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Geotechnical investigation and testing — Laboratory testing of soil —

Part 6: Fall cone test

Reconnaissance et essais géotechniques — Essais de laboratoire sur les sols —

Partie 6: Essai de pénétration de cône

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 17892-6 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 341, *Geotechnical investigation and testing*, in collaboration with ISO Technical Committee ISO/TC 182, *Geotechnics*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces ISO/TS 17892-6:2004, which has been technically revised. It also incorporates the Technical Corrigendum ISO/TS 17892-6:2004/Cor 1:2006.

A list of all parts in the ISO 17892 series can be found on the ISO website.

Introduction

This document covers areas in the field of geotechnical engineering never previously standardized internationally. 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 Reference [1]).

Geotechnical investigation and testing — Laboratory testing of soil —

Part 6:
Fall cone test

1 Scope

This document specifies a method of undrained strength index testing of both undisturbed and remoulded specimens of fine grained soils by the fall cone method.

This document is applicable to the laboratory estimation of undrained shear strength of a soil test specimen within the scope of geotechnical investigations.

In the fall cone test, a cone is allowed to fall with its tip towards a soil specimen, and the resulting penetration of the cone into the soil is measured. The penetration values are used to estimate the undrained shear strength. The fall cone test produces a complex shear in the test specimen, and does not represent either a vertical triaxial compression or a horizontal shear test. However, this index test may be correlated to some estimate of undrained shear strength determined in the laboratory by other test methods.

As the test is performed on a small laboratory specimen, the result may not agree with laboratory tests on larger specimens. In addition, the test specimen may not be fully representative of the soil in its natural state in the field; for example, the test specimen may not have fissures present *in situ* at a larger spacing than the specimen size.

Therefore, for the above reasons, the test can be regarded as an estimation of undrained shear strength, rather than a true measurement of it.

The ratio of the remoulded shear strength to the undisturbed shear strength may be used to estimate the sensitivity of a soil specimen. Time-dependent measurement of the shear strength may be used to assess the thixotropic regain of strength of a remoulded soil specimen.

NOTE This document fulfils the requirements of the strength index testing of soils for geotechnical investigation and testing in accordance with EN 1997–1 and EN 1997–2.

2 Normative references

The following documents are referred to in text in such a way that some or all of their content constitutes requirements 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.

ISO 14688-1, *Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description*

ISO 17892-1, *Geotechnical investigation and testing — Laboratory testing of soil — Part 1: Determination of water content*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
fall cone undrained shear strength of undisturbed soil
c_{ufc}
undrained shear strength of an undisturbed fine grained soil specimen estimated by the fall cone method

3.2
fall cone undrained shear strength of remoulded soil
c_{urfc}
undrained shear strength of a remoulded fine grained soil specimen estimated by the fall cone method

4 Equipment

See Annex A for calibration requirements for the equipment in this clause.

4.1 Cone apparatus

The apparatus shall permit the cone to be held firmly initially and to be released instantaneously to fall freely in the vertical direction into the soil specimen.

The apparatus shall have a mechanism which allows the cone to be raised or lowered and adjusted so that the tip of the cone just touches the surface of the specimen before the cone is released.

The cone apparatus shall be equipped with a method of measuring the penetration across the range of at least 4 mm to 20 mm penetration. Methods include a linear scale alongside the shaft, or a circular dial with a pointer needle or an electronic transducer, in both cases bearing on the upper end of the shaft. If the scale is designed for manual reading, it shall be marked in increments of 1 mm or better.

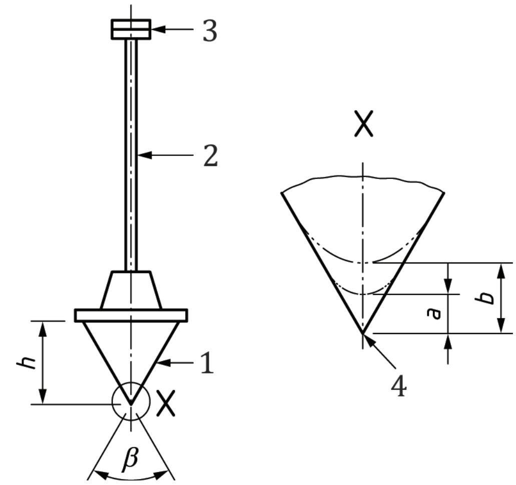
4.2 Fall cones

A set of cones with cone angles of 30° or 60° and masses (i.e. mass of cone plus shaft) covering a range of possible shear strengths shall be used. Typical examples of suitable fall cones are given on Table 1. There is limited experience or validation of cones of alternative configuration, for example, heavier than 400 g. Alternate cones should be used with caution.

Table 1 — Set of fall cones - typical total masses and tip angles

Mass	g	10	60	80	100	400
Tip angle β	°	60	60	30	30	30

A 60 g/60° cone is shown in Figure 1 as a typical example of such a cone.



Key

1	cone	*a*	deviation from the geometrical tip at manufacturing
2	shaft	*b*	maximum wear
3	index mark	*h*	height of the conical tip
4	cone tip	*β*	tip angle

Figure 1 — Example of a fall cone

When penetration readings are taken from a linear scale alongside the shaft, there shall be a distinct index mark for reference near the top of each shaft which shall be clearly visible when viewing the scale.

The cones shall be made of or be coated with a corrosion-resistant material such as stainless steel or chromium, and should have smooth polished surfaces with an average roughness, R_a, of less than 0,8 µm. Cones with significant wear or scratches shall be replaced.

The masses of the cones, together with their shafts, shall be within 1 % of the nominal mass and the tip angles shall be within 0,2° of the nominal angles.

The deviation from the geometrical tip at manufacturing, *a*, shall be less than 0,1 mm. The maximum wear, *b*, shall be less than 0,3 mm (see Figure 1).

The height of the conical tip, *h*, shall be greater than the maximum penetration used in the measurement.

4.3 Ancillary apparatus

— sample extruder;

— wire cutter;

— glass plate and tools to trim undisturbed specimens with flat and parallel ends;

— tools to prepare a remoulded soil specimen such as a spatula and straight edge;

— suitable cup to hold remoulded specimens for testing, shall be made of a rigid non-corrodible material, with a base parallel to the rim and at least 50 mm in diameter and 25 mm in depth;

— equipment as necessary to determine water content.