SLOVENSKI STANDARD
SIST-TS CEN ISO/TS 17892-5:2004

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Geotehniļ no preiskovanje in preskuġanje ï Laboratorijsko preskuġanje zemljin ï 5. del: Edometrski preskus s postopnim obremenjevanjem (ISO/TS 17892-5:2004)

Geotechnical investigation and testing - Laboratory testing of soil - Part 5: Incremental loading oedometer test (ISO/TS 17892-5:2004)

Geotechnische Erkundung und Untersuchung - Laborversuche an Bodenproben - Teil 5: Oedometerversuch mit stufenweiser Belastung (ISO/TS 17892-5:2004)

Reconnaissance et essais géotechniques - Essais de laboratoire sur les sols - Partie 5: Essai de chargement par paliers a l'oedometre (ISO/TS 17892-5:2004)

Ta slovenski standard je istoveten z: CEN ISO/TS 17892-5:2004

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93.020	Zemeljska dela. Izkopavanja. Gradnja temeljev. Dela pod zemljo	Earthworks. Excavations. Foundation construction. Underground works

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ICS 13.080.20; 93.020

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Geotechnical investigation and testing - Laboratory testing of soil - Part 5: Incremental loading oedometer test (ISO/TS 17892-5:2004)

Reconnaissance et essais géotechniques - Essais de sol au laboratoire - Partie 5: Essai à l'oedomètre sur sol saturé (ISO/TS 17892-5:2004)

Geotechnische Erkundung und Untersuchung - Laborversuche an Bodenproben - Teil 5: Oedometerversuch mit stufenweiser Belastung (ISO/TS 17892-5:2004)

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Foreword

This document (CEN ISO/TS 17892-5:2004) 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.

CEN ISO/TS 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 grain soils

— Part 8: Unconsolidated undrained triaxial test

— Part 9: Consolidated triaxial compression tests on water saturated soils

— Part 10: Direct shear tests

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

— 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 is intended for determination of the compression, swelling and consolidation properties of soils. The cylindrical test specimen is confined laterally, is subjected to discrete increments of vertical axial loading or unloading and is allowed to drain axially from the top and bottom surfaces.

The main parameters derived from the oedometer test relate to the compressibility and rate of primary consolidation of the soil. Estimates of preconsolidation pressure, rate of secondary compression, and swelling characteristics are sometimes also obtainable.

The main parameters which can be derived from the oedometer test carried out on undisturbed samples are:

1) compressibility parameters;

2) coefficient of consolidation;

3) apparent preconsolidation pressure or yield stress;

4) coefficient of secondary compression;

5) swelling parameters.

The fundamentals of the incremental loading oedometer test include:

— stress path corresponds to one-dimensional straining;

— drainage is one-dimensional and axial.

The stress paths and drainage conditions in foundations are generally three dimensional and differences can occur in the calculated values of both the magnitude and the rate of settlement.

The small size of the specimen generally does not adequately represent the fabric features present in natural soils.

Analysis of consolidation tests is generally based on the assumption that the soil is saturated. In case of unsaturated soils, some of the derived parameters may have no physical meaning.

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 1997-2, *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).*

CEN ISO/TS 17892-2, *Geotechnical investigation and testing — Laboratory testing of soil — Part 2: Determination of density of fine grained soil (ISO/TS 17892-2:2004).*

3 Terms and definitions

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

3.1
excess pore pressure
pore water pressure over and above the equilibrium pore pressure at the end of consolidation

3.2
primary consolidation
process whereby soil compresses as a result of an increase (or decrease) in effective stress due to dissipation of excess pore pressure under constant total applied stress accompanied by drainage of water from the voids

3.3
secondary consolidation
process in which compression occurs after full excess pore pressure dissipation

3.4
swelling
expansion due to reduction of effective stress

NOTE Swelling includes both the reverse of compression and the reverse of consolidation.

3.5
undisturbed sample
normally a sample of quality class 1 according to prEN 1997-2

4 Symbols

For the purposes of this document, the following symbols apply.

A Cross-sectional area of specimen.

e Void ratio, i.e. volume of pores relative to volume of solid particles.

e_0 Original void ratio, i.e. void ratio of the specimen at the start of the test.

e_f Void ratio of the specimen at the end of an increment: this is the void ratio of the specimen at the start of the next increment.

D Diameter of the oedometer ring.

H Height of the specimen.

H_0 Original height, i.e. height of the specimen at the start of the test: this is normally taken as the depth of the oedometer ring.

H_i Initial height, i.e. height of the specimen at the start of an increment: this is the height of the specimen at the end of the previous increment.

H_f Height of the specimen at the end of an increment: this is the height of the specimen at the start of the next increment.

H_s Equivalent height of solids.

m_d Dry mass of specimen.

ε_v Vertical strain.

ρ Initial density of specimen.

ρ_d Initial dry density of specimen.

ρ_s Particle density.

σ'_s Swelling pressure, i.e. the pressure required to maintain constant volume (i.e. to prevent swelling) when a soil is flooded with water.

σ_v Total vertical stress, i.e. the vertically applied force divided by the horizontal cross-sectional area.

σ'_v Effective vertical stress, i.e. the difference between the total vertical stress and the pore water pressure.

5 Equipment

5.1 Requirements

5.1.1 Oedometer ring

5.1.1.1 The oedometer ring shall be indelibly marked with a unique identification number. The cutting edge shall not be damaged.

5.1.1.2 The internal dimensions shall conform to the following:

— diameter: minimum 35 mm;

— height *(H):* not less than 12 mm;

— ratio *(D/H):* not less than 2,5.

5.1.1.3 The ring shall either be laterally confined to restrict expansion under load, or have sufficient stiffness to prevent the internal diameter expanding by more than 0,05 % when subjected to the maximum horizontal stress resulting from the test.

5.1.1.4 The ring shall be made of corrosion-resistant metal or other suitable material and shall have a sharp cutting edge. The internal surface shall be smooth, and shall be lubricated with a thin film of silicone grease, petroleum jelly, or other suitable lubricant.

5.1.2 Porous plates

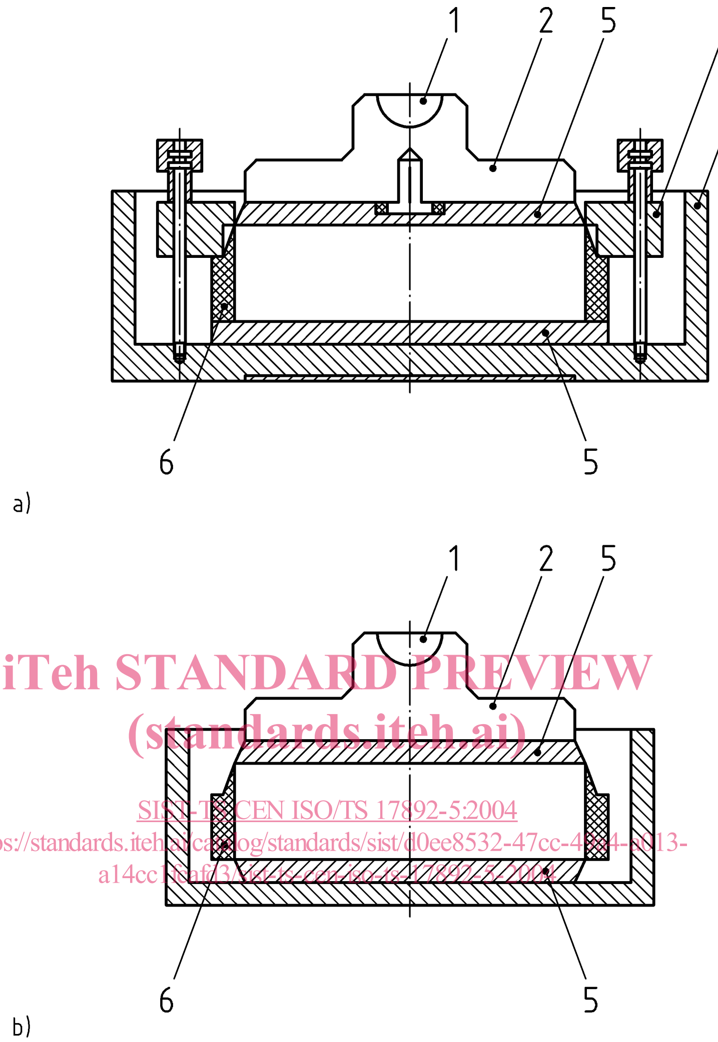
5.1.2.1 The top and bottom porous plates shall be of corrosion-resistant material and shall allow free drainage of water, while preventing intrusion of soil particles into their pores. The upper and lower surfaces shall be plane, clean and undamaged. The material shall be of negligible compressibility under the maximum stress likely to be applied during the test and shall be thick enough to prevent breakage under load.

5.1.2.2 If necessary, a filter paper may be used to prevent intrusion of the soil into the porous stones. However, the permeability of the stones and the filter paper shall be sufficiently high to prevent retardation of the drainage of the specimen.

5.1.2.3 The diameter of the top porous plate shall be about 0,5 mm less than the internal diameter of the oedometer ring, and may be tapered towards the upper face to minimize the risk of binding due to tilt.

5.1.2.4 In a fixed-ring cell the bottom porous plate shall be large enough to support the oedometer ring.

5.1.2.5 In a floating-ring cell the diameter of the bottom porous plate shall be about 0,5 mm less than the internal diameter of the ring. The bottom porous plate shall be similar to the top plate, but tapered towards the lower face (see Figure 1).



Key

a) Fixed ring oedometer
b) Floating ring oedometer
1 Seating
2 Loading cap
3 Lateral restraint for ring
4 Cell body
5 Porous plates
6 Oedometer ring

Figure 1 — General arrangements of typical oedometer cells

5.1.2.6 Before use, new porous plates shall be saturated by boiling in distilled or de-ionised water for at least 20 min. They shall then be kept immersed in distilled water until required for use.

5.1.2.7 The surface of the porous plates which have previously been used shall be cleaned with a natural bristle or nylon brush, followed by a check that the plates are readily permeable to water and that the pores are not clogged by soil particles. They shall then be saturated by boiling as described above.

In soft soils the difference between the diameter of the porous plate and the internal diameter of the ring may need to be reduced to 0,2 mm to avoid extrusion of soil.

5.1.3 Cell body

5.1.3.1 The cell body shall be of suitable corrosion-resistant metal or other suitable material.

5.1.3.2 A fixed-ring cell (see Figure 1a) shall accept the oedometer ring with a push fit and shall be rigid enough to prevent significant lateral deformation of the ring when under load.

5.1.3.3 A floating-ring cell (see Figure 1b) shall provide adequate clearance around the outside of the ring.

5.1.3.4 The assembled cell (see Figure 1) shall be watertight and shall hold water to a level which submerges the upper porous plate.

5.1.3.5 All components shall be made of materials which are not corrodible by electro-chemical reaction with each other, or the soil and the pore water.

5.1.4 Loading cap

5.1.4.1 The loading cap shall be rigid enough to ensure negligible deformation under load.

5.1.4.2 It shall be fitted with a central load seating and shall be mounted centrally in the consolidation cell.

5.1.4.3 If porous disks with a thickness of less than 6 mm are used, then the loading cap shall have perforations or grooves to allow the free drainage of pore water.

5.1.5 Deformation gauge

5.1.5.1 The deformation gauge may be either a dial gauge or an electrical displacement transducer, rigidly supported for measuring the vertical deformation of the specimen during the test.

5.1.5.2 The gauge shall have a travel of at least 10 mm with a resolution and accuracy of 0,002 mm. When a travel exceeding 10 mm is required (e.g. for highly compressible soil) an accuracy and resolution of 0,01 mm is acceptable.

If non-conventional equipment is used the reference system used for the measurements should be clearly defined in order to clarify which components of the apparatus contribute to the compliance of the measuring system.

5.1.6 Loading frame

5.1.6.1 The loading frame shall have a rigid bed on which the cell body is supported.

5.1.6.2 The loading frame shall allow the application of vertical stresses acting centrally on the loading cap only.

5.1.6.3 The vertical stress applied to the specimen shall be accurate to better than 1 % or 1 kPa. The stress shall remain constant within these limits throughout the duration of a loading increment. The mechanism shall allow the application of a given load increment within a period of 2 s without significant impact.

5.1.6.4 Adequate arrangements shall be made to ensure stability of the load frame, or a group of load frames, when fully loaded.

5.1.7 Ancillary apparatus

The ancillary apparatus consists of:

— balance, accuracy 0,03 g, readable to 0,01 g or better;

— timer readable to 1 s;

— maximum/minimum thermometer readable to 1 °C;

— metal disk with flat, smooth and parallel end faces. The diameter shall be about 1 mm less than the internal diameter of the oedometer ring and the height shall be the same as that of the ring;

— apparatus for determination of water content;

— apparatus for determination of particle density;

— vernier callipers reading to 0,05 mm.