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Geotechnical investigation and testing — Laboratory testing of soil —

Part 2: Determination of density of fine-grained soil

Reconnaissance et essais géotechniques — Essais de sol au laboratoire —

Partie 2: Détermination de la masse volumique d'un sol fin

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Foreword

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ISO/TS 17892-2 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 182, *Geotechnics*, Subcommittee SC 1, *Geotechnical investigation and testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European pre-Standard..." to mean "...this Technical Specification...".

ISO 17892 consists of the following parts, under the general title *Geotechnical investigation and testing — Laboratory testing of soil*:

— *Part 1: Determination of water content*

— *Part 2: Determination of density of fine-grained soil*

— *Part 3: Determination of particle density — Pycnometer method*

— *Part 4: Determination of particle size distribution*

— *Part 5: Incremental loading oedometer test*

— *Part 6: Fall cone test*

— *Part 7: Unconfined compression test on fine-grained soil*

— *Part 8: Unconsolidated undrained triaxial test*

— *Part 9: Consolidated triaxial compression tests on water-saturated soil*

— *Part 10: Direct shear tests*

— *Part 11: Determination of permeability by constant and falling head*

— *Part 12: Determination of the Atterberg limits*

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Foreword

This document (CEN ISO/TS 17892-2:2004) has been prepared by Technical Committee CEN/TC 341 “Geotechnical investigation and testing”, the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 182 “Geotechnics”.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: 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.

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— *Part 12: Determination of the Atterberg limits*

Introduction

This document covers areas in the international field of geotechnical engineering never previously standardised. It is intended that this document presents broad good practice throughout the world and significant differences with national documents is not anticipated. It is based on international practice (see [1]).

1 Scope

This document specifies methods of test for the determination of the bulk and dry density of intact soil or rock within the scope of the geotechnical investigations according to prEN 1997-1 and prEN 1997-2.

The bulk density of a soil is useful in the determination of the in-situ overburden stresses at various depth (geostatic stresses). Furthermore, bulk and dry density can qualitatively describe the mechanical characteristics of a soil via empirical relationships which are to be found in the technical literature. Such relationships should be used only as guidelines and should be supplemented by direct measurements of the mechanical characteristics.

This document describes three methods:

a) linear measurements method;

b) immersion in water method;

c) fluid displacement method.

The linear measurement method is suitable for the determination of the density of a specimen of cohesive soil of regular shape, including specimens prepared for other tests. The specimens used are normally in the form of either rectangular prisms or straight cylinders.

The immersion in water method covers the determination of the bulk density and dry density of a specimen of natural or compacted soil by measuring its mass in air and its apparent mass when suspended in water. The method is employable whenever lumps of material of suitable size can be obtained.

The fluid displacement method covers the determination of the bulk density and dry density of a specimen of soil by measuring mass and displacement of water or other appropriate fluid after immersion. The method is employable whenever lumps of material of suitable size can be obtained.

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.

prEN 1997-1, *Eurocode 7 - Geotechnical design — Part 1: General rules.*

prEN 1997-2*, Eurocode 7 - Geotechnical design — Part 2: Ground investigation and testing.*

CEN ISO/TS 17892-1, *Geotechnical investigation and testing — Laboratory testing of soil — Part 1: Determination of water content (ISO/TS 17892-1:2004).*

3 Terms and definitions

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

3.1
bulk density
ρ
mass of soil or rock per unit volume of the material, including any water or gas it contains

3.2
dry density
ρ_d
mass of oven-dried soil contained in a unit volume

NOTE The term unit weight, denoted by γ, is used when calculating the force exerted by a mass of soil, and is derived from the mass density by the equation $\gamma = \rho \cdot g$, where g is the acceleration due to gravity (in m/s²). The value of g varies between 9,82 m/s², and 9,79 m/s², depending upon latitude.

3.3
undisturbed sample
normally a sample of quality class 1, according to prEN 1997-2

4 Equipment

4.1 Linear measurement method

The following items are necessary for the linear measurement method:

— Cutting and trimming tools (e.g. a sharp knife, wire saw, spatula, scoop);

— steel straightedge and try-square;

— steel rule;

— vernier callipers;

— balance, accuracy 0,03 g;

— apparatus for water content determination according to CEN ISO/TS 17892-1.

4.2 Immersion in water method

The following items are necessary for the immersion measurement method:

— A watertight container of a suitable size;

— a balance, accuracy 0,3 g;

— a cradle and supporting frame similar in principle to that shown in Figure 1 which, with the frame attached to the scoop or platform of the balance, can support the cradle below the balance;

— equipment for melting paraffin wax;

— apparatus for water content determination according to CEN ISO/TS 17892-1;

— materials: plasticine or putty and paraffin wax.

4.3 Fluid displacement method

The following items are necessary for the fluid displacement method:

— A cylindrical metal container with a siphon tube;

— a tight container to act as a receiver for the fluid siphoning over from the container;

— a balance, accuracy 0,3 g;

— equipment for melting paraffin wax;

— apparatus for water content determination according to CEN ISO/TS 17892-1;

— materials: plasticine or putty and paraffin wax;

— alternatively, the apparatus described in 4.2 can be used. In such case, a correction for the uplift for the cradle shall be included in the calculations.

5 Test procedure

5.1 Linear measurement method

5.1.1 General

The principle of the method is to weigh a specimen of known volume. Three procedures are specified for preparing the specimen. Other methods are also accepted if they provide undisturbed specimens of regular shape.

5.1.2 Specimen from block sample

5.1.2.1 At least 10 mm from the outside face of the block sample shall be cut away and an approximately rectangular prism of soil slightly larger than the final dimensions of the specimen shall be formed. If the specimen is to be used for some other test its shape and dimensions shall be appropriate for that test, too.

5.1.2.2 The ends of the prism shall be made plane and parallel using the mitre box, or by careful trimming and checking with straightedge and try square on the glass plate. The test specimen may be either rectangular or cylindrical.

5.1.2.3 For a rectangular specimen the other four faces of the prism shall be trimmed so that they are mutually perpendicular and at right angles to the end faces. Flatness and squareness shall be accurate to within 0,5 % of each dimension.

5.1.2.4 For a cylindrical specimen the specimen shall be placed in a soil lathe and the excess soil cut in thin layers. The specimen shall be rotated between each cut until a cylindrical specimen is produced. The specimen shall not be trimmed while it is being rotated. After trimming the specimen shall be moved from the lathe. It shall be cut to the required length and the ends shall be made plane and normal to the specimen axis to within 0,5°. A split mould may be used as a jig for this operation if of sufficient accuracy.

5.1.3 Specimen directly extruded from sample tube

5.1.3.1 End caps and wax or other protective material shall be removed from each end.

5.1.3.2 Each end of the sample shall be trimmed to give a flat surface normal to the axis of the tube.