SLOVENSKI STANDARD
oSIST prEN 16929:2016

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Preskusne metode - Leseni stropi - Ugotavljanje vibracijskih lastnosti

Test Methods - Timber flooring systems - Determination of vibration properties

Prüfverfahren - Holzdecken - Bestimmung der Schwingungseigenschaften

Méthodes d’essais - Systèmes de plancher en bois - Détermination des propriétés vibratoires

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ICS:

91.060.30	Stropi. Tla. Stopnice	Ceilings. Floors. Stairs
91.080.20	Lesene konstrukcije	Timber structures

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Test Methods - Timber flooring systems - Determination of vibration properties

Méthodes d'essais - Systèmes de plancher en bois - Détermination des propriétés vibratoires

Testverfahren - Holzdecken - Bestimmung von Schwingungseigenschaften

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Contents

Page

European foreword

This document (prEN 16929:2015) has been prepared by Technical Committee CEN/TC 124 “Timber Structures”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

Introduction

The serviceability requirements of timber floors with timber or wood based decking become more decisive in design because of the use of high strength materials, prefabricated timber construction elements and longer spans. Beside deflection requirements for static loads given in appropriate design codes the dynamic aspects have to be considered, especially for lightweight timber floors where a pedestrian body mass is quite influential. Human footfall is a significant source of vibration and if its effects are not assessed accurately during the design of a lightweight floor structure it may be rendered uncomfortable for occupants.

Vibrations induced by footsteps in floors can annoy occupants or disturb operation of sensitive equipment and processes, if the vibrations are not properly controlled. Proper controlling relies on a good understanding of the nature of floor vibrations induced by footsteps. The magnitude and type of floor vibrations induced by footsteps from normal walking are mainly controlled by the inherent dynamic properties of the floor system: stiffness, mass and its capacity to dissipate vibration energy (damping). These properties are in turn determined by floor materials, design and construction.

When assessing the response of lightweight floor structures to pedestrian induced vibration, only frequencies below 40-50 Hz are of interest. Floors with a fundamental frequency below 8 Hz are labelled as a low-frequency floor and will have to deal with resonance effects caused by walking action. Vibrations with frequencies over 40-50 Hz are no longer perceivable by occupants.

When assessing vibration modes of a timber floor structure supported on two opposite sides it is assumed that in the span direction only the first-order fundamental vibration mode is occurring. Since the stiffness in transverse direction is usually much lower than in span direction, vibration modes will excite in the transverse direction. Several vibration modes in the 8 – 40/50 Hz range may occur.

1 Scope

This European Standard specifies test methods for the determination of the fundamental frequency, damping, unite point load deflection and acceleration amplification of timber or wood-based engineering beams and flooring systems.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13183 (all parts), *Moisture content of a piece of sawn timber*

EN 322, *Wood-based panels - Determination of moisture content*

3 Terms and definitions

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

3.1
decking
surface element that contributes to the integrity of the flooring system and is connected to the joists. The characteristic of the decking is that it is supported by joists and, when subjected to load, free to deflect between the joists

3.2
flooring system
specified assembly of joists and decking

3.3
fundamental frequency
lowest first-order natural vibration frequency

3.4
joist
beam made of timber or timber in combination with a wood based engineered product to support and connect to the decking

3.5
natural frequency
a frequency in which a specimen oscillates in a free vibration mode each vibration mode has its own natural frequency

3.6
span
distance between supports parallel to the main floor load bearing elements

3.7
internal support beam
a beam that acts as a non-rigid support for joists

Note 1 to entry: A support beam act as intermediate support or as end-supports for joists.

3.8
vibration
the oscillation of a system about its equilibrium position

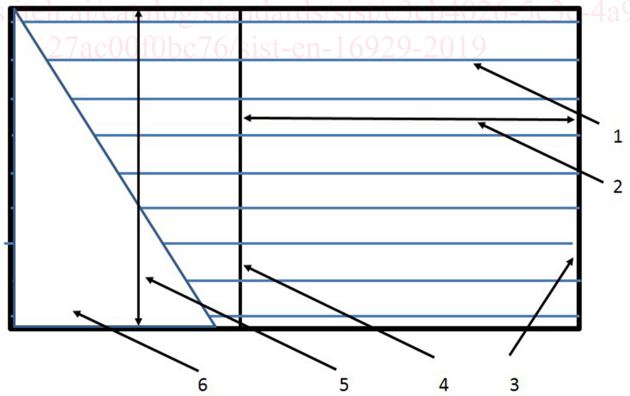
3.9
vibration mode
the behaviour of a system or an object that is characterized by its natural frequency, modal damping and mode shape

Note 1 to entry A system can have many vibration modes and multiple vibration modes can be oscillating (and interfering) at the same time. Each vibration mode depends on the structure configurations, material properties and boundary conditions of the system.

3.10
damping
damping is the energy dissipation of a vibrating system

Note 1 to entry Damping consist of material and structural damping as well as damping by furniture and floor finishing (floating floor).

Note 2 to entry Figure 1 shows a typical flooring system.



Key

1 joist

2 span

3 edge support for joists

4 interior support beam

5 width

6 decking

Figure 1 — Typical flooring system

4 Determination of dimensions of flooring systems

The span, width and depth of the flooring system shall be measured:

— in laboratory tests to an accuracy of 1mm. The depth measurements shall not be taken at a location closer than 150 mm to the ends;

— *in situ* tests to an accuracy of 1 % or 10 mm, whichever is less.

5 Determination of moisture content

For laboratory tests: The moisture content of the flooring system components shall be determined, for timber in accordance with EN 13183, and for wood-based products in accordance with EN 322.

6 Determination of the floor mass

For laboratory tests, the weight of the whole flooring system or individual components shall be determined using scales with an accuracy of less than 1 % or 0,1 kg whichever is less and reported in kg/m^2.

7 Conditioning

For *in situ* and laboratory tests, the temperature and relative humidity of the environment shall be recorded

8 Laboratory tests

8.1 Determination of the fundamental frequency

8.1.1 Principle

A supported flooring system is exposed to an impulse load and acceleration measurements are taken. From the data the acceleration response shall be determined and the fundamental frequency calculated.

8.1.2 Test setup

The flooring system is simply supported on a rigid support structure. Accelerometers are used to measure the vibration or other measuring devices may be used provided they produce reliable test data. The accelerometer shall be attached to the flooring system at the geometrical floor centre.

During the frequency tests the background noise produced by the structure that holds the supports or other vibration producing surrounding devices should be kept to a minimum to avoid interference with the test results. For this reason the bending stiffness of the supporting structure should be considerably higher than the flooring system.

NOTE 1 If there is an interest in higher vibration modes or transverse vibration modes more accelerometers can be used.

Before the floor test the natural frequencies of the supporting structure should be measured in each direction. This can be done using the same equipment and releasing a hammer or alternative peak-load on the supporting structure. None of the natural frequencies of the supporting structure shall be in interfering range of the expected fundamental frequency of the flooring system.

NOTE 2 Altering the natural frequencies of the supporting structure can be done by adjusting weight and/or stiffness.

8.1.3 Support detailing

Support conditions at both ends shall be reliable such that interference with the vibration frequency of the flooring system during the test is kept to a minimum. Trials to find out which support material and which conditions produce reliable results need to be carried out.

The support condition can have a major influence on the detection of natural frequencies of the flooring system. Interference of oscillations may occur which is generally considered very disturbing and should be avoided. This is usually caused by two or more natural frequencies very close to each other.

Reasons could be:

— the support is too long, see Figure 1;

— the contact surface is not perfectly supporting the flooring system due to surface imperfections of the flooring system or/and support;

— the flooring system does not rest over the whole contact support area without leaving any gap. The flooring system but also the supporting material can be warped (torsional or twisted) or bent. This may be solved by using wedges to close any void or to plane the supporting material, respectively, Figure 2. A poor contact can be improved by using a wedge, using soft material like cardboard;

— the amplitude of interfering frequencies may become smaller when the dead load weight is increased;

— the supporting steel structure may vibrate in horizontal direction (perpendicular to the vibration direction of the flooring system) and interfere with the recorded vibration data. This might be tackled by using a small width to height ratio of the supporting (steel) structure, Figure 3.

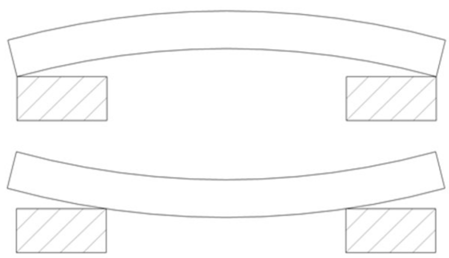


Figure 2 — Possible cause of oscillation of beams on supports