SLOVENSKI STANDARD
SIST EN 14146:2004

01-september-2004

Preskuġanje naravnega kamna ï Ugotavljanje dinamiļ nega modula elastiļ nosti (z meritvijo osnovne resonanļ ne frekvence)

Natural stone test methods - Determination of the dynamic modulus of elasticity (by measuring the fundamental resonance frequency)

Prüfverfahren für Naturstein - Bestimmung des dynamischen - Elastizitätsmoduls (durch Messung der Resonanzfrequenz der Grundschwingung)

Méthodes d'essai pour pierres naturelles - Détermination du module d'élasticité dynamique (par la mesure de la fréquence de résonance fondamentale)

Ta slovenski standard je istoveten z: **EN 14146:2004**

ICS:

73.020	Rudarstvo in kamnolomsko izkopavanje	Mining and quarrying
91.100.15	Mineralni materiali in izdelki	Mineral materials and products

SIST EN 14146:2004 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14146

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ICS 73.020; 91.100.15

English version

Natural stone test methods - Determination of the dynamic modulus of elasticity (by measuring the fundamental resonance frequency)

Méthodes d'essai pour pierres naturelles - Détermination du module d'élasticité dynamique (par la mesure de la fréquence de résonance fondamentale)

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This European Standard was approved by CEN on 16 January 2004.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
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Contents

page

Foreword

This document (EN 14146:2004) has been prepared by Technical Committee CEN /TC 246, "Natural stones", the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by October 2004, and conflicting national standards shall be withdrawn at the latest by October 2004.

This draft standard is one of the series of draft standards for tests on natural stone.

Test methods for natural stone consist of the following:

EN 1925, *Natural stone test methods – Determination of water absorption coefficient by capillarity*

EN 1926, *Natural stone test methods – Determination of compressive strength*

EN 1936, *Natural stone test methods – Determination of real density and apparent density and of total and open porosity*

EN 12370, *Natural stone test methods – Determination of resistance to salt crystallisation*

EN 12371, *Natural stone test methods – Determination of frost resistance*

EN 12372, *Natural stone test methods – Determination of flexural strength under concentrated load*

EN 12407, *Natural stone test methods – Petrographic examination*

EN 13161, *Natural stone test methods – Determination of flexural strength under constant moment*

EN 13373, *Natural stone test methods – Determination of geometric characteristics on units*

EN 13755, *Natural stone test methods – Determination of water absorption at atmospheric pressure*

EN 13919, *Natural stone test methods – Determination of resistance to ageing by SO_2 action in the presence of humidity*

EN 14066, *Natural stone test methods – Determination of resistance to ageing by thermal shock*

EN 14147, *Natural stone test methods – Determination of resistance to ageing by salt mist*

prEN 14157, *Natural stone test methods – Determination of the abrasion resistance*

EN 14158, *Natural stone test methods – Determination of rupture energy*

EN 14231, *Natural stone test methods – Determination of the slip resistance by means of the pendulum tester*

prEN 14579, *Natural stone test methods – Determination of sound speed propagation*

prEN 14580, *Natural stone test methods – Determination of the static elastic modulus*

prEN 14581, *Natural stone test methods – Determination of thermal expansion coefficient*

No existing European Standard is superseded.

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

1 Scope

This European Standard defines methods to determine the fundamental resonance frequency of natural stone and the calculation of the dynamic modulus of elasticity.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative reference 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 13373, *Natural stone test methods – Determination of geometric characteristics on units*

3 Principle

The present standard defines methods to determine the fundamental resonance frequency and to calculate the dynamic modulus of elasticity.

There are two methods for measuring fundamental resonance, depending on which method is used to vibrate the specimen under analysis. One method is based on continuous excitation, the other is based on instantaneous excitation. Both methods consist of making a specimen of stone vibrate using either longitudinal, flexural or torsional vibrations, and then determining the corresponding fundamental resonance frequency.

4 Symbols

b	width of a prismatic specimen in millimetres
d	diameter of a cylindrical specimen in millimetres
h	height of prismatic specimen in millimetres
ℓ	length of specimen in millimetres
F_L	longitudinal fundamental resonance frequency in Hertz
F_F	flexural fundamental resonance frequency in Hertz
F_T	torsional fundamental resonance frequency in Hertz
F_1 and F_2	frequency for amplitudes equal to $\pm\sqrt{2}/2$ of the maximum amplitude
ρ	apparent density of the specimen in kg m^{-3}
i	radius of giration of the section of the specimen $i = \sqrt{\frac{I}{A}}$ in mm
A	surface area of the cross section of the specimen
I	moment of inertia of the specimen

$I = \frac{bh^3}{12}$ for prismatic specimens with a rectangular base

$I = \frac{b^4}{12}$ for prismatic specimens with a square base

$I = \frac{\Pi d^4}{64}$ for cylindrical specimens

v	Poisson coefficient
T	correction coefficient for calculating Ed_L
C	correction coefficient for calculating Ed_F
R	correction coefficient for calculating Ed_T
Ed_L	longitudinal dynamic modulus of elasticity in MPa, determined from the longitudinal fundamental resonance frequency
Ed_F	flexural dynamic modulus of elasticity in MPa, determined from the flexural fundamental resonance frequency
Ed_T	torsional dynamic modulus of elasticity in MPa, determined from the torsional fundamental resonance frequency
s	standard deviation

5 Apparatus

5.1 Continuous excitation mode

The apparatus comprises:

5.1.1 a variable frequency generator, with a frequency range of min. 20kHz,

5.1.2 an emitting transducer and a receiving transducer that must be brought into contact with the specimen. It is recommended to generate slight adhesion to the test specimen using a bonding product (rubber, putty, etc.). The natural resonance frequency of the transducer must be at least twice the presumed fundamental resonance frequency of the specimen.

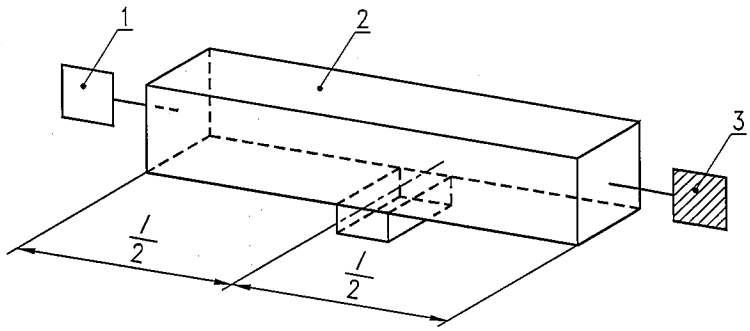
5.1.3 a device that is used to record or indicate the beginning of specimen resonance,

5.1.4 a system that measures or calculates the specimen's fundamental resonance frequency with an accuracy better than or equal to 0,5%,

5.1.5 a work surface isolated from external vibrations, with the possibility to make measurements

5.1.6 specimen stands made of rigid metal whose length is at least equal to the width b

NOTE These supports are either rectangular or square section prisms whose width is less than 5% of the length ℓ of the specimens for longitudinal and torsional vibration (see Figures 1a and 2a) or small triangular section prisms for flexural vibration (see Figure 3a). In the case of cylindrical specimens, the supports should be notched. The positions of the supports are indicated in Figures 1, 2 and 3.



Key
1 Emitter
2 Specimen
3 Receiver

Figure 1a - Position of the transducers for longitudinal vibration

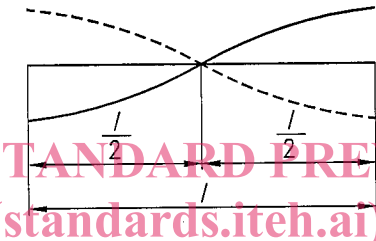


Figure 1b - Fundamental mode for longitudinal vibration

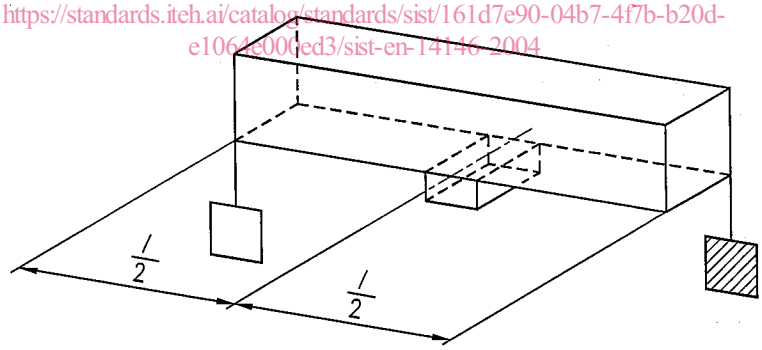


Figure 2a - Position of the transducers for torsional vibration

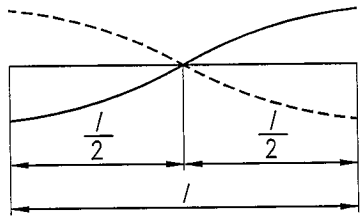


Figure 2b - Fundamental mode for torsional vibration