SLOVENSKI STANDARD
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Geotehnično preiskovanje in preskušanje - Preskušanje geotehničnih konstrukcij - 1. del: Preskušanje nosilnih pilotov s statično osno stiskalno obremenitvijo (ISO/DIS 22477-1:2017)

Geotechnical investigation and testing - Testing of geotechnical structures - Part 1: Pile load test by static axially loaded compression (ISO/DIS 22477-1:2017)

Geotechnische Erkundung und Untersuchung - Prüfung von geotechnischen Bauwerken und Bauwerksteilen - Teil 1: Pfahlprobebelastungen durch statische axiale Druckbelastungen (ISO/DIS 22477-1:2017)

Reconnaissance et essais géotechniques - Essais de structures géotechniques - Partie 1: Essai de charge statique axiale en compression (ISO/DIS 22477-1:2017)

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ICS:

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

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Geotechnical investigation and testing — Testing of geotechnical structures —

Part 1:
Pile load test by static axially loaded compression

Reconnaissance et essais géotechniques — Essais de structures géotechniques —

Partie 1: Essai de charge statique axiale en compression

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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).

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For an explanation on 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 22477-1 was prepared by Technical Committee ISO/TC 182, *Geotechnics*, and by Technical Committee CEN/TC 341, *Geotechnical investigation and testing* in collaboration. The committee responsible for this document is CEN TC341/WG4

ISO 22477 consists of the following parts, under the general title *Geotechnical investigation and testing — Testing of geotechnical structures*:

— *Part 1: Pile load test by static axial compression*

— *Part 2: Pile load test by static axially loaded tension*

— *Part 3: Pile load test by static transversally loaded tension*

— *Part 4: Pile load test by dynamic axially loaded compression test*

— *Part 5: Testing of pre-stressed anchors*

— *Part 6: Testing of nailing*

— *Part 7: Testing of reinforced fill*

Geotechnical investigation and testing — Testing of geotechnical structures —

Part 1:
Pile load test by static axially loaded compression

1 Scope

This Standard establishes the specifications for the execution of static pile load tests in which a single pile is subjected to an axial static load in compression in order to define its load-displacement behaviour.

The provisions of EN 22477-1 apply to vertical piles as well as raking piles.

All types of piles are covered by this standard.

The tests considered in this Standard are limited to maintained load tests. Pile load tests with constant penetration rate and cyclic load tests are not covered by this standard.

EN ISO 22477-1 shall be used in conjunction with EN 1997-1. Numerical values of partial factors for limit states and of correlation factors to derive characteristic values from static pile load tests to be taken into account in design are provided in EN 1997-1.

This Standard provides specifications for:

a) checking that a pile will behave as designed,

b) measuring the resistance of a pile under given geotechnical conditions.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1990, *Eurocode 0: Basis of structural design*.

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

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

EN 1536, *Execution of special geotechnical work — Bored piles*.

EN 10002-2, *Metallic materials — Tensile testing — Part 2 : Verification of the force measuring system of the tensile testing machines*.

EN 12699, *Execution of special geotechnical work — Displacement piles*.

EN 14199, *Execution of special geotechnical work — Micropiles*.

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in EN 1990, EN 1997 and the following apply.

3.1 Terms, definitions

3.1.1
pile load
load applied to the head of the pile during the test

Note 1 to entry: for embedded jack tests, the load may be applied at different levels (see Annex B).

3.1.2
load increment
increment of load added or removed during the course of the test

3.1.3
Equivalent pile base diameter
for noncircular pile sections with A being the area of the relevant pile base, the equivalent diameter equals $\sqrt{(4/\pi).A}$

3.1.4
working pile
pile for the foundation of a structure (EN 1536)

3.1.5
test pile
pile to which loads are applied to determine the resistance-displacement characteristics of the pile and the surrounding ground (EN 1536)

3.1.7
Measured compressive resistance
Measured value of the compressive resistance at the ultimate limit state, in one or several pile load tests

Note 1 to entry: The recommended failure criteria is defined in EN 1997-1.

3.1.6
creep rate
Ratio of the increase in pile head displacement and the logarithm of time during a specified time interval (usually the last 30 min of a load step)

3.2 Symbols

D_b	equivalent pile base diameter
N	axial force
Q	pile load applied to the head of the pile during the test
ΔQ	load increment
$Q_{\max}$	predefined maximum load to be applied for the test
Qb	base load
Qs	shaft friction
Rb	pile base resistance
Rb,m	measured value of Rb in one or several pile load tests
R_c	compressive resistance of the ground against a pile, at the ultimate limit state
$R_{c,cr}$	critical creep load in compression

$R_{c;m}$	**measured value of R_c in one or several pile load tests**
R_s	**pile shaft resistance**
$R_{s,m}$	measured value of R_s in on or several pile load tests
q_s	unit shaft friction
s_h	axial displacement of pile head
s_b	axial displacement of pile base
t	time
z	depth
α	creep rate

4 Equipment

4.1 General

The selection of the equipment shall take into account the aim of the test, the ground conditions, the execution of the test and the expected displacement of the pile under the maximum test load.

4.2 Reaction device

The reaction device for pile compressive loads can be:

— dead load (kentledge);

— ground anchorage either by tension piles or ground anchors;

— a structure over the test pile (e.g. for jacked underpinning piles);

Note : The reaction device can be the test pile itself where the load is applied at depth by one or more hydraulic jacks which are cast into the pile for bi-directional pile loading (see Annex B).

Dead load should not be used for tests of raking piles, unless particular measures are carefully considered with respect to the stability and displacements of the kentledge system.

The influence of the reaction system on the test pile shall be minimised. Minimum required distances are shown in Figures 1a to 1e.

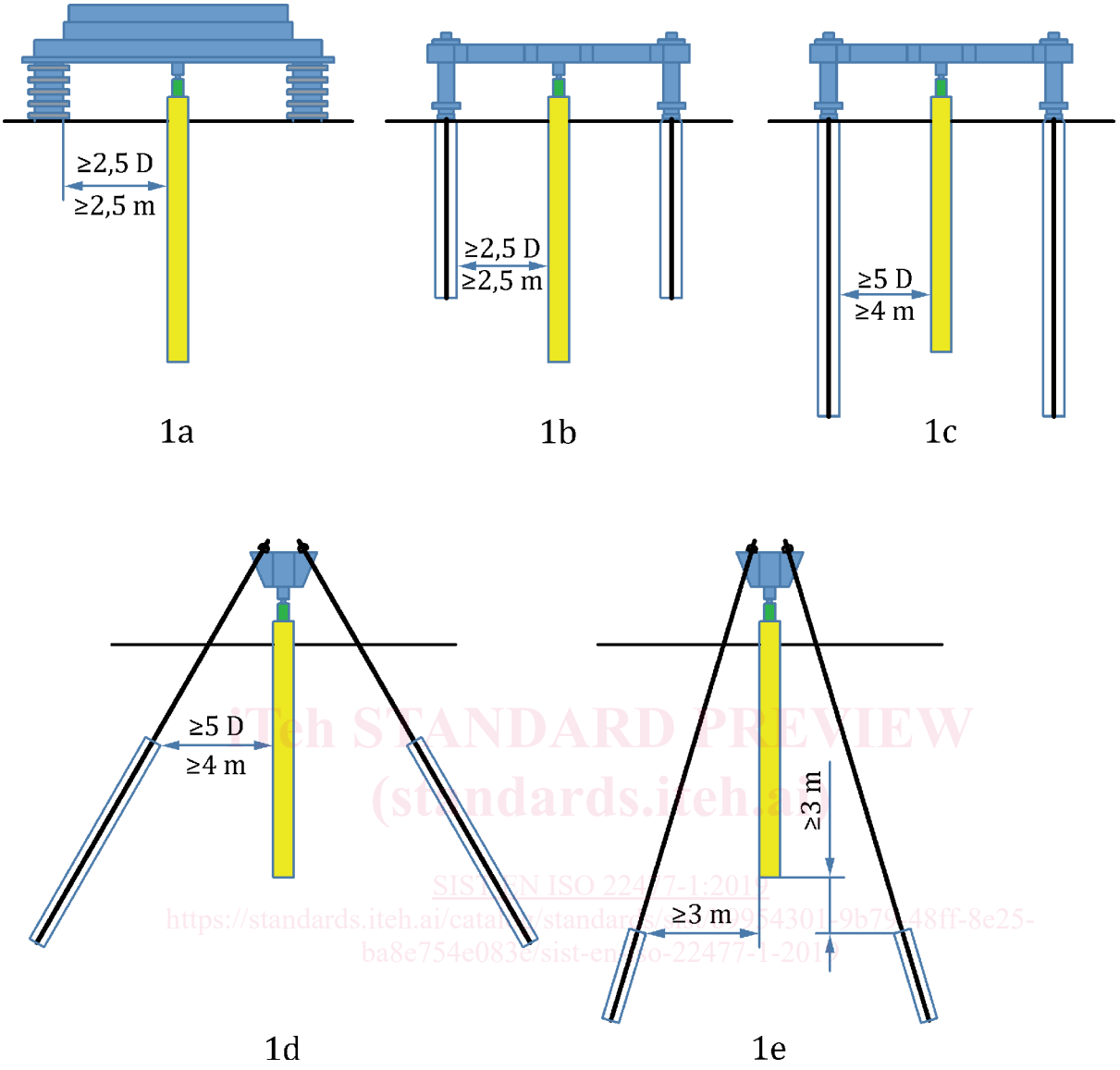

Figure 1 — Reaction system

For static pile load tests on micropiles, this distance may be reduced. However, a minimum clear distance of 1,5 m is recommended.

The reaction system shall be designed to resist the maximum test load Q_{max} in accordance with the relevant European standards.

To avoid excessive uplift or instability of the kentledge, the dead load should be centred and in excess of the maximum test load Q_{max} by at least 10 %.

Working piles may be used as reaction piles, provided that their structural resistance is sufficient and there is no detrimental effect on their ability to perform as part of the structure. The uplift of the working piles shall be monitored during the test and this data included in the test report

Reaction piles and anchors should be arranged symmetrically around the test pile. In cases of non-symmetrical reaction systems measures shall be taken to avoid excessive rotation and/or translation of the reaction system.

4.3 Force input

One or more hydraulic jacks should be used to apply the load on the test pile.

If several hydraulic jacks are used to apply the test load, they shall be arranged symetrically, the same make and model and be supplied by a common supply from one hydraulic unit. Each hydraulic jack shall be provided with a shut-off valve and an additional pressure gauge.

4.3.1 Practical considerations

A spherical seating shall be incorporated above the hydraulic jack.

If a single jack is used, it shall be arranged centrally on the pile cap in order to ensure the pile is loaded axially without eccentricity of loading.

A rigid plate shall be placed on the pile head or cap to distribute the load.

4.3.2 Specifications of force input

The jacking force and stroke of the jack shall exceed Q_{max} and the expected deformations (pile head displacement and those of the reaction system under load).

It shall be possible to decrease or increase the load fluently without any shocks or vibrations and to maintain the load at any required value.

NOTE To satisfy the required accuracies, an automatic and continuous electric or hydraulic control and regulation of the jack force may be used. Alternatively, a hand pump with accurate measurement of pressure or load and permanent regulation may be considered.

The accuracy of the force regulation shall be in accordance to the test purpose.

The accuracy of the force regulator shall be better than 0,5 % of Q_{max} or 5 kN, whichever the greatest.

4.3.3 Measurement of pile head displacements

The displacements of the pile head shall be measured either by dial gauges or transducers, supported from reference beams.

Reference beams should be supported independently from the test pile.

The clear distance between the supporting ends of the reference beams and the test pile and reaction piles or the nearest edge of the kentledge support should be at least 2,5 m or 2.5*D*, whichever is the greatest.

One end of each reference beam should be free to slide.

The position of the reference beams shall be checked by a secondary control measuring system, such as levelling methods or other measurement methods. The position of the pile head should be also checked by this secondary control system.

The axial pile head displacement shall be measured with at least three displacement transducers or dial gauges. They shall be arranged symmetrically (see Figure 1) and parallel to the axis of the pile. The friction between the pile head and the sensors should be minimized by using suitable devices such as glass plates fixed beneath the sensors.