SLOVENSKI STANDARD
SIST EN 13036-8:2009

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Značilnosti cestnih in letališkib površin - Preskusne metode - 8. del: Določanje indeksov prečne neravnosti

Road and airfield surface characteristics - Test methods - Part 8: Determination of transverse unevenness indices

Oberflächeneigenschaften von Straßen und Flugplätzen - Prüfverfahren - Teil 8: Bestimmung der Parameter zur Ermittlung der Breitenunebenheit

Caractéristiques de surface des routes et aérodromes - Méthodes d'essais - Partie 8 : Détermination des indices d'uni transversal

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ICS:

17.040.20	Lastnosti površin	Properties of surfaces
93.080.10	Gradnja cest	Road construction
93.120	Gradnja letališč	Construction of airports

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Road and airfield surface characteristics - Test methods - Part 8: Determination of transverse unevenness indices

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Foreword

This document (EN 13036-8:2008) has been prepared by Technical Committee CEN/TC 227 “Road materials”, 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of an identical text or by endorsement, at the latest by September 2008, and conflicting national standards shall be withdrawn at the latest by September 2008.

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Introduction

Road profile transverse unevenness affects safety and ride comfort. Transverse uneveness demands can differ from one road to another and are highly related to the speed limit, the kind of traffic, the climatic conditions, the accepted comfort limits, etc. Road profile transverse unevenness is consequently key information for acceptance of newly laid pavements and for road maintenance management systems.

Road profile transverse unevenness encompasses a variety of aspects, such as: the crossfall of the transverse profile, irregularities or different defects in the transverse profile (steps, ridges/dips and edge slumps) and the longitudinal ruts in the wheel paths caused by the traffic.

The measurement of road transverse unevenness has been a subject of much research for more than 70 years, resulting in many different measuring methods. Measurement devices can be split into:

- stationary equipment, such as e.g. the straightedge for irregularities and longitudinal ruts or rod and level for crossfall in single profiles,

- dynamic equipment, such as e.g. the profilometer, which is dependant on the characteristics of the device, suitable for measuring all mentioned aspects for single profiles as well as section (mean) values.

This European Standard has been written to be used in conjunction with the European Standards EN 13036-6 (Profilometer) and EN 13036-7 (Straightedge).

1 Scope

This European Standard defines the different transverse unevenness indices of the pavement surface of roads and airfields and the appropriate methods of evaluation and reporting.

The indices have been defined principally independent of the measurement device.

This European Standard focuses on transverse unevenness measurements for the following three purposes:

- indices to provide a means for quality control of pavement surfaces of newly laid pavements, especially with respect to crossfall and the evidence of irregularities due to improper laying and/or compacting action.

- indices to be used for evaluating the condition of pavements in service as part of routine condition monitoring programs. They are intended to detect transverse deformations caused by the traffic, pavement wear or subsurface movement.

- indices to be used for resurfacing activities on pavements in use.

The parameters and evaluation methods are applicable both for roads and airfields.

2 Normative references

The following referenced documents are indispensable for the application 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 13036-6:2008, *Road and airfield surface characteristics — Test methods — Part 6: Measurement of transverse and longitudinal profiles in the evenness and megatexture wavelength ranges*

EN 13036-7, *Road and airfield surface characteristics — Test methods — Part 7: Irregularity measurement of pavement courses: the straightedge test*

3 Terms and definitions

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

3.1
acquisition repetition interval
travelled distance between two consecutive transverse profile measurements

3.2
bias
difference between the expectation of the test results and an accepted reference value

NOTE Bias is the total systematic error as contrasted to random error. There may be one or more systematic error components to the bias. A large systematic difference from the accepted reference value is reflected by a large bias value (see ISO 3534-1).

3.3
crossfall
transverse gradient across a section or full width of a pavement measured perpendicular to the centre line

NOTE Crossfall can be expressed as a percentage, a ratio (e.g. 1 to 30) or as an angle to the horizontal. By convention, it is positive when the right end of the profile is lower than its left end for right hand traffic and the opposite for left hand traffic.

3.4
edge slump
deviation of the pavement edge below a straight reference line

3.5
irregularity
any deviation of a surface from the straight reference line

3.6
layer
structural element of a pavement laid in a single operation

3.7
pavement
structure composed of one or more layers of selected material designed to carry traffic

3.8
pavement surface or surface course
upper layer of the pavement that is in contact with the traffic

3.9
precision
closeness of agreement between independent test results obtained under stipulated conditions

NOTE Precision depends only on the distribution of random errors. The measure of precision is usually computed as a standard deviation of the test results. Less precision is reflected by a larger standard deviation (see ISO 3534-1).

3.10
repeatability
maximum difference expected between two measurements made by the same machine, with the same tyre, operated by the same crew on the same section of road in a short space of time, with a probability of 95 %.

3.11
ridge
any deviation above a straight reference line

3.12
dip
any deviation below a straight reference line

3.13
rut/pothole
any deviation below the straight reference line, normally in the wheel path

3.14
rut depth
greatest deviation of the transverse profile of a pavement surface and a virtual straight reference line of length L sliding on the surface of the profile within the limits of the analysed width, by leaving one edge of the rut towards the other edge.

NOTE 1 The length of the virtual reference should be mentioned within the results.

NOTE 2 Rut depth is normally expressed in millimetres.

3.15
section
length of road between defined points (e.g. location references, specific features or measured distances) comprising a number of subsections over which a continuous sequence of measurements is made

3.16
step
vertical displacement from the straight reference line

3.17
theoretical water depth
difference in elevation between a horizontal reference line going through the highest point of a transverse profile at the low side of the wheel path and the deepest point in the wheel path

NOTE 1 Theoretical water depth is normally expressed in millimetres

NOTE 2 Theoretical water depth is an indicator of the risk of aquaplaning. The theoretical water depth in a depression or dip is often called "pond depth".

3.18
transverse profile
intersection between the road surface and a reference plane perpendicular to the road surface and to the lane direction

3.19
trueness
closeness of agreement between the average value obtained from large series of test results and an accepted reference value

NOTE The measure of trueness is usually expressed in terms of bias (8.3) and reflects the total systematic error as contrasted to random error. There may be one or more systematic error components to the trueness. A large systematic difference from the accepted reference value is reflected by a large value (see ISO 3534-1).

3.20
wheel paths
area of a pavement surface where the large majority of vehicle wheel passages are concentrated (see Figure 1)

4 List of symbols

X is the crossfall;

I_S is the step height;

I_R is the ridge height;

I_D is the dip depth;

I_E is the edge slump;

R_R is the rut depth right wheel path;

R_L is the rut depth left wheel path;

W_R is the theoretical water depth right wheel path;

W_L is the theoretical water depth left wheel path.

5 Parameters

5.1 General

The transverse profile can be characterized by the following parameters (see Figure 1):

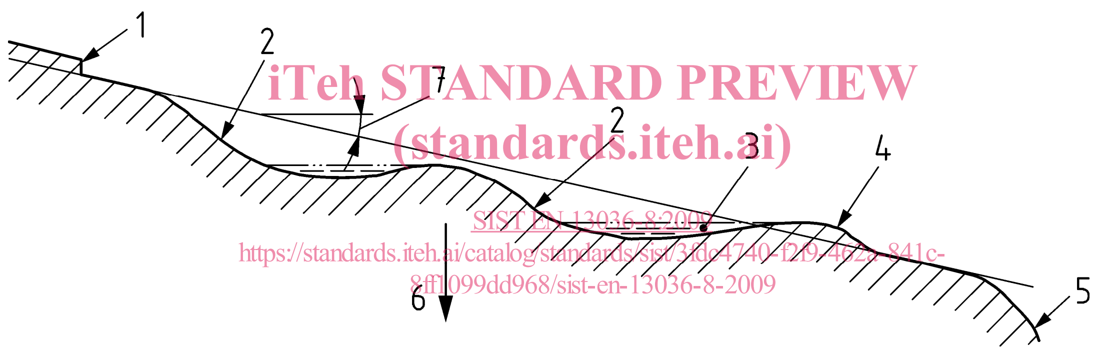
— the crossfall X of the transverse profile;

— the heights of the different irregular defects in the transverse profile, such as ridges/dips, steps and edge slump, the so-called irregularities I;

— the rut depth R in the wheel paths caused by the traffic;

— the theoretical water depth W in the ruts.

In the following the calculation principles of each of these parameters will be explained.



Key

1 step
2 rut
3 water depth
4 ridge/bump
5 edge slump
6 gravity
7 crossfall

Figure 1 — Schematic overview of the different characteristics of transverse unevenness

5.2 Crossfall X

Pavements are designed with a crossfall for traffic safety reasons, namely to make it possible to safely pass curves with different radius and for water drainage purposes.

Crossfall mean X is defined as the angle between the horizontal and the regression straight line through the transverse road profile fixed by at least seven measurement points across that profile. In literature this is often called the regression-line definition.

New pavements can be measured with a straightedge as described in Annex A.

5.3 Irregularities

Irregularities can be caused by improper laying and/or compaction in the construction phase or by deformations caused by the traffic, pavement wear or subsurface movement during the normal use of the pavement.

In the following the different types, such as steps, ridges/dips and edge slump, will be explained.

5.3.1 Step height I_S

The calculation principle of the step height I_S is shown in Figure 2.

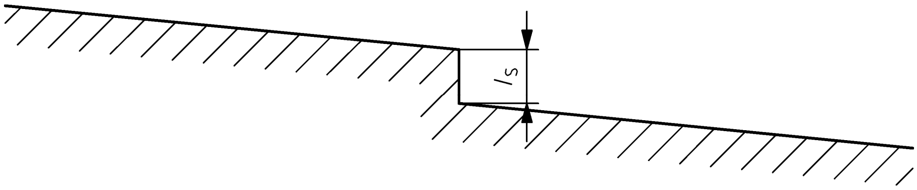


Figure 2 — Transverse profile of a pavement surface showing step height I_S

5.3.2 Ridges/dips, respectively I_R, I_D

The ridge I is defined as the distance between a straight reference line and the highest point of the ridge, see Figure 3.

When I/p > 1 there is a ridge; at lower ratio there are bumps.

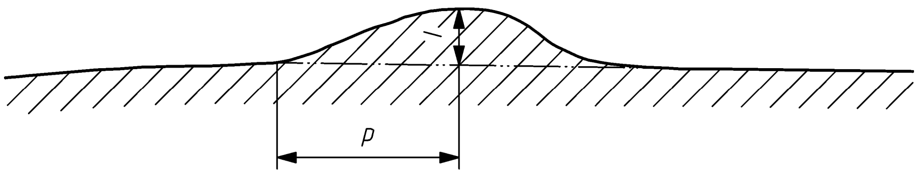


Figure 3 — Transverse profile of a pavement surface showing ridge height I_R

For calculation of the depth of dips the same principle can be used, with the difference that the distance between the straight reference line and the deepest point of the dip is measured.

5.3.3 Edge Slump I_E

The calculation principle of the edge slump I_E is shown in Figure 4.