SLOVENSKI STANDARD
SIST-TS CEN ISO/TS 17892-9:2004

01-december-2004

Geotehniļ no preiskovanje in preskuġanje - Laboratorijsko preskuġanje zemljin - 9. del: Konsolidiran triosni tlaļ ni preskus na z vodo zasiļ enih zemljinah (ISO/TS 17892-9:2004)

Geotechnical investigation and testing - Laboratory testing of soil - Part 9: Consolidated triaxial compression tests on water saturated soil (ISO/TS 17892-9:2004)

Geotechnische Erkundung und Untersuchung - Laborversuche an Bodenproben - Teil 9: Konsolidierte triaxiale Kompressionsversuche an wassergesättigten Böden (ISO/TS 17892-9:2004)

Reconnaissance et essais géotechniques - Essais de laboratoire sur les sols - Partie 9: Essai en compression a l'appareil triaxial sur sols saturés consolidés (ISO/TS 17892-9:2004)

Ta slovenski standard je istoveten z: CEN ISO/TS 17892-9:2004

ICS:

13.080.20	Fizikalne lastnosti tal	Physical properties of soils
93.020	Zemeljska dela. Izkopavanja. Gradnja temeljev. Dela pod zemljo	Earthworks. Excavations. Foundation construction. Underground works

SIST-TS CEN ISO/TS 17892-9:2004 en

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CEN ISO/TS 17892-9

October 2004

ICS 13.080.20; 93.020

English version

Geotechnical investigation and testing - Laboratory testing of soil - Part 9: Consolidated triaxial compression tests on water saturated soil (ISO/TS 17892-9:2004)

Reconnaissance et essais géotechniques - Essais de sol au laboratoire - Partie 9 : Essai triaxial consolidé sur sols saturés (ISO/TS 17892-9:2004)

Geotechnische Erkundung und Untersuchung - Laborversuche an Bodenproben - Teil 9: Konsolidierte triaxiale Kompressionsversuche an wassergesättigten Böden (ISO/TS 17892-9:2004)

This Technical Specification (CEN/TS) was approved by CEN on 2 February 2004 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

CEN members are the national standards bodies of 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.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. CEN ISO/TS 17892-9:2004: E

Contents

Figures

Foreword

This document (CEN ISO/TS 17892-9:2004) 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-grained soils.

— Part 8: Unconsolidated undrained triaxial test.

— Part 9: Consolidated triaxial compression tests.

— Part 10: Direct shear tests.

— Part 11: Permeability tests.

— Part 12: Determination of 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 covers the determination of stress-strain relationships and effective stress paths for a cylindrical, water-saturated[1)] specimen of undisturbed, remoulded or reconstituted soil when subjected to an isotropic or an anisotropic stress under undrained or drained conditions and thereafter sheared under undrained or drained conditions within the scope of the geotechnical investigations according to prEN 1997-1 and -2. The test methods provide data that are appropriate to present tables and plots of stress versus strain, and effective stress paths.

Special procedures such as:

a) Tests with lubricated ends;

b) tests with local measurement of strain or local measurement of pore pressure;

c) tests without rubber membranes;

d) extension tests;

e) shearing where cell pressure varies;

f) shearing at constant volume (no pore pressure change)

are not covered.

The conventional triaxial apparatus is not well suited for measurement of the initial moduli at very small strains. However, strains halfway up to failure are considered to be large enough to be measured in conventional triaxial cells.

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: Design assisted by laboratory testing*

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

3 Terms and definitions

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

3.1
CIU-test
isotropically consolidated undrained test

3.2
CAU-test
anisotropically consolidated undrained test

3.3
CID-test
isotropically consolidated drained test

---

1) Water saturated refers to the in-situ condition. The material tested need not necessarily be saturated at all stages during the laboratory testing.

3.4
CAD-test
anisotropically consolidated drained test

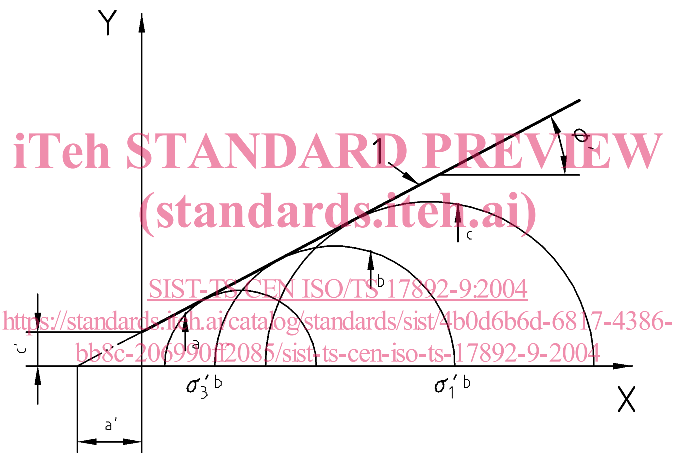
3.5
back pressure
external pressure by which the pore pressure is increased prior to consolidation or shearing in order to saturate the filters, the pore pressure measuring system and the specimen

3.6
failure
stress or strain condition at which failure takes place

NOTE If no specification for the failure state is given, failure may be considered to occur at the peak deviator stress.

3.7
effective shear strength parameter
friction angle ϕ' and cohesion intercept c' both in terms of effective stress (see Figure 1)

NOTE These parameters relate to the shear stress mobilized at the failure state specified.



Key

a Test 1
b Test 2
c Test C
X effective normal stress
Y shear stress
c´ effective cohesion intercept
a' attraction intercept
ϕ' effective friction angle

Figure 1 — Mohr stress circles at failure

3.8
cohesive soils
soils that behave as if they were actually cohesive, e.g. clay and clayey soils

NOTE Most soils in this group behave cohesively due to negative pore pressure and friction, and not due to cohesion.

3.9
undisturbed simple
sample of quality class 1 according to prEN 1997-2

4 Symbols

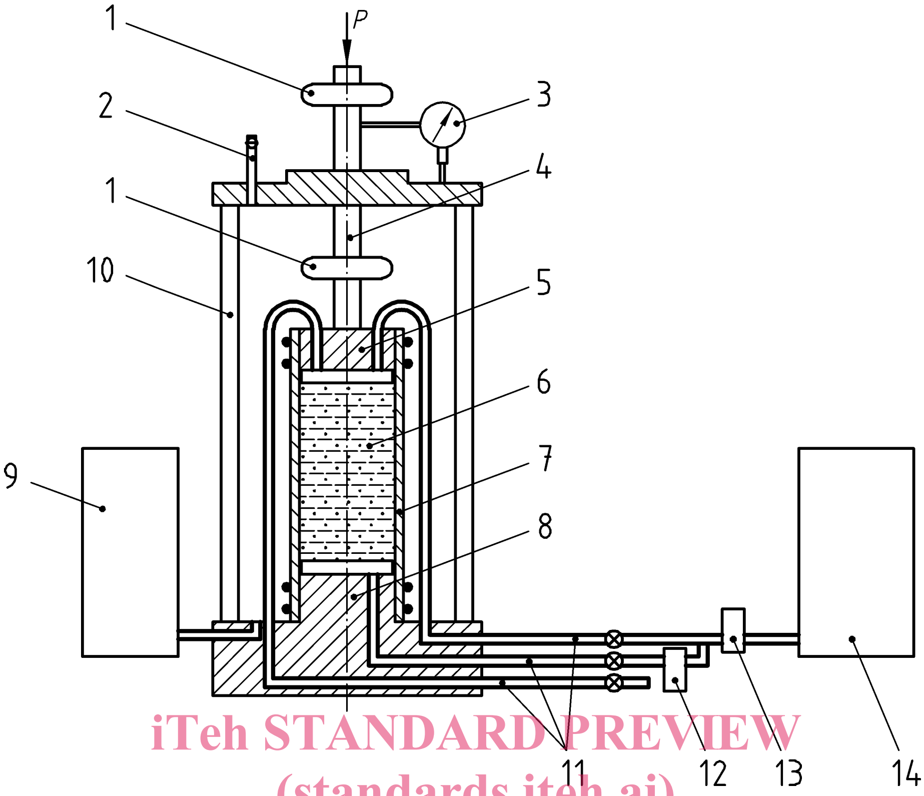
ε_1 and ε_{vol}	vertical and volumetric strain, respectively, during shearing.
σ_{cell}	total cell pressure.
σ_1 and σ_1'	major total and major effective stress, respectively (see note).
σ_3 and σ_3'	minor total and minor effective stress, respectively (see note).
$\sigma_1 - \sigma_3$	deviator stress.
u and Δu	total pore pressure and change in pore pressure respectively.
σ_{1C}'	major effective stress at end of consolidation.
σ_{3C}'	minor effective stress at end of consolidation.

NOTE Except perhaps in the case of anisotropic consolidation of strongly overconsolidated materials, σ_1 will be equal to the vertical stress and σ_3 will be equal to the horizontal stress for all tests described in this draft. If the vertical stress is greater than the horizontal one, the vertical stress shall be called σ_V instead of σ_1 and the horizontal stress σ_H instead of σ_3.

5 Equipment

5.1 General

A schematic diagram of an apparatus for triaxial testing is shown in Figure 2.



Key

1 alternative positions for load measuring device
2 air bleed
3 vertical compression measuring device
4 piston
5 top cap
6 soil specimen
7 membrane
8 pedestal
9 device for measurement and control of cell pressure
10 triaxial cell
11 drainage tubes
12 pore pressure sensor
13 volume change sensor
14 device for measurement and control of back pressure
P vertical load

Figure 2 — Example of a triaxial test unit

5.2 Triaxial cell

5.2.1 The triaxial cell shall be able to withstand a total cell pressure equal to the sum of the consolidation stress and the back pressure without significant of cell fluid out of the cell.

A cell with a maximum cell pressure of 2000 kPa will be sufficient for nearly all cases. Transparent cells should be used.

5.2.2 The sealing bushing and piston guide shall be designed such that the piston runs smoothly and maintains alignment.

5.2.3 The testing procedure, the accuracy of the load measuring device, the design of the piston, its sealing and guide and the design of the connection between the piston and the top cap shall be such that the load at failure is known to an accuracy of ± 3 % or to an accuracy of ± 1 N, whichever is the greater. It shall be ensured that this accuracy can be achieved with the worst possible combination of vertical and horizontal force and bending moment acting at that end of the piston that projects into the triaxial cell.

If the load measuring device is situated outside the triaxial cell (see Figure 2), it shall be ensured that the friction between the piston and its sealing bushing is low enough or repeatable enough to permit the failure load to be determined with the required accuracy.

NOTE Smooth running of the piston when subjected to no horizontal load and no cell pressure is no guarantee that this is the case.

If the load measuring device is situated inside the triaxial cell, it shall be ensured that the device is sufficiently insensitive to horizontal forces and/or bending moments to achieve the required accuracy. The influence of the cell pressure on the load cell, if any shall be sufficiently repeatable to be corrected for.

5.2.4 The top cap and the pedestal and the connection between the top cap and the piston shall be designed such that their deformations are negligible compared to the deformations of the soil specimen.

5.2.5 The diameter of the top cap and of the pedestal shall normally be equal to the diameter of the specimen. Specimens with diameters smaller than the diameter of the end caps may be tested provided cavities under the membrane at the ends of the specimen can be avoided.

5.2.6 The vertical stress applied on the specimen due to the weight of the top cap shall not exceed 3 % of the unconfined compressive strength (compressive strength is equal to two times the shear strength) of the specimen or 1 kPa whichever is the greater.

For cohesionless specimens held together with a suction the unconfined compressive strength in this connection may be assumed to be equal to the maximum deviator stress the specimen can sustain with the applied suction without collapsing.

5.2.7 The valves on the drainage tubes coming from the filter discs shall not cause a pressure change greater than 1 kPa when operated in a closed saturated pore pressure system. All valves shall be able to withstand the applied pressure without leakage.

Both the top and the pedestal should, preferably, have two drainage tubes so that the filter discs can be flushed with water after mounting of the specimen.

5.3 Confining membrane

5.3.1 The soil specimen shall be confined by an elastic membrane which effectively prevents the cell fluid from penetrating into the specimen.

5.3.2 Combinations of confining membranes and filter strips that give a combined correction on the deviator stress (σ_1-σ_3) of more than 10 % at failure should not be used (see 5.5, 7.4 and 7.5).

5.3.3 If O-rings are used to seal the confining membrane to the top and to the pedestal, their dimensions and elastic properties shall be such the confining membrane is firmly sealed to the top cap and to the pedestal.

If rubber membranes are used, membranes with following properties should be used.

— unstretched diameter between 95 % and 100 % of specimen (after being stored in water);

— thickness not exceeding about 1 % of the specimen diameter;

— elastic modulus (measured in tension) not exceeding 1600 kPa.