Determination of minimum and maximum dry densities of non-cohesive soil

DIN 18126

ICS 93.020

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Descriptors: Subsoil, soil, density, testing.

Baugrund, Untersuchung von Bodenproben – Bestimmung der Dichte nichtbindiger Böden bei lockerster und dichtester Lagerung

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Contents

Foreword

This standard has been prepared by Technical Committee *Baugrund; Versuche und Versuchsgeräte* of the *Normenausschuß Bauwesen* (Building and Civil Engineering Standards Committee).

Amendments

As compared to the September 1989 edition, the standard has been editorially revised.

Previous editions

DIN 18126: 1981-03, 1989-09.

Continued on pages 2 to 13.

Translation by DIN-Sprachendienst.

In case of doubt, the German-language original should be consulted as the authoritative text.

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1 Scope and field of application

This standard is intended for use in earthworks and foundation engineering. It specifies methods of determining the limiting densities of non-cohesive soil whose particle size distribution (grading) does not change significantly during the test (e.g. as a result of the crushing of particles, segregation of coarse particles or loss of fine particles).

The method serves to obtain results that closely reproduce those which may be encountered under conditions of the densest or loosest state of packing of the particles of non-cohesive soil. The results obtained serve to assess the compactibility of soil and provide a reference parameter for the densities of natural or artificially compacted soils.

2 Normative references

This 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 titles of the publications are listed below. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

DIN 4022-1	Subsoil and groundwater – Classification and description of soil and rock: borehole logging of soil and rock not involving continuous core sample recovery
DIN 4235-1	Compacting of concrete by vibration – Vibrators and vibration mechanics
DIN 18124	Soil analysis – Determination of particle density using pyknometers
DIN 18125-2	Soil analysis – In-situ determination of soil density
DIN 18127	Soil analysis – Proctor test

3 Concepts

3.1 Maximum density

Maximum dry density at the densest possible state of packing of soil particles achieved under the test conditions specified in subclause 7.3. Designated by $max\ \varrho_d$.

3.2 Vibrating table test

Test in which the sample, while subjected to a specified load, is vibrated at a given frequency and amplitude.

3.3 Two-prong impactor test

Test in which the sample is placed into a mould that is struck by the prongs of an impactor, thus compacting the sample material.

3.4 Minimum density

Minimum dry density at the loosest possible state of packing of soil particles achieved under the test conditions specified in subclause 7.4. Designated by $min\ \varrho_d$.

3.5 Porosity at minimum and maximum densities

The porosity at minimum density, $max\ n$, is given by:

$$max\ n = 1 - \frac{min\ \varrho_d}{\varrho_s} \tag{1}$$

The porosity at maximum density, $min\ n$, is given by:

$$min\ n = 1 - \frac{max\ \varrho_d}{\varrho_s} \tag{2}$$

where

ϱ_d is the dry density as defined in DIN 18125-2;

ϱ_s is the particle density as defined in DIN 18124.

3.6 Voids ratio at minimum and maximum density

The voids ratio at minimum density, $max\ e$, is given by:

$$max\ e = \frac{\varrho_s}{min\ \varrho_d} - 1 \tag{3}$$

The voids ratio at maximum density, $min\ e$, is given by:

$$min\ e = \frac{\varrho_s}{max\ \varrho_d} - 1 \tag{4}$$

3.7 Compactness

The compactness, D, is given by:

$$D = \frac{max\ n - n}{max\ n - min\ n} = \frac{\varrho_d - min\ \varrho_d}{max\ \varrho_d - min\ \varrho_d} \tag{5}$$

3.8 Density index

The density index, I_D, is given by:

$$I_D = \frac{max\ e - e}{max\ e - min\ e} = \frac{max\ \varrho_d\,(\varrho_d - min\ \varrho_d)}{\varrho_d\,(max\ \varrho_d - min\ \varrho_d)} \tag{6}$$

3.9 Compactibility index

The compactibility index, I_f, is given by:

$$I_f = \frac{max\ e - min\ e}{e} = \frac{\varrho_s\,(max\ \varrho_d - min\ \varrho_d)}{min\ \varrho_d\,(\varrho_s - max\ \varrho_d)} \tag{7}$$

4 Designation

Designation of the vibrating table test for determining minimum density, using a test mould with an internal diameter of 150 mm:

Test DIN 18126 – 150

Designation of the two-prong impactor test for determining minimum density, using a test mould with an internal diameter of 71 mm:

Test DIN 18126 – 71

5 Apparatus

The following is required.

5.1 Vibrating table test

a) Cylindrical compaction moulds with internal diameters, d_z, of 100 mm, 150 mm and 250 mm, as specified in figure 1 and table 1 of DIN 18127, February 1993 edition, fitted with a removable extension not less than 50 mm, 60 mm and 120 mm high, respectively.

b) Loading plunger with spring and superimposed weight, as shown in figures 1 to 4 and specified in table 1. It shall be provided with two rings with a diameter that ensures a clearance between plunger and mould of 0,25 mm. The mass of the plunger at rest shall be such that the sample is subjected to a surface stress of 10 kN/m^2.

c) Vibrating table to produce quasi-harmonic vibrations at a frequency of 50 Hz, with the table moving vertically. It shall be fitted with a clamping device to hold the mould in place and be capable of accommodating a load of 2,5 kN. The vibration amplitude shall be 1,4 mm from a cold start for any load acting on the vibrating table, the amplitude not exceeding 1,7 mm in continuous operation. To this end, the amplitude shall be set for the mass of the 250 mm mould, with sample. Compensatory weights shall be added when smaller moulds are used. The overshoot when the table is switched off shall not last longer than 1,5 seconds. To achieve this, the table shall be equipped with a braking device or another device with a similar function.

NOTE: The vibration amplitude can be checked by means of a measuring wedge, in accordance with DIN 4235-1. In order to check the duration of rise in amplitude, the amplitude is to be measured as a function of time, using an oscillograph.