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Wood and parquet flooring - Determination of bending properties
- Test methods

Parquets et planchers en bois - Détermination des
propriétés de flexion - Méthodes d'essai

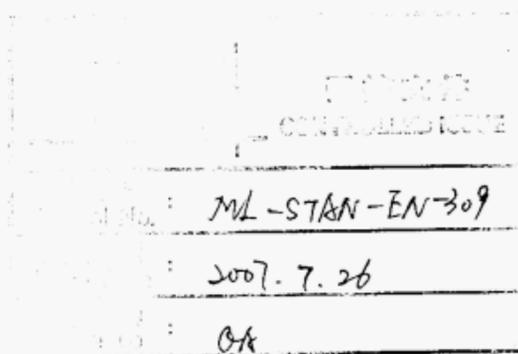
Parkett und andere Holzfußböden - Bestimmung der
Biegeeigenschaften - Prüfmethode

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Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 175, 'Round and sawn timber', the Secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2000, and conflicting national standards shall be withdrawn at the latest by September 2000.

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This standard is one of a series of standards concerning wood and parquet flooring and wood panelling and cladding.

1. Scope

This European Standard specifies two methods of determining the bending properties of wood and parquet flooring: a method with a static line load and a method with a static point load.

The methods apply to wood and parquet flooring installed on a non-continuous support and thus assuming static load-bearing conditions.

In this standard, the following properties are dealt with:

- bending stiffness,
- bending capacity,
- maximum load.

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.

prEN 13756 Wood floor covering – Terminology

3. Definitions

For the purposes of this European Standard, the definitions given in prEN 13756 apply together with the following:

3.1

bending properties of a test assembly

Various characteristics of a test assembly borne by discontinuous supports under loads applied between the supports.

3.2

test assembly

Set of wood flooring elements (including parquet) assembled according to the instructions of the manufacturer for the purpose of being tested.

3.3

element

The smallest individual part (e.g. a finger, a strip) of wood flooring (including parquet).

3.4

bending stiffness

Per unit of its width, the ratio of the variation of load upon the corresponding variation of deflection of the test assembly.

3.5**bending capacity**

Per unit of its width, the maximum moment leading to the failure of the test assembly.

3.6**maximum load**

Maximum force leading to the failure of the test assembly.

3.7**static line load**

Bending force applied to the test assembly by means of a bar whose axis is parallel to the axis of the supports.

3.8**static point load**

Bending force applied to the test assembly by means of a bar whose axis is perpendicular to the plane of the test assembly.

3.9**span**

Distance between the axes of supporting battens or joists.

4. Principle**4.1 General**

The tests are carried out on a test assembly made up with several elements jointed according to the manufacturer's instructions.

4.2 Static line load

The bending stiffness and bending capacity are determined by applying a static line load across the mid span of a test assembly. The bending stiffness is calculated from the slope of the load-deflection curve.

4.3 Static point load

The bending stiffness and maximum load of a test assembly are determined by the application of a static point load at the most vulnerable point of the test assembly.

NOTE: The present test method on static point loading is based on EN 1195.

5. Apparatus**5.1 Measuring instruments for dimensions and deflection**

For length, width and span, use a measuring instrument accurate to $\pm 0,5$ mm.

For thickness, use a measuring instrument accurate to $\pm 0,1$ mm.

For measuring deflections, use a gauge accurate to $\pm 0,1$ mm either independent or, if consistent with the above accuracy and the hardness of the materials of the test assembly, built into the loading head.

5.2 Loading equipment

5.2.1 Accuracy

It shall be able to measure the load to an accuracy of ± 1 %.

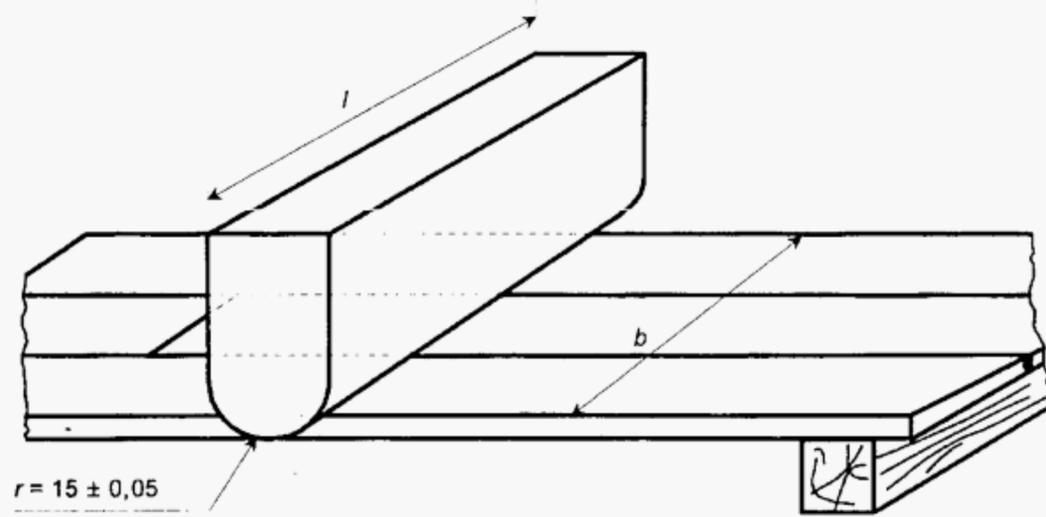
5.2.2 Static line load

The load shall be applied by a steel loading head, with a contact face rounded to a radius of $(15 \pm 0,05)$ mm, whose length l exceeds the width b of the test assembly (see figure 1a). Its axis shall be parallel to the face of the test assembly and perpendicular to the length of the elements making it up.

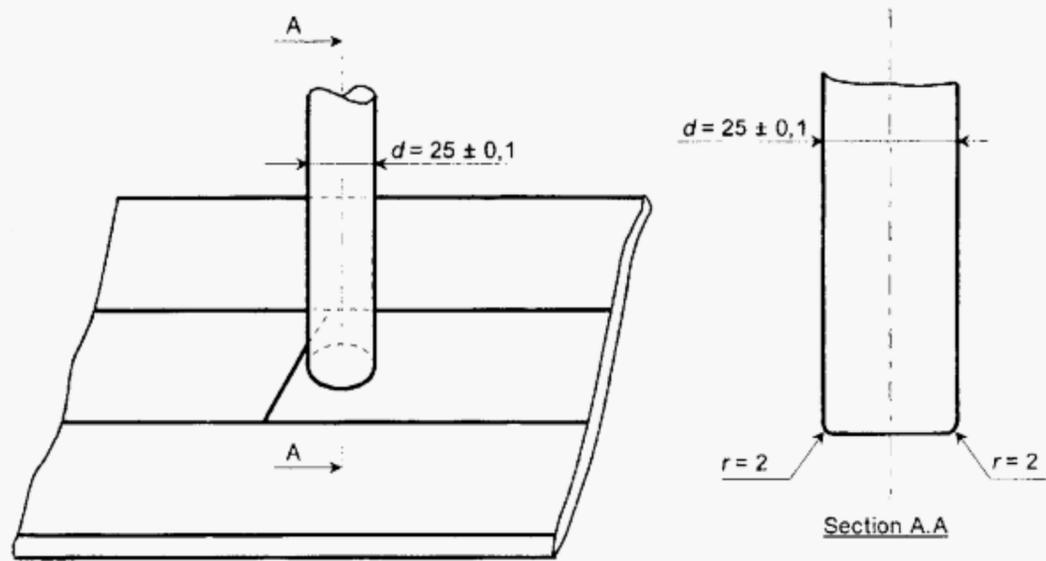
5.2.3 Static point load

The load shall be applied by a steel cylindrical loading head with a diameter of $(25 \pm 0,1)$ mm; the edge of the contact surface shall be rounded to a radius r of 2 mm (see figure 1b). Its axis shall be perpendicular to the face of the test assembly.

Dimensions in millimetres.



a) Static line loading head $l > b$



b) Static point loading head

Figure 1: Loading equipment

5.3 Support

A flat rigid table with devices, adjustable in span, to fix the battens of the test assembly (see figure 2).

The support is stiff enough if, under the load applied in the test, its deflection is less than 0,1 mm in the direction of the applied force.

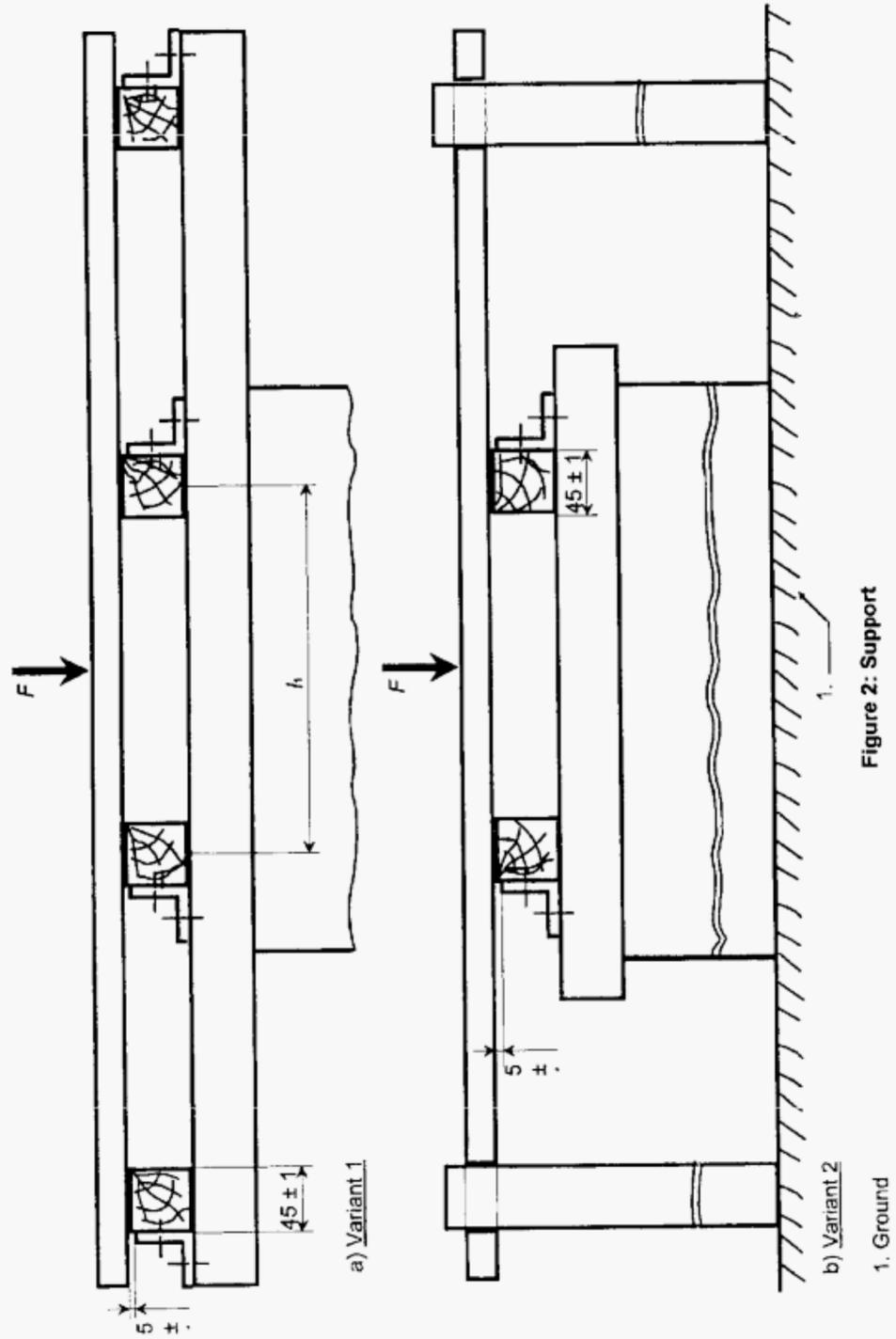
The clearance between the back of the test assembly and the support shall be consistent with the deflection under failure load. The depth of the battens or their supports shall be suitable for that purpose.

The length of the table shall be consistent with the length of the test assembly.

The end-supports can be independent of the two supports of the central span, but they shall not move relative to the central supports.

The load can be applied by movement of either the loading head or of the supporting table.

Dimensions in millimetres.



6. Test assembly

6.1 Preparation of a test assembly (see figure 3)

A set of at least four elements or a multiple thereof shall be assembled as defined below:

One element on each side of two end-jointed elements, the end joint shall be roughly in line with the centre-point of the length of the two side elements. The width b of the assembly shall be at least 290 mm measured from the centre of the load on the central element to the edges. If it is not, additional elements shall be jointed symmetrically on each side so as to reach that width.

The elements shall be fixed on at least two battens according to the manufacturer's instructions.

NOTE 1: The manufacturer's instructions can specify the span, the type of fixing, etc.

The battens shall be made of timber with a density of at least 400 kg/m³. Their width shall be (45 ± 1) mm, their depth shall be at least 45 mm and, if necessary, adjusted to the stroke of the loading head between the contact point on the test specimen and the failure point.

NOTE 2: When required as supports for a defined end-use, joists, instead of battens, can be used to make up the assembly.

The joint between the elements shall be made according to the manufacturer's instructions including:

- position of the end-joint relative to the battens,
- pattern of the joint,
- assembly operations: type of glue, application, curing time, etc.

Lengths of elements in excess of the end supports shall be cut off.

6.2 Sampling

6.2.1 General

The samples, taken at random, shall be defined for a given type of wood and parquet flooring as they are defined in the corresponding product standard.
The samples can be coated or not.

6.2.2 Static line load

The number of elements necessary to make at least six assemblies shall be sampled to make an estimate of the mean value of the bending properties.

If the determination of the characteristic value of the bending properties is required, 32 assemblies shall be sampled.

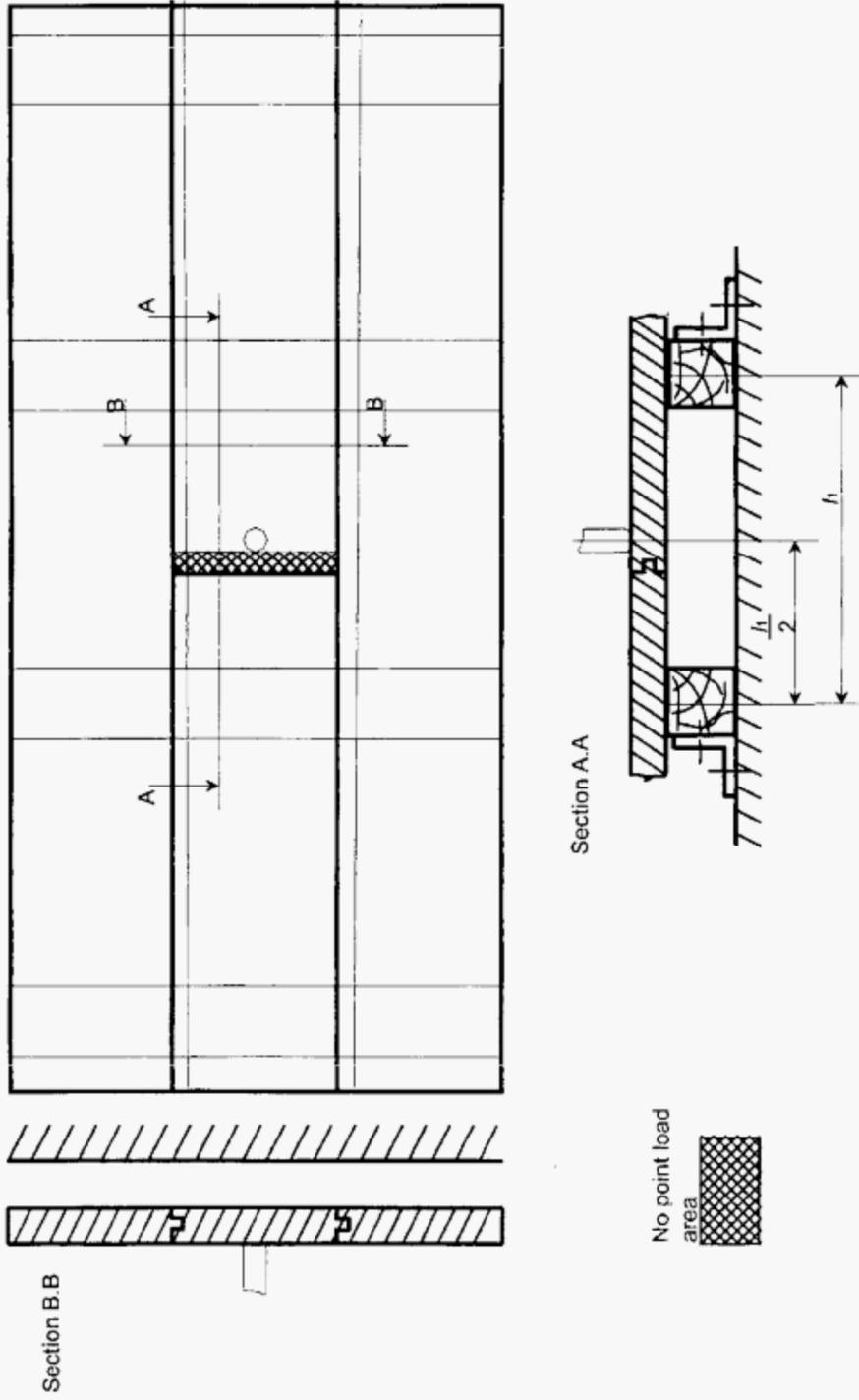


Figure 3: Test assembly

6.2.3 Static point load

6.2.3.1 Determination of the most vulnerable point

A certain number of assemblies, depending upon the design to be tested, is necessary to determine the most vulnerable point of the assembly.

NOTE: Usually, the most vulnerable point of a test assembly is a joint.

6.2.3.2 Estimation of the failure load

At least five assemblies are required.

6.2.3.3 Test

The number of elements necessary to make at least six assemblies shall be sampled to determine an estimate of the mean value of the bending properties.

If the determination of the characteristic value of the bending properties is required, 32 assemblies shall be sampled.

6.3 Conditioning

Test assemblies shall be conditioned according to the specification defined by the manufacturer at the time of delivery.

7. Procedure

7.1 General

Measure the width and thickness of each test assembly with the apparatus as defined in 5.1:

- the width at the mid-point of the central span,
- the thickness at central span on each edge of the test assembly.

7.2 Static line load

7.2.1 Placing of the test assembly

Place the test assembly flat on the supporting table, the face facing the central loading head, with its longitudinal axis at right angles to that of the supports with the centre point under the load (see figure 1a). The battens shall be properly clamped in a fixed position relative to the support.

Adjust the loading head relative to the battens in the middle of the central span to ± 1 mm along the loading line.

If not built in the loading head or if the indentation of the loading head, into the face of the test assembly, exceeds 0,1 mm, adjust the measuring gauge under the test assembly, in the axis of the loading head.

7.2.2 Determination of the bending stiffness of the test assembly

Throughout the test, the load shall be applied at a constant rate of loading head movement relative to the test assembly. The velocity of the loading head shall be (10 ± 5) mm/min.

Measure and record:

- two loads, respectively F_1 and F_2 (as shown in figure 4) at approximately 10 % and 40 % of the maximum load F_{max} , to an accuracy of 1 %,
- the corresponding deflections a_1 and a_2 in the middle of the test assembly (below the loading head) to an accuracy of 0,1 mm.

NOTE: These two pairs of readings are in the straighter portion of the load-deflection curve (see figure 4 below).

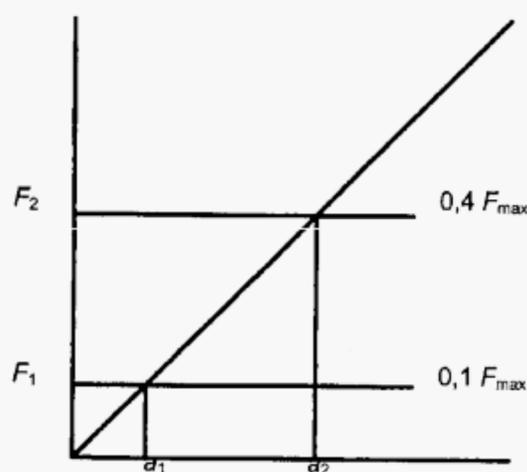


Figure 4: Load deflection curve within the range of elastic deformation

7.2.3 Determination of the maximum load for the test assembly

To determine the maximum load for the test assembly, apply a load, increasing at a rate to give a uniform movement of the loading head, until failure of the test assembly occurs. The rate shall also be such that failure should occur in (300 ± 120) s. Record the maximum load F_{max} to an accuracy of 1 %.

7.3 Static point load

7.3.1 Placing of the test assembly

Set up the test assembly on the support table of the testing machine, as described in 5.3.

The span l_1 between the axes of the battens shall be adjusted, within ± 1 mm symmetrically to the loading head, to the value defined by the manufacturer.

The test assembly shall be placed on the supporting table, with the loading head at the mid-point of the width of the test assembly.

7.3.2 Preliminary testing

7.3.2.1 Determination of the most vulnerable point

By trial and error, determine the weakest point of the test assembly, using a velocity of (10 ± 5) mm/min for the application of the load.

7.3.2.2 Estimation of the failure load $F_{\max, \text{est}}$

The velocity of the loading movement shall be such that failure of the test assembly occurs in (300 ± 120) s.

Record the maximum load as well as the time to reach it.

This operation shall be carried out on at least five assemblies.

Calculate the average estimated maximum load $F_{\max, \text{est}}$.

Calculate the average velocity required to achieve failure in the specified time.

7.3.3 Bending stiffness test

The loading procedure shall be as shown in figure 5.

- Increase the value of $F/F_{\max, \text{est}}$ to 0,1 giving point 01 on the load/time and load/deflection diagrams in figure 5,
- then to 0,4 giving point 04,
- maintain this load (point 14),
- decrease from 0,4 (point 14) to 0,1 (point 11),
- maintain this load,
- then increase again from 0,1 (point 21) to 0,4 (point 24),
- decrease from 0,4 to 0.

Measure the deflection, relative to the supporting battens, at points 01, 04, 21 and 24, using one of the following methods:

- a) if the indentation on the face of the test assembly is less than 0,1 mm at 40 % of $F_{\max, \text{est}}$, the deflection can be measured by means of a gauge built in the loading head or
- b) on the underside of the test assembly, by means of a transducer placed in the centre of the load.

The second diagram in figure 5 shows the load as a fraction of the estimated maximum load, $F/F_{\max, \text{est}}$, plotted against deflection. Bending stiffness is the slope of the line between the values 0,1 and 0,4 for $F/F_{\max, \text{est}}$.

The load shall be increased or decreased at a rate such that the range of fraction $F/F_{\max, \text{est}}$ from 01 to 04 is reached in (60 ± 15) s.

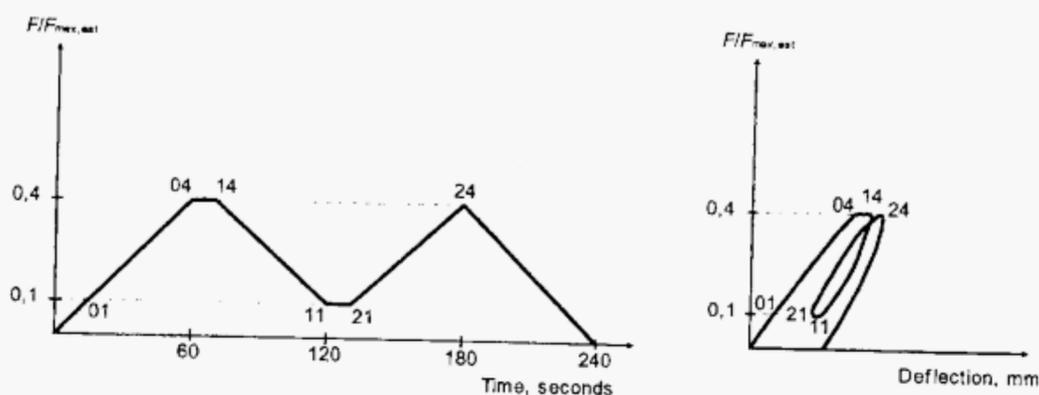


Figure 5: Loading procedure for bending stiffness test

7.3.4 Bending strength test

The load shall be applied at a rate such that a constant rate of deflection takes place and at a rate such that failure occurs in (300 ± 120) s. The method of carrying out the test shall be as in 7.3.2.2.

8. Expression of the results for a test assembly

8.1 Thickness

The thickness of the test assembly is the average of the measurement of the thickness of the test assembly as defined in 7.2.

8.2 Static line load

8.2.1 Bending stiffness per unit of width

The bending stiffness per meter of each test assembly is calculated from the formula:

$$St_1 = \frac{F_4 - F_1}{(a_4 - a_1)b} \quad (1)$$

where:

- St_1 is the bending stiffness per unit of width, in newtons per millimetre;
- b is the width of the test assembly, in metres;
- F_1 is the load at about 10 % of the maximum load, in newtons;
- F_4 is the load at about 40 % of the maximum load, in newtons;
- a_1 is the deflection corresponding to the load F_1 , in millimetres;
- a_4 is the deflection corresponding to the load F_4 , in millimetres.

The bending stiffness of each test assembly shall be expressed to three significant figures.

8.2.2 Bending capacity per unit of width

The bending capacity per meter of each test assembly is calculated from the formula:

$$M_n = \frac{F_{\max} \times l_1}{b} \quad (2)$$

where:

- M_n is the bending capacity per unit of width, in newton metres;
- F_{\max} is the maximum load, in newtons;
- b is the width of the test assembly, in metres;
- l_1 is the distance between the axes of the battens of the central span, in metres.

The bending capacity of each test assembly shall be expressed to three significant figures.

8.3 Static point load

8.3.1 Deflection

The deflection w_m of the weakest point of the test assembly, at $0,4 F_{\max, \text{est}}$ is the average of the two loadings defined in the procedure:

$$w_m = \frac{4}{3} \times \frac{(w_{04} - w_{01}) + (w_{24} - w_{21})}{2} \quad (3)$$

where:

w_{01} , w_{04} , w_{21} , w_{24} are the deflections measured at the points 01, 04, 21, 24 in figure 5, in millimetres.

8.3.2 Bending stiffness

The bending stiffness of the weakest point of each test assembly is given by the second loading as defined in the procedure:

$$R = \frac{F_{24} - F_{21}}{w_{24} - w_{21}} \quad (4)$$

where:

F_{21} , F_{24} are the loads applied at the points 21, 24 in figure 5, in newtons;

R is the bending stiffness of the weakest point of a test assembly, in newtons per millimetre.

8.3.3 Load

Record the maximum load F_{max} of the weakest point as well as the mode of failure of the test assembly.

9. Expression of the results for a sample

9.1 Common statistical methods

A normal distribution is assumed.

9.1.1 Mean value

$$m = \frac{\sum_{i=1}^n P_i}{n} \quad (5)$$

where:

m is the mean value of the performance of the sample;
 P_i is the performance of "ith" test assembly;
 n is the number of test assemblies in the sample.

9.1.2 Standard deviation

$$s = \left[\frac{\sum_{i=1}^n (P_i - m)^2}{n - 1} \right]^{1/2} \quad (6)$$

where:

s is the standard deviation.

All the other parameters are defined in 9.1.1.

9.1.3 Estimates of the mean

$$m_{est} = m + (\alpha \times t_{05} \times \frac{s}{n^{1/2}}) \quad (7)$$

where:

m_{est} is the estimate of the mean;
 α is the coefficient equal to: + 1 for an upper estimate
 - 1 for a lower estimate;
 t_{05} is the Student coefficient for a one sided 5 % liability.

All the other parameters are defined in 9.1.1 and 9.1.2.

Table 1 gives the Student coefficient for a range of values of n .

9.1.4 Characteristic values

Depending of the property, the characteristic values are either the 5th percentile or the 95th percentile of the assumed normal distribution.

A characteristic value is given by the following formula:

$$X_k = m + (\alpha \times t_{05} \times s) \tag{8}$$

where:

- X_k is the characteristic value
- α is the coefficient equal to: + 1 for the 95th percentile
- 1 for the 5th percentile.

All the other parameters are defined in 9.1.1, 9.1.2 and 9.1.3.

Table 1: Student coefficient for a range of values of n

Number of test assemblies n	Student coefficient t_{05}
6	2,02
7	1,94
8	1,90
9	1,86
10	1,83
11	1,81
12	1,80
13	1,78
14	1,77
15	1,76
16	1,75
17	1,75
18	1,74
19	1,73
20	1,73
21	1,72
22	1,72
23	1,72
24	1,71
25	1,71
26	1,71
27	1,71
28	1,70
29	1,70
30	1,70
40	1,68
60	1,67
120	1,66
∞	1,645

9.2 Static line load

The values shall be expressed to three significant figures.

The lower estimate shall be calculated in accordance with 9.1.3.

If required, the characteristic values shall be calculated in accordance with 9.1.4 (5th percentile value both for bending stiffness and bending strength).

9.3 Static point load

The lower estimate of the mean shall be calculated according to 9.1.3 for bending stiffness and maximum load.

The upper estimate of the mean shall be calculated according to 9.1.3 for deformation.

The additional test assemblies tested to determine the estimate of the maximum load shall be used to calculate this result if they do not deviate by more than 20 % of the mean value obtained in the test.

If required, the characteristic deformation, bending stiffness and bending strength shall be calculated according to 9.1.4:

- 95th percentile for deformation,
- 5th percentile for bending stiffness and maximum load.

All the values shall be expressed to three significant figures.

10. Test report

The test report shall contain the following information:

- the name and address of the laboratory,
- the name and address of the company requesting the test,
- the sampling procedure and the identification of the sample,
- the date of delivery,
- the date of period of the test(s),
- the type (the brand if any) and the full description of the elements (e.g.: lay-up, face appearance), face view and cross sections at scale 1/1,
- if relevant, the characteristics of elements at the time of delivery
- the conditioning applied to the elements prior to their assembly and testing,
- the description of the assembly,
- the description of the jointing procedure to achieve that assembly,

- the climatic conditions within the laboratory during the test(s),
- the reference to this test method and, if any, the deviations,
- a short description of the apparatus involved in the test,
- the span between the battens (or joists),
- the width of the test assembly,
- for each tested property, each individual result according to this test method, including the mode of failure,
- the evaluation of the results (estimate of the mean and, if required, characteristic value of each tested property).

Annex A
(informative)
Bibliography

EN 1195 Timber structures - Test methods -
Performance of structural floor decking

BS EN
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