest width of laminations intended to be produced by the manufacturer. The layers shall have the greatest thickness intended to be produced by the manufacturer.



Key

1 cross lamination

2 cut cross lamination

Figure F.9 — Shear test for cross laminated timber with loads in plane direction – net cross section

The shear strength shall be declared by shear strength of net cross section $f_{v,xy,090,lay}$ in N/mm².

F.4.3 Shear values for glue lines between layers – torsional shear

For each combination of layer thickness, layer width and strength grade of laminations 20 specimens shall be tested within type testing.

Regarding moisture content of specimens, time to failure and accuracy of measurements EN 408 applies.

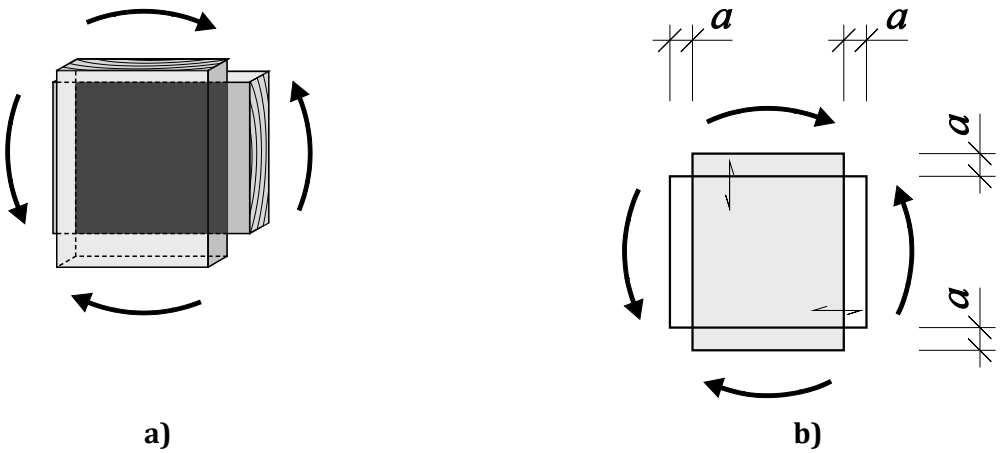
Test results shall be given either for gross cross section or for layers in span direction only (net cross section).

Layers shall have the greatest thicknesses and laminations the smallest width intended to be produced by the manufacturer.

The overlap a according to Figure F.10 of each board or wood based panel shall be 30 mm.

No restraints by support (like compression or tension in rotation axis) shall be put on test specimen.

The torsional shear strength of cross laminated timber shall be declared by the shear strength $f_{mz,9090}$ in N/mm² of the cross laminated timber, calculated by polar moment of inertia of the glued surface and layup.



Key

a overlap of laminations or wood based panels

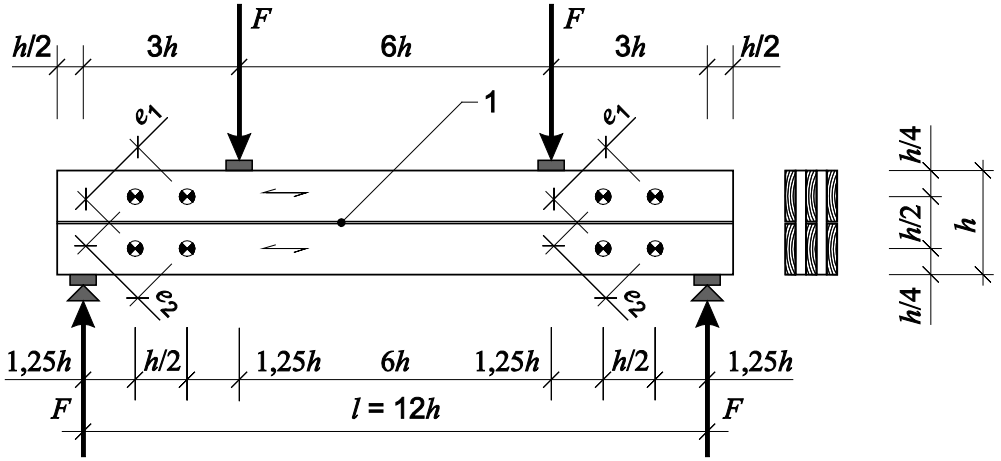
Figure F.10 — Shear test for cross laminated timber with in plane loads – torsional shear

F.4.4 Shear stiffness for cross laminated timber in plane by bending test

Regarding the number of specimens F.4.1 applies.

The load configuration shall be taken from Figure F.11 if cross laminated timber is built up from timber layers without edge bonds or from wood based panel layers with butt joints. The gaps of non-edge bonded layers or butt joints of wood based panels shall be positioned on the neutral axis of the specimens.

To ensure that no bonds between laminations exist, saw cuts through the full depth of the outermost layers should be provided.



Key

1 gaps between laminations or wood based panels

h height of specimen

l span of specimen

Figure F.11 — Shear test for cross laminated timber with loads in plane direction – Shear stiffness

The shear stiffness in plane shall be declared by $(A\ G)_{xy,xlam}$ in N.

F.4.5 Large finger joint - Bending test

Regarding the number of specimens F.4.1 applies.

The layup of the specimens shall have the maximum layer thickness of cross-layers intended to be jointed by the manufacturer. Specimens having the minimum and the maximum number of layers intended to be jointed by the manufacturer shall be taken.

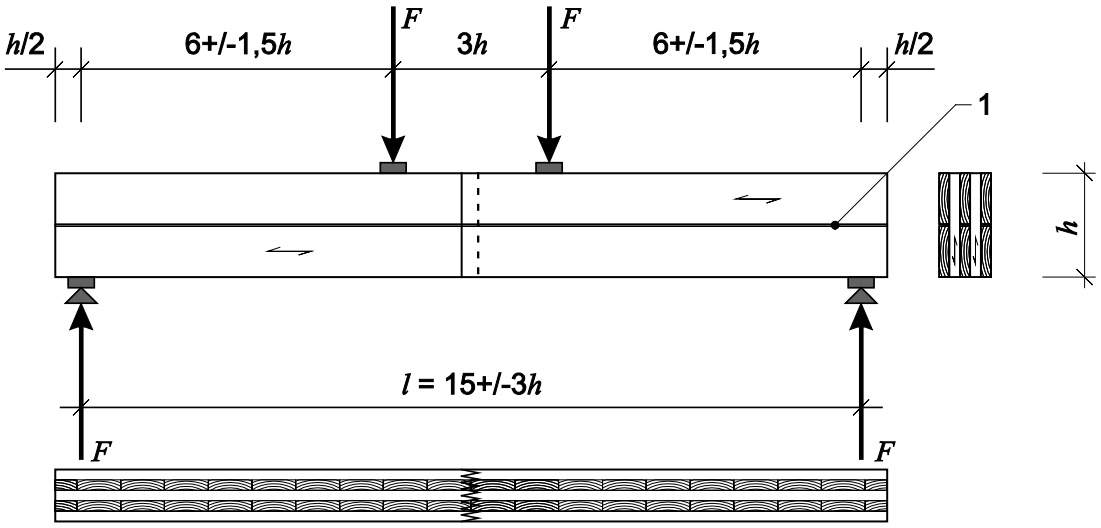
The specimen shall have a minimum width of 300 mm and the full cross sectional thickness of the element from which they are taken. Specimens shall be taken from each side of an element.

It is allowed to do the testing without conditioning the specimens as described in EN 408. The specimens shall have a moisture content of $u \leq 15$ %. The moisture content shall be reported.

The load configuration shall be taken from Figure F.12.

The large finger joint shall be placed in the middle of the specimen.

Each test result shall be equal or greater than the declared characteristic bending strength of the large finger joint.



Key

1 gaps between laminations

h height of specimen

l span of specimen

Figure F.12 — Bending test with cross laminated timber containing a large finger joint with loads in plane

The bending strength of large finger joints in cross laminated timber shall be declared as the bending strength of the outermost layer at the large finger joint $f_{mz,0,lfj}$ in N/mm² and the layup. The resistance to bending shall also be given in the test report.

Annex G
(normative)

Measurement of moisture content

G.1 General

Moisture meters shall enable to measure the moisture content of the timber with an accuracy of ± 2 % moisture content.

The accuracy of a moisture meter according to EN 13183-2 or EN 13183–3 shall be checked for all relevant species by comparison with results from measurements with the oven dry method according to EN 13183-1.

G.2 Measurement of moisture content of boards during production

The moisture content of each board shall be measured.

The accuracy of the moisture meter shall be checked for each combination of species and preservative treatment (if relevant) with timber pieces having representative cross sections and with moisture contents covering the likely range of moisture contents during production, but at least a range of 8 % moisture content difference.

If the measurement is done by an electrical resistance moisture meter the electrodes shall be driven into one face of the board at a distance of at least 0,3 times the width from the edge and at least 0,3 m from either end of the board so that the tips of the electrodes penetrate into a depth of 0,3 times the thickness of the board. Lower penetration depths are allowed if correlation with moisture content is checked within factory production control.

If the measurement is done by an in-line capacitive moisture meter the mean value of the measured data are to be used.

G.3 Mean moisture content of cross laminated timber made from timber laminations

The moisture content shall be measured with an electrical resistance moisture meter. Measurements shall be done at a point not nearer than 1 m from either end or in the centre of the piece if it is less than 2 m long using insulated electrodes having a maximum penetration length of 40 mm.

The mean value of the moisture content shall be calculated from at least two measurements, done at the top and the bottom of the cross laminated timber.

Annex H
(normative)

Separation tests with finger joints in laminations produced with contact-free application of adhesive

An arbitrarily chosen finger joint shall be sampled directly after pressing, but before curing.

A slab with the uncured finger joint shall be cut next to the slot bases and all finger surfaces shall be separated by manual breaking.

The adhesive coverage of all finger surfaces shall be inspected visually and the result shall be documented.

Annex I
(normative)

Minimum production requirements

I.1 Personnel

The personnel shall have adequate training in the production of cross laminated timber and in the factory production control in order to meet the relevant requirements of 6.3.

I.2 Production and storage facilities

I.2.1 General

The production and storage facilities shall be suitable for all phases of the production of cross laminated timber, taking into consideration the requirements given in this standard.

I.2.2 Facilities for drying and storage of timber

Drying facilities of sufficient capacity shall be available when the drying is carried out by the manufacturer of the cross laminated timber.

Storage facilities of sufficient capacity shall be available to maintain the required moisture content of the timber and the wood-based panels.

Storage facilities of sufficient capacity shall be available to achieve the required temperature of the timber and the wood-based panels for the respective operation.

I.2.3 Facilities for processing and storage of adhesives

Unless resin and hardener are pumped directly from storage tanks and mixed automatically during application, there shall be a separate area for the preparation of the adhesive (mixing of resin and hardener). There shall also be suitable resin and hardener storage facilities and an area for cleaning the adhesive equipment.

I.2.4 Facilities for production and curing

The air temperature and relative humidity in the facilities for production and curing shall ensure that the required temperature at the glue line is reliably achieved and that no inadmissible changes in moisture content occurs until the cross laminated timber are fully cured.

The air temperature in the production facilities shall be at least 15°C. The instructions of the adhesive manufacturer shall be regarded. During curing of the glue lines under pressure and during post-curing the air temperature shall be at least 18°C. If the glue line is directly heated, e.g. using radio frequency equipment, the air temperature shall be at least 15 °C.

During the production of the cross laminated timber the relative humidity in a conventional production process shall be between 40 % and 75 %. During curing the relative humidity shall be at least 30 %.

I.3 Equipment

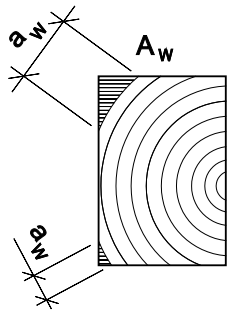
The equipment shall be suitable for all phases of the production, taking into consideration the requirements given in this standard.

I.4 Finger joints in laminations

I.4.1 Wane and edge damages

There shall be no wane or edge damage affecting more than two corners at the joint within the finger length and within 75 mm of the root of the fingers. The area, A_w, of the wane at any corner shall not exceed 1 % of the cross sectional area (see Figure I.1).

NOTE Conformity with this requirement can be verified by measuring the diagonal a_w of the wane and demonstrating that it is less than the maximum diagonal given in Figure I.2 as a function of the cross sectional area A.



Key

a_w maximum diagonal of wane

A_w area of the wane

Figure I.1 — Cross section of timber with wane

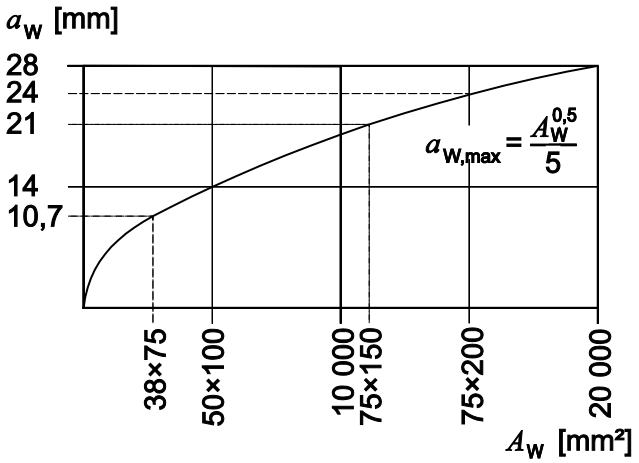


Figure I.2 — Maximum diagonal of wane $a_{w,max} = A^{0,5}/5$

I.4.2 Finger joint geometry

The geometry of the fingers shall permit the joint to be self-interlocking after pressing. Recommended relations for b_t/b_{cut} are $1{,}1 \leq b_t/b_{cut} \leq 1{,}2$.

The finger length l_j, the pitch p, the tip width b_t, the reduction factor $v = b_t/p$ and the finger angle α shall fulfil Formulae (I.1) and (I.2), respectively:

$$l_j \geq 4\,p\,(1 - 2\,v) \tag{I.1}$$

$$\alpha \leq 7{,}1° \tag{I.2}$$

The reduction factor v shall be $v \leq 0{,}18$ and the finger length l_j shall be $l_j \geq 10$ mm.

Commonly used cutter geometries are given in Table I.1.

Table I.1 — Commonly used geometries of the cutters

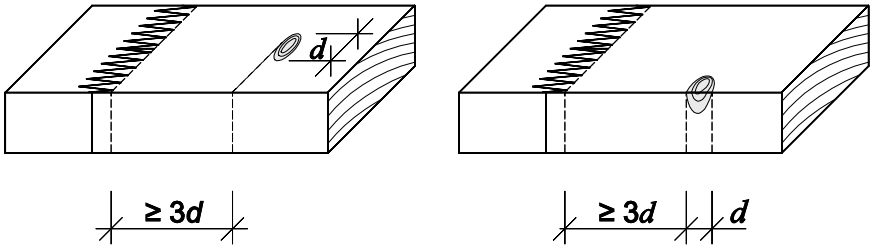
Finger length l_j (mm)	Pitch p (mm)	Width of cutter b_{cut} (mm)	Reduction factor v
15	3,8	0,42	0,11
15	3,8	0,6	0,16
20	5,0	0,5	0,10
20	6,2	1,0	0,16

I.4.3 Knots and local grain deviation

Knots with a diameter smaller than 6 mm may be disregarded.

There shall be no knots or pronounced grain disturbance within the joint itself.

Outside the joint the distance between a knot and the end of the cross-cut timber shall be not less than (l_j + 3d), where l_j is the finger joint length. See Figure I.3, except where an appropriate automated system guarantees that in the range of the finger joints the grain orientation is parallel to the longitudinal direction.



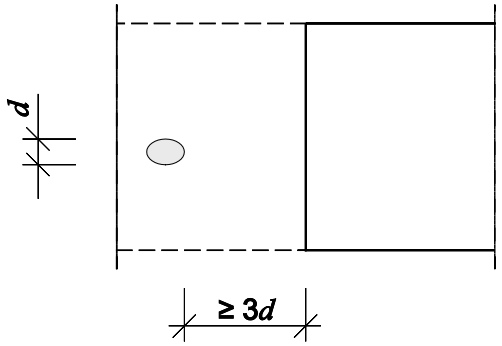
Key

d knot diameter

l_j finger joint length

Figure I.3 — Minimum distance from the base of the finger joint and a knot

Where timber pieces are cross-cut to remove a knot, the end of the cross-cut shall be not less than 3*d* (see Figure I.4), except where an appropriate automated system guarantees that in the range of the finger joints the grain orientation is parallel to the longitudinal direction.



Key

d knot diameter

Figure I.4 — Minimum distance for a cross-cut to remove a knot

I.4.4 Moisture content at bonding

The moisture content of each board shall be measured according to G.2 with a moisture meter according to G.1.

At assembly, the moisture content of each board shall be between 6 % and 15 %. Additionally, the instructions of the adhesive manufacturer shall be followed.

The moisture content of two boards to be jointed shall not differ by more than 5 % moisture content.

I.4.5 Bonding surface and application of the adhesive

I.4.5.1 General

At the time of bonding the bonding surfaces shall be clean.

The adhesive shall be used in accordance with the instructions of the adhesive manufacturer.

The adhesive shall be applied to both timber ends unless different requirements are given in the following subsections.

The application method shall ensure that all finger flanks in the assembled joint are covered with the adhesive.

I.4.5.2 Manual application

If the adhesive is applied manually it may be applied to only one of the timber ends. It shall be checked visually that adhesive is applied to all finger flanks. This general requirement may be considered satisfied if adhesive is squeezed out of all four surfaces of the joint when the pressure is applied.

I.4.5.3 Application by machine

The suitability of the adhesive for a separate application of resin and hardener shall be verified in accordance with I.4.5.4.

If the adhesive is applied by comb or roller the adhesive shall be applied to both timber ends over a length of at least 75 % of the finger length.

If the adhesive is applied by comb or roller, it may be applied to only one of the timber ends. It shall be checked visually that adhesive is applied to all finger flanks. This general requirement may be considered satisfied, if adhesive is squeezed out of all four surfaces of the joint when the pressure is applied.

If resin and hardener are applied separately by comb or roller the resin may be applied to one timber end and the hardener to the other. The production equipment shall have a device (e.g. a balance or a flow rate meter) to control and document the effective ratio of resin and hardener used. The application of resin and hardener shall be done by two independent application devices, e.g. by two combs with one nozzle or one comb with two nozzles per finger-flank. The application device shall ensure that resin and hardener are applied evenly over at least 75 % of the finger length.

I.4.5.4 Additional requirements for contact free application

Adhesives may be applied contact free if it is ensured by monitoring, documentation and additional tests according to Annex I in factory production control (FPC) (see Table 4) that the adhesive application results in the fulfilment of the principal requirements, i.e. that all finger surfaces in the assembled joint are covered with adhesive.

The following shall be continuously monitored:

a) The amount of adhesive applied shall be monitored by an automated system;

b) The application process shall be monitored;

   1) for two-sided contact free application either by visual monitoring or by an automated system (e.g. optical or other apt sensors);

   2) for one-sided contact free application by an automated system.

c) All results obtained shall be recorded and stored.

I.4.6 Time between cutting and adhesive application

The adhesive application for finger joints in laminations shall be done within 6 h after cutting the finger joint profile.

I.4.7 Pressure

The relative tip gap $e = l_t/l_j$ should be $0{,}01 \leq e \leq 0{,}08$ after pressing.

If the pressure is applied in a cyclic finger joint press the full pressure shall be applied to the finger joint for at least 1 s for laminations for the production of cross laminated timber.

I.4.8 Curing

The temperature of the timber at the glue line during curing shall not be less than 18 °C. The not fully cured jointed laminations shall be moved in a way that the curing process is not affected by deformation or vibration.

The jointed laminations may be further processed if it can be ensured that the finger joint strength is not affected.

The requirements of the technical data sheet of the adhesive shall apply.

Before production of curved cross laminated timber the finger joints shall be fully cured.

I.5 Bonding of laminations and layers

I.5.1 General

The adhesive shall be tested according to the relevant standards taking into account the species and type of wood-based panels intended to be used.

I.5.2 Moisture content at bonding

At assembly, the moisture content in every lamination or wood-based panel shall be from 6 % up to 15 % (inclusive) unless the adhesive manufacturer requires different moisture content within the given range.

The range of moisture content between adjacent laminations bonded together parallel to the fibre shall be not greater than 5 %.

I.5.3 Bonding surfaces and adhesive application

All bonding surfaces shall be made suitable for the bonding procedure. Laminations shall be planed before bonding. The planning shall be carried out not more than 24 h before bonding, unless the species and the storage environment are such that unacceptable surface changes will not take place. With species that are difficult to bond, e.g. have a high resin content or where the laminations have been treated with preservative, planning shall be carried out within 6 h before bonding.

The application of the adhesive shall ensure a uniform application of the required quantity and a reliable mixing of the components of the adhesive.

At the time of adhesive application the bonding surfaces shall be clean.

The adhesive shall be used in accordance with the instructions of the adhesive manufacturer.

I.5.4 Cramping

The cramping pressure shall be chosen depending on the materials and thicknesses of the layers, the species, types of wood-based panels, the adhesive and kind of processing in order to fulfil the requirements for glue line thickness given in I.5.5. The requirements of the data sheet of the adhesive manufacturer shall be regarded.

I.5.5 Glue line thickness

For phenolic and aminoplastic adhesives mixed before use the glue line thickness shall not exceed the maximum glue line thickness declared by the adhesive manufacturer or 0,6 mm, whichever is the smaller. For the separate application of resin and hardener the maximum glue line thickness shall be less than or equal to 0,3 mm.

For moisture curing one-component polyurethane adhesives and emulsion polymer isocyanate adhesives tested with a glue line thickness of 0,5 mm the maximum glue line thickness shall be less than or equal to 0,3 mm.

For emulsion polymer isocyanate adhesives tested with a glue line thickness of 0,3 mm the maximum glue line thickness shall be less than or equal to 0,2 mm.

The glue line thickness shall be checked with a magnifying glass with which the glue line thickness can be determined with an accuracy of 10 %.

Single local deviations, e.g. as a result of chatter marks due to planning, may be disregarded.

I.5.6 Curing

The temperature of the timber at the glue line during curing under pressure and during the required post-curing time shall not be less than 18 °C.

The cross laminated timber shall be moved or processed in a way that the post-curing process is not affected by deformation or vibration.

I.6 Cross laminated timber with large finger joints

I.6.1 Cross laminated timber to be jointed

The cross laminated timber to be jointed shall be straight, shall have the same cross section and layup and shall be jointed in a way that no regular change between the grain directions of the layers in the joint occurs. They shall have an overall thickness from 51 mm up to 345 mm (inclusive). The minimum thickness of the outermost layers shall be greater than or equal to 17mm.

The cross laminated timber to be jointed shall solely comprise timber layers.

I.6.2 Moisture content at bonding

The mean moisture content of the cross laminated timber shall be less than 15 %. The difference of the mean moisture contents of the components to be jointed shall be less than 2 %. Additionally the instructions of the adhesive manufacturer shall be followed.

I.6.3 Finger joint geometry

The requirements of I.4.3 apply with the following amendment: The finger length l_{lfj} shall be at least 45 mm.

NOTE A common profile has a nominal finger length l_{lfj} *of* 50 mm, a pitch p of 12 mm and a tip width b_{cut} of 2 mm.

I.6.4 Machining of the fingers

The large finger joints shall be machined flatwise, so that the fingers are visible at two narrow sides of the cross laminated timber, see Figure 3.

The machining of the fingers shall be carried out not more than 24 h before bonding. With species that are difficult to bond, e.g. have a high resin content, or where the laminations have been treated with preservatives, cutting shall be carried out not more than 6 h before bonding. These time limits may be extended up to 72 h (24 h for species which are difficult to bond) if moisture induced deformation of the fingers is prevented by appropriate means e.g. airtight coverings and securing the finger profiles by counterpieces.

The total area with damaged fingers shall be less than 5 %. Only timber layers having fibre directions parallel to the finger direction shall be taken into account.

I.6.5 Adhesive, bonding surface and adhesive application

The adhesive shall be applicable for the species intended to be used. Separate application of resin and hardener is not permitted. The adhesive shall be used in accordance with the instructions of the adhesive manufacturer.

At the time of adhesive application the bonding surfaces shall be clean.

The adhesive shall be applied evenly and in the required quantity so that continuous adhesive squeeze out is achieved along all glue lines during cramping and all finger surfaces in the assembled joint are covered with adhesive.

I.6.6 Cramping

The cramping equipment shall ensure the required pressure over the whole area of the large finger joint.

The cramping pressure shall be taken from the documentation of the adhesive manufacturer. It shall be not less than 0,3 N/mm^2. The cramping pressure should be calculated taking into account only the layers parallel to the finger joint direction.

It shall be ensured that no splitting results from cramping.

The cramping pressure shall be maintained for a minimum period of 1 min after visible adhesive squeeze out has ceased.

It may be necessary to apply a pressure perpendicular to the finger plane to prevent splitting of the components and to ensure a sufficient lateral pressure on the outmost fingers.

I.6.7 Glue line thickness

The thickness of the glue line between the cross laminated timber components made with phenolic or aminoplastic adhesives shall be checked with a magnifying glass capable to determining glue line thicknesses to an accuracy of 10 % and shall be in accordance with the instructions of the adhesive manufacturer but not more than 0,6 mm. The thickness of the glue line made with moisture curing one component polyurethane adhesives shall be less or equal than 0,3 mm. Measurements at knots shall be disregarded.

The relative tip gap $e = l_t/l_{lfj}$ (see Figure 2) shall be $0{,}02 \leq e \leq 0{,}08$ over the full joint depth after pressing.

I.6.8 Curing

Requirements of I.5.6 shall apply with the following amendments.

The uncured cross laminated timber with large finger joints shall be moved in a way that no differential movement takes place in the joint.

Curing of the cross laminated timber with large finger joints and further processing shall take place in accordance with the instructions of the adhesive manufacturer.

Annex ZA
(informative)

Clauses of this European Standard addressing the requirements of the EU Construction Products Regulation

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under Mandate M/112 "Structural timber products and ancillaries" given to CEN by the European Commission and the European Free Trade Association.

If this European standard is cited in the Official Journal of the European Union (OJEU), the clauses of this standard, shown in this annex, are considered to meet the requirements of the relevant mandate, under the Regulation (EU) No. 305/2011.

This annex deals with the CE marking of the cross laminated timber intended for the uses indicated in Table ZA.1 shows the relevant clauses applicable.

This annex has the same scope as in Clause 1 of this standard related to the aspects covered by the mandate and is defined by Table ZA.1.

Table ZA.1 — Relevant clauses for cross laminated timber

Construction products:	Structural cross laminated timber [a] and Structural cross laminated timber with large finger joints [a]		
Intended uses:	for the manufacture of structural elements to be used In buildings and bridges		
Essential characteristics	**Clauses in this European Standard related to essential characteristics**	**Regulatory classes**	**Notes**
Modulus of elasticity, Bending strength, Compressive strength, Tensile strength and Shear strength [b] determined from geometrical data and properties of layers and expressed as:			
Strength and stiffness properties of timber layers	5.1.3	-	Assessed or tested according to EN 14081–1 and declared as strength class or individual value
Strength and stiffness properties of wood-based panel layers, if relevant	5.1.4	-	Assessed according to 5.1.4 and declared as technical class or strength and stiffness properties for wood-based panels according to EN 13986 or for LVL according to EN 14374
Geometrical data	5.2.2	-	Determined according to 5.2.2 and declared as overall size, layup, grooves (if any), edge bonds (if any) and ratio of lamination width to lamination thickness
Bending strength(s) of large finger joints, if relevant	5.2.4	-	Tested according to 5.2.4 and declared as bending strength(s) of large finger joints relevant for the intended use

Bonding strength, expressed as			
Bonding strength of finger joints in laminations;	5.2.5.2	-	Tested according to 5.1.2 and declared as characteristic bending or tension strength of the timber by declaration of strength class or individual value
Bonding strength of edge bonds between laminations, if relevant	5.2.5.3	-	Tested according to 5.2.5.3 and declared as "Pass shear"
Bonding strength of glue lines between layers	5.2.5.4	-	Tested according to 5.2.5.4 and declared as "Pass delam" or "Pass shear"
Bonding strength of large finger joints, if relevant	5.2.5.5	-	Tested according to 5.2.4 and declared as characteristic bending strength(s) of large finger joints relevant for the intended use
Resistance to fire [c] expressed as			
Geometrical data	5.2.2	-	Determined according to 5.2.2 and declared as overall size, layup, grooves (if any) and edge bonds (if any)
Charring rate, to be obtained from:		-	
Density of timber	5.1.1	-	Assessed or tested according to EN 14081–1 and declared as characteristic density of timber by declaration of strength class or individual value
Density of wood-based panels, if relevant	5.1.4	-	Assessed according to 5.1.4 and declared as characteristic density of wood-based panel by declaration of technical class or single value for wood-based panels according to EN 13986 or single value for LVL according to EN 14374
Species [d]	5.1.5	-	Declared according to 5.1.5
Reaction to fire [e] expressed as			
Reaction to fire of layers	5.2.7.2	-	Assessed according to EN 14081–1 for timber layers and according to EN 13986 or EN 14374 for wood-based panel layers and declared as reaction to fire classes of layers
Reaction to fire from tests	5.2.7.3	A1 to F	Tested and classified according to EN 13501–1 and declared as reaction to fire class
Dimensional stability, expressed as			
Moisture deformation factor or species	5.2.8		Declared as single values or as species

Release / content of dangerous substances as			
Release of formaldehyde	5.2.9.1	-	Tested according to Annex A and declared as class E1 or E2
Release / content of other dangerous substances[f] Substance X, if relevant	5.2.9.2	-	Tested and declared as relevant
Durability of bonding strength expressed as			
Species	5.1.5	-	Declared according to 5.1.5
Adhesives	5.1.6	-	Tested according to 5.1.6 and declared as adhesive families; adhesive types and adhesive subclasses, if relevant
Minimum pressing time of: Phenolic, aminoplastic adhesive, if relevant	5.1.6.2	-	Tested according EN 302–6 and declared as "MPT"
Moisture curing one component polyurethane adhesive, if relevant	5.1.6.3	-	Tested according to EN 15416–5 and declared as "MPT"
Emulsion polymer isocyanate adhesive, if relevant	5.1.6.4	-	Tested according to EN 15416–5 and declared as "MPT"
Durability against biological attack (i.e. resistance to biological organisms) expressed as durability of			
Laminations without preservative treatment	5.2.10.2.1 and 5.2.10.2.2	-	Tested or assessed according to 5.2.10.2.2 and declared as durability class according to EN 350–2
Laminations with preservative treatment	5.2.10.2.1 and 5.2.10.2.3	-	Tested and assessed according to 5.2.10.2.3 and declared according to EN 15228:2009, Clause 6,
Wood-based panel layers	5.2.10.2.1 and 5.2.10.2.4	-	Assessed according to 5.2.10.2.4 and declared as technical class for wood-based panels according to EN 13986 or durability class according to EN 350–2 for LVL according to EN 14374

a Only cross laminated made from coniferous species listed in 5.3.2 and poplar, which are not treated to improve the fire performances.

b The declared information enables the designer to calculate the mechanical resistance for the specific end use situation.

c The declared information enables the designer to calculate the resistance to fire according to EN 13501–2 for the specific end-use situation.

d As for durability of bonding.

e The characteristics may be affected by the preservative treatment of timber against biological attack.

f These substances are to be declared only if regulated in the market of destination.

The declaration of the product performance related to certain essential characteristics is not required in those Member States (MS) where there are no regulatory requirements on these essential characteristics for the intended use of the product.

In this case, manufacturers placing their products on the market of these MS are not obliged to determine nor declare the performance of their products with regard to these essential characteristics and the option "No performance determined" (NPD) in the information accompanying the CE marking and in the declaration of performance (see ZA.3) may be used for those essential characteristics.

ZA.2 Procedure for Assessment and Verification of Constancy of Performance (AVCP) of cross laminated timber

ZA.2.1 AVCP

The AVCP system for cross laminated timber and cross laminated timber with large finger joints established by EC Decisions 97/176/EC of 1997-02-17 (*see OJEU L73 of 1997-03-14*) as amended by EC decision 2001/596/EC of 2001-01-08 (*see OJEU L209 of 2001-08-02*) is shown in Table ZA.2 for the indicated intended use(s) and relevant level(s) or class(s) of performance.

Table ZA.2 — System of AVCP

Product	Intended uses	Levels or classes of performance	AVCP system
Structural glued laminated products and other glued timber products NOTE Timber products can be treated against fire, biological attack or not treated.	Used in buildings and bridges	–-	1
AVCP System 1: See Regulation (EU) No. 305/2011 (CPR) Annex V, 1.2.			

NOTE 1 Cross laminated timber (with or without large finger joints) is considered as other glued timber products.

NOTE 2 Cross laminated timber (with or without large finger joints) treated with fire retardants is not covered in this standard.

The AVCP of the cross laminated timber in Table ZA.1 shall be according to the AVCP procedures indicated in Table ZA.3 resulting from application of the clauses of this European Standard indicated therein. The content of tasks of the notified body shall be limited to those essential characteristics as provided for, if any, in Annex III of the relevant mandate and to those that the manufacturer intends to declare.

Table ZA.3 — Assignment of AVCP tasks for cross laminated timber under system 1

Tasks		Content of the task	AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared	6.1, 6.3
	Further testing of samples taken at factory according to the prescribed test plan	Essential characteristics of Table ZA.1 relevant for the intended use which are declared	6.1, 6.3.2.6
	Assessment of the performance of the cross laminated timber (with or without large finger joints) on the basis of testing calculation, tabulated values or descriptive documentation of the product	Essential characteristics of Table ZA.1 relevant for the intended use which are declared, except: reaction to fire and bonding strength (including durability of bonding strength)	6.1, 6.2
Tasks for the notified product certification body	Assessment of the performance of the cross laminated timber (with or without large finger joints) on the basis of testing (including sampling), calculation, tabulated values or descriptive documentation of the product	Essential characteristics of Table ZA.1 relevant for the intended use which are declared, namely reaction to fire and bonding strength (including durability of bonding strength)	6.1, 6.2
	Initial inspection of manufacturing plant and of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which are declared, Documentation of the FPC.	6.1, 6.3.4
	Continuing surveillance, assessment and evaluation of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which are declared, namely bending strength, compressive strength, tensile strength shear strength, release of formaldehyde, reaction to fire bonding strength (including durability of bonding strength). Documentation of the FPC.	6.1, 6.3.5

ZA.2.2 Declaration of performance (DoP)

ZA.2.2.1 General

The manufacturer draws up the DoP and affixes the CE marking on the basis of the different AVCP systems set out in Annex V of the Regulation (EU) No 305/2011.

In case of products under system 1:

— the factory production control and further testing of samples taken at the factory according to the prescribed test plan, carried out by the manufacturer; and;

— the certificate of constancy of performance issued by the notified product certification body on the basis of the assessment of performance of the cross laminated timber (with or without large finger joints) carried out on the basis of type testing (including sampling), Type Calculation, tabulated values or descriptive documentation of the product; initial inspection of the manufacturing plant and of factory production control and continuing surveillance, assessment and evaluation of factory production control.

ZA.2.2.2 Content

The model of the DoP is provided in Annex III of the Regulation (EU) No 305/2011 as amended by Delegated Regulation (EU) No 574/2014 of 21 February 2014. According to this Regulation, the DoP shall contain, in particular, the following information:

— the reference of the product-type for which the declaration of performance has been drawn up;

— the AVCP system or systems of the construction product, as set out Tables ZA.2 and ZA.3 in accordance with Annex V of the CPR;

— the reference number and date of issue of the harmonized standard which has been used for the assessment of each essential characteristic;

— where applicable, the reference number of the Specific Technical Documentation used and the requirements with which the manufacturer claims the product complies.

The DoP shall in addition contain:

a) the intended use or uses for the construction product, in accordance with the applicable harmonized technical specification;

b) the list of essential characteristics, as determined in the harmonized technical specification for the declared intended use or uses;

c) the performance of at least one of the essential characteristics of the construction product, relevant for the declared intended use or uses;

d) where applicable, the performance of the construction product, by levels or classes, or in a description, if necessary based on a calculation in relation to its essential characteristics determined in accordance with the Commission determination regarding those essential characteristics for which the manufacturer shall declare the performance of the product when it is placed on the market or the Commission determination regarding threshold levels for the performance in relation to the essential characteristics to be declared;

e) the performance of those essential characteristics of the construction product which are related to the intended use or uses, taking into consideration the requirements in relation to the intended use or uses where the manufacturer intends the product to be made available on the market;

f) for the listed essential characteristics for which no performance is declared, the letters “NPD” (No Performance Determined).

Regarding the supply of the DoP, Article 7 of the Regulation (EU) No 305/2011 and the Commission Delegated Regulation (EU) No 157/2014 of 30 October 2014 apply.

The information referred to in Article 31 or, as the case may be, in Article 33 of Regulation (EC) No 1907/2006, (REACH) shall be provided together with the DoP.

ZA.2.2.3 Example of DoP

The following gives an example of a filled-in DoP for cross laminated timber.

DECLARATION OF PERFORMANCE

No. 001-CPR 2015-07-14

1.	Unique identification code of the product-type:	**cross laminated timber-spruce-layup ABC**
2.	Intended use/es:	**for the manufacture of structural elements to be used in buildings and bridges**
3.	Manufacturer:	**AnyCo (complete address and contact data to be given)**
4.	Authorized representative:	**No external authorized representative**
5.	System/s of AVCP:	**System 1**
6a.	Harmonized standard:	**EN 16351**
	Notified bodies:	**Notified product certification body No. 5678**
7	Declared performance	

Essential characteristics		**Performance**
Modulus of elasticity, bending strength; compressive strength; tensile strength; shear strength as		
Strength and stiffness properties of timber layers as strength class of layers		C30-C24-C24-C24-C30
Geometrical data:	Cross section (mm)	2 450 × 211 mm
	Layup (thickness in mm and orientation):	42l-42w-43l-42w-42l
	Other	No edge bonds, no grooves, b / t_l > 4
Bonding strength as		
Bonding strength of finger joints in laminations declared as bending strength of timber expressed as strength class of layers		C30-C24-C24-C24-C30
Bonding strength of glue lines between layers		Pass Shear
Bonding strength of edge bonds between laminations		Pass Shear
Dimensional stability as		
Moisture deformation factors		$k_{cor,90}$ = 0,0024 for deformations perpendicular to the plane; $k_{cor,0}$ = 0,0002 for deformations in plane.

Essential characteristics		**Performance**
Resistance to fire		
Geometrical data		As for modulus of elasticity, bending strength; compressive strength; tensile strength and shear strength
Charring rate as	Species	Spruce *(picea abies)*
	Densities of layers expressed as strength class of layers	C30-C24-C24-C24-C30
Reaction to fire		D-s2, d0
Release of formaldehyde		E1
Durability of bonding strength as		
Species		Spruce *(picea abies)*
Adhesive		for bond lines between layers: MUF, EN 301 I 70 GP 0,3 S for finger joints in laminations: MUF, EN 301 I 70 FJ 0,1 S
Verification of minimum pressing time		MPT
Durability against biological attack as		
Natural durability against wood destroying fungi: Durability class		5

10. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 8. This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

……

(name and function)

…… ……

(place and date of issue) (signature)

ZA.3 CE marking and labelling

The CE marking symbol shall be in accordance with the general principles set out in Article 30 of Regulation (EC) No 765/2008 and shall be affixed visibly, legibly and indelibly:

— to the cross laminated timber or;

— to a label attached to it.

Where this is not possible or not warranted on account of the nature of the product, it shall be affixed:

— to the packaging or;

— to the accompanying documents.

The CE marking shall be followed by:

a) the last two digits of the year in which it was first affixed;

b) the name and the registered address of the manufacturer, or the identifying mark allowing identification of the name and address of the manufacturer easily and without any ambiguity;

c) the unique identification of the product-type;

d) the reference number of the declaration of performance;

e) the level or class of the performance declared;

- modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength as:
  - strength class or individual values of timber layers, technical class or individual values of wood based panel layers;
  - geometrical data (overall sizes, layup, grooves (if relevant), edge bonds (if relevant) and ratio of lamination width to lamination thickness);
  - and bending strength(s) of large finger joints (if relevant);
- bonding strength as:
  - bonding strength of finger joints in timber as strength class or individual values of timber layers;
  - bonding strength of glue lines between layers as “Pass delam” or “pass shear”:
  - bonding strength of edge bonds as “pass shear”, if relevant;
  - and bonding strength of large finger joints as bending strength(s) of large finger joints, if relevant;
- resistance to fire expressed as:
  - as geometrical data (overall sizes, layup, grooves (if relevant), edge bonds (if relevant) and ratio of lamination width to lamination thickness);
  - charring rate expressed as:
    - characteristic densities of timber layers expressed as strength classes or individual values of timber layers;
    - characteristic density of wood-based panel layers expressed as technical classes or individual values of wood based panel layers;
    - species;
  - reaction to fire: class (including smoke and droplets) as class acc. to EN 13501-1, either as:
    - reaction to fire class(s) of layers;
    - or based on results of the relevant tests, specified in the standards, referred therein;

- dimensional stability according to 5.2.8 as moisture deformation factor according to 5.2.2.6 or as species listed in 5.1.5;
- release of formaldehyde declared as class E1 or E2;
- release /content of other dangerous substances, see 5.2.9.2, where applicable;
- durability of bonding strength expressed as:
  - species;
  - adhesive families according to 5.1.6.1;
  - adhesive types and subclasses according to EN 301 or EN 15425;
  - "MPT", if the minimum pressing time under referenced conditions has been tested according to EN 302-6 or EN 15416-5;
- durability against biological attack (i.e. resistance to biological organisms):
  - for timber laminations without preservative treatment as natural durability: declared as durability class according to EN 350-2;
  - for treated timber laminations in accordance with EN 15228:2009, Clause 6;
  - for wood-based panel layers as technical class according to EN 13986 or durability class according to EN 14374.

f) the dated reference to the harmonized technical specification applied;

g) the identification number of the notified body;

h) the intended use laid down in the harmonized technical specification applied;

Figure ZA.1 gives an example of a CE marking.

CE 4321 **AnyCo Ltd** **15** 001CPR2015–07–14		*CE marking, consisting of the "CE"-symbol* *Identification number of the product certification body* *Name and the registered address of the manufacturer, or identifying mark* *Last two digits of the year in which the marking was first affixed* *Reference number of the DoP*
EN 16351:2015 Cross laminated timber –Spruce layup ABC For the manufacture of structural elements to be used in buildings and bridges		*No. of European standard applied, as referenced in OJEU* *Unique identification of the product-type* *Intended use of the product as laid down in the European standard applied*
Modulus of elasticity, bending strength, compressive strength, tensile strength and shear strength		*Level or class of the performance declared* *l = lengthwise; w = crosswise*
– Geometrical data as		
– cross sectional size *(mm)*	2 450 × 211	
– layup (mm/orientation)	42l – 42w – 43l – 42w – 42l	
– edge bonds	No structural edge bonds	
– grooves in laminations	No grooves	
– ratio of b_l / t_l	> 4	
– strength, stiffness and characteristic density of layers	C30 – C24 – C24 – C24 – C30	
– bending strength of finger joints in laminations as bending strength of timber	C30 – C24 – C24 – C24 – C30	
Bonding strength as		
– bonding strength of finger joints as bending strength of timber	C30 – C24 – C24 – C24 – C30	
– bonding strength of glue lines between layers	Pass shear	
– bonding strength of edge bonds	Pass shear	
Resistance to fire		
– Geometrical data as		
– cross sectional size *(mm)*	2 450 × 211	
– layup (mm/orientation)	42l – 42w – 43l – 42w – 42l	
– edge bonds	No structural edge bonds	
– grooves in laminations	No grooves	
– ratio of b_l / t_l	> 4	
– characteristic density of layers	C30 – C24 – C24 – C24 – C30	
– species of timber layers	*Picea abies*	
Reaction to fire	D-s2, d0	
Dimensional stability		
– moisture deformation factor perpendicular to plane	$k_{cor,90}$ = 0,0024	
– in plane	$k_{cor,0}$ = 0,0002	
Release of formaldehyde	E1	*Dangerous substances other than formaldehyde need only to be declared if there is at least one additional regulated dangerous substance which obliges the manufacturer to declare. In this case, the substance has to be mentioned.*
Durability of bonding strength as		
– species of timber layers	*Picea abies*	
– adhesive for bond lines between layers	MUF, EN 301 I70 GP 0,3 S	
– adhesive for finger joints in laminations	MUF, EN 301 I70 FJ 0,1 S	
Durability as		
– durability against wood destroying fungi	Durability class 5	

Figure ZA.1 — Example of CE marking given in the commercial documents, accompanying cross laminated timber

Bibliography

[1] EN 302-5, *Adhesives for load-bearing timber structures — Test methods— Part 5: Determination of maximum assembly time under referenced conditions*

[2] EN 384, *Structural timber— Determination of characteristic values of mechanical properties and density*

[3] EN 1912, *Structural Timber— Strength classes— Assignment of visual grades and species*

[4] EN 13353, *Solid wood panels (SWP)— Requirements*

[5] EN 13501-2, *Fire classification of construction products and building elements— Part 2: Classification using data from fire resistance tests, excluding ventilation services*

[6] EN 13556, *Round and sawn timber— Nomenclature of timbers used in Europe*

[7] EN 14080, *Timber structures — Glued laminated timber and glued solid timber - Requirements*

[8] EN 15497, *Structural finger jointed solid timber— Performance requirements and minimum production requirements*

[9] EN ISO 9001, *Quality management systems— Requirements (ISO 9001)*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™