BRITISH STANDARD

BS EN
13377:2002

Prefabricated timber formwork beams — Requirements, classification and assessment

The European Standard EN 13377:2002 has the status of a British Standard

ICS 91.220

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 13377:2002.

The UK participation in its preparation was entrusted by Technical Committee B/514, Access and support equipment, to Subcommittee B/514/26, Falsework, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Attention is drawn to National Annex NA (informative) which contains additional information and explanations for UK users.

Cross-references

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English version

Prefabricated timber formwork beams - Requirements, classification and assessment

Poutrelles de coffrage préfabriquées en bois - Exigences, classification et évaluation

Industriell gefertigte Schalungsträger aus Holz - Anforderungen, Klassifizierung und Nachweis

This European Standard was approved by CEN on 29 May 2002.

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Contents

Foreword

This document EN 13377:2002 has been prepared by Technical Committee CEN/TC 53 "Temporary works equipment", 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of an identical text or by endorsement, at the latest by February 2003, and conflicting national standards shall be withdrawn at the latest by February 2003.

The annexes A, B, C and D are normative, the annexes E and F are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard is a product standard primarily for use in the field of falsework and formwork.

Formwork beams should be made so that the properties specified in clause 5 are retained under site conditions such as exposure to water, water vapour and cement.

Whilst this European Standard deals with the two most common types of prefabricated timber formwork beams in use it is not intended to prevent development of other types of formwork beams made of timber and wood based materials.

Research and development in the field of panel materials is continuous. Even if formwork beams are made with materials which do not conform with this European Standard, the principles of this European Standard should be considered in the design and assessment of such beams.

To obtain test results and their statistical evaluation annexes A and B respectively can be used. The values for strength and stiffness given in Tables 1 and 2 have been established from experience. To use these values, the partial safety factor for actions, γ_F, should be taken into account as well as the partial safety factor for the material, γ_M, and modification factor, k_{mod}, for timber, (see ENV 1995-1-1). Annex E gives some guidance. For more information on timber see the Bibliography in annex F.

1 Scope

This European Standard specifies classification, requirements and assessment procedures for prefabricated timber formwork beams. It also gives information on production control requirements.

Prefabricated timber formwork beams are intended for use in falsework and formwork and to be loaded in the direction of the beam depth.

They are of glued I-shaped construction consisting of two identical flange members of solid timber connected by a single web of wood based material with beam depths of 160 mm, 200 mm and 240 mm, or connected by or a lattice of solid timber members with a beam depth of 240 mm beam depth.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

EN 310, *Wood-based panels – Determination of modulus of elasticity in bending and of bending strength.*

EN 317, *Particleboards and fibreboards — Determination of swelling in thickness after immersion in water.*

EN 319, *Particleboards and fibreboards — Determination of tensile strength perpendicular to the plane of the board.*

EN 323, *Wood based panels — Determination of density.*

EN 338, *Structural timber — Strength classes.*

EN 385:1995, *Finger jointed structural timber — Performance requirements and minimum production requirements.*

EN 408, *Timber structures —Solid timber and glued laminated timber — Determinations of some physical and mechanical properties.*

EN 518, *Structural timber — Grading — Requirements for visual strength grading standards.*

EN 519, *Structural timber — Grading — Requirements for machine strength graded timber and grading machines.*

EN 636-3, *Plywood — Specifications — Part 3: Requirements for plywood for use in exterior conditions.*

ENV 1995-1-1:1993, *EUROCODE 5: Design of timber structures — Part 1-1: General rules and rules for buildings.*

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

prEN 13353, *Solid-wood-panels — Requirements.*

prEN 13354, *Solid-wood-panels — Bonding quality — Test method.*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the application of this European Standard, the following terms and definitions apply.

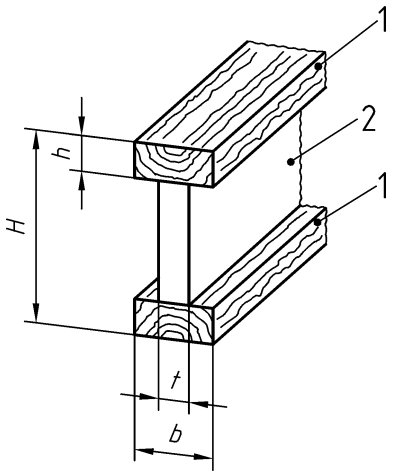
3.1.1
formwork beam
beam in formwork construction and loaded in the direction of the beam depth

3.1.2
timber formwork beam
glued prefabricated I-shaped beam consisting of two identical flange members of solid timber connected by a web of wood based panel material or a lattice of solid timber members

3.1.3
panel web beam
timber formwork beam in which the web is made of a wood based panel material (see Figure 1a))

3.1.4
lattice web beam
timber formwork beam made with lattice struts (see Figure 1b)).

3.1.5
lattice strut
member, positioned diagonally or at right angles to the flange, which connects two parallel flange members (see Figure 1b))



Key

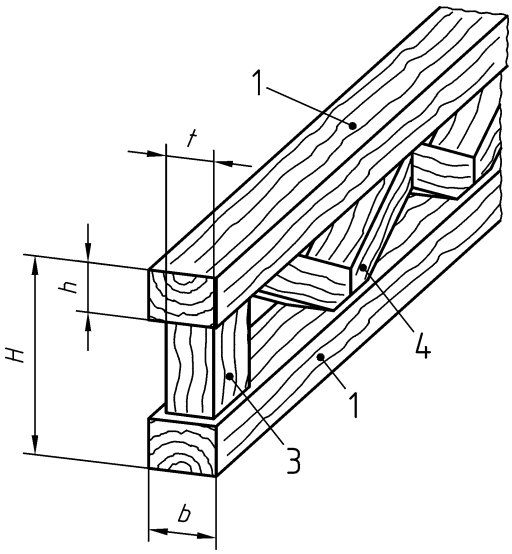
H Depth of beam

b Flange width

h Depth (thickness) of flange

t Thickness of web

a) Panel web beam (type P)



Key

1 Flange

2 Panel web

3 Vertical strut

4 Diagonal strut

b) Lattice web beam (type L)

Figure 1 — Timber formwork beams
General construction and symbols used for the dimensions

3.2 Symbols

The principal symbols used in this standard are listed below:

Number	Symbol	Denomination	Unit
1	a	module of the lattice web beam	mm
2	b	flange width	mm
3	e	distance of proportion at load positions	
4	E	modulus of elasticity	kN/mm^2
5	E_I	bending stiffness	kNm^2
6	F	action	kN
7	H	depth of beam	mm
8	h	depth (thickness) of flange	mm
9	I	second moment of area	mm^4
10	k_{mod}	modification factor	
11	k_s	statistical factor	
12	L	span of beam	m
13	M	bending resistance	kNm
14	n	number of specimens	
15	R	resistance	kN/mm^2
16	s	standard deviation	
17	t	thickness of web	mm
18	V	shear resistance	kN
19	W	section modulus	mm^3
20	y	mean value	
21	y_i	single value	
22	γ_F	partial safety factor for actions	
23	γ_M	partial safety factor for material	
Subscripts			
24	...b	bearing	
25	...d	design level in limit state	
26	...i	typical/any value	
27	...k	characteristic value (limit state)	
28	...m	"supported between node points"	
29	...mod	modification	
30	...n	"supported at node point"	
31	...s	statistical	
32	...u	ultimate (limit state)	
33	...y	value related to transformed values	
34	...5	5 % quantile value	

4 Classification

This standard specifies types of beam; the classification is based on:

— the web construction: Type P for a panel web beam;
Type L for a lattice web beam;

— the overall depth, H: the two digits in the identification symbols represent the depth in centimetres.

The nominal load bearing and rigidity properties for each class are listed in Tables 1 and 2.

For classification see Tables 1 and 2. The identification symbols are given in column 1 of Tables 1 and 2.

Table 1 — Classification, dimensions and structural properties of panel web beams

1	2	3	4	5	6	7
Class	beam depth H [mm]	minimum flange width b [mm]	E_I [kNm^2]	V_k [kN]	$R_{b,k}$ [kN]	M_k [kNm]
P16	160	65	200	18,4	36,8	5.9
P20	200	80	450	23,9	47,8	10.9
P24	240	80	700	28,2	56,4	14.1
NOTE 1 For explanation of symbols, see 3.2.						
NOTE 2 For calculation of ”safe working loads”, see annex E.						

Table 2 — Classification, dimensions and structural properties of lattice web beams

1	2	3	4	5	6	7	8	9
Class	beam depth H [mm]	minimum flange width b [mm]	E_I [kNm^2]	V_k [kN]	$R_{b,n,k}$ [kN]	$R_{b,m,k}$ [kN]	$M_{n,k}$ [kNm]	$M_{m,k}$ [kNm]
					supported at nodes	supported in between nodes	supported at nodes	supported in between nodes
L24	240	80	800	28,2	60,7	43,4	15,2	8,7
NOTE 1 For explanation of symbols, see 3.2.								
NOTE 2 For calculation of ”safe working loads”, see annex E.								

To obtain the required bearing area, the lateral compression strength for the strength class C 24 with 5,3 N/mm² in accordance with EN 338:1995 shall be used.

5 Performance requirements

5.1 General

Beams shall conform to the requirements of this clause according to their class. Conformity with the requirements shall be verified, see clauses 6 and 7, and manufacturing shall be subject to production control, see clause 8 and annex C.

All requirements should be met with a moisture content of solid timber members of (12 ± 2) % (manufacturing target moisture content).

5.2 Material and assembly requirements

5.2.1 Solid timber components – strength class

Members of solid timber shall at least conform to strength class C 24 of EN 338.

NOTE It is recommended that the growth ring width is less than 4 mm and the amount of compression wood does not exceed 20 %.

5.2.2 Wood based panel components

The web shall be made of one of the following materials:

a) plywood conforming to EN 636-3;

b) solid wood panels for use in exterior conditions conforming to prEN 13353;

c) any other wood based material, which conforms after passing the wet-dry-cyclic test (see annex D) with the subsequent requirements:

   i) tension strength perpendicular to the plane determined in accordance with EN 319 shall not be less than 0,1 N/mm^2 (see D.3.1); and

   ii) irreversible swelling shall not exceed 20 % (see D.3.2).

   The following properties of this wood based material shall be made available:

   — density established in accordance with EN 323;

   — bending strength established in accordance with EN 310;

   — thickness swelling established in accordance with EN 317;

   — internal bond established in accordance with EN 319.

The established properties shall be used as requirements for production control (see annex C).

5.2.3 Shear strength of the glue line in beam sections with webs conforming to 5.2.2c

After applying the wet-dry cyclic testing procedure given in annex D, the mean value of the shear strength of beam sections shall be at least 9 kN (see D.4.6).

5.2.4 Glued finger joints

Glued finger joints in flanges shall conform to EN 385.

5.2.5 Glue

Glue shall fulfil the requirements of type I of EN 301.

5.3 Dimensions

5.3.1 Principal dimensions

The length of the beam shall conform to the manufacturers declared dimension within a tolerance of 10 mm.

The beam depth, H, shall conform to the data in Tables 1 and 2 within a limit deviation of ± 1 % or ± 2 mm, whichever is the smaller.

The flange width, b, shall conform to the data in Tables 1 and 2 and to the manufacturers declared dimension within a limit deviation of + 1 % and – 1,5 %.

The web thickness, t, shall conform to the manufacturers declared dimension within a limit deviation of ± 3 %.

The lattice dimensions shall conform to the manufacturers declared dimensions within a limit deviation of ± 1,5 %.

5.3.2 Dimensional movement due to moisture variation

Within the range of moisture content of 10 % to 20 %, the dimensional movement of depth H shall not exceed 1,0 % of H.

5.4 Structural properties

5.4.1 General

The characteristic resistances given in 5.4.2 and 5.4.3 are for the 5 % quantile with a 75 % confidence level.

5.4.2 Panel web beam

The values of the characteristic ultimate resistance and stiffness of a panel web beam shall be at least as great as the values given in Table 1 for the relevant class.

a) The characteristic ultimate shear resistance, V_{k}, see column 5.

b) The characteristic ultimate bearing resistance, $R_{\mathrm{b,k}}$, see column 6.

c) The characteristic ultimate bending resistance, M_{k}, see column 7.

d) The stiffness, E_{I}, see column 4.

5.4.3 Lattice web beam

The values of the characteristic ultimate resistance and stiffness of a lattice beam shall be at least as great as the values given in Table 2.

a) The characteristic ultimate shear resistance, V_{k}, see column 5.

b) The characteristic ultimate bearing resistance, $R_{\mathrm{b,n,k}}$, when supported at node points, see column 6.

c) The characteristic ultimate bearing resistance, $R_{\mathrm{b,m,k}}$, when supported between node points, see column 7.

d) The characteristic ultimate bending resistance, $M_{\mathrm{n,k}}$, when is supported at node points, see column 8.

e) The characteristic ultimate bending resistance, $M_{\mathrm{m,k}}$, when supported between node points, see column 9.

f) The stiffness, E_{I}, see column 4.

6 Prototype assessment

For each model of beam a sample of prototype beams shall be assessed. For this purpose, a model of beam is of one construction but of any length. The model of beam shall conform to the requirements of clauses 5 and 10 of this standard and the manufacturer's specifications.

7 Evaluation of conformity

7.1 General

Evaluation of the model of beam shall verify conformity to the relevant requirements of this standard.

7.2 Process of assessment

7.2.1 For the prototype beams the following shall be made available by the manufacturer:

— class of beam;

— product drawings;

— specification (standard, grade or type) of materials;

— specification of the glue;

— required testing sample of components and beams for tests of web material to evaluate conformity with requirements of 5.2.2.c and 5.3, if web material according 5.2.2.c is used;

— required testing sample of prototype beams for tests to evaluate conformity with requirements of 5.4.

7.2.2 It shall be verified that the prototype beams conform to the requirements of 5.2.

Beams with web materials in accordance with 5.2.2.c shall be tested as specified in annex D. Test results shall conform to the requirements of 5.2.2.c and 5.2.3.

7.2.3 It shall be verified that the prototype beams conform to the requirements of 5.3.

7.2.4 Verification of the structural properties specified in 5.4 shall be by testing in accordance with A.1 and A.2 and calculation in accordance with A.3.

7.2.5 For each test specified in A.2 and for tests at each of the stages given in annex D, a minimum number of 10 tests on specimens chosen from a batch of 50 beams is required. Specimens chosen shall have glued finger joints in one or both flanges and in the web in accordance with Figures A.1 and A.2.

7.2.6 Characteristic resistances and stiffnesses representing the 5 % quantile level with a 75 % confidence level shall be calculated from the test results using the method specified in annex B.

7.3 Statement of conformity

On completion of a successful evaluation of conformity (see clause 8), a statement to that effect shall be given. This statement shall express that the model of beam conforms to the beam class and the related requirements of this standard and shall include:

— the reference number(s) of test(s) or examination report(s);

— the identification of the particular beams examined.

8 Ongoing production inspection

Ongoing production inspection shall be carried out.

Minimum production control requirements are given in annex C.

Information on requirements for inspection level L and M of EN ISO 9001 and is given in annex F.

9 Marking

Each beam shall be durably marked with insoluble ink. The size of the lettering shall be at least 25 mm.

NOTE The marking is intended to remain legible for the lifetime of the beam.

Each beam shall be marked with the following:

— the identification of the manufacturer by name, logo, code or trade mark;

— EN 13377 and the class of the beam (classification);

— the inspection level, when inspection in accordance with annex F is applied;

— sign of the independent certification system (for inspection level M only) if annex F is applied;

— production identification data, so that the manufacture can be traced.

10 Instructions for use

The manufacturer shall provide a set of instructions for the user; the instruction manual shall include:

a) the class of beam;

b) the beam dimensions and self-weight;

c) an explanation of the marking of a beam;

d) instructions for the use and mechanical properties of beams, including the handling during erection and dismantling;

e) an advice that damaged beams shall not be used;

f) instructions for storage and maintenance.

Annex A
(normative)

Test and calculation methods to establish structural parameters

A.1 General

This annex specifies methods to establish or verify structural parameters.

A.2 Test methods

A.2.1 Arrangements for loading to determine structural values

The loading equipment and the rate of loading shall conform to EN 408 – determination of bending strength. Test reporting shall be in accordance with EN 408.

Where the test methods of this annex do not specify details, reference shall be made to EN 408.

Beams shall be tested at a wood moisture content of the flanges of (12 ± 2) %.

Each beam shall be positioned as shown in the relevant figures. Each beam shall contain a glued finger joint in one or both flanges and the web in the area shown in Figures A.1 and A.2. In the length of the beam, glued finger joints in the flanges and the web shall not be more than 50 mm apart.

Each load shall be applied at the top through a block which has a length of 200 mm, a thickness of at least 40 mm and a width at least as wide as the flange of the beam. It shall be made of either hardwood or plywood.

Each support point below shall comprise a steel plate which has a length equal to the depth of the beam, H, a thickness of at least 20 mm and a width at least as big as that of the flange of the beam.

For number of tests see 7.2.5. In all tests, record the maximum values reached.

A.2.2 Tests for panel web beams

A.2.2.1 Test for shear resistance, V

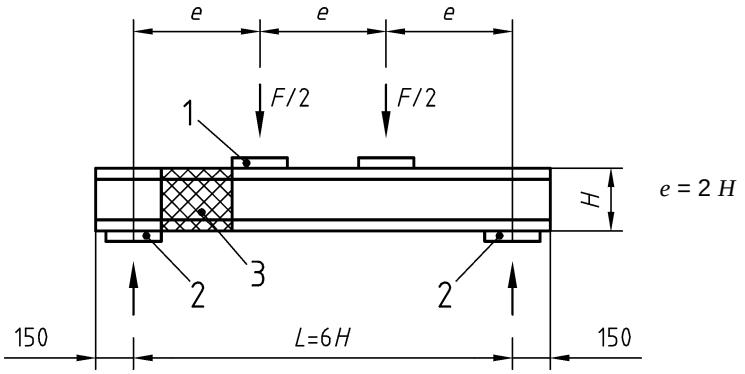
The test arrangement is given in Figure A.1a). The shear resistance, V_k, is equal to the ultimate force F/2.

A.2.2.2 Test for bending resistance, M

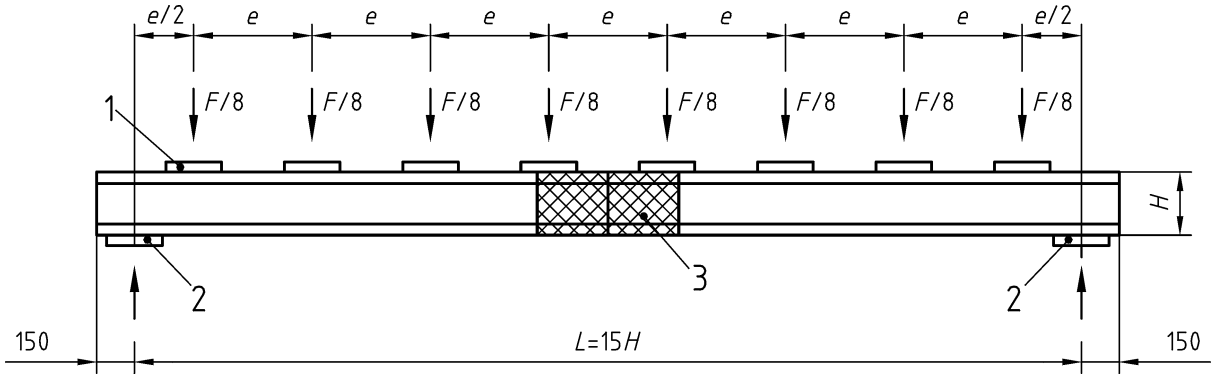
The test arrangement is given in Figure A.1b). The bending resistance M is calculated from the ultimate forces F/8 and their position.

A.2.2.3 Test for bearing resistance, R_b

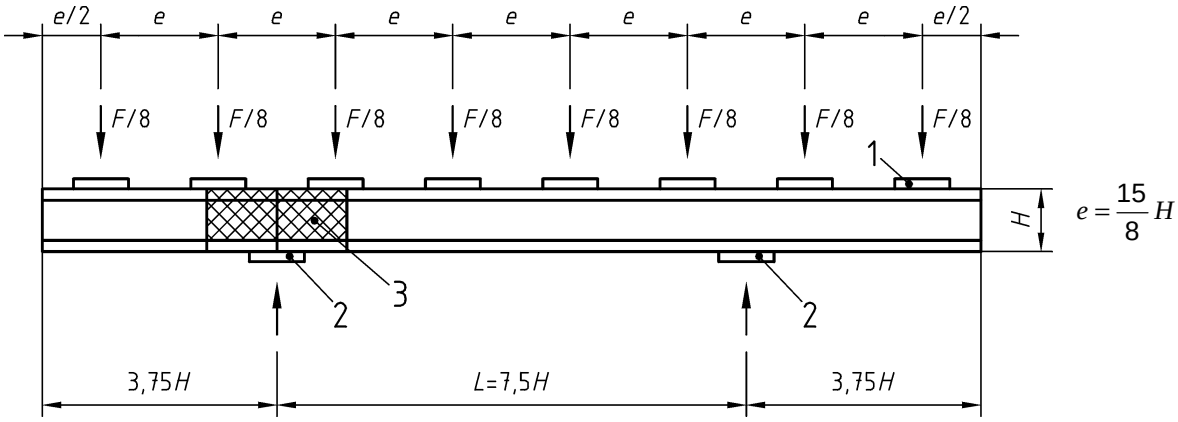
The test arrangement is given in Figure A.1c). The bearing resistance R_b is equal to the ultimate force F/2.



a) Test arrangement for shear resistance, V



b) Test arrangement for bending resistance M



c) Test arrangement for bearing resistance R_b

Key
1 Block to spread load
2 Steel plate
3 Area for glued finger joints in flange and/or web

NOTE For explanation of symbols, see 3.2.

Figure A.1 — Test arrangements for panel web beams

A.2.3 Tests for lattice web beam L24

A.2.3.1 Test for the shear resistance, V

The test arrangement is given in Figure A.2a).

The shear resistance is equal to the ultimate force F/2.

A.2.3.2 Test for bending resistance, $M_{n,}$ when supported at node points

The test arrangement is given in Figure A.2b).

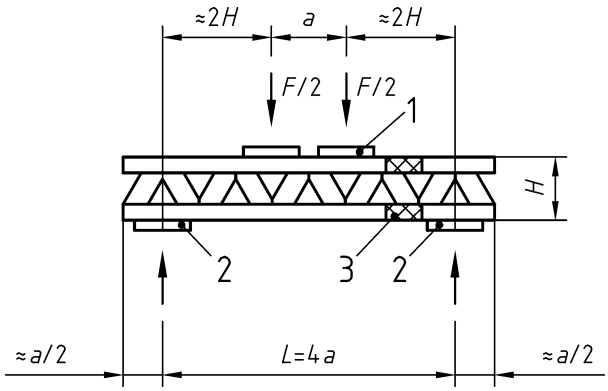
The bending resistance M_n is calculated from the ultimate forces F/8 and their position.

A.2.3.3 Test for bending resistance, M_m, and for bearing resistance, $R_{b,m}$ when the beam is supported between the node points.

The test arrangement is given in Figure A.2c). The bending resistance, $M_{\mathbf{m}}$, is calculated from the ultimate force F/8 and their position. The resistance, $R_{b,m}$, is equal to the ultimate force F/2.

A.2.3.4 Test for bearing resistance, $R_{b,n}$ of a beam supported at node points

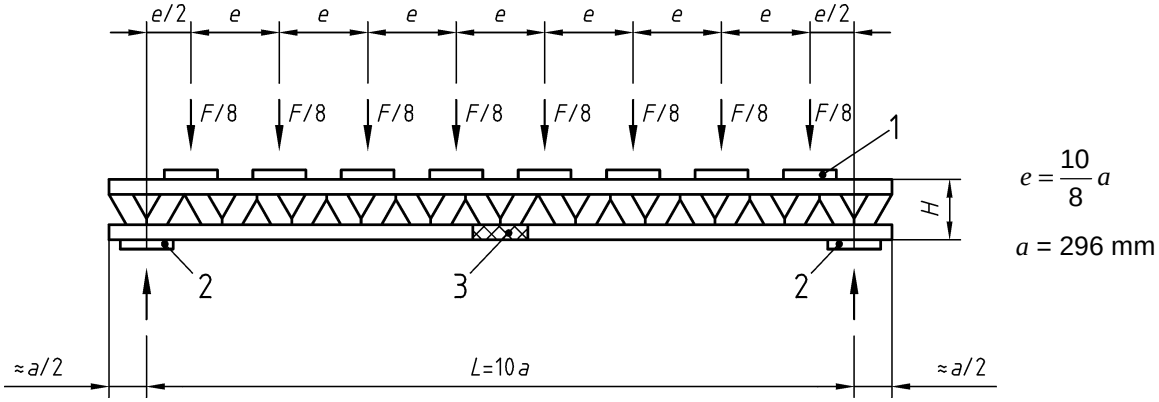
The test arrangement is given in Figure A.2d). The bearing resistance, $R_{b,n}$, is the ultimate force F/2.



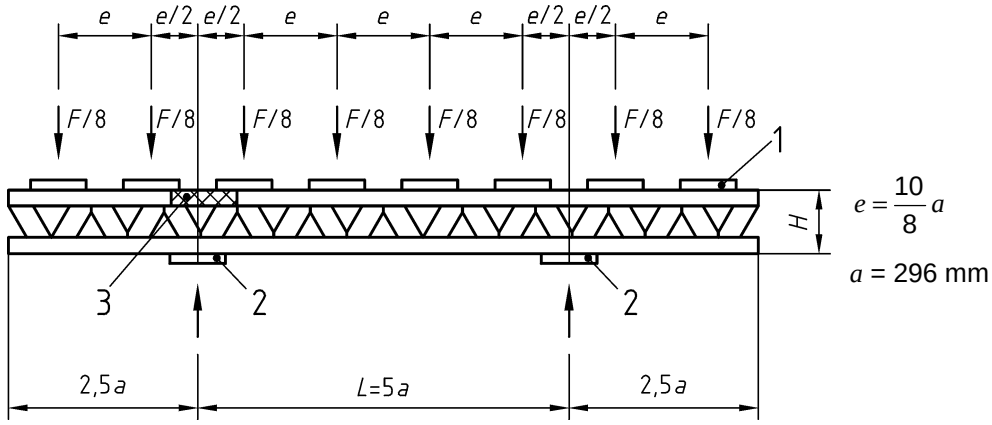
a = 296 mm

a) Test arrangement for shear resistance, V

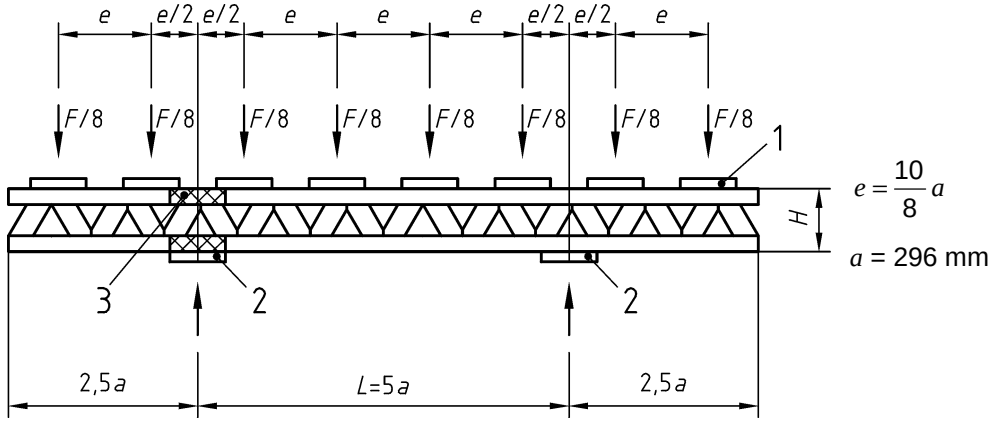
Figure A.2 — Test arrangements for lattice web beams, continued



b) Test arrangement for bending resistance, M_n



c) Test arrangement for bending resistance, M_m, and for bearing resistance, $R_{b,m}$, when a beam is supported between the node points



d) Test arrangement for the bearing resistance, $R_{b,n}$, of a beam supported at its node points

Key

1 Block to spread load
2 Steel plate
3 Area for glued finger joints in flange

NOTE For explanation of symbols, see 3.2.

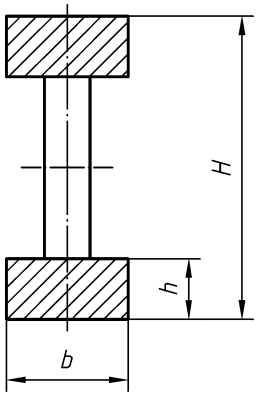
Figure A.2 — Test arrangements for lattice web beams

A.3 Calculation of the bending stiffness

A.3.1 The moment of inertia, I, shall be calculated from the equation:

$$I = \frac{b}{12}\left[H^3 - (H - 2h)^3\right]$$

NOTE For the purposes of this calculation, the full rectangular area of the flanges is taken, but the net web area is ignored.



Key
H = depth of beam
h = depth (thickness) of flange
b = width of flange

Figure A.3 — Geometrical data for calculation of second moment of inertia I

A.3.2 To calculate the stiffness, E_I, multiply the moment of inertia, I, by the mean value of the modulus of elasticity of 11 000 N/mm^2. This modulus of elasticity is appropriate for the timber strength class C24 of EN 338.

A.4 Test report

The results of tests shall be recorded in accordance with EN 408 including details of how they were established and reference to all standards used in the process.

Annex B
(normative)

Statistical analysis of test results for the calculation of the characteristic value

B.1 This method establishes the 5 % quantile of the set of test values $R_{u,i}$ with 75 % confidence level. It assumes that the test values have a logarithmic distribution.

B.2 Transform the data using the following equation:

$$y_i = \log_e R_{u,i}$$

B.3 Calculate the mean value and the standard deviation for the n test results using the following equations:

$$y = 1/n\ (\Sigma y_i)$$

$$s_y = \frac{1}{(n-1)} \cdot \Sigma\ (y_i - y)^2$$

B.4 Calculate the 5 %-quantile value using the following equation:

$$y_5 = y - k_s \cdot s_y$$

with k_s according to Table B.1

Table B.1 — Values of k_s for determining the 5 %-quantile for the 75 % confidence level

n	2	3	4	5	6	7	8	9	10	11	12	13
k_s	5,12	3,15	2,68	2,46	2,33	2,25	2,19	2,14	2,10	2,07	2,05	2,03
n	14	15	16	17	18	19	20	21	22	23	24	25
k_s	2,00	1,99	1,98	1,96	1,95	1,94	1,93	1,92	1,92	1,91	1,90	1,90
n	26	27	28	29	34	39	44	49	54	55	—	
k_s	1,89	1,88	1,88	1,87	1,87	1,85	1,83	1,82	1,81	1,80	1,64	

n number of specimens

k_s statistical factor, considering number of specimens and confidence level

NOTE This standard specifies a minimum number of specimens of 10. Values of k_s for smaller numbers of specimens are shown shaded.

B.5 Transform the value obtained in B.4 to give the actual characteristic strength using the following equation:

$$R_{u,5} = \exp y_5$$

Annex C
(normative)

Minimum requirements for production control

C.1 This annex sets out the main points which have to be incorporated in the production control system established for each model of beam. Table C.1 gives requirements for materials and bought-in-components. Table C.2 gives requirements for beam manufacture.

Table C.1 — Internal control of materials and bought-in-components

Test subject	Property	Test references	Minimum frequency of testing
timber members (flanges, struts)	dimensional tolerances	as clause 5	2 per shift[a]
	timber quality (grade)	EN 518, EN 519	every piece
	moisture content	EN 13183-2	every piece
finger joints in flange or webs	bending resistance	EN 385 bending test EN 408	1 per 10 000 linear meters
	glue consistency	visual inspection	1 per shift[a]
	glue viscosity	viscosity test	1 per week
	glue application	visual inspection	every piece or joint
wood based panels according to 5.2.2.a	dimensional tolerances		1 per shift[a]
	wood species, number and thickness of layers	EN 636-3	1 per delivery
	bonding quality	prEN 13354	1 per 10 000 linear meters
wood based panels according to 5.2.2.b	dimensional tolerances		1 per shift[a]
	wood species, number, quality and thickness of layers	prEN 13353	1 per week
	bonding quality		1 per 10 000 linear meters
wood based panels according to 5.2.2.c	dimensional tolerances		1 per shift[a]
	density	EN 323	
	bending strength	EN 310	1 per delivery
	thickness swelling	EN 317	
	internal bond	EN 319	

[a] Shift or 8 h period of production

Table C.2 — Control of beam manufacture

Parameter	Characteristic to be checked	Requirements	Frequency of inspection
Dimensions	length of beam	as data drawing see 5.2	2 per shift[a]
	depth of beam	as data drawing	2 per 10 000 linear meters
glued joints (web/flanges)	geometry	as data drawing see 5.3	1 per shift
	bonding quality	wood failure percentage (minimum 70 %)[b]	1 per shift
strength & stiffness	shear resistance	see 5.4[c]	5 per month
	bearing resistance		
	bending resistance		
gluing	glue data (production, delivery, expiry date)		continuously
	gluing conditions (humidity, temp, pressure)		
surface	finishing	as specified by manufacturer	every piece

[a] Shift or 8 h period of production.

[b] Wood failure percentage. For the control of the glued joints between the web and flanges a piece of a beam with a minimum length of 0,5 m shall be tested. After curing of the glue lines the joints are destroyed by mechanical demolition (e.g. by means of hammer). After demolition the wood failure percentage of the glue lines is determined.

[c] Test method for beams from production: Fingerjoints will be located where the production requires and not as specified in prototype testing.

Annex D
(normative)

Test procedures for beams with webs conforming to 5.2.2.c)

D.1 General

The procedure specified in D.2 to D.4 establishes the change of properties of the web material after accelerated wet-dry cycling. It is intended for materials other than those specified in 5.2.2.c). Typical examples of such material are particleboard or oriented strandboard.

D.2 Wet-dry cyclic testing procedure for web material, beam sections with a length of 50 mm

D.2.1 Wet-dry cycles

One cycle consists of:

— 1 day vacuum water soaking (absolute pressure p = (0,5 ± 0,1) bar, water temperature (20 ± 5) °C);

— approximately 2 days drying at 60 °C–65 °C.

After drying the weight of the specimens shall be within a range of ± 5 % of the weight before soaking.

D.2.2 The completion of the cycling process shall be controlled by values obtained from the glue line shear test, see D.4. After every fifth wet-dry-cycle determine the mean value of the shear strength of the glue line in accordance with D.4. When a later mean value is not less than 92 % of the proceeding mean value, the cycling may be stopped. It shall be stopped after 20 cycles.

D.3 Test method for web materials

D.3.1 Test method for tension strength perpendicular to the plane

D.3.1.1 This tensile test shall be carried out in accordance with EN 319 (internal bond).

D.3.1.2 Establish the mean value of a first set from the sample. This forms the initial value.

D.3.1.3 Subject the rest of the sample to wet-dry cycles until the criteria specified in D.2.2 is reached.

D.3.1.4 Establish the final mean value.

D.3.2 Test method for irreversible swelling

D.3.2.1 The irreversible swelling is the mean swelling in thickness at the end of the wet-dry cycles.

D.3.2.2 Swelling in thickness shall be determined in accordance with EN 317 but instead of the water immersion, the wet-dry cycles defined in D.2.1 shall be applied until the criteria of D.2.2 is fulfilled.

D.4 Test procedure for glue line shear test on beam sections with a length of 50 mm

D.4.1 The principle of the test is to apply a load at the ends of the web of a beam section 50 mm long (see Figure D1) to establish the shear failure load.

NOTE Sample size minimum 50.

D.4.2 A basic plate is arranged so that it supports two support plates which in turn support the solid timber of each flange. The support plates shall be shaped in such a way that they do not provide any support to the web. A loading device is provided which transmits force from above to the outer 25 mm of each end of the web and is shaped so that bears only on the web.

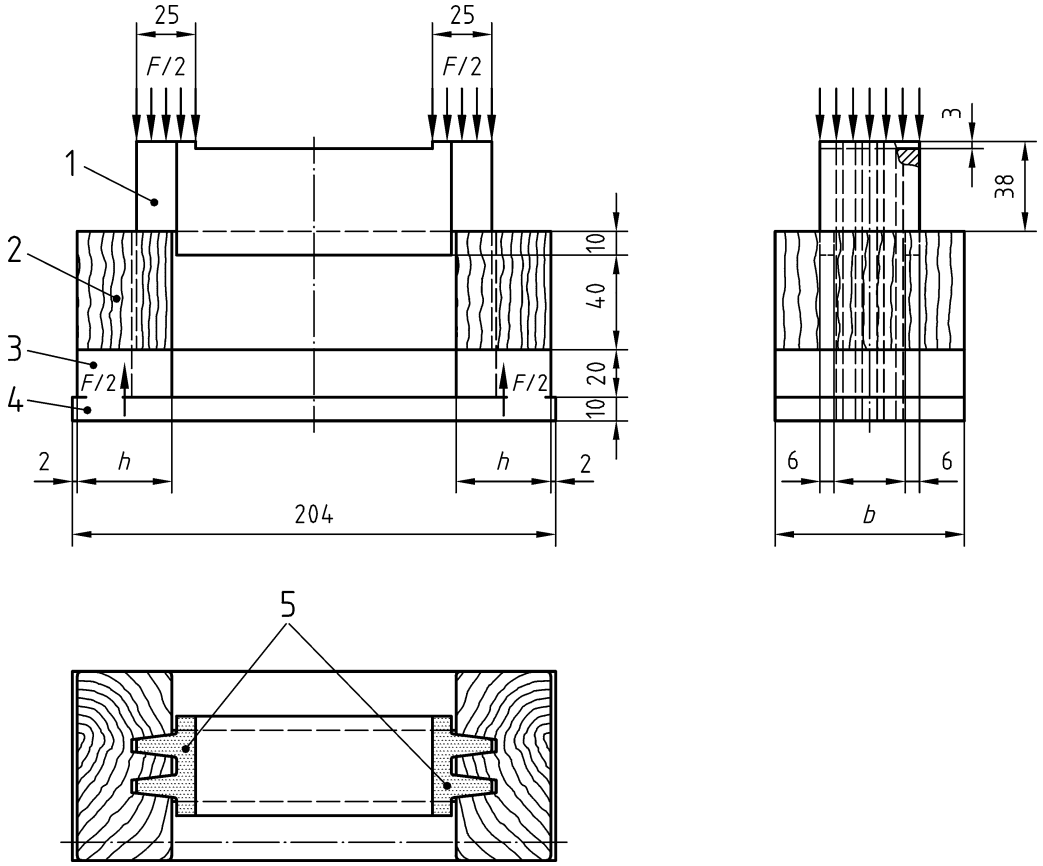
D.4.3 Take 10 beam sections out of the sample. Apply load until the web flange joint fails. Record the values. Calculate the mean value.

D.4.4 Subject the rest of the sample to five wet-dry cycles. Then repeat the test on 10 beam sections and calculate the mean value. Express it as a percentage of the previous value.

D.4.5 Repeat the cycling, testing and calculation until the criteria specified in D.2.2 is reached.

D.4.6 Establish the mean value of the glue line shear test results after the last cycle.

Dimensions in millimetres



Key

1 Loading device
2 Specimen
3 Support plate
4 Basic plate
5 Loading area

Figure D.1 — Test arrangement for glueline shear test
(figure shows a P20 beam as an example;
for other types other dimensions will be appropriate)

Annex E
(informative)

Values for use in calculation for site use

E.1 This annex provides information on site use based on ENV 1995-1-1. In some countries applying the National Application Document (NAD) could result in different values.

NOTE Under site conditions the equilibrium moisture content of formwork beams can be considered as Service Class 2 according to ENV 1995-1-1.

E.2 Calculation of the limit state design resistance, R_d, of beams conforming to this standard and to ENV 1995-1-1.

The following is an excerpt from ENV 1995-1-1. (Text in *italic* is not part of ENV 1995-1-1).

The design value X_d of a material property is defined as:

$$X_d = k_{mod} \cdot X_k/\gamma_M$$

where symbols are defined as follows:

X_k characteristic value of material property. *Annex B sets out how to convert test results to a characteristic value appropriate for use with this standard.*

γ_M partial safety factor for the material property, *given in 2.3.3.2 of ENV 1995-1-1:1993.*

For wood and wood based material it should be taken as 1,3.

k_{mod} modification factor taking into account the effect on the strength parameters of the duration of the load and the moisture content in the structure. *Under typical site conditions formwork beams are used in Service Class 2, ENV 1995-1-1, where there is a moisture content of 20 % or less. For prefabricated timber formwork beams, k_{mod} should be taken as 0,9, unless local conditions require a lower value.*

E.3 A safe working value of a material property when multiplied by the partial safety factor for load, γ_F, should be equal or less than the limit state design resistance. Thus the safe working value of a material property may be calculated by dividing the limit state design resistance by $\gamma_F \cdot \gamma_F$ should be taken as 1,5.

E.4 Safe working values for shear force, bearing force and bending moment given in Tables E.1 and E.2, in columns 5 to 7 are calculated according to E.2 and E.3 from figures in Tables 1 and 2 of this standard. The permitted pressure lateral to the fibre is obtained in accordance to E.2 with the value for the lateral compression strength given in clause 4. The value for γ_F is taken as 1,5, γ_M as 1,3 and k_{mod} as 0,9.

Table E.1 — Safe working loads for panel web beams
Nominal beam depth, minimum flange width, E_I, and safe working loads

1	2	3	4	5	6	7
class	depth H (mm)	minimum flange width b (mm)	E_I (kNm^2)	Q (kN)	A (kN)	M (kNm)
P16	160	65	200	8,5	17	2,7
P20	200	80	450	11,0	22	5,0
P24	240	80	700	13,0	26	6,5

Table E.2 — Safe working loads and stiffness values for lattice web beams
Nominal beam depth, minimum flange width and safe working loads

1	2	3	4	5	6	7	8	9
class	depth H (mm)	minimum flange width b (mm)	E_I (kNm^2)	Q (kN)	A (kN)		M (kNm)	
					at nodes	in between nodes	at nodes	supported in between nodes
L24	240	80	800	13	28	20	7,0	4,0

For explanation of symbols, see 3.2.

Symbols not explained in 3.2:

Q safe working value of shear force

A safe working value of bearing force

M safe working value of bending moment

NOTE 1 The centre line of any support should be at least 150 mm from the end of the beam.

Annex F
(informative)

Ongoing production inspection

F.1 This annex gives information on inspection for two levels, L and M, of EN ISO 9001.

F.2 For both levels the inspection given in annex C should be applied.

F.3 For level M, the external inspection should be in accordance with Table F.1.

F.4 The manufacture of timber formwork beams is controlled by one of the following inspection levels:

Inspection level L

The production quality control is carried out by the manufacturer. The manufacturer should be approved to EN ISO 9001.

Inspection level M

The production quality control is carried out under the supervision of an approved independent certification organisation.

Table F.1 — Control of beams manufacture for inspection level M

Parameter	Characteristic to be checked	Requirements	Frequency of inspection
Dimensions	length of beam depth of beam	as manufacturer drawing as manufacturer drawing	5 per month
glued joints (web/flanges)	geometry bonding quality	as drawing min. wood failure. 70 %	5 per month[a]
strength & stiffness	shear resistance bearing resistance bending resistance	see 5.4	5 per month[a]
gluing	glue data (production, delivery, expiry date) gluing conditions (humidity, temp, pressure)		1 per month
surface	finishing	as specified by manufacturer	1 per month

[a] Where production is less than 10 000 per month, the inspection rate should be one per 2 000 m.

Bibliography

EN 384, *Structural timber — Determination of characteristic values of mechanical properties and density.*

EN 386, *Glued laminated timber — Performance requirements and minimum production requirements.*

EN 387, *Glued laminated timber — Large finger joints — Performance requirements and minimum production requirements.*

EN 460, *Guide to the durability requirements for wood to be used in hazard classes.*

EN 636-1, *Plywood — Specifications — Part 1: Load bearing boards for use in dry conditions.*

EN 636-2, *Plywood — Specifications — Part 2: Plywood for use in humid conditions.*

EN 1058, *Wood based panel — Determination of characteristic values of mechanical properties and densities.*

EN 1194, *Timber structures — glued laminated timber – Strength classes and determination of characteristic values.*

EN 12369-1, *Wood based panels — Characteristic values for structural design — Part 1: OSB, particleboards and fibreboards.*

ISO 4470, *Sawn timber — Determination of the average moisture content of a lot.*

National Annex NA
(informative)

Additional information on prefabricated timber formwork beams for use in the UK

The prefabricated timber formwork beams covered in this European standard are not made in the UK at present. They are not specifically covered by the current national specification on falsework BS 5975[1,2].

The following information has been listed to help UK users.

a) The strength data for prefabricated formwork beams are in limit state terms, and need to be factored, typically by 1,95, for use in a Permissive Stress calculation to give traditional safe working loads. Most manufacturers will supply data in this form, and care should be taken to ensure that the data supplied are correctly interpreted.

The requirement for moisture content is not mandatory. Where the greatest confidence in the strength is needed, the buyer should seek confirmation from the supplier that the beams conform.

NOTE 1 For more detailed information on Permissive Stress calculations see the final paragraph of the Introduction and Annex E.
NOTE 2 Table E.1 and Table E.2 give values in traditional Permissible Stress terms.

b) The values for bearing resistance, $R_{b,k}$, given in Table 1 and Table 2 are only applicable when the supports are as large as those specified in **A.2.1**. (See also note 1 of **E.4**.)

c) Attachment of a beam to plywood to make a panel is carried out using M6 x 60 Torx headed screws. Ring shanked nails may cause damage when dismantling.

d) Beams are usually not more than 6 m long. If a beam is damaged, the damaged part may be cut off. For lattice type beams, this cut should take account of the node points. Replacement protective end caps are usually available from suppliers.

e) Arrangements for loading should be in accordance with the arrangements given in **A.2.1**. Supports should be of adequate area and positioned appropriately, taking account of the test configurations (see **A.2.1**).

f) It is recommended that beams are stored outside to maintain their moisture at ambient conditions, appreciably higher than interior conditions. Problems can occur with form panels, which have been fabricated with beams of too low a moisture content when they reach the site. With a change of moisture content, beams will change their dimensions as they take up moisture out of doors, whereas the material forming the panel face will remain essentially constant in size. This can lead to panel warping.

g) Beam accessories are made for a specific manufacturer's product and, because the requirements of this standard are written in terms of performance, may not be suitable for use with another manufacturer's product.

[1] *Code of practice for falsework.*
[2] prEN 12812, *Falsework — Performance requirements and general design,* is approaching Formal Vote stage.

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