BS EN 12871:2013

BSI Standards Publication

Wood-based panels — Determination of performance characteristics for load bearing panels for use in floors, roofs and walls

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National foreword

This British Standard is the UK implementation of EN 12871:2013. It supersedes BS EN 12871:2010 which is withdrawn.

Whilst evaluating the compliance of wood or wood-based floor or roof decking (domestic and non-domestic), in accordance with the procedure in Clause 6, and taking into account the requirements for concentrated load given in the National Annex to EN 1991-1-1, the UK committee has given the following recommendations:

1. Floor decking in ground floors and in intermediate floors should be assigned to service class 1.
2. Roof decking should be assigned to service class 1 or 2 where appropriate.
3. Roof decking may be considered as short term loading where access is limited.
4. The partial factor γ_Q may be taken as 1.35 (utilising K_{FI} of 0.9 given in Annex B of EN 1990 for Reliability Class RC1) for both floors and roofs.
5. The reduction factor K_{red} as defined in Annex B (B.2.3) of this standard should be set at 0.89.
6. In the UK there is no codified deflection limit for panels spanning between joists, therefore the example limits in equations B.2 and B.3 in Annex B (informative) are not relevant.

The UK participation in its preparation was entrusted to Technical Committee B/541, Wood based panels.

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.

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

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Wood-based panels - Determination of performance characteristics for load bearing panels for use in floors, roofs and walls

Panneaux à base de bois - Détermination des caractéristiques de performance des panneaux travaillants utilisés en planchers, toitures et murs

Holzwerkstoffe - Bestimmung der Leistungseigenschaften für tragende Platten zur Verwendung in Fußböden, Wänden und Dächern

This European Standard was approved by CEN on 1 May 2013.

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.

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Foreword

This document (EN 12871:2013) has been prepared by Technical Committee CEN/TC 112 “Wood-based panels”, the secretariat of which is held by DIN.

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 December 2013, and conflicting national standards shall be withdrawn at the latest by December 2013.

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 supersedes EN 12871:2010.

Compared to EN 12871:2010, the following changes have been made:

a) the title of the standard has been changed, because this standard now only deals with determining performance characteristics;

b) proposals for national performance requirements are given in Annex B; Annex B includes a new reduction factor for ultimate limit state;

c) for soft body impact tests, 3 impact classes have been defined to describe the performance; they can be related to load categories as suggested in Annex B;

d) this standard does not include testing of racking behaviour nor uniformly distributed loads as these are covered by testing according to EN 594 or calculation according to EN 1995-1-1 respectively;

e) the possibility to increase the span in dependence on the roof slope was included to Annex B;

f) the reference for the statistical evaluation of the results has been changed to EN 1058;

g) the load pad used for point load testing is now 50 mm x 50 mm in all cases, see Annex A.

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

This European Standard provides methods for determining performance characteristics for concentrated loads and impact on wood-based panels used for structural floor or roof decking and for impact on wood-based panels used for wall sheathing.

This European Standard takes the approach of type testing specific structures. This approach yields an optimised design since the results from the testing shall apply only to one specific design.

This revision incorporates experiences from use, adopts the load area for concentrated load defined in EN 1991-1-1 and the evaluation methods from EN 1058.

This European Standard contains an informative annex with proposals for national requirements to the characteristics determined by this European Standard, based on Eurocodes and national annexes.

1 Scope

This European Standard specifies:

- concentrated load test and assessment methods for floor and roof decking;
- soft body impact assessment methods and classification system for floors, roofs and walls.

This European Standard does not include racking testing or uniformly distributed loads as these are covered by testing according to EN 594 or calculation according to EN 1995-1-1 respectively.

This European Standard specifies the procedure for determining the performance characteristics through type testing, of load-bearing wood-based panels fitted on:

a) structural joists for decking:

   1) in flooring applications in load categories A, B, C and D;

   2) in roof applications in load categories H and I;

for which type testing involves:

   i) punching shear under concentrated loading;

   ii) vertical soft body impact;

b) studs for walling application for which type testing involves:

   1) pendular soft body impact.

Annex A (normative) lists modifications to EN 1195, particularly the contact area of the loading head that may be used for concentrated loading.

Annex B (informative) provides proposals for national performance requirements.

Annex C (informative) provides examples for a decking application in a floor and a roof.

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.

2.1 General

EN 596, *Timber structures — Test methods — Soft body impact test of timber framed walls*

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

EN 1058, *Wood-based panels — Determination of characteristic 5-percentile values and characteristic mean values*

EN 1156, *Wood-based panels — Determination of duration of load and creep factors*

EN 1195, *Timber structures — Test methods — Performance of structural floor decking*

EN 1990:2002, *Eurocode — Basis of structural design*

EN 1991-1-1, *Eurocode 1: Actions on structures — Part 1-1: General actions — Densities, self-weight, imposed loads for buildings*

EN 1995-1-1:2004, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*

2.2 Product standards

EN 300, *Oriented Strand Boards (OSB) — Definitions, classification and specifications*

EN 312, *Particleboards — Specifications*

EN 622-2, *Fibreboards — Specifications — Part 2: Requirements for hardboards*

EN 622-3, *Fibreboards — Specifications — Part 3: Requirements for medium boards*

EN 622-5, *Fibreboards — Specifications — Part 5: Requirements for dry process boards (MDF)*

EN 634-2, *Cement-bonded particleboards — Specifications — Part 2: Requirements for OPC bonded particleboards for use in dry, humid and external conditions*

EN 636, *Plywood — Specifications*

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

EN 14279, *Laminated Veneer Lumber (LVL) — Definitions, classification and specifications*

3 Terms and definitions

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

3.1
service class 1
service class 1 is characterised by a moisture content in the materials corresponding to a temperature of 20 °C and the relative humidity of the surrounding air only exceeding 65 % for a few weeks per year

[SOURCE: EN 1995-1-1:2004, 2.3.1.3]

3.2
service class 2
service class 2 is characterised by a moisture content in the materials corresponding to a temperature of 20 °C and the relative humidity of the surrounding air only exceeding 85 % for a few weeks per year

[SOURCE: EN 1995-1-1:2004, 2.3.1.3]

3.3
service class 3
service class 3 is characterised by climatic conditions leading to higher moisture contents than in service class 2

[SOURCE: EN 1995-1-1:2004, 2.3.1.3]

3.4
serviceability limit states
SLS
states that correspond to conditions beyond which specified service requirements for a structure or structural member are no longer met

[SOURCE: EN 1990:2002, 1.5.2.14.]

3.5
ultimate limit states
ULS
states associated with collapse or with other similar forms of structural failure

[SOURCE: EN 1990:2002, 1.5.2.13]

Note 1 to entry: Specifically to this standard, it applies to the maximum force F_{max} applied to the tested component.

3.6
characteristic value
value of a material or product property having a prescribed probability of not being attained in a hypothetical unlimited test series

Note 1 to entry: This value generally corresponds to a specified fractile of the assumed statistical distribution of the particular property of the material or product. A nominal value is used as the characteristic value in some circumstances.

[SOURCE: EN 1990:2002, 1.5.4.1]

Note 2 to entry: In this standard, the probability of failing to pass the value is 5 % (5th percentile of the distribution).

3.7
load category
for decking applications, class of imposed load defined according to their end-uses in EN 1991-1-1

Note 1 to entry: The load values are defined in the National Annexes to EN 1991-1-1 or, where not available, in EN 1991-1-1.

3.8
structural wall-sheathing
vertical (or quasi-vertical) assembly of wood-based panels, supported by studs, capable of taking up loading in the 3 directions of space

3.9
structural floor-decking
horizontal (or quasi-horizontal) assembly of wood-based panels fixed to supporting joists and spanning over them

Note 1 to entry: When a load is applied on the decking, it is free to deflect between the joists.

3.10
sub-floor
structural panel meant to be covered by overlays

3.11
structural roof-decking
usually, sloping assembly of wood based panels, fixed to supporting joists and spanning over them

Note 1 to entry: Roof assemblies are tested horizontally.

Note 2 to entry: When a load is applied on the decking, it is free to deflect between the joists.

3.12
warm roof
roof design in which the panels supported by the joists are placed below the insulation

Note 1 to entry: Usually, the panels are considered to be under conditions corresponding to service class 1.

3.13
cold roof
roof design in which the panels and some of the supporting joists are placed above the insulation

Note 1 to entry: Usually, the panels are considered to be under conditions corresponding to service class 2.

3.14
set
irreversible deformation (unevenness between two adjoining panels) of the test floor, wall or roof after the removal of the applied load

3.15
punching shear strength
stress in the section of a panel under a concentrated load applied perpendicularly to its face by means of a loading head with a specified cross section

4 Symbols and subscripts

4.1 Symbols

A	Contact area of a square load pad
F	Force applied to the component being tested
L	Span between joists or studs (axis to axis distance) with horizontal test assembly
L_α	Increased span between joists or studs (axis to axis distance), as a function of roof slope
Q_k	Characteristic concentrated load for the relevant load category, specified in National Annexes to EN 1991-1-1
R	Stiffness of the structural decking or sheathing for concentrated loading (experimental value) and racking
k_def	Deformation factor defined by EN 1995-1-1
k_dis	Correction factor converting test loads, for consideration of influence of size and shape of the load pad
k_mod	Modification factor defined by EN 1995-1-1
k_red	Reduction factor for local types of failure
w_{fin}	Final deflection
α	Roof slope
γ_M	Material partial factor defined by National Annexes to EN 1995-1-1 or, where not available, by EN 1995-1-1
γ_Q	Action partial factor defined by National Annexes to EN 1990 or, where not available, by EN 1990

ψ_2 Factor for the quasi-permanent value of actions, defined by National Annexes to EN 1990 or, where not available, by EN 1990

4.2 Subscripts

$_i$ Individual test value

$_k$ Characteristic (in this standard, 5th percentile for test values)

$_{max}$ Maximum value

$_{mean}$ Mean value

$_{ser}$ related to Serviceability Limit State

5 General requirements

5.1 Specification of panels intended for load-bearing application

Table 1 specifies the wood-based panel types for load bearing purposes in floor-decking, roof-decking and wall sheathing.

Table 1 — Panel product specification standards for structural decking (floors and roofs) and sheathing (walls)

Panel type	Technical class	Relevant EN
Particleboard	P4 P6 P5 P7	EN 312
OSB	OSB/2 OSB/3 OSB/4	EN 300
Plywood	EN 636-1 S EN 636-2 S EN 636-3 S	EN 636
Solid wood panel	SWP/1 S SWP/2 S SWP/3 S SWP/1 SD SWP/2 SD SWP/3 SD	EN 13353
LVL	LVL/1 LVL/2 LVL/3	EN 14279
Fibreboard	HB.LA HB.HLA1 HB.HLA2 MBH.LA1 MBH.LA2 MBH.HLS1 MBH.HLS2 MDF.LA MDF.HLS	EN 622-2 EN 622-3 EN 622-5
Cement bonded particle board [a]	—	EN 634-2

[a] To be used only if the following properties are determined:
- the bending properties according to EN 789 and EN 1058,
- the mechanical durability according to EN 1156 for k_{mod} and k_{def}

5.2 Mechanical properties

5.2.1 General

Test methods relevant to this standard are set out in Table 2.

Table 2 — European Standards relating to mechanical properties and test methods

Items	Relevant standard
Concentrated load	
Floor decking	EN 1195 and Annex A
Roof decking	EN 1195 and Annex A
Sampling	See 5.3
NOTE Proposals for performance requirements are provided in Annex B.	
Soft body impact test	
	Relevant standard
Floor decking	EN 1195
Wall sheathing	EN 596
Roof decking	EN 1195
Classification	See 6.2.5.2 (for floor and roof decking). See 6.3.2 (for wall sheathing).
Sampling	See 5.3.

5.2.2 Concentrated load on structural floor or roof decking on joists

The following performance characteristics of the component shall be assessed for the relevant load category:

a) Stiffness and serviceability load (serviceability limit state);

b) Maximum load (ultimate limit state).

5.2.3 Soft body impact test

The performance to soft body impacts of the component, decking or walling applications, shall be evaluated.

NOTE The impact test is designed to simulate the action of falling person or object. The impact energy is increased in stages and the floor, roof or wall is checked for damage at each stage.

5.3 Sampling

The panels to be used for an initial type testing (ITT) shall be sampled from at least 3 production runs over a period of at least three weeks.

The minimum number of test points is defined in Table 3.

Table 3 — ITT sampling for floors, roofs and walls

Test	Concentrated load EN 1195	Soft body impact EN 1195 (floors and roofs)	Soft body impact EN 596 (walls)
Number of test points	12 + 1 [a]	5	3

[a] additional test points for the determination of the estimate of F_{max}.

NOTE Additional test points improve the determination of the characteristic values.

NOTE For concentrated loading, provided that the size of the set-up allows for measurements on and off edge areas, several points can be tested on the same set-up. Therefore, the number of set-ups can be less than the number of test points specified in Table 3.

6 Determination of performance characteristics

6.1 General Recommendations

6.1.1 Dimensional tolerances: length and width

When measured in accordance with EN 324-1, at a relative humidity of (65 ± 5) % and a temperature of (20 ± 2) °C, the tolerances on the nominal length and width of the panel should be:

— + 0,0 mm;

— - 3,0 mm.

6.1.2 Dimensional tolerances: thickness

When measured in accordance with EN 324-1, at a relative humidity of (65 ± 5) % and a temperature of (20 ± 2) °C, the tolerances on the nominal thickness t of the panels should be those given in their own product standards.

6.1.3 Dimensional changes: linear expansion

The expansion in either length or width due to a change in ambient relative humidity from 30 % to 85 % at 20 °C should not exceed 4 mm/m when tested in accordance with EN 318.

6.1.4 Discrepancy at joints between panels

The acceptable unevenness at the joint between the upper faces of adjoining panels may depend on the overlay material and the end use.

NOTE Sanding, at least locally to level minor unevenness, can be required.

6.1.5 Edge profile of tongued and grooved or similar panels

The tongue and groove profiles of the supplied panels should be identical to those of the ITT panels.

6.2 Structural floor or roof decking on joists

6.2.1 General

The weakest point in the floor or roof shall be determined prior to testing. All subsequent tests shall be carried out at this point.

NOTE The weakest point of a floor or roof is often mid span on the groove side of a tongued and grooved panel.

6.2.2 Determination of stiffness characteristics (serviceability limit state) for concentrated load

The tests for determination of the stiffness and of the deflection shall be carried out according to EN 1195 with the modifications given in Annex A.

The mean value of stiffness (R_{mean}) shall be calculated from the individual R-values, see 7.1.

6.2.3 Determination of the serviceability load corresponding to the elasticity limit

When type tested, the serviceability limit state $F_{\text{ser,i}}$ of a decking is reached if, on the load deflection curve, a discontinuity, showing irreversible damage, occurs, even if cracks or other damages are not visible. This points to the elasticity limit of the decking.

The characteristic value ($F_{\text{ser,k}}$) of the weakest parts of the set-ups is processed from the individual test values ($F_{\text{ser,i}}$) according to 7.1.

NOTE 1 In service, the serviceability limit state is reached when visible cracks or other significant changes are found, which can impair the normal function of the floor or roof.

NOTE 2 The serviceability limit state for the concentrated load is not covered by EN 1195.

NOTE 3 F_{ser} is critical for panels failing at a low deflection level.

If the load-deflection graphs are missing in a EN 1195 test report, $F_{\text{ser,k}}$ shall be derived from $F_{\text{max,k}}$ in accordance with:

$$F_{\text{ser,k}} = 0,7 F_{\text{max,k}} \quad (1)$$

NOTE 4 The factor 0,7 is derived from analysis of European test results, according to EN 1195, on particleboards, OSB, MDF and plywood panels.

6.2.4 Determination of $F_{\text{max,k}}$

The test for determination of F_{max} shall be carried out according to EN 1195 with the modifications given in Annex A. The characteristic value ($F_{\text{max,k}}$) of the weakest parts of the set-ups is processed from the individual test values ($F_{\text{max,i}}$) according to 7.1.

6.2.5 Determination of Impact Class for soft body impact

6.2.5.1 General

The soft body impact test purports to assess the resistance of the flooring or roofing to actions imposed during the life of the building, excluding the period of construction.

The tests for determination of the performance regarding impact load shall be carried out according to EN 1195. The performance is described by the Impact Class as defined in 6.2.5.2.

For structural floor and roof decking, impact testing shall only be carried out if axis to axis distance (span) of the joists exceeds 300 mm.

6.2.5.2 Requirements for classification

For Impact Class I Table 4 specifies the sequence and the requirements.

Table 4 — Sequence of testing and requirements for Impact Class I

Drop height mm	Impact Energy J	Requirement
150 [a]	45	No visible damage or crack on any of the 5 set-ups
300 [a]	90	No visible damage or crack on any of the 5 set-ups
450	135	Visible cracks permitted on 1 set-up in the sample
600	180	Impact body not allowed through the damage
750	225	Impact body not allowed through the damage
900	270	Impact body allowed through 1 set-up in the sample [b]
Each set-up shall go through all the above energy levels.		
Energy levels are service class independent.		
[a] Serviceability limit is exceeded if set is above 1 mm.		
[b] The impact body damages the set-up so that it is no longer still supported by the panel(s).		

For Impact Class II Table 5 specifies the sequence and the requirements.

Table 5 — Sequence of testing and requirements for Impact Class II

Drop height mm	Impact Energy J	Requirement
150 [a]	45	No visible damage or crack on any of the 5 set-ups
300 [a]	90	No visible damage or crack on any of the 5 set-ups
450	135	Visible cracks permitted on 1 set-up in the sample
600	180	Impact body allowed through 1 set-up in the sample [b]
Each set-up shall go through all the above energy levels		
Energy levels are service class independent		
[a] Serviceability limit is exceeded if set is above 1 mm.		
[b] The impact body damages the set-up so that it is no longer still supported by the panel(s).		

6.3 Structural wall sheathing on studs

6.3.1 General

The weakest point in wall shall be determined prior to testing. All subsequent tests shall be carried out at this point.

6.3.2 Soft body impact test

Testing for impact load shall be carried out according to EN 596.

As there are no factors given to allow for design modifications to the construction, the results of tests in accordance with EN 596 shall be applied only to walls meeting the same construction specifications as those tested (design by testing).

The pendular soft body impact requirements of this standard apply where walls may be subject to impacts during the life of the building, excluding the period of construction.

The sequence of testing and requirements for Impact Class III are given in Table 6.

Table 6 — Sequence of testing and requirements for Impact Class III

Drop height mm	Energy of 1 impact J	Number of impacts on same point	Requirement
240	120	3	No visible damage or crack on any of the 3 set-ups of the sample
480	240	1	No visible damage or crack on any of the 3 set-ups of the sample
Each set-up shall go through all the above energy levels. Serviceability limit is exceeded if set is above 1 mm. Energy levels are service class independent. EN 596 specifies the point of impact on the wall specimen to be (1 500 $\pm$ 250) mm above the intended floor level. However, for some types of buildings, such as gymnasiums and warehouses, greater heights can be considered.			

7 Evaluation

7.1 Concentrated load

The evaluation of the mean value R_{mean} and the 5 % characteristic values $F_{\text{max,k}}$ and $F_{\text{ser,k}}$ should be based on EN 1058.

NOTE An example of the necessary calculations is given in Annex C.

7.2 Impact load

The evaluation of impact tests should be in accordance with Table 4, Table 5 or Table 6.

8 Report

The report shall include the following:

a) panel type, thickness and specification including drawing of tongue and groove (or similar), including tolerances;

b) test report in accordance with EN 1195 (floors and roofs) and EN 596 (walls);

c) the values of $F_{ser,k}$, $F_{max,k}$ and R_{mean} (floors and roofs);

d) the impact class;

e) compliance with this standard.

Additional information on the following properties can also be given:

1) dimensional tolerances, length and width;

2) thickness tolerances;

3) dimensional changes: linear expansion;

4) differential set at joints between panels.

Annex A
(normative)

Modification to EN 1195

A.1 Scope

EN 1195 applies to floors but not to roofs. However, the test procedure in EN 1195 is relevant to that application provided that the apparatus is modified appropriately.

A.2 Modification to EN 1195

Pending modification of EN 1195 and to allow application of EN 1195 to roof decking on joists, all the references to "floors" should be replaced by "decking for flooring and roofing applications".

Moreover, for the tests for roof deckings and floor deckings the area of the load pad shall be a square of 50 mm x 50 mm.

The square of 50 mm x 50 mm complies with the loading area recommended in EN 1991-1-1 for any decking (floors A, B, C and D as well as roofs H and I in the scope of this standard) and yields failure force values corresponding to EN 1995-1-1. In order to obtain comparable results between test houses, the edges of the loading head should be nominally parallel to the edges of the panel in the test specimen.

NOTE For test results obtained prior to the publication of this standard, with cylindrical loading head with a diameter of 25 mm or 50 mm, the maximum load is converted into EN 1991-1-1 values by applying the relevant k_{dis} factor in Table A.1.

Table A.1 — Area correction factors k_{dis} for loading pads used for concentrated loading

Loading pad	Ø 25 mm	Ø 50 mm	50 mm x 50 mm	490 mm^2 $\leq A <$ 2 500 mm^2
k_{dis}	0,65	0,90	1,00	$1{,}7 \cdot 10^{-4}\ A + 0{,}564$
A contact area of a square pad applying the concentrated load, in square millimetres.				

Annex B
(informative)

Proposal for performance requirements

B.1 Introduction

This annex contains proposals for performance requirements to panels used for roofing and flooring, related to the reaction to concentrated load and soft body impact. The requirements are recommended to be applied in the absence of national requirements.

B.2 Concentrated load

B.2.1 General

The required loads for structural decking, uniformly distributed or concentrated, are given in National Annexes to EN 1991-1-1 or, where not available, in EN 1991-1-1.

According to EN 1990 and to EN 1995-1-1, actions and mechanical properties are weighted with partial coefficients.

An action partial coefficient γ_Q, defined in National Annexes to EN 1990 or, where not available, EN 1990, should be applied on the imposed loads.

A material partial coefficient γ_M, is defined in National Annex to EN 1995-1-1 or, where not available, in EN 1995-1-1, should be applied on the material strength.

The panel strength and stiffness should be modified by means of k_{mod} and k_{def} as defined in EN 1995-1-1.

The compliance with the requirements for uniformly distributed loads should be verified by calculation, in accordance with National Annexes to EN 1990, EN 1991-1-1 and EN 1995-1-1.

The following properties regarding performance for concentrated loads should be determined by testing in accordance with the procedure specified in Clause 6.

$F_{\text{max,k}}$ characteristic load-carrying capacity for concentrated load at ultimate limit state;

$F_{\text{ser,k}}$ characteristic load-carrying capacity for concentrated load at serviceability limit state;

R_{mean} mean stiffness for concentrated load.

The procedure is the following: taking into account the relevant coefficients or requirements, the applied load is processed and the result is a load to be compared to an imposed load, in relation to the intended end use and its load category.

The requirements proposed in this annex are intended to limit deformations and prevent damage to wood-based panels used for structural floor or roof decking on joists.

This standard does not include requirements for the supporting joists or frame members.

NOTE The requirements for the supports are defined in EN 1995-1-1.

B.2.2 Serviceability limit state

B.2.2.1 Calculation of the final (long-term) deflection w_{fin}

According to EN 1995-1-1 the final deformation should be determined from

$$w_{fin} = \frac{Q_k}{R_{mean}} \cdot (1 + \psi_2 \cdot k_{def}) \quad \text{(B.1)}$$

where

Q_k is the characteristic concentrated load for the relevant load category, taken from the National Annex to EN 1991-1-1;

Ψ_2 is a load combination factor given in the National Annex to EN 1990;

k_{def} is the deformation factor for the relevant panel depending on the service class, taken from EN 1995-1-1.

B.2.2.2 Stiffness requirement for panels used in structural floor decking and structural roof decking

The final deformation w_{fin} for the concentrated load Q_k should fulfil:

$$w_{fin} \leq \min \begin{cases} 6\,mm \\ L/100 \end{cases} \quad \text{for flooring} \quad \text{(B.2)}$$

$$w_{fin} \leq \min \begin{cases} 12\,mm \\ L/50 \end{cases} \quad \text{for roofing} \quad \text{(B.3)}$$

B.2.2.3 Requirement to serviceability load for panels used in structural floor decking and structural roof decking

The following requirement should be fulfilled:

$$F_{ser,k} \geq k_{dis} \cdot Q_k \quad \text{(B.4)}$$

where

k_{dis} is the correction factor of load pad (see Table A.1);

Q_k is the characteristic concentrated load for the relevant load category, taken from the National Annex to EN 1991-1-1.

B.2.3 Ultimate limit state

The requirements for concentrated loads refers to partial factors given in National Annexes to EN 1990 and EN 1995-1-1 and loads given in the National Annex to EN 1991-1-1. Thereby, the suggested requirements reflect the national differences in safety levels, but the requirements might be modified by national regulations.

If the National Annexes do not give the factors and loads, the recommended values in the Eurocodes should be used.

The following requirement should be fulfilled:

$$F_{\max,k} \geq k_{dis} \cdot k_{red} \cdot \gamma_M \cdot \gamma_Q \cdot \frac{Q_k}{k_{\mathrm{mod}}} \quad \text{(B.5)}$$

where

k_{dis} is the correction factor of load pad (see Table A.1);

k_{red} is a reduction factor taking into account that punching shear or other local types of failure that may occur are not threatening life and health of people;

Q_{k} is the characteristic concentrated load for the relevant load category, taken from the National Annex to EN 1991-1-1;

γ_{M} is the partial safety factor for wood-based panels according to the National Annex to EN 1995-1-1;

γ_{Q} is the partial safety factor for live load given in the National Annex to EN 1990;

k_{mod} is the modification factor depending on load duration and service class for the relevant load category and type of panel, taken from EN 1995-1-1. The load duration for live loads is defined in the National Annex to EN 1995-1-1.

Based on experience of use the recommended value is k_{red} = 0,67, which is considered safe when the partial factors γ_{M} and γ_{Q} correspond to the recommended values in EN 1995-1-1 and EN 1990 for consequence class CC 2 (normal) and inspection level IL2 (normal). If e.g. reduced partial safety factors are defined for the concentrated load in the National Annexes to the Eurocodes the value of k_{red} should be increased accordingly.

The structures ability to act as a diaphragm is only reduced by a negligible amount if a local failure should occur. The combination of local failure and wind load or earth quake that requires diaphragm action will be an accidental load case where the reduction is acceptable, even it is unknown.

B.2.4 Increase of span L_{α} as a function of roof slope

If the requirements given in B.2.2 and B.2.3 are fulfilled, the span used at tests with horizontal test assemblies may be increased as a function of roof slope:

$$L_{\alpha} = \frac{L}{\cos\alpha} \quad \text{(B.6)}$$

$$\alpha \leq 45\,°$$

where

L_{α} is the increased span, as a function of roof slope;

L is the span, used at test with horizontal test assembly;

α is the roof slope.

B.3 Soft body impact

B.3.1 General

The requirement for soft body impact should state which impact class the panel should conform with, when tested with a span at least equal to the actual span. The impact loading and requirements are given in Table 5 for Impact Class I and in Table 6 for Impact Class II.

NOTE National safety documents can specify other Impact Classes.

B.3.2 Requirements

Wood-based panels used for floors in load category A, B, C and D according to the National Annex to EN 1991-1-1 should conform with Impact Class I.

Wood-based panels used for roofs in load category H according to the National Annex to EN 1991-1-1 should conform with Impact Class II.

Wood-based panels used for roofs in load category I according to the National Annex to EN 1991-1-1 should conform with Impact Class I.

Wood-based panels used for wall sheathing on studs should conform with Impact Class III.

Annex C
(informative)

Example

C.1 General

In order to show the implementation of the equations of this standard and the recommendation of Annex B, the following example is developed.

C.2 Features of the end use

C.2.1 Decking for flooring in housing applications (load category A)

1) Span specified by the designer: 610 mm;

2) Specified type of panel: OSB 3 complying with EN 300.

C.2.2 Decking for an accessible cold roof (load category I)

1) Span specified by the designer: 610 mm;

2) Specified type of panels: OSB 3 complying with EN 300.

NOTE A cold roof implies service class 2.

C.3 Type testing values of the component

C.3.1 Main features of the testing (according to EN 1195)

1) Panel thickness: 18 mm;

2) Span: 610 mm;

3) Loading pad: square of 50 mm x 50 mm.

C.3.2 Results

The exploitation of the results was made in accordance with EN 12871. The serviceability characteristic strength $F_{ser,k}$, the mean stiffness in bending R_{mean} and the ultimate characteristic strength $F_{max,k}$ were determined.

The results are set out in Table C.1.

Table C.1 — Test results according to EN 1195

Span (mm)	OSB 3, 18 mm		
	R_{mean} (N/mm)	$F_{max,k}$ (N)	$F_{ser,k}$ (N)
610	576	4 240	3 740

NOTE 1 F_{ser} was determined using graphical analysis.

NOTE 2 $F_{ser,k,05}$ and $F_{max,k,05}$ were determined based on EN 1058 assuming log-normal distribution and unknown coefficient of variation.

C.4 Values for the calculation parameters

As an example based on EN 1995-1-1, EN 1991-1-1 and EN 1990, Table C.2 provides the recommended values for the parameters to be applied on OSB 3 panels in load category:

— A (residential floors) in service class 1;

— I (accessible roofs) in service class 2 (cold roof).

National Annexes to the above standards may differ from one country to another and hence should be referred to.

Table C.2 — Values for the calculation parameters

EN 1995-1-1				EN 1991-1-1		EN 1990	EN 12871	
Service class	k_{mod} (medium term)	k_{def}	γ_M	γ_Q	Q_k (kN)	Ψ_2 (Housing)	k_{dis} (50 mm x 50 mm)	k_{red}
1	0,70	1,5	1,2	1,5	2,0	0,3	1,00	0,67
2	0,55	2,25	1,2	1,5	2,0	0,3	1,00	0,67

NOTE In most of the countries, the imposed concentrated load Q_k is 2 kN for category A.

C.5 Determination of the Limit States of the component and compliance to recommended requirements

C.5.1 Ultimate Limit State (according to B.2.3)

C.5.1.1 Floor application in SC1

$$F_{max,k} \geq k_{dis} \cdot k_{red} \cdot \gamma_M \cdot \gamma_Q \cdot \frac{Q_k}{k_{mod}} = 1{,}0 \cdot 0{,}67 \cdot 1{,}2 \cdot 1{,}5 \cdot \frac{2{,}0}{0{,}70} = 3{,}4 \text{ kN}$$

$F_{max,k}$ (= 4,24 kN) ≥ 3,4 kN — The component complies.

C.5.1.2 Cold roof application in SC2

$$F_{max,k} \geq k_{dis} \cdot k_{red} \cdot \gamma_M \cdot \gamma_Q \cdot \frac{Q}{k_{mod}} = 1{,}0 \cdot 0{,}67 \cdot 1{,}2 \cdot 1{,}5 \cdot \frac{2{,}0}{0{,}55} = 4{,}4 \text{ kN}$$

$F_{max,k}$ (= 4,24 kN) < 4,4 kN — The component does not comply.

C.5.2 Serviceability Limit State (according to B.2.2)

C.5.2.1 Deflection limit for flooring

Deflection limit: $w_{fin,lim} = \min \left\{ 610/100 = 6{,}1 \text{ mm} \right.$

C.5.2.2 Floor application in SC1

$$w_{fin} = \frac{Q_k}{R_{mean}} \cdot \left(1 + \Psi_2 \cdot k_{def}\right) = \frac{2000}{576} \cdot \left(1 + 0{,}3 \cdot 1{,}5\right) = 5{,}0 \text{ mm}$$

w_{fin} (= 5,0 mm) ≤ 6 mm — The component complies.

C.5.2.3 Deflection limit for roofing

Deflection limit: $w_{fin,lim} = \min \left\{ 610/50 = 12{,}2 \text{ mm} \right.$

C.5.2.4 Cold roof application in SC2

$$w_{fin} = \frac{Q_k}{R_{mean}} \cdot \left(1 + \Psi_2 \cdot k_{def}\right) = \frac{2000}{576} \cdot \left(1 + 0{,}3 \cdot 2{,}25\right) = 5{,}8 \text{ mm}$$

w_{fin} (= 5,8 mm) ≤ 12,2 mm — The component complies.

C.5.2.5 Serviceability load (according to B.2.2.3)

$$F_{ser,k} \geq k_{dis} \cdot Q_k = 1{,}0 \cdot 2{,}0 = 2{,}0 \text{ kN}$$

$F_{ser,k}$ (= 3,74 kN) ≥ 2,0 kN — The component complies.

C.5.3 Summarisation

The component (OSB3, thickness: 18 mm, span: 610 mm) is usable as flooring in housing (load category A, SC 1), but it is not usable as accessible cold roof (load category I, SC 2).

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Eurocode 1

[3] EN 1991-1-2, *Eurocode 1: Actions on structures — Part 1-2: General actions — Actions on structures exposed to fire*

[4] EN 1991-1-3, *Eurocode 1 — Actions on structures — Part 1-3: General actions — Snow loads*

[5] EN 1991-1-4, *Eurocode 1: Actions on structures — Part 1-4: General actions — Wind actions*

[6] EN 1991-1-5, *Eurocode 1: Actions on structures — Part 1-5: General actions — Thermal actions*

[7] EN 1991-1-6, *Eurocode 1 - Actions on structures Part 1-6: General actions — Actions during execution*

[8] EN 1991-1-7, *Eurocode 1 — Actions on structures — Part 1-7: General actions — Accidental actions*

Particleboards

[9] EN 321, *Wood-based panels — Determination of moisture resistance under cyclic test conditions*

NOTE This standard also applies to OSB, fibreboards and cement bonded particleboards.

[10] EN 1087-1, *Particleboards — Determination of moisture resistance — Part 1: Boil test*

NOTE This standard also applies to fibreboards.

Plywood

[11] EN 313-1, *Plywood — Classification and Terminology — Part 1: Classification*

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