Social- og Boligstyrelsen
Danish Authority of Social Services and Housing

DS/EN 1995-1-1 DK NA:2019

National Annex to
Eurocode 5: Design of timber structures –
Part 1-1: General - Common rules and rules for buildings

Foreword

This National Annex (NA) is a revision of DS/EN 1995-1-1 DK NA:2014 and replaces the latter as from 2019-09-10. For a transition period until 2019-12-31, this National Annex as well as the previous National Annex will be applicable.

Corrections have been made as a consequence of the publication of DS/EN 1990 DK NA:2019, including the new Annex B5, Inspection during execution.
In addition, the recommendations for deflection have been altered, and floor vibrations have been clarified.
The complementary information on the clarification of requirements for materials and structural finger jointed solid timber has been deleted since the transition period for EN 15497 has now expired.
The complementary information on prefabricated wall, floor and roof elements has been adjusted.

This NA lays down the conditions for the implementation in Denmark of EN 1995-1-1 for construction works in conformity with the Danish Building Regulations.

This NA applies to construction works covered by section 16(1) of the Danish Building Regulations (new scheme) as well as to construction works covered by sections 24 to 27 of the Danish Building Regulations (old scheme).

In this NA, the only difference between the new and old scheme is in relation to determining γ_3 in 2.4.1(1)P.
For more information see DS/EN 1990 DK NA:2019.

A National Annex contains national provisions, viz. nationally applicable values or selected methods. The Annex may furthermore provide non-contradictory, complementary information.

This NA includes:

- an overview of possible national choices and clauses containing complementary information;
- national choices;
- non-contradictory, complementary information.

For structures covered by sections 24 to 27 of the Danish Building Regulations BR18, or not covered by the Danish Building Regulations, levels of checking may still be used for the calculation of structures in ultimate limit states. For structures covered by section 16(1) of the Danish Building Regulations, levels of checking cannot be applied.

Overview of possible national choices and complementary information

The list below identifies the clauses where national choices are possible and the applicable/not applicable informative annexes. Furthermore, clauses giving complementary information are identified. Complementary information is given at the end of this National Annex.

Clause	Subject	National choice[1)]	Complementary information[2)]
2.3.1.2(2)P	Load-duration classes	National choice	
2.3.1.3(1)P	Service classes	National choice	
2.4.1(1)P	Design value of material property	National choice	
6.1.7(2)	Shear	National choice	
6.4.3(8)	Double tapered, curved and pitched cambered beams	National choice	
7.2(2)	Limiting values for deflections of beams	National choice	
7.3.3(2)	Vibrations - Residential floors	National choice	
8.3.1.2(4)	Nailed timber-to-timber connections: Rules for nails in end grain	National choice	
8.3.1.2(7)	Nailed timber-to-timber connections: Species sensitive to splitting	National choice	
9.2.2(2)	Trusses with punched metal plate fasteners – Requirements		Complementary information
9.2.2(4)	Trusses with punched metal plate fasteners – Minimum overlap		Complementary information
9.2.4.1(7)	Wall diaphragms - General	National choice	
9.2.5.3(1)	Bracing of beam or truss systems: Modification factors	National choice	Complementary information
10.9.2(3)	Special rules for trusses with punched metal plate fasteners: Erection, maximum bow	National choice	Complementary information
10.9.2(4)	Special rules for trusses with punched metal plate fasteners: Erection, maximum deviation from true vertical alignment	National choice	Complementary information

Clause	Subject	National choice[1)]	Complementary information[2)]
Annex A	Block shear and plug shear failure at multiple dowel-type steel-to-timber connections	To be applied	
Annex B	Mechanically jointed beams	To be applied	
Annex C	Built-up columns	To be applied	
	Prefabricated wall, floor and roof elements		Complementary information
	Wood-based panels for structural roofs, floors and walls		Complementary information

1)
Applicable: The Annex is applicable in Denmark and has the same status as specified in the Eurocode.
National choice: A national choice has been made.
To be applied: Informative annex is used as normative.
2)
Complementary information: Non-contradictory, complementary information on how to use the Eurocode.

National choices

2.3.1.2(2)P Load-duration classes
Examples of assignment of actions to load-duration classes in Denmark appear from Table 2.2 DK NA.

Table 2.2 DK NA - Examples of load-duration assignment

Load-duration class	Examples of loads
Permanent action	Self-weight
Long-term action	Actions on silos Storage, Category E, see EN 1990
Medium-term action	Other variable actions
Short-term action	Snow loads Variable loads on concrete forms Variable loads on scaffolding and temporary structures Short-term forces due to temperature and moisture exposure
Instantaneous action	Accidental actions Wind actions Impact forces, including impact allowance Random person loads (concentrated loads) on roofs and similar loads Mooring forces from ships Short-term actions on quays Braking and acceleration forces Wave and ice pressures

2.3.1.3(1)P Service classes
Examples of structures assigned to the service classes described in (2)P, (3)P and (4)P:

- **Service class 1**
  - structures in heated buildings where moisture is not added to the air, e.g. dwellings, offices and shops.

- **Service class 2**
  - structures in ventilated, not permanently heated buildings, e.g. weekend cottages, unheated garages and storehouses;
  - ventilated structures protected against precipitation, e.g. ventilated roof structures.
- **Service class 3**
  - structures in moist rooms;

- structures exposed to precipitation or water, including concrete forms and outdoor scaffolding;
- timber frames for felted roofs if these are not designed in such a way that they may be assigned to Service class 2.

2.4.1(1)P Design value of material property
Instead of Table 2.3 in EN 1995-1-1, the following table is used:

Table 2.3 DK NA – Partial factors (γ_M) for the ultimate limit state for material properties and resistances

Persistent and transient design situations	
Glued laminated timber, LVL and panels	$\gamma_M = 1{,}30\ \gamma_0\ \gamma_3$
Solid timber	$\gamma_M = 1{,}35\ \gamma_0\ \gamma_3$
Dowel-type fasteners, e.g. nails, screws, bolts, dowels	$\gamma_M = 1{,}35\ \gamma_0\ \gamma_3$
Glued joints, including glued-in bolts	$\gamma_M = 1{,}50\ \gamma_0\ \gamma_3$
Connections made with punched metal plate fasteners	$\gamma_M = 1{,}35\ \gamma_0\ \gamma_3$
Accidental design situation	$\gamma_M = 1{,}00$

The partial factors in Table 2.3 DK NA have been determined in accordance with Annex F in DS/EN 1990 DK NA.
$\gamma_M = \gamma_1\ \gamma_2\ \gamma_3\ \gamma_4$ where

- γ_1 takes into account the type of failure;
- γ_2 takes into account the uncertainty related to the design model;
- γ_3 takes into account the extent of checking;
- γ_4 takes into account the variation of the strength parameter or resistance.

When determining γ_1, the following types of failure have been assumed:

Glued laminated timber, LVL and panels	Warning of failure without residual resistance
Solid timber	Warning of failure without residual resistance
Connections with metal fasteners	Warning of failure without residual resistance
Glued joints	No warning
Connections made with punched metal plate fasteners	Warning of failure without residual resistance

According to the old scheme (cf. the foreword) factory-made composite members subject to external inspection such as structural timber elements and prefabricated timber members made with punched metal plate fasteners may be assigned to the extended level of checking when determining the sub-partial factor γ_3 in accordance with the following table:

Sub-partial factor depending on the extent of checking

Level of checking	Extended	Normal	Reduced
γ_3	0,95	1,0	1,10

Under a new scheme, the sub-partial factor $\gamma_3 = 1{,}0$, however for composite members with attestation levels AVCP 1+, 1 and 2+ it may be taken as $\gamma_3 = 0{,}95$ according to DS/EN 1990 DK NA:2019 Annex F DK NA (8).

The factor γ_0 appears from DS/EN 1990 DK NA, Table A1.2(B+C) DK NA. For combinations of actions 1 and 2 that apply to all structures above ground, $\gamma_0 = 1$.

6.1.7(2) Shear

$k_{cr} = 1{,}0$ is applied for all wood materials.

6.4.3(8) Double tapered, curved and pitched cambered beams

Expression (6.55) is used.

7.2(2) Limiting values for deflections of beams

The table below specifies the recommended values. The client may specify other values, higher or lower.

Table 7.2 DK NA - Examples of limiting values for deflections of beams

Deflections which normally secure satisfactory deformation conditions in dwellings and offices for beams of length l for structures of service classes 1 and 2. For cantilevered roof structures, double deflection may be used.

	Action	w_{inst}	w_{fin} [1)]
Roof structures	Self-weight, structures without camber		$l/400$
	Self-weight, structures with camber[2)]		$l/250$
	Characteristic snow loads	$l/400$	
	Characteristic wind actions	$l/250$	
Floor structures [3)]	Self-weight		$l/400$
	Characteristic imposed load	$l/400$	

1. w_{fin} is calculated according to 2.2.3(5).
2. Provided that the camber is at least 80% of w_{fin}.
3. Vibration conditions shall be checked according to 7.3.3(2)

7.3.3(2) Vibrations – Residential floors

The recommendation in the note regarding a and b should be followed for residential floors; it is recommended, however, to use only that part of the curve in Figure 7.2 where $a \leq 2$ mm/kN. Experience has shown that satisfactory vibration conditions for conventional timber beams are achieved when the following deflection requirements are fulfilled:

- Between dwellings and spans up to 6 m: $w_{inst} \leq 1{,}7$ mm for the concentrated load 1 kN;
- In single dwellings and spans up to 5 m: $w_{inst} \leq l/600$ for the uniformly distributed load 1,5 kN/m^2.

Further information is given in A1.4.4 in DS/EN 1990 DK NA.

8.3.1.2(4) Nailed timber-to-timber connections: Rules for nails in end grain
The alternative to 8.3.1.2(3) may be applied, but not, however, for smooth nails.

8.3.1.2(7) Nailed timber-to-timber connections: Species sensitive to splitting
Addition:
For timber with a moisture content less than 10 % at the time of erection, the recommendation in EN 1995-1-1 should be observed.
Predrilling may be omitted for wood with a moisture content larger than 10 % when $d < 5$ mm.

9.2.4.1(7) Wall diaphragms – General
Both methods may be applied.

9.2.5.3(1) Bracing of beam or truss systems: Modification factors
The following Danish modification factors in Table 9.2 DK NA for the determination of stiffness and resistance of stabilising structures are recommended:

Table 9.2 DK NA

Factor	Value
k_s	3,0
$k_{f,1}$	80
$k_{f,2}$	100
$k_{f,3}$	50

NOTE - See also "Non-contradictory, complementary information".

10.9.2(3) Special rules for trusses with punched metal plate fasteners: Erection, maximum bow

$a_{bow,perm} \leq 10$ mm.

NOTE - See also "Non-contradictory, complementary information".

10.9.2(4) Special rules for trusses with punched metal plate fasteners: Erection, maximum deviation from true vertical alignment

$a_{dev,\ perm} \leq 10$ mm.

NOTE - See also "Non-contradictory, complementary information".

Non-contradictory, complementary information.

9.2.2(2) Trusses with punched metal plate fasteners – Requirements

Punched metal plate fasteners should not be used for permanent structures of service class 3.

NOTE - A heavily varying moisture content may in time cause the panels to loosen.

9.2.2(4) Trusses with punched metal plate fasteners – Minimum overlap

Where a punched metal plate fastener is utilised to no more than 80 % of its load-bearing capacity, the requirement for a minimum overlap of one third of the height of the timber member may be disregarded. It is to be verified that the timber is not subject to splitting.

NOTE 1 - This guidance is based on the Danish requirements for increased insulation thicknesses and the associated increased timber dimensions.

NOTE 2 - The requirement for a minimum overlap of 40 mm is an absolute requirement, and in design erection tolerances have to be added. Where the requirement for one third of the height of the timber member is decisive, it is not necessary to add tolerances if the splitting capacity can be verified for the actual position.

9.2.5.3(1) Bracing of beam or truss systems: Modification factors

Where at least 8 equal, closely spaced solid timber members in compression are supported by closely spaced transverse bracings, e.g. braced by battens, half of the bending stiffness and the bending strength of the timber members may be used to resist and transfer q_d.

For less than 8 members, $n/16$ of the bending stiffness and the bending strength may be used.

For truss elements and other structures for which it can be assumed that the initial deviations are not unilateral, the following expression may be used for the calculation of q_d in expression (9.37) instead of n

$$n_{ef} = \min\left[3\sqrt{n}; n\right]$$

When the initial deviations are not unilateral, the accumulated force F_{akku} in the transverse bracing member supporting n members in compression may be taken as

$$F_{akku} = \min\left[\sqrt{n}\, F_d; 3F_d\right]$$

where F_d is the design stabilising force according to expression (9.35).

10.9.2(3) Special rules for trusses with punched metal plate fasteners: Erection, maximum bow

For spans $l > 5$ m, $a_{bow,perm}$ may be increased to $\pm\, l/500$, with a maximum of $\pm$ 45 mm, where l is the maximum horizontal dimension and a_{bow} is measured in relation to the erection plane aimed at, see Figure 10.9.2 DK NA a).

The local deflection measured with a 3 m straightedge is in no place to exceed 15 mm.

10.9.2(4) Special rules for trusses with punched metal plate fasteners: Erection, maximum deviation from true vertical alignment

For structure heights >1 m, $a_{dev,perm}$ may be increased to h/100, with a maximum of 45 mm, where h is the height of the structure of the vertical plane considered, and a_{dev} is measured as the local difference between the deflection at the top and bottom in this plane, see Figure 10.9.2 DK NA b). Furthermore, for l > 14 m the deviation in any point from the erection plane aimed at is to be no more than $a_{dev,perm}$, see Figure 10.9.2 DK NA c).

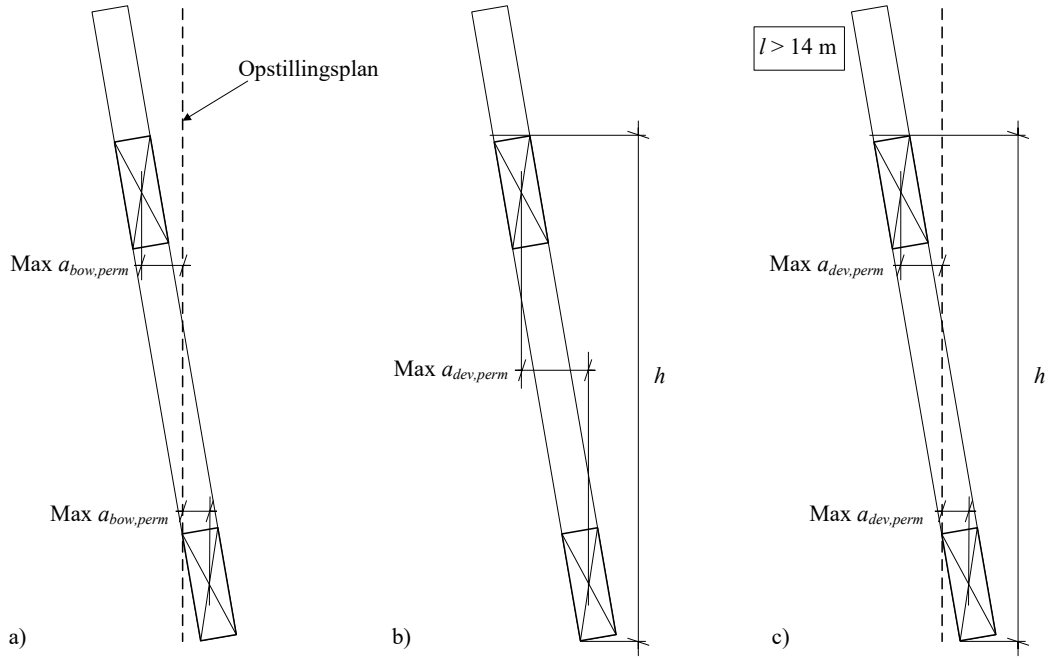

Figure 10.9.2 DK NA - Erection tolerances for trusses with punched metal plate fasteners

Prefabricated wall, floor and roof elements

Until the harmonised standard for timber elements is available as an EN for CE marking, *prEN 14732-1:2006, Timber structures — Prefabricated wall, floor and roof elements – Requirements* (published as DS/INF prEN 14732-1:2009) is to be used with the following exceptions, amendments and clarification as the basis of certification for inspection or certification schemes.

NOTE - Excluded are CE marked products according to an ETA.

Amendments:

- Clause ZA.2.2, Elements under attestation of conformity system 1 (adhesively bonded elements and mechanically fixed elements in reaction to fire Classes (A1 – C)),
- Clause ZA.2.3, Elements under attestation of conformity system 2+ (mechanically fixed elements).

Until EN 14732-1 enters into force, at least one FPC inspection is to be carried out per year.

Exclusions:

The following clauses are replaced by the certificate and marking rules of the inspection or certification scheme:

- ZA.2.4 EC Certificate and Declaration of conformity;
- ZA.3 CE marking and labelling.

Clarification:
prEN 14732-1:2006 (skal der ikke stå: EN 14732-1:2009?) specifies methods for evaluating the performance of prefabricated structural (load-bearing) wall, floor and roof elements consisting of framing members of wood and/or wood based materials and one or both sided panels or boards connected to the joists by suitable adhesive bonding or mechanical fixing. The cavities of the elements may be filled entirely or partially with insulating materials. The exterior faces of the panels or boards may also be covered with insulation material. This standard applies to elements which require but do not include an external finishing layer when installed, such as brickwork or a roof covering. The standard also covers volume elements (boxes, attics and bays) of prefabricated structural wall, floor and roof elements assembled at the factory. The standard does not apply to elements incorporating doors, windows and services (cables, water mains etc.) and their installation.

The requirements apply to all load-bearing members contributing to resisting the imposed load, snow load, wind action and accidental action, respectively. Excepted are construction works which - according to BR2018 - are assigned to structural class 1 (KK1) and fire class1 (BK1), where the building is assigned risk class 1 and where the total floor area of the building does not exceed 600 m^2, i.e. typically single-family houses and summer houses.

Wood-based panels for structural roofs, floors and walls
The harmonised standard EN 13986:2004, *Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking*, makes reference to requirements specified in EN 12871:2013, *Wood-based panels - Determination of performance characteristics for load bearing panels for use in floors, roofs and walls*.
The requirements specified in the informative Annex B in EN 12871:2013 are applied with the following changes:

- Expression (B.3) is replaced by $R_{mean} \geq 6000\ t/L$ [N/mm], where t and L are given in mm.
- In expression (B.5) $k_{red} = 0{,}7$
- Expression (B.6) applies to $\alpha \leq 40°$
- The impact requirement for wood-based panels used for wall sheathing in B.3.2 does not apply, and the panels shall not be marked "Wall".

Products already placed on the market may be used when the requirements laid down in EN 12871:2001 including DS/EN 13986/NA:2007 or EN 12871:2010 including DS/EN 1995-1-1 DK NA:2013 have been fulfilled.