# SLOVENSKI STANDARD
# SIST EN 1521:2001

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**Določ evanje upogibne trdnosti betona iz lahkega agregata z odprto strukturo**

Determination of flexural strength of lightweight aggregate concrete with open structure

Bestimmung der Biegezugfestigkeit von haufwerksporigem Leichtbeton

Détermination de la résistance a la flexion du béton de granulats légers a structure ouverte



**Ta slovenski standard je istoveten z:** **EN 1521:1996**



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English version

# Determination of flexural strength of lightweight aggregate concrete with open structure

Détermination de la résistance à la flexion du béton de granulats légers à structure ouverte

Bestimmung der Biegezugfestigkeit von haufwerksporigem Leichtbeton



This European Standard was approved by CEN on 1996-10-19. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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**CEN**

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

## Contents





## Foreword

This European Standard has been prepared by Technical Committee CEN/TC 177 "Prefabricated reinforced components of autoclaved aerated concrete or light-weight aggregate concrete with open structure", 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of an identical text or by endorsement, at the latest by May 1997, and conflicting national standards shall be withdrawn at the latest by May 1997.

**In order to meet the performance requirements as laid down in the product standard for prefabricated components of lightweight aggregate concrete with open structure, a number of standardized test methods are necessary.**

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

## 1 Scope

This European Standard specifies a method of determining the flexural (tensile) strength of lightweight aggregate concrete with open structure (LAC) according to prEN 1520 by means of prismatic test specimens taken from prefabricated components.

## 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.

EN 992 Determination of dry density of lightweight aggregate concrete with open structure

prEN 1520 Prefabricated components of lightweight aggregate concrete with open structure

## 3 Principle

The flexural strength is determined by applying a uniform bending moment in the middle third of the span of a simply supported prismatic test specimen by means of two-point loading. The maximum load sustained is recorded, and the flexural strength is calculated.



## 4 Apparatus

a) any saw suitable for wet cutting reinforced LAC components;

b) calipers, capable of reading the dimensions of test specimens to an accuracy of 0,1 mm;

c) a straight-edge with a length of approximately 450 mm, feeler gauges (0,2 mm, 0,5 mm, 1,0 mm, and 3 mm) and a square, for checking the planeness and the squareness of test specimens;

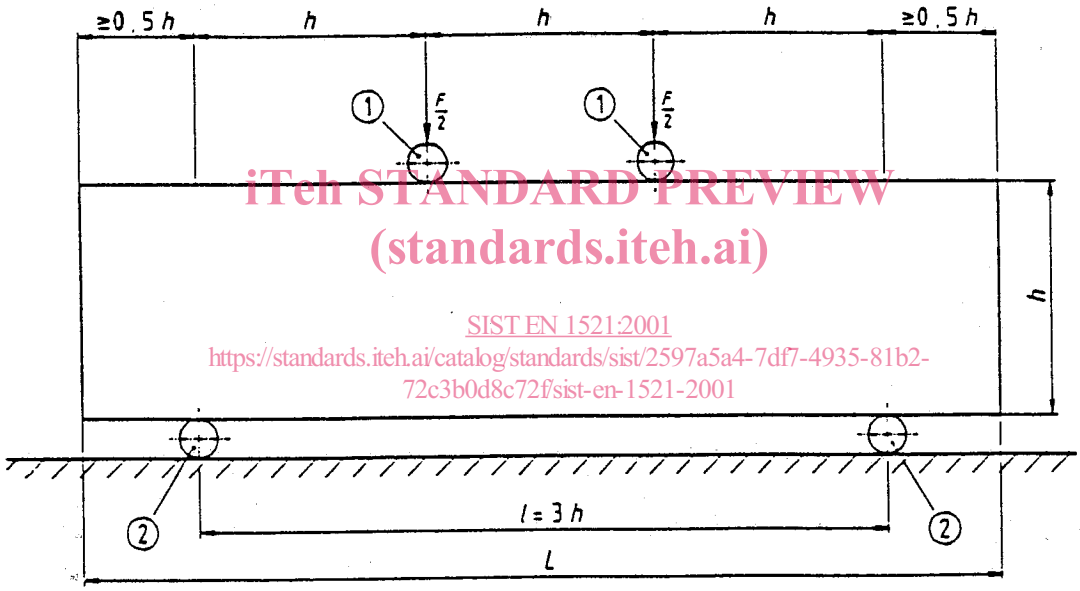
d) a balance, capable of determining the mass of test specimens to an accuracy of 0,1 %;

e) a testing machine capable of applying a vertical compressive load at the required uniform rate without shock or interruption. The precision of the machine and the load indication shall be such that the ultimate load can be determined with an accuracy of ± 2 %. The measuring range shall be such that the ultimate load is higher than one tenth of the range used.

f) a loading device according to figure 1, for transmitting the load of the testing machine to the test specimen.

The device for applying the loads shall consist of two supporting rollers and two loading rollers. The rollers shall be manufactured from steel and shall have a circular cross-section with a diameter between 15 mm and 40 mm; they shall be at least 10 mm longer than the width of the test specimen. The axes of all rollers shall be parallel to each other. Each roller, except one of the supporting ones, shall be capable of rotating around its longitudinal axis and of being inclined in a plane normal to the longitudinal axis of the test specimen. After correct centring in the testing machine, the axes of the hinges of the three inclinable rollers shall be situated on a vertical plane which shall not deviate by more than ± 1 mm from the axis of the compression force of the testing machine.

The middle axis between the loading rollers or the supporting rollers, respectively, shall not deviate from the axis of the testing machine (axis of the vertical compression force) by more than ± 1 mm.






1 Loading rollers (capable of rotation and of being inclined independently of each other)
2 Supporting rollers (one fixed and the other capable of rotation and of being inclined)

**Figure 1: Loading arrangement**

The centre distance, *l*, between the the supporting rollers (i.e. the span length) shall be equal to 3*h*, where *h* is the nominal height of the test specimen (normally 100 mm).

The loading rollers shall be equally spaced between the supporting rollers as shown in figure 1.

All rollers shall be adjusted in their correct position with all distances having an accuracy of ± 1 mm.

g) a room or cabinet, capable of maintaining a temperature of (20 ± 5) °C, for storage of the test specimens;

h) a ventilated drying oven, capable of maintaining temperatures of (45 ± 5) °C and (105 ± 5) °C;

j) a water storage tank, for conditioning of test specimens. Provision of automatic control of water temperature to (20 ± 5) °C shall be made where the tank is located in a room not having temperature controlled within that range.

## 5 Test specimens

### 5.1 Sample

The sample for the preparation of the test specimens (usually a prefabricated reinforced component) shall be taken in such a manner that it is representative of the product to be investigated.

### 5.2 Shape and size of test specimens

The reference test specimens shall be prisms, cut from prefabricated components, with a height $h$ = 100 mm, a width $b$ = 100 mm, and a length of $L$ = 400 mm.

Test specimens of other sizes may be used, provided that the flexural strength determined on such test specimens can be directly related to the flexural strength determined on prisms 100 mm x 100 mm x 400 mm.



### 5.3 Number of test specimens

A test set shall consist of three test specimens.



### 5.4 Preparation of test specimens

The test specimens shall be taken from the central area near the longitudinal axis of the component in such a way that their longitudinal axis is parallel to the longitudinal axis of the component and that one of the longitudinal surfaces coincides with that surface of the component, where the maximum flexural stresses are expected to occur under service conditions.

The test specimens shall be cut from the component at an age of 2 d if possible. They shall contain no reinforcing bars. The surfaces of the test specimens shall be plane and perpendicular to each other.

The planeness of the surfaces shall be checked along both of their diagonals and along the lines where the loading forces and the support reactions will be applied, by means of a straight-edge and, if necessary, by means of feeler gauges. Deviations by more than 3,0 mm along the diagonals and by more than 0,2 mm along the lines where the loading forces and the support reactions will be applied shall be corrected by grinding or cutting.

The angle between adjacent longitudinal faces of the test specimens shall also be checked, using a square and, if necessary, a 1 mm feeler gauge. Deviations from squareness by more than 1 mm per 100 mm (≈ 0,6°) shall be corrected by grinding or cutting.

Alternatively, if the surfaces in contact with the loading rollers or support rollers depart from a plane by not more than 0,5 mm, rubber or leather strips may be used as a load distributing intermediate layer between the rollers and the bearing surfaces, instead of grinding these areas.

The rubber or leather strips shall be of uniform thickness (approximately 5 mm), 25 mm in width, and shall extend over the full width of the test specimen.

### 5.5 Examination of test specimens and determination of their dimensions and volume

The test specimens shall be examined visually, and any abnormalities shall be reported.

The dimensions of the test specimens shall be measured to an accuracy of 0,1 mm, using calipers. Measurements may be taken before or after conditioning according to 5.6.

The width $b$ and the height $h$ shall be measured at both ends ($b_1$ and $b_3$ or $h_1$ and $h_3$, respectively) and at midspan ($b_2$ or $h_2$, respectively), each value being the mean value of a total of two individual measurements, taken at two opposite longitudinal faces.

The total length $L$ shall be measured along the middle axes of two opposite longitudinal surfaces.



The volume $V$ of the individual test specimens shall be calculated by multiplying the arithmetic mean value of length measurements by the geometric mean value of width measurements $(b_1 + 2b_2 + b_3)/4$ and the geometric mean value of height measurements $(h_1 + 2h_2 + h_3)/4$.



### 5.6 Conditioning of test specimens

After cutting, the test specimens shall be allowed to dry for (1 ± 0,5) h in air with the temperature of (20 ± 5)°C. Immediately afterwards they shall be sealed in vapour proof sealing and cured for 14 d at the above temperature. After this curing period the sealing shall be removed, and the test specimens shall be stored in a ventilated drying oven at a temperature of (45 ± 5)°C until constant mass is attained. The mass of the test specimens is considered constant if after 24 h of further drying it has not changed by more than 0,2 %.

Directly after removal from the drying oven, the test specimens shall be immersed in water of drinking water quality at (20 ± 5)°C for a period of 7 d.

Then the test specimens shall be allowed to drip dry for (1 ± 0,5) h before determination of the flexural strength.

Immediately before testing, the moist mass $m_{hum}$ of the test specimens shall be determined to an accuracy of 0,1 %.

NOTE: The purpose of the drying and wetting procedure specified in this clause is simulation of unfavourable conditions with respect to flexural strength due to possible shrinkage cracking and strength reduction due to water saturation.

## 6 Testing procedure

### 6.1 Flexural test

All testing machine bearing surfaces shall be wiped clean and any loose material shall be removed from the surfaces of the test specimen that will be in contact with the rollers.

The loading device shall be correctly centred in the compression testing machine (see 4f)).

The test specimen shall be placed on the support rollers of the loading device in the testing machine, correctly centred and aligned perpendicular to the rollers and supported on the surface corresponding to the surface of the component from which the test specimen has been taken and where the maximum tensile stresses are expected to occur in the component when in use.

The longitudinal axis of the test specimen shall not deviate by more than ± 1 mm from the (theoretical) plane of the hinges of the inclinable rollers (see 4f)).



The load shall not be applied before all loading and supporting rollers are resting evenly against the test specimen.



Subsequently, the load may be applied rapidly, but without shock, up to approximately 50 % of the anticipated breaking load. Thereafter, without stopping, the load shall be increased continuously until rupture occurs, at an uniform rate which constantly increases the stress in the extreme fibres at approximately 0,02 N/mm² per s, when calculated in accordance with clause 7 (see note).

When using a manually controlled testing machine, any tendency for the selected rate of loading to decrease, as test specimen failure is approached, shall be corrected by appropriate adjustment of the controls.

When using an automatically controlled testing machine, the rate of loading shall be periodically checked to ensure that the rate is constant and at the required level.

The maximum load indicated shall be recorded.

NOTE: The required loading rate of the testing machine for test specimens with square cross-section is given by equation (1):

$$R = s\ h^2/3 \qquad \ldots(1)$$