BRITISH STANDARD

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789:2004

Timber structures — Test methods — Determination of mechanical properties of wood based panels

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ICS 79.040

BSI
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National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/518, Timber structures, which has the responsibility to:

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Summary of pages

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 789

October 2004

ICS 79.040

Supersedes EN 789:1995

English version

Timber structures - Test methods - Determination of mechanical properties of wood based panels

Structures en bois - Méthodes d'essai - Détermination des propriétés mécaniques des panneaux à base de bois

Holzbauwerke - Prüfverfahren - Bestimmung der mechanischen Eigenschaften von Holzwerkstoffen

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Foreword

This document (EN 789:2004) has been prepared by Technical Committee CEN/TC 124 "Timber Structures", the secretariat of which is held by SFS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2005, and conflicting national standards shall be withdrawn at the latest by April 2005.

This document supersedes EN 789:1995.

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10.2 Loading equipment

The loading equipment shall be capable of measuring the load to an accuracy of 1% of the maximum load applied to the test piece.

10.3 Measurement of deformation

When shear modulus of rigidity (G) is to be determined, deflection gauges shall be attached to both sides of the test piece, parallel to each other, as shown in Figure B1. The gauge length along which deformation is measured shall be the compression diagonal at 45° to the rails passing through the centre of the shear area. The gauge length shall be between 120 mm and 150 mm and centred between the rails along this line.

NOTE Attachment of the gauges may be with pins inserted in 3 mm diameter drilled holes or by glued mounts with the contact area being less than 5 mm diameter.

10.4 Loading method

The load applied shall be applied evenly over the top surface of the uppermost rail as single force acting along the longitudinal axis of the test piece, parallel to the rails. A suitable apparatus for applying equal loads to the rails is shown in Figure 6.

Dimensions in millimetres

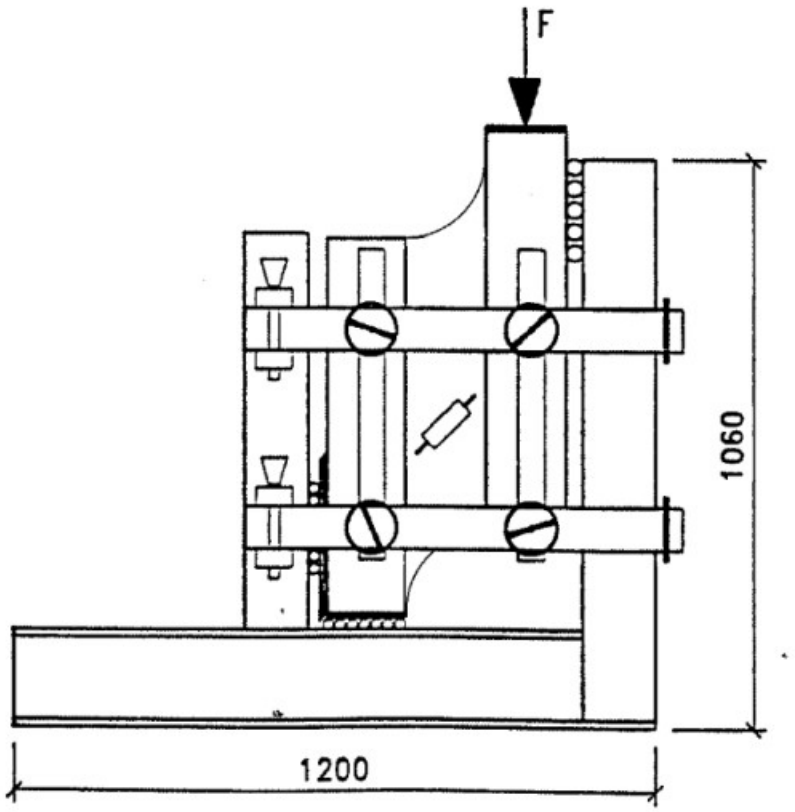


Figure 6 - Loading arrangement for panel shear test

11.5 Expression of results

11.5.1 Planar shear strength

The planar shear strength shall be calculated from the following formula:

$$f_r = \frac{F_{max}}{lb}$$

where

F_{max} is the maximum load obtained during testing

b is the width of the test specimen

l is the length of the test specimen

The planar shear strength shall be calculated to three significant figures.

11.5.2 Planar shear modulus of rigidity

Using the data obtained plot the load-deformation graph. Use that section of the graph between $0,1F_{max}$ and $0,4F_{max}$ for a linear regression analyses.

The planar shear modulus of rigidity shall be calculated from the following formula:

$$G_r = \frac{(F_2 - F_1)}{(u_2 - u_1)} \frac{t}{lb}$$

where

t is the panel thickness of test specimen

$F_2 - F_1$ is the increment of load between $0,1F_{max}$ and $0,4F_{max}$, see Figure 3

$u_2 - u_1$ is the increment of deformation corresponding to $F_2 . F_1$ using the linear regression line, see Figure 3

u_2 and u_1 are means of the deformations measured on both faces of the test piece

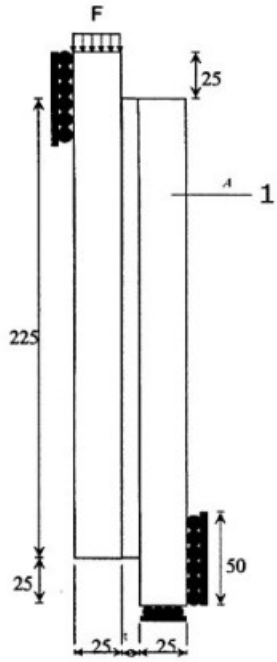
b is the width of the test specimen

l is the length of the test specimen

The planar shear modulus of rigidity shall be calculated to an accuracy of 1%.

NOTE Guidance. Evaluation of the variability of G_r has shown that for panel product with 'high' G_r (small deformations) the coefficient of variation can be high (50%).

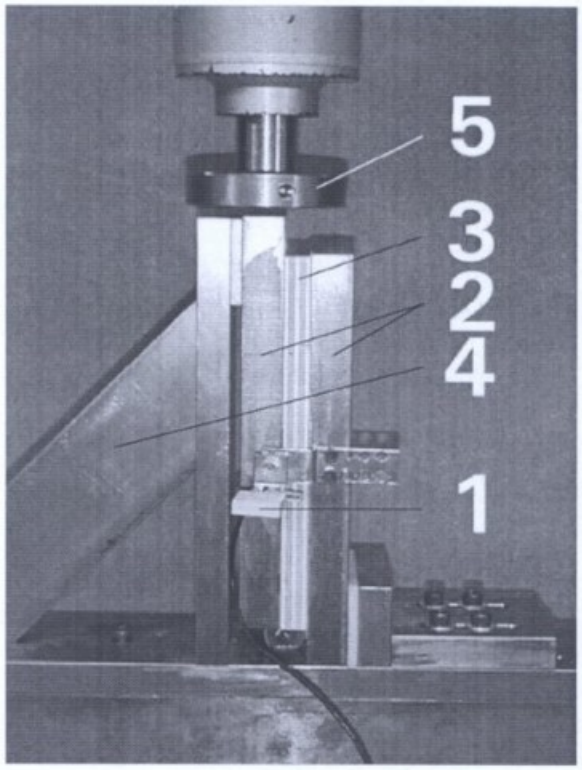
Dimensions in millimetres



Key

1 Steel

Figure 7a - Loading arrangement for planar shear



Key

1 Gauge equipment for measuring deformation
2 Steel plates
3 Test piece
4 Test rig bracing for measuring deformation
5 Test machine - Compression plate and load cell.

Figure 7b - Example of planar shear test set up

12 Test report

12.1 General

The test report shall include details of the test material, the method of test used and the test results. The amount of detail given under each of these headings will depend on the purpose of the tests.

12.2 General data

The following data shall be given:

a) name of the testing organisation;

b) name(s) of the supplier(s) of the test material;

c) general description of the test material;

d) place and date of sampling.

Dimensions in millimetres

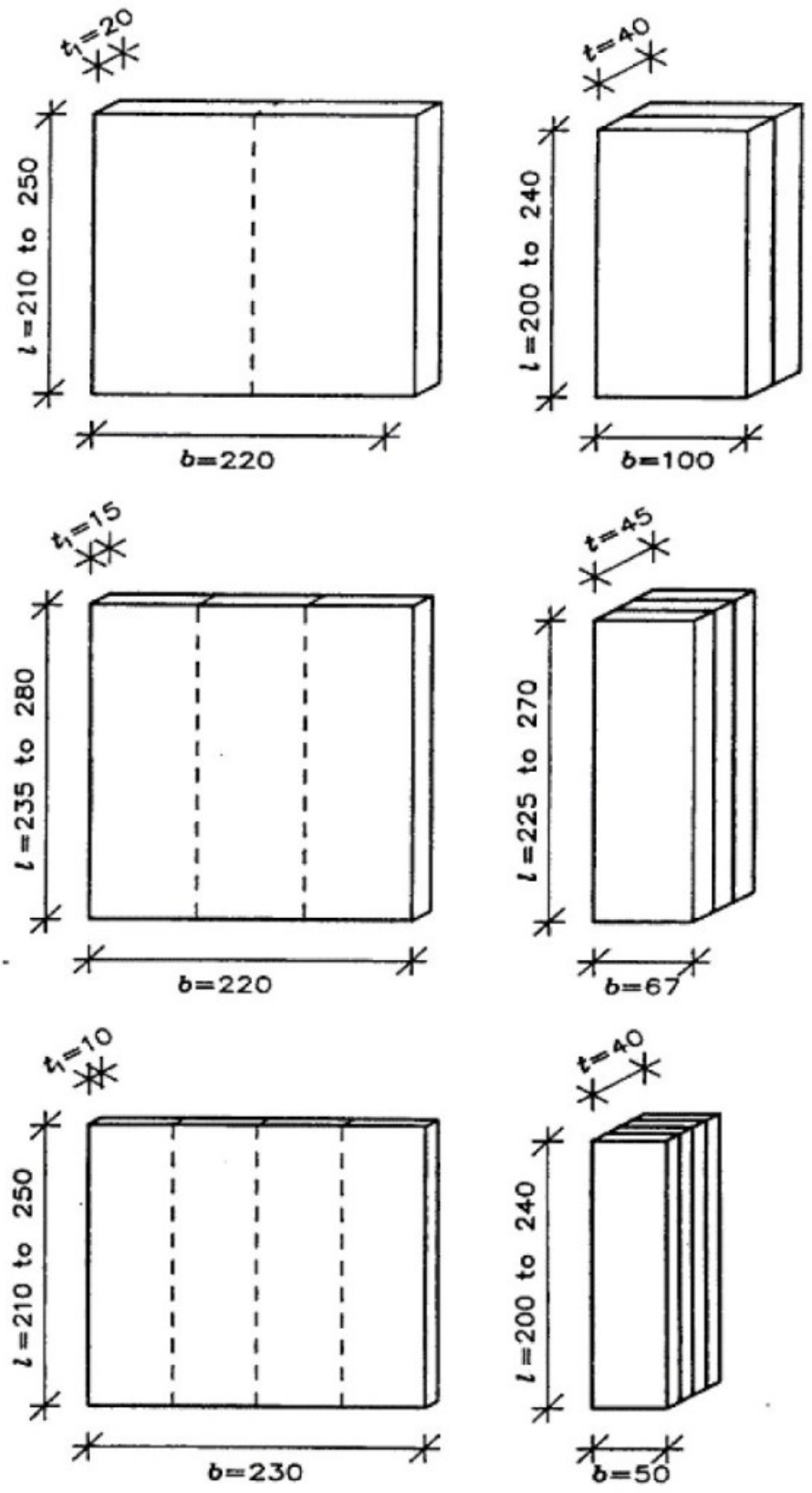


Figure A.2 - Examples of test pieces from panels having a thickness of less than 40 mm

Table A.1 - Typical sizes of test pieces from panels having a thickness in the range of 6mm to 40 mm

Panel thickness t_1 (mm)	Number of pieces cut from a specimen	Specimen		Test piece	
		Length *l* (mm)	Width *b* (mm)	Length *l* (mm)	Width *b* (mm)
$t_1 \geq 40$	1	-	220	$5t_1$ to $6t_1$	200
$20 \leq t_1 < 40$	2	210 – 250 to 400 – 480	210	200 – 240 to 390 – 470	100
$14 \leq t_1 < 20$	3	220 – 260 to 310 – 370	220	210 – 250 to 300 – 360	67
$10 \leq t_1 < 14$	4	210 – 250 to 270 – 320	230	200 – 240 to 260 – 310	50
$8 \leq t_1 < 10$	5	210 – 250 to 230 – 280	240	200 – 240 to 220 – 270	40
$6 \leq t_1 < 8$	7	210 – 245 to 260 – 300	340	200 – 250 to 250 - 290	40

Annex B
(normative)

Panel shear test pieces

The test piece shall be rectangular in cross-section. The thickness of the test piece shall be equal to the thickness of the specimen as measured. Other dimensions of the test piece are given in Figure B.1.

NOTE 1 With certain panel materials, constructions and thicknesses, valid results may only be obtainable either in the longitudinal or the lateral direction.

Timber rails having minimum dimensions of 35 mm x 145 mm x 700 mm long shall be bonded to both sides of the test piece at each edge. The width of the rails may be increased to eliminate a shear failure between the rails and the test piece. The rails shall be spaced (150 ± 2) mm apart with their ends even with the test piece at two diagonally opposite corners as shown in Figure B.1. Prior to bonding, the rails and the test piece shall be conditioned to the approximate moisture content at which the test piece is to be tested.

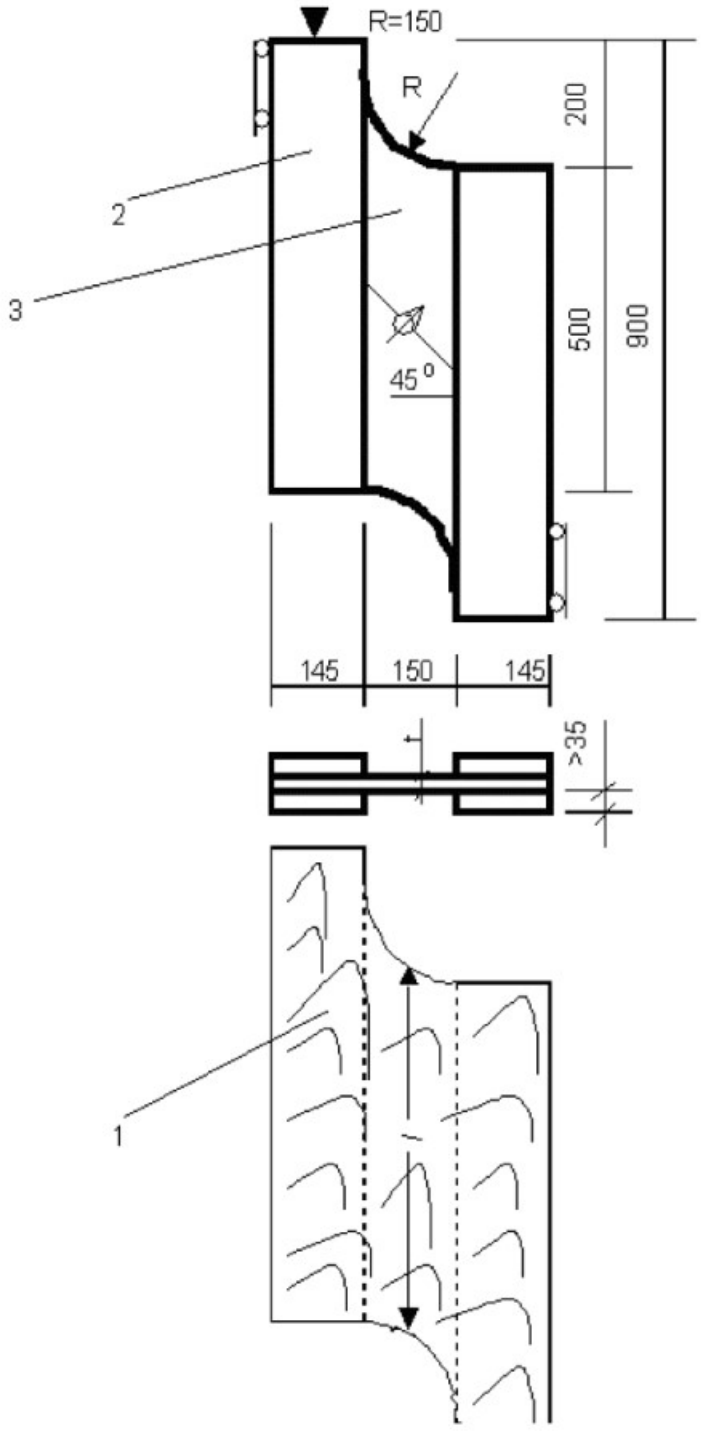
NOTE 2 Previous experience has shown that rails should be of "good quality" material with a minimum compression strength parallel to grain of 35 N/mm^2 and a minimum bending E_m of 9000 N/mm^2. This is to ensure that the stiffness of the rails is greater than that of the test panels and to ensure the stresses in the rails remain below 40% of ultimate.

A suitable PRF adhesive shall be used to attach the rails.

NOTE 3 Some panel materials have high panel shear strength but insufficient internal bond and planar shear strength to transfer these stresses from the rails into the panel. In these cases, the rail may separate from the test piece. This may be prevented by applying lateral pressure to the rails, for example by the use of bolts.

Steel rails may be substituted for timber rails and clamping may be substituted for bonding provided that no crushing of the test piece or slippage between rail and test piece occurs. Special rail facings may be needed to develop adequate friction between rails and test piece. The clamping method is particularly well suited to reconstituted panel materials that would otherwise require bolting to prevent planar shear in the test piece under the rails.

Dimensions in millimetres



Key

1	Panel
2	Rail
3	Test piece
4	Radius
5	Load
t	Thickness

Figure B.1 - The specimen and test set up for panel shear test

Annex C
(normative)

Planar shear test pieces

The test piece shall be rectangular in cross-section and its thickness shall be equal to the thickness of the panel. The width of the test piece shall be (100 ±1) mm and its length shall be (225 ±1) mm.

Thickness measurement shall be carried out in the four corners of the test piece 10 mm from edges. If the difference between maximum and minimum thickness is above 0,5 mm the panel thickness is regarded as uneven. Sanding of the test piece on two sides prior to gluing between steel plates is then necessary.

If test pieces fail in the surface layer with only a few particle/fibres adhering to the metal plate. Then subsequent test pieces may be lightly sanded on both sides prior to gluing. The amount of material removed from each face by sanding should not exceed 0,5 mm or 5% of the panel thickness, whichever is the lower.

The test piece shall be bonded between two steel plates, rectangular in cross-section, 25 mm thick, 250 mm long and having a minimum width of 100 mm. The steel plates shall be bonded to the test piece with an adhesive sufficient to preclude a significant contribution of adhesive creep to the measured deformation. One end of each steel plate shall project 25 mm beyond the end of the test specimen as shown in Figure 7a. A rig should be used during gluing to ensure that the ends of the two steel plates remain parallel to each other.

NOTE 1 Guidance. A low-temperature-hardening, epoxy-type adhesive, which debonds when it is heated to 150°C - 200°C, has been found to be suitable.

NOTE 2 Guidance. Steel plates 2°mm to-5 mm wider than the test piece can be used to make the gluing of steel plates to the specimen easier with regard to surplus glue.

NOTE 3 Guidance. If only the planar shear strength is to be tested, the test may be carried out using thinner, disposable plates, bonded to the test pieces. These then fit into modified 25 mm thick steel test plates, which have machined recesses. This method has been found to produce unreliable measurements of deformation and should not therefore be used for the calculation of planar shear modulus.

Annex D
(informative)

Compression properties perpendicular to the plane of the panel (bearing)

D.1 Test piece

The cross-sectional dimensions of the test piece shall be 45 mm x 70 mm. The test piece shall comprise a number of layers where each layer is a complete thickness of the panel being tested. The number of layers used shall be selected so that the total height of the test piece is between 50 mm and 90 mm. The individual layers shall be bonded together to produce a composite test piece with thin, rigid glue-lines. The composite test piece shall then be machined to a square cross- section as illustrated in Figure D.1. The upper and lower bearing surfaces shall be plane and parallel. Following machining, the test pieces shall be conditioned according to Clause 6.1.

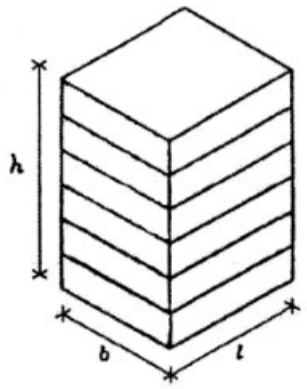


Figure D.1 – Composite glued test piece for compression test perpendicular to the plane comprising a number of identical layers

D.2 Loading equipment

The loading equipment shall be capable of measuring the load to an accuracy of 1% of the load applied to the test piece.

D.3 Loading method

The test piece shall be mounted vertically between the test machine platens ensuring that the platens extend over each of the four sides of the test piece by a distance at least equal to the width of the test piece. No initial stresses shall be induced in the test piece during its positioning in the test machine.

The test piece shall be loaded concentrically.

NOTE This can be achieved using spherically seated loading-heads.

After an initial load has been applied, the loading-heads shall be locked to prevent rotation or angular movement during the test.

D.4 Test procedure

D.4.1 Rate of application of the load

The load F shall be applied at a constant rate of cross-head movement throughout the test. The rate of loading shall be adjusted so that the maximum load $F_{c,90,\,max}$ is reached within (300 ± 120) s.

NOTE This rate should be determined from the results of preliminary tests.

D.4.2 Measurement of deformation

The deformation of the test piece between the top and bottom platens of the test machine shall be measured continuously throughout the test to an accuracy of 0,005 mm and a load-deformation curve produced.

D.5 Expression of results

D.5.1 Strength perpendicular to the plane of the panel

The compressive strength $f_{c,90}$ shall be determined from the formula:

$$f_{c,90} = \frac{F_{c,90,max}}{bl}$$

The compressive strength shall be calculated to three significant figures. The method for determining $F_{c,90,\,max}$ is illustrated in Figure D.2

The symbols are as given in Clause 4.

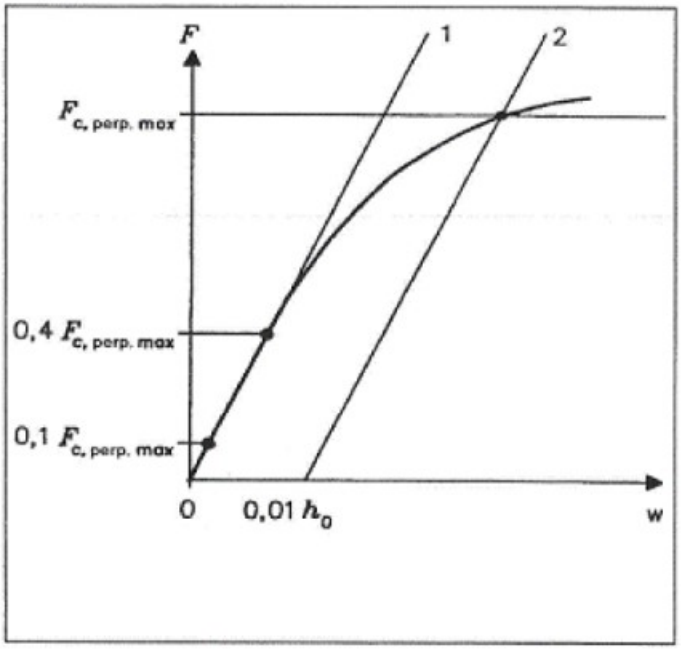


Figure D.2 – Load – deformation diagram for the compression test perpendicular to the plane of the panel

D.5.2 Compression modulus of elasticity perpendicular to the plane of the panel

Using the data obtained plot the load-deformation graph. Use that section of the graph between $0,1F_{max}$ and $0,4F_{max}$ for a linear regression analyses.

The modulus of elasticity $E_{c,90}$ shall be calculated from the formula:

$$E_{c,perp} = \frac{(F_2 - F_1)l_1}{(u_2 - u_1)bl}$$

where

F_2 - F_1 is the increment of load between $0,1F_{max}$ and $0,4F_{max}$, see Figure D.2.

u_2 - u_1 is the increment of deformation corresponding to F_2 - F_1 using the linear regression line, see Figure 3.

u_2 and u_1 are means of the deformations measured on both faces.

The modulus of elasticity shall be calculated to three significant figures.

D.6 Test report

The test report shall include the details set out in Clause 12.

Bibliography

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

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