



**SLOVENSKI STANDARD**  
**SIST EN 12699:2002**  
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Uvod

Execution of special geotechnical work - Displacement piles

Ausführung spezieller geotechnischer Arbeiten (Spezialtiefbau) -Verdrängungspfähle

Exécution des travaux géotechniques spéciaux - Pieux avec refoulement de sol

**Ta slovenski standard je istoveten z: EN 12699:2000**

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 12699**

December 2000

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English version

## Execution of special geotechnical work - Displacement piles

Exécution des travaux géotechniques spéciaux - Pieux  
avec refoulement de sol

Ausführung spezieller geotechnischer Arbeiten  
(Spezialtiefbau) - Verdrängungspfähle

This European Standard was approved by CEN on 24 November 2000.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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

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

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## Foreword

This European Standard has been prepared by Technical Committee CEN/TC 288 "Execution of special geotechnical works", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2001, and conflicting national standards shall be withdrawn at the latest by June 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This Standard has been prepared by the Working Group (WG 5) of the Technical committee of the Execution of Special Geotechnical Works (TC 288) of the European Committee for Standardisation (CEN). The general remit of TC 288 is the standardisation of the execution procedures for geotechnical works ( including testing and control methods) and of the required material properties. WG 5 has been working with the subject area of displacement piles.

The document has been prepared to stand alongside ENV 1997 *Eurocode 7 Part 1: Geotechnical Design, General Rules*. Clause 7 of this Standard covers design aspects of piles.

This document has been drafted by a working group comprised of experts from 14 countries and is based on review of 12 national and international codes of practice.

The annexes A und B are informative.

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## 1 Scope

**1.1** This standard establishes general principles for the execution of displacement piles, that means piles which are installed in the ground without excavation or removal of material from the ground except for limiting heave, vibration, removal of obstructions or to assist penetration.

Piles are driven into the ground using impact, vibration, pressing, screwing or a combination of these methods.

**1.2** The material of displacement piles covered by this standard can be :

- steel ;
- cast iron ;
- concrete, mortar ;
- timber ;
- grout ;
- combination of above.

**1.3** This standard covers prefabricated, cast in place, or a combination of these methods to form displacement piles of regular shape.

Examples are given in Figures A.2 and A.3 in annex A.

**1.4** This standard is limited to piles with a diameter or maximum cross sectional dimension greater than 150 mm.

**1.5** Other than practical considerations there are for the purpose of this Standard no limitations regarding shaft or base enlargements, length or rake.

**1.6** The provisions of the standard apply to :

- single piles ;
- pile groups ;
- walls formed by concrete sheet piles.

**1.7** Columns constructed by ground improvement techniques (such as mixed in place columns, jet grouting, compaction grouting, vibro flotation, stone columns) are not covered by this standard. Bored piles are covered in EN 1536. Steel and timber sheet piles walls are covered in EN 12063. Micropiles are covered in (WI 00288010)<sup>1)</sup>.

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<sup>1)</sup> A standard on micropiles is under preparation.



## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 288-2, *Specifications and approval of welding procedures for metallic materials - Part 2 : Welding procedures specifications for arc welding.*

EN 499, *Welding consumables - Covered electrodes for manual metal arc welding of non alloy and fine grain steels - Classification.*

EN 791, *Drill rigs – Safety.*

EN 996, *Piling Equipment - Safety Requirements.*

EN 1536, *Execution of special geotechnical works - Bored piles.*

EN 10248, *Hot rolled sheet piling of non alloy steels.*

EN 25817, *Arc welded joints in steel - guidance on quality levels for imperfections (ISO 5817:1992).*

EN 29692, *Metal-arc welding with covered electrode, gas-shielded metal-arc welding and gas welding - Joint preparations for steel.*

ENV 206, *Concrete - Performance, production, placing and compliance criteria.*

ENV 1991-1, *Eurocode 1- Basis of design and actions on structures - Part 1 : Basis of design.*

ENV 1992-3, *Eurocode 2 : Design of concrete structures - Part 3 : Concrete foundations.*

ENV 1993-5, *Eurocode 3 : Design of steel structures - Part 5 : Piling.*

ENV 1994-1-1, *Eurocode 4 : Design of composite steel and concrete structures - Part 1-1 : General rules and rules for buildings.*

ENV 1995-1-1, *Eurocode 5 - Design of timber structures - Part 1.1 : General rules and rules for buildings.*

ENV 1997-1: 1994, *Eurocode 7 : Geotechnical design - Part 1 : General rules.*

EN ISO 4063, *Welding and allied processes - Nomenclature of processes and reference numbers (ISO 4063:1998).*

prEN 12063, *Execution of special geotechnical work - Sheet pile walls.*

prEN 12794:1997, *Precast concrete foundation piles.*

## 3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply:

### 3.1

#### **displacement pile**

pile which is installed in the ground without excavation or removal of material from the ground except for limiting heave, vibration, removal of obstructions or to assist penetration

**3.2****prefabricated (displacement) pile**

pile or pile element which is manufactured in a single unit or in pile segments before installation

**3.3****cast in place (displacement) pile**

pile installed by driving a closed ended concrete shell or permanent or temporary casing, and filling the hole so formed with plain or reinforced concrete

**3.4****combined pile**

pile made up of two or more types or sizes of piles joined together. The connection between the components is designed to transmit load and to prevent separation during and after construction. (= composite pile) See Figure A.8 of annex A

**3.5****screw pile**

pile in which the pile or pile tube comprises a limited number of helices at its base and which is installed under the combined action of a torque and a vertical thrust. By the screwing-in and/or by the screwing-out, the ground is essentially laterally displaced and virtually no soil is removed. See Figure A.10 of annex A

**3.6****jacked pile**

pile pressed into soil by means of static force

**3.7****grouted pile**

prefabricated pile fitted with an enlarged shoe to create along a part or the full perimeter of the pile a space which is filled during driving with grout, mortar or microconcrete. See Figure A.11 of annex A

**3.8****post grouted pile**

pile where shaft and/or base grouting is performed after installation through pipes fixed along or incorporated in the pile. See Figure A.12 of annex A

**3.9****casing**

steel tube used temporarily or permanently to support shaft walls during the construction of a pile. In permanent situation the casing can act as a protective or load bearing unit

**3.10****drive tube**

steel tube used to displace the ground during the formation of a driven, cast in place pile. Drive tube is withdrawn during concreting

**3.11****liner, lining**

a tube, generally of thin steel plate, forming part of the shaft of a pile, e.g. used for the protection of pile shafts in soft or aggressive grounds or to reduce negative skin friction

**3.12****pile joint**

means of joining lengths of pile elements either by welding or by mechanical joints (examples see Figures A.7, A.8 and A.9 of annex A)

**3.13****pile shoe**

shoe or point fitted to the base of a pile or drive tube to form the toe (examples see Figures A.4a to A.4h and A.13 of annex A)

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**3.14****wings**

shaft enlargements to steel piles formed by welding steel sections to the pile. (see example in Figure A.2j of annex A)

**3.15****leader**

steel sections used for guiding driving equipment and/or pile during driving. See Figure A.6 of annex A

**3.16****impact hammer**

tool of construction equipment for driving piles by impact (striking or falling mass)

**3.17****vibrator (vibrating hammer)**

tool of construction equipment for driving or extracting piles, drive tubes or casing by the application of vibratory forces

**3.18****helmet**

device, usually steel, placed between the base of the impact hammer and the pile or drive tube so as to uniformly distribute the hammer impact to the top of the pile. See Figure A.6 of annex A

**3.19****hammer cushion**

device or material placed between the impact hammer and the helmet to protect the hammer and the pile head from destructive direct impact. The hammer cushion material shall have enough stiffness to transmit hammer energy efficiently into the pile. See Figure A.6 of annex A

**3.20****pile cushion**

material, usually softwood, placed between the helmet and the top of a precast concrete pile. See Figure A.6 of annex A

**3.21****follower**

a temporary extension, used during driving, that permits the driving of the pile top below ground surface, water surface, or below the lowest point to which the driving equipment can reach without disengagement from the leaders

**3.22****mandrel**

a steel core for driving that is inserted into a closed-end tubular pile. After installation the mandrel is withdrawn

**3.23****driving**

method to bring the piles into the ground to the required depth, such as hammering, vibrating, pressing, screwing or by a combination of these or other methods

**3.24****driven pile**

pile which is forced into the soil by driving, the soil being displaced by the pile or drive tube

**3.25****driving assistance**

method used to assist a pile to penetrate the ground e.g. jetting, preboring, preblasting, predriving

**3.26****coring**

removal of soil by core sampler (e.g. to mitigate the effects of heave by pile driving)

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- 3.27  
jetting**  
use of pressurised water to facilitate the driving of a pile by means of hydraulic displacement of parts of the soil
- 3.28  
preboring (preaugering, predrilling)**  
boring through obstructions or materials too dense to penetrate with the planned pile type and driving equipment
- 3.29  
grouting**  
injection of a fluid cementitious mixture (e.g. cement grout, mortar, micro concrete)
- 3.30  
restrike**  
a single hammer blow to a prefabricated pile that is monitored for energy input and measurement of pile strain/acceleration and/or pile set are made, to allow assessment of pile bearing resistance
- 3.31  
redrive (1)**  
an additional series of hammer blows used to drive the prefabricated pile to re-establish the required driving resistance
- 3.32  
redrive (2)**  
method used to form an enlarged shaft on a temporarily cased driven cast in place pile
- 3.33  
initial pile**  
first working pile on construction site
- 3.34  
test pile**  
pile to which a load is applied to determine the resistance deformation characteristics of the pile and surrounding ground
- 3.35  
trial pile**  
pile installed to assess the practicability and suitability of the construction method for a particular application
- 3.36  
preliminary pile**  
pile installed before the commencement of the main piling works or section of the works for the purpose of establishing the suitability of the chosen type of pile, driving equipment and/or for confirming the design, dimensions and bearing capacity
- 3.37  
driving criteria**  
driving parameters used to be fulfilled when driving a pile
- 3.38  
set**  
mean permanent penetration of a pile in the ground per blow measured by a series of blows
- 3.39  
monitoring**  
the passive role of checking the technical quality of the piling process
- 3.40  
supervision**  
the active role of overseeing or directing the piling operations

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**3.41****recording**

to make a permanent record of the facts relating to the piling operations and aspects monitored

**3.42****maintained load pile test**

static loading test in which a testpile has loads applied in incremental stages, each of which is held constant for a certain period or until pile motion has virtually ceased or has reached a prescribed limit (ML - test)

**3.43****constant rate of penetration pile load test**

static loading test in which a test pile is forced into the ground at a constant rate and the force is measured (CRP - test)

**3.44****dynamic pile load test**

loading test where a pile is subjected at the pile head to a dynamic force for analysis of its load bearing capacity

**3.45****sonic test , low strain integrity test**

integrity test where a series of waves is passed between a transmitter and a receiver through the concrete of a pile and where the characteristics of the received waves are measured and used to infer continuity and section variations of the pile shaft

**3.46****sonic coring**

sonic integrity test of pile concrete carried out from core drillings in a pile shaft or from a pre-placed tube system

**3.47****working level**

level of the piling platform on which the piling rig works. See Figure A.13 of annex A

**3.48****casting level**

final level to which the concrete is cast. It is above the cut off level by a margin depending on the execution procedure. See Figure A.13 of annex A

**3.49****cut off level**

prescribed level to which a pile is cut or trimmed back to before connecting it to the superstructure. See Figure A.13 of annex A

**3.50****toe level**

lowest level of pile. See Figure A.13 of annex A

**3.51****pile top**

upper area of pile. See Figure A.13 of annex A

**3.52****pile head**

upper part of pile. See Figure A.13 of annex A

**3.53****pile shaft**

the body of the pile between the head and the base. See Figure A.13 of annex A

**3.54****pile bottom**

lower part of a pile. See Figure A.13 of annex A

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- 3.55**  
**pile base**  
bottom area of pile. See Figure A.13 of annex A
- 3.56**  
**cathodic protection**  
a means of protecting steel piles from corrosion by providing a consumable anode or by applying an external electrical potential
- 3.57**  
**stray current**  
direct current that is induced in the soil which can cause corrosion of a pile
- 3.58**  
**initial set**  
stage after mixing concrete when it turns from liquid to solid
- 3.59**  
**second choice**  
prefabricated section originally manufactured for other purposes but accepted as suitable for use as a pile e.g. steel pipe for oil
- 3.60**  
**heave**  
upward movement of ground or pile
- 3.61**  
**brooming**  
separation of fibres at the toe or head of a timber pile
- NOTE In EN 1536 annex A there is an explanation of common piling terms.

## 4 Information needed

**4.1** Any information relevant to the execution of the works on site shall be provided with the specification for the works.

**4.2** The following minimum information should be considered and made available before commencement on site :

- a) ground investigation report(s) at the construction site, as well as additional information of the subsoil at the building site, such as the presence of **(standards.iteh.ai)**
- structure and foundation remnants ; [SIST EN 12699:2002](https://standards.iteh.ai/catalog/standards/sist/977a6dd9-607b-45cd-a33c-410052cc9/sist-en-12699-2002)
  - artificial elements (utility lines and services) ; <https://standards.iteh.ai/catalog/standards/sist/977a6dd9-607b-45cd-a33c-410052cc9/sist-en-12699-2002>
  - underground contamination or hazards ;
  - presence of fill material ;
  - obstructions ;
- b) specifications on design and execution of the piling works and additional requirements for the supervision, monitoring or testing of the works ;
- c) present topographic data, such as :
- slope, actual ground level ;

- location of main grid lines and site datum level ;
  - piling platform level(s) related to site datum ;
- d) site conditions and limitations which can affect the piling work, such as :
- size of working area, topography, slope, access roads, access limitations for equipment and materials, head-room restrictions ;
  - concurrent activities , e.g. dewatering, tunnelling, deep excavations ;
  - presence of trees, overhead cables / power lines ;
  - proximity of potential unstable slopes ;
- e) environmental conditions and limitations which can affect the piling work, in relation with :
- presence and condition of sensitive buildings or installations in the vicinity of the piling works ;
  - environmental restrictions e.g. on noise, vibration or pollution ;
  - any legal or statutory restrictions e.g. time restrictions ;
- f) other aspects such as :
- possible corrosion and abrasion problems ;
  - previous experience with displacement piles or other foundation methods on or adjacent to the site ;
  - foundations of adjacent buildings.

**4.3** Any additional or deviating requirements falling within the permission clauses given in this standard shall be established and agreed before the commencement of the works and the quality control system shall be suitably amended, e.g. for :

- reduced or increased geometrical construction deviations ;
- application of different alternative construction materials ;
- special reinforcement, e.g. the use of steel tube or steel sections or fibres (steel or manmade) ;
- grouting of pile shafts or bases ;
- use of rock shoes ;
- use of driving assistance (preboring, waterjetting, ...)
- use of friction reducing coatings.

## 5 Site investigation

**5.1** The general requirements for the ground investigation are contained in ENV 1997-1:1994.

**5.2** The ground investigation shall be sufficiently extended to recognise the presence of all ground formations and layers affecting the construction and performance of the piles, and to determine their characteristic strength and deformation properties required for the design.

**5.3** The following information, when relevant for the execution of displacement piles should be given in the ground investigation report(s) :