



**SLOVENSKI STANDARD**  
**oSIST prEN 13863-5:2022**

**01-marec-2022**

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**Betonska vozišča - 5. del: Določanje sprijemne napetosti moznikov v betonskih voziščnih konstrukcijah**

Concrete pavements - Part 5: Determination of the bond stress of dowels to be used in concrete pavements

Fahrbahnbefestigungen aus Beton - Teil 5: Bestimmung der Bindungsspannung von Dübeln für Fahrbahnbefestigungen aus Beton

Chaussées en béton - Partie 5 : Détermination de la contrainte d'adhérence de goujons à utiliser dans les chaussées en béton

**Ta slovenski standard je istoveten z: prEN 13863-5**

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**ICS:**

91.100.30	Beton in betonski izdelki	Concrete and concrete products
93.080.20	Materiali za gradnjo cest	Road construction materials

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

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**prEN 13863-5**

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## Concrete pavements - Part 5: Determination of the bond stress of dowels to be used in concrete pavements

Chaussées en béton - Partie 5 : Détermination de la contrainte d'adhérence de goujons à utiliser dans les chaussées en béton

Fahrbahnbefestigungen aus Beton - Teil 5: Bestimmung der Bindungsspannung von Dübeln für Fahrbahnbefestigungen aus Beton

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 227.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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## European foreword

This document (prEN 13863-5:2022) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

EN 13863, *Concrete pavements*, is currently composed with the following parts:

- *Part 1: Test method for the determination of the thickness of a concrete pavement by survey method*
- *Part 2: Test method for the determination of the bond between two layers*
- *Part 3: Test methods for the determination of the thickness of a concrete pavement from cores*
- *Part 4: Test methods for the determination of wear resistance of concrete pavements to studded tyres*
- *Part 5: Determination of the bond stress of dowels to be used in concrete pavements<sup>1)</sup>*
- *Part 6: Test method for the determination of the tensile strength of concrete on cylindrical discs<sup>2)</sup>*

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<sup>1)</sup> Document under preparation.

<sup>2)</sup> Document under preparation.

**prEN 13863-5:2022 (E)****1 Scope**

This document specifies a method for the determination of the bond stress of dowels in concrete pavements.

**2 Normative references**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

EN 206, *Concrete — Specification, performance, production and conformity*

EN 12390-2, *Testing hardened concrete — Part 2: Making and curing specimens for strength tests*

EN 12390-4, *Testing hardened concrete — Part 4: Compressive strength — Specification for testing machines*

**3 Terms, definitions and symbols**

For the purposes of this document, the following terms, definitions and symbols apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

**3.1 Terms and definitions****3.1.1 bond stress**

stress generated in the contact area between the dowel and the concrete by the restrained movement due to the bond

**3.1.2 coating thickness**

thickness of the coating material of the dowel

**3.1.3 pull-out force**

force, which works on the dowel during the pull-out test

**3.1.4 pull-out distance**

distance, over which the dowel moves during the pull-out test

**3.2 Symbols****Table 1 — Symbols**

Symbol	Signification	Dimension
$X_i$	Individual value of X	

$X_m$	Arithmetic average value of X	
$d$	Diameter of the coated dowel	mm
$l$	Length of the concrete specimen	mm
$l_d$	Length of the dowel	mm
$l_{d,c}$	Length of the part of the dowel embedded in concrete	
$l_{d,r}$	Length of the part of the dowel not embedded in concrete	
$F_{P,n}$	Pull-out force at a displacement of 0,25 mm in the $n^{\text{th}}$ cycle	kN
$f_{d,P,n}$	Bond stress in the $n^{\text{th}}$ cycle	MPa
$w$	Width of the concrete specimen	mm
$h$	Height of the concrete specimen	mm

## 4 Principle

The dowels are cast in a block of concrete. After 24 h they are pulled out of the concrete four times over a defined distance and pushed in again. The fifth time they are completely pulled out of the concrete. The pull-out force and the geometry of the dowel are used to calculate the bond stress.

## 5 Apparatus

### 5.1 Apparatus for production of the test specimens

**5.1.1 Prismatic mould** with the following dimensions (see Annex A):

- $l = 200$  mm;
- $w = 200$  mm;
- $h =$  at least 50 mm higher than half the nominal length of the dowel.

**5.1.2 Caliper** with an accuracy of 0,1 mm.

**5.1.3 Ruler** with an accuracy of 1,0 mm

**5.1.4 Dial gauge** with an accuracy of 0,02 mm.

**5.1.5 Climate chamber** set to  $(20 \pm 2) ^\circ\text{C}$  and  $(65 \pm 5) \%$  relative humidity.

### 5.2 Load equipment

**5.2.1 Testing machine**, class 1 according to EN 12390-4 with a maximum load of at least 100 kN and force-controlled load increase at least up to 0,4 kN/s and displacement rate of at least 0,05 mm/s. The travel shall be at least half of the length of the dowel.

## 6 Test specimen

### 6.1 Dowels

Ten dowels shall be randomly selected out of the production to be controlled.

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### 6.2 Concrete

The concrete to be used to produce the test specimen shall comply with EN 206 and shall have an average compressive strength, according to EN 12390-3, between 40,0 MPa and 60,0 MPa at 28 d. The cubes shall be 150 mm × 150 mm × 150 mm and shall be produced and stored according to EN 12390-2.

The maximum nominal upper aggregate size shall be between 20 mm and 31,5 mm inclusive. CEM I cement, according to EN 197-1, shall be used. Air entrainers and retarding agents shall not be added to the concrete.

NOTE The concrete strength corresponds to C30/37 or C35/45.

### 6.3 Test specimen

The pull-out test shall be executed on 3 dowels, randomly selected out of the 10 dowels (6.1). Each chosen dowel for the pull-out test shall be cast centrally and vertically in a concrete block, with a size of  $l \times w \times h$  (see 5.1.1 and Annex A), covering up to half length of the dowel ( $\pm 5$  mm) by concrete. The dowel has to be fixed in order to prevent any movement of the dowel in the fresh concrete.

The test specimen shall be stored in a climatic chamber set to  $(20 \pm 2)$  °C and  $(65 \pm 5)$  % relative humidity until testing.

## 7 Procedure

### 7.1 Dimensions of the dowels

The diameter, including the coating of all 10 dowels shall be determined with a caliper in the centre of the bar and 10 mm away from the end surfaces. The arithmetic average of the diameter,  $d_m$ , shall be calculated from all 30 measurements.

The length of all 10 dowels shall be determined with a ruler. The arithmetic average of the length  $l_{d,m}$  shall be calculated.

### 7.2 Determination of the bond stress

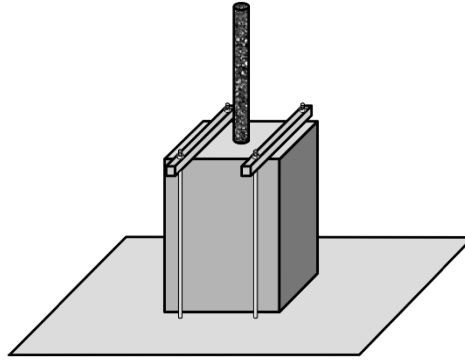
The bond stress shall be determined on 3 test specimens according to 6.3 ( $24 \pm 1$ ) h after casting.

The remaining length of the dowel  $l_{d,ri}$  shall be measured with a ruler. If the remaining length differs more than 10 mm from half of the nominal length of the dowel the test specimen is to be rejected and a new test specimen has to be prepared.

The test specimen has to be fixed in the test frame in order to keep the specimen in place during testing. The temperature during the test shall be  $(20 \pm 5)$  °C.

The test specimen (cube with embedded dowel) has to be braced on the table of the test rig with the side with the embedded dowel on top (see Figure 1).





**Figure 1 — Example of test rig with braced test specimen**

The tensile load shall be applied in the axle of the dowel with a non-slip traction.

The force shall be applied with a loading rate of  $13 \pm 3$  kN/min ( $0,22 \pm 0,05$ ) kN/s up to the static friction and ongoing up with a rate of  $2 \pm 0,5$  mm/min ( $0,03 \pm 0,01$  mm/s) to a maximum pull-out distance of  $(5 \pm 0,1)$  mm controlled by the load equipment. The force-displacement diagram shall be recorded. The displacement corresponds to the pull-out distance and shall be measured with a dial gauge. The applied pull-out force  $F_{P,i,n}$  at a displacement of 0,25 mm shall be recorded.

The dowel shall be pushed back into the concrete block with a rate of  $(0,5 \pm 0,2)$  mm/s to its primary position.

This procedure shall be done four times on the same dowel.

Afterwards with equal loading rate the dowel shall be completely pulled out of the concrete block. Any damage, like abrasion or delamination, to the coating of the embedded part of the dowel in the concrete cube, shall be recorded.

## 8 Calculation and presentation of the test result

### 8.1 Test result

With the average of the recorded maximum applied force the bond stress is calculated for each specimen as follows:

$$l_{d,ci} = l_{d,m} - l_{d,ri} \quad , \text{ in mm}$$

$$f_{d,Pi} = \frac{F_{P,i}}{\pi \times d_m \times l_{d,ci}} \quad , \text{ in MPa}$$

The individual bond stress  $f_{d,Pi}$  shall be calculated to the nearest 0,01 MPa.

The test result  $f_{d,Pm}$  is the arithmetic average of the three individual bond stresses  $f_{d,Pi}$ , calculated to the nearest 0,01 MPa.

### 8.2 Precision

The precision for this test method has not been determined.

## 9 Report

The test report shall contain at least the following information:

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- a) identification of the client, manufacturer and date of fabrication, if known;
- b) reference to the standard EN 13863-5;
- c) identification of the dowels ( $l_{di}$ ,  $d_i$ ) (see Annex B);
- d) type of concrete used (compressive strength at 28 d);
- e) date of test specimen preparation;
- f) age of specimen at testing (in h);
- g) dimensions of test specimens (nominal  $l_i$ ,  $w_i$ ,  $h_i$ ,  $l_{d,ri}$  and  $l_{d,ci}$ );
- h) force-displacement diagram for the first and last loading for every test specimen;
- i) the pull-out force  $F_{Pi,1}$  and  $F_{Pi,5}$  for every test specimen;
- j) any damage to the coating such as abrasion or delamination;
- k) individual  $f_{d,Pi,1}$ ,  $f_{d,Pi,5}$  and average bond stress  $f_{d,Pm,1}$  and  $f_{d,Pm,5}$ .

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