



SLOVENSKI STANDARD
SIST EN 1536:2002
01-julij-2002

izvajanje specialnih geotehniških del - Borene pile

Execution of special geotechnical work - Bored piles

Ausführung spezieller geotechnischer Arbeiten (Spezialtiefbau) - Bohrpfähle

Exécution des travaux géotechniques spéciaux - Pieux forés

Ta slovenski standard je istoveten z: **EN 1536:1999**

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1536

February 1999

ICS 93.020

English version

Execution of special geotechnical work - Bored piles

Exécution des travaux géotechniques spéciaux - Pieux
forés

Ausführung spezieller geotechnischer Arbeiten
(Spezialtiefbau) - Bohrpfähle

This European Standard was approved by CEN on 1 June 1997.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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 Central Secretariat has the same status as the official versions.

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

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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of an identical text or by endorsement, at the latest by August 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.

The 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 3 has been charged with the subject area of bored piles, including barrettes but not "mini piles" of diameter less than 0,3 m.

For bored piles not included in this European Standard, the construction should follow, as far as applicable, the general principles of this EN 1536.

The document has been prepared to stand along side with ENV 1997-1: Eurocode 7: Geotechnical design - Part 1: General rules. Clause 7 "Design related considerations" of this European Standard expands on design only where necessary (e.g. the detailing of reinforcement) but provides full coverage of the construction and supervision requirements.

It has been drafted by a working group comprising delegates from 11 countries and against a background of more than 30 pre-existing piling standards and codes of practice both national and international. In view of different construction methods used internationally and the respective experience it can be necessary to supplement this European Standard or parts of it by a National Foreword to cater for specific or local situations.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are to bound to implement this European Standard: Austria, Belgium, Czechovakia, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

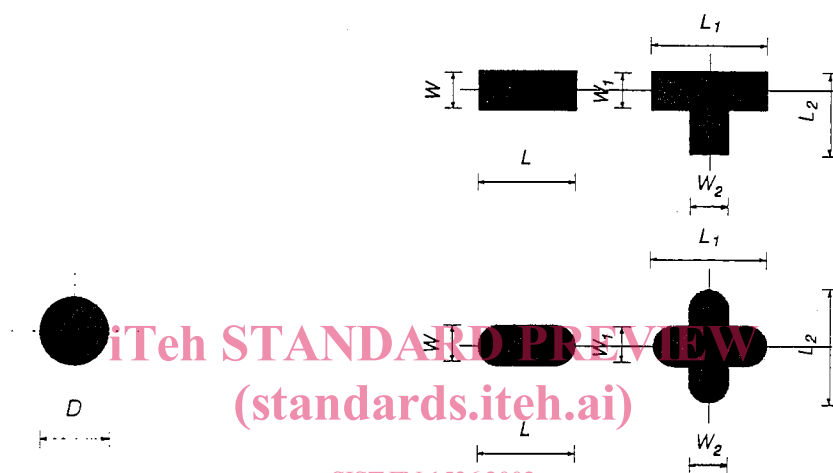
1 Scope

1.1 This European Standard establishes general principles for the construction of piles

- which are formed in the ground by excavation and
- which contain a structural member to transfer loads and or limit deformations.

1.2 This European Standard covers

- piles with circular shape (see figure 1) and
- piles with barrette shape, provided the section is concreted in a single operation.



D : Pile diameter

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L : Barrette length

W : Barrette thickness

A : Cross-sectional area of the shaft

Figure 1 : Circular bored pile

Figure 2 : Examples of barrette piles and dimensions

1.3 The barrette shapes covered are rectangular, T- or L shaped in plan or any other similar configuration (see figure 2).

1.4 This European Standard covers piles with:

- uniform cross-section (straight shaft);
- telescopically changing shaft dimensions;
- excavated base enlargements; or
- excavated shaft enlargements

(see figure 3).

NOTE : The shape of the pile base and of an enlargement can depend on the tool used for the excavation.

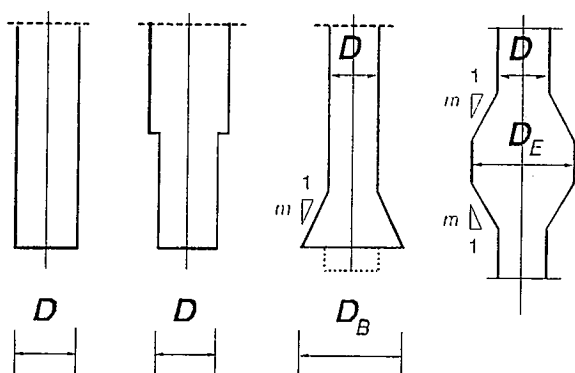


Figure 3 : Examples for straight shaft piles and piles with shaft and base enlargement

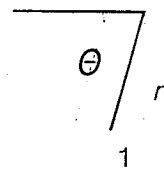


Figure 4 : Definition of the rake

1.5 The provisions of this European Standard apply to piles with the following dimensions :

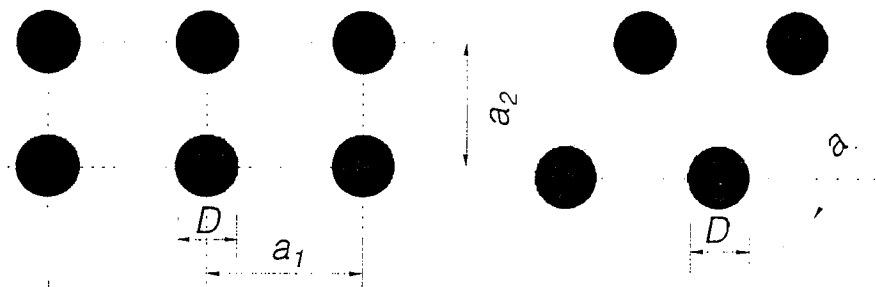
- shaft diameter : $0,3 \leq D \leq 3,0$ m (see figure 1 and figure 3);
- dimension for cast-in-place barrette piles : $W_i \geq 0,4$ m (see figure 2);
- ratio between the dimensions : $L_i / W_i \leq 6$
where:
 L_i is the largest dimension of a cast-in-place barrette pile and
 W_i is the least dimension of a cast-in-place barrette pile (see figure 2);
- least dimension $\geq 0,3$ m for precast elements used in barrette piles or piles:
 $D_p \geq 0,3$ m and
 $W_p \geq 0,3$ m respectively
where:
 D_p is the diameter of a circular precast element;
 W_p is the thickness of a rectangular precast element;
- rake generally : $n \geq 4$ ($\theta \geq 76^\circ$) (see figure 4) ;
- rake for permanently cased piles : $n \geq 3$ ($\theta \geq 72^\circ$);
- base enlargements or cross-sectional area of barrette piles: $A \leq 10$ m² ;

1.6 Shaft or base enlargements covered by this European Standard are:

- base enlargements in non-cohesive ground :
 $D_B / D \leq 2$ and
in cohesive ground : $D_B / D \leq 3$;
- shaft enlargements in any ground : $D_E / D \leq 2$;
- slope of the enlargement in non-cohesive ground :
 $m \geq 3$ and
in cohesive ground : $m \geq 1,5$
(see figure 3).

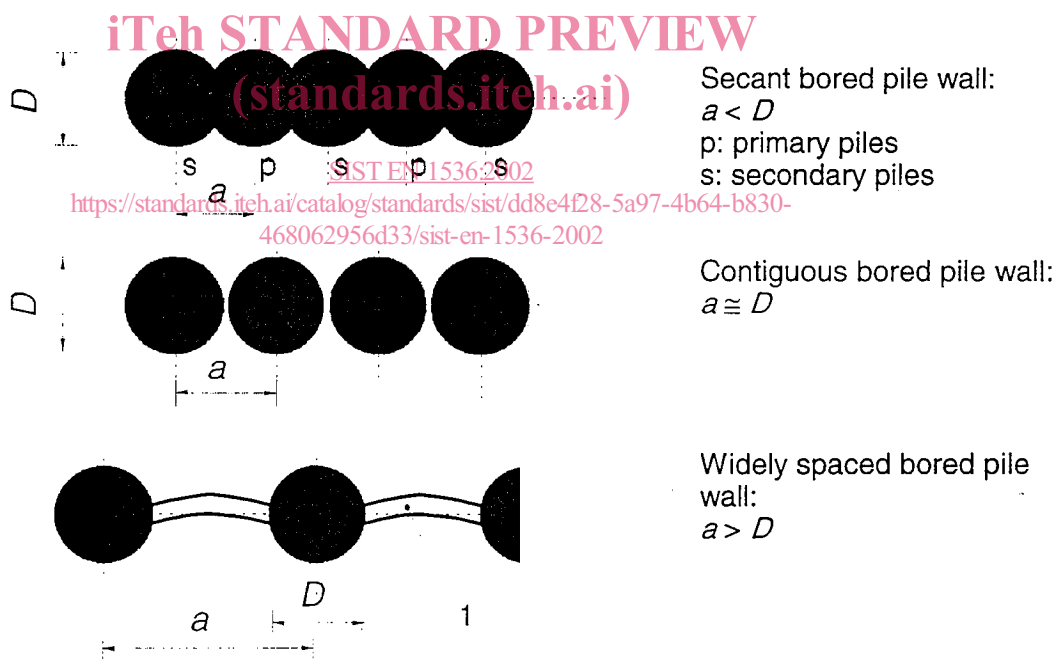
1.7 The provisions of this European Standard apply to :

- single piles;
- pile groups (see figure 5);
- walls formed by piles (see figure 6).



D : Shaft diameter
 a : Distance of the piles according to design

Figure 5 : Examples of pile groups



a : Distance of the piles
1: Lagging

Figure 6 : Examples of bored pile walls

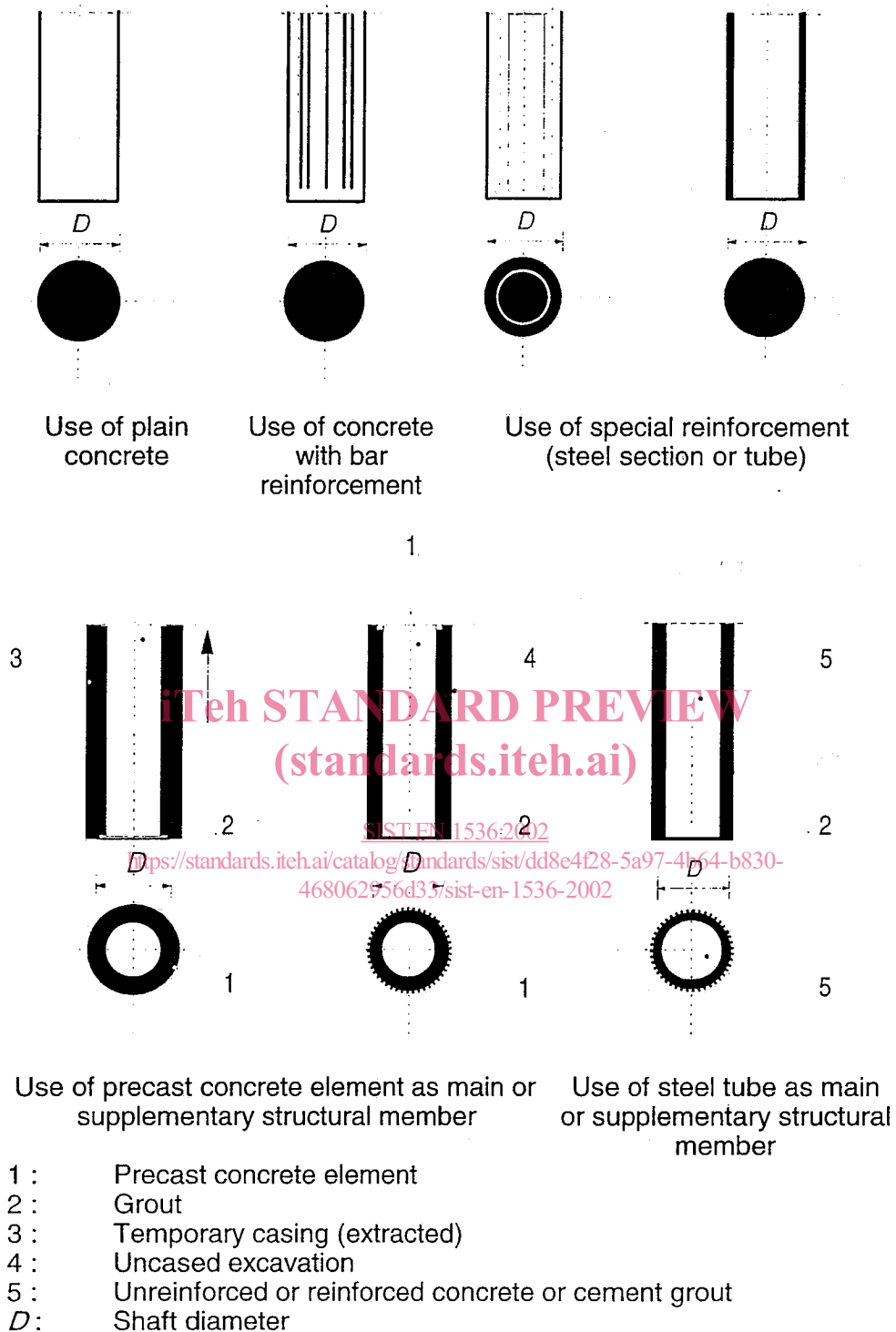


Figure 7 : Examples of circular piles

1.8 The piles which are the subject of this European Standard can be excavated by continuous or discontinuous methods using support methods for stabilizing the excavation walls where required.

1.9 This European Standard applies only to construction methods that allow the designed cross-sections to be produced.

1.10 The provisions apply to piles where the bearing member is constructed

- of unreinforced (plain) concrete,
- of reinforced concrete,
- of concrete reinforced by means of special reinforcement such as steel tubes, steel sections or steel fibres,
- of precast concrete (including prestressed concrete) elements or steel tubes where the annular gap between the element or tube and the ground is filled by concrete, cement or cement-bentonite grout

(see figure 7).

1.11 Micropiles, mixed-in-place columns, columns constructed by jet grouting, ground improvement for piling, mixed-in-place pile bases and diaphragm walls are not covered by this European Standard.

2 Normative references

NOTE 1 : This European Standard incorporates by 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.

NOTE 2 : Exceptionally, the list of normative references contains also European Standards and Prestandards which are at the draft stage. If one of those documents has become a European Standard, the references shall be checked.

2.1 Users of this European Standard shall satisfy themselves that the standards and other references used are current issues and that there is compatibility between the reference documents employed.

2.2 List of documents to which normative reference is made in the text :

ENV 197-1	1992	Cement - Composition, specifications and conformity criteria - Part 1: Common cements
ENV 206	1990	Concrete - Performance, production, placing and compliance criteria
EN 791	1996	Drill rigs - safety
prEN 1008	1997	Mixing water for concrete - Specification for sampling, testing and assessing the suitability of water, including wash water from recycling installations in the concrete industry as mixing water for concrete
EN 1538	1998	Execution of special geotechnical works - Diaphragm walls
ENV 1991-1	1994	Eurocode 1 : Basis of design and actions on structures - Part 1: Basis of design
ENV 1992-1-1	1991	Eurocode 2 : Design of concrete structures - Part 1-1 : General rules and rules for buildings
ENV 1994-1-1	1992	Eurocode 4 : Design of composite steel and concrete structures - Part 1-1: General rules for buildings
ENV 1997-1	1994	Eurocode 7 : Geotechnical design - Part 1: General rules
EN 10025	1990	Hot rolled products of non-alloy structural steels - Technical delivery conditions
ENV 10080	1995	Steel for reinforcement of concrete, weldable ribbed reinforcing steel B 500 - Technical delivery conditions for bars, coils and welded fabric
EN 10210-1	1994	Hot finished structural hollow sections of non-alloy and fine grain structural steels - Part 1: Technical delivery requirements
prEN 12620	1996	Aggregates for concrete including those for use in roads and pavements

3 Definitions

NOTE : The following definitions are used for the construction of bored piles covered by this European Standard. Additional explanations of piling terms are listed in Annex A. For the purposes of this European Standard, the following definitions apply.

3.1 pile

fr : **pieu**
de : **Pfahl**

Slender structural member in the ground for the transfer of actions. For the purpose of this European Standard the slenderness ratio is not limited.

3.2 bored pile

fr : **pieu foré**
de : **Bohrpfahl**

Pile formed with or without a pile casing by excavating or boring a hole in the ground and filling with plain or reinforced concrete.

3.3 barrette

fr : barrette
de : Schlitzwandelement

Discrete length of diaphragm wall, usually short, or a number of interconnecting lengths cast simultaneously (e.g. L-, T- or cruciform shapes), used to support vertical and/or lateral loads.

3.4 compression pile

fr : pieu en compression
de : Druckpfahl

Pile to resist compressive forces.

3.5 continuous flight auger pile (CFA-pile)

fr : pieu à la tarière continue creuse (CFA)
de : Schneckenbohrpfahl

Bored pile formed by means of a hollow stemmed continuous flight auger through the stem of which concrete or grout is pumped as the auger is extracted (see figure A.9).

3.6 end bearing pile

fr : pieu travaillant en pointe
de : Spitzendruckpfahl

Pile transmitting forces to the ground mainly by compression on its base.

3.7 enlarged base

fr : base élargie
de : Fußaufweitung

Base of a pile formed to have an area greater than that of its shaft. For bored piles, normally constructed by the use of special underreaming or bellong-out tools (see figure 3).

3.8 friction pile

fr : pieu flottant
de : Reibungspfahl

Pile transmitting actions to the ground mainly by friction and adhesion between the lateral surface of the pile and the adjacent ground.

3.9 prepacked pile

fr : pieu ballasté injecté
de : Prepacked-Pfahl

Pile where the completed excavation is filled with coarse aggregate which is subsequently injected with cement mortar from the bottom up.

3.10 shaft diameter

fr : diamètre du fût
de : Pfahldurchmesser

Diameter of the part of the pile between the pile head and the pile base :

- a) for bored piles constructed with casings: equal to external diameter of the casing ;
- b) for bored piles constructed without a casing: equal to the maximum diameter of the boring tool.

3.11 tension pile

fr : pieu en traction
de : Zugpfahl

Pile designed to resist tensile forces.

3.12 preliminary pile

fr : pieu préliminaire
de : Probepfahl (1)

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 and/or for confirming the design, dimensions and bearing capacity.

3.13 trial pile

fr : pieu de faisabilité
de : Probepfahl (2)

Pile installed to assess the practicability and suitability of the construction method for a particular application.

3.14 test pile

fr : **pieu d'essai**
de : **Probepfahl (3)**

Pile to which loads are applied to determine the resistance deformation characteristics of the pile and the surrounding ground.

3.15 working pile

fr : **pieu de fondation**
de : **Bauwerkspfahl**

Pile for the foundation of a structure.

3.16 static pile test

fr : **essai de chargement statique de pieu**
de : **statische Probelastung**

Loading test where a pile is subjected to chosen axial and/or lateral forces at the pile head for the analysis of its capacity.

3.17 maintained load pile test

fr : **essai de chargement par palier**
de : **lastgesteuerte Probelastung**

Static loading test in which a test pile 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).

3.18 constant rate of penetration test

fr : **essai de chargement à vitesse d'enfoncement constante**
de : **weggesteuerte Probelastung**

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

3.19 dynamic pile test

fr : **essai de chargement dynamique de pieu**
de : **dynamischer Pfahlversuch**

Loading test where a dynamic force is applied at the pile head for assessment of pile capacity.

3.20 integrity test

fr : **essai d'intégrité**
de : **Integritätsprüfung**

Test carried out on an installed pile for the verification of soundness of materials and of the pile geometry.

3.21 sonic test

fr : **essai d'auscultation sonore par réflexion**
de : **Ultraschallversuch**

Integrity test of a pile where a series of sonic 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.

3.22 sonic coring

fr : **essai d'auscultation sonore par transparence**
de : **Ultraschallversuch im Pfahl**

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

4 Needs for the construction of bored piles

4.1 Any information important for the execution for the works on site should :

- a) be provided with the specifications of the works;
- b) be available before commencement on site; and
- c) include:
 - the geotechnical information (see clause 5);
 - the site conditions, (e.g. size, site boundaries, topography, slope, access, limitations);
 - existence, location and condition of adjacent structures, (e.g. buildings, roads, utilities or services), underground structures and foundations, archaeological remains, headroom restrictions (e.g. power lines);
 - underground contamination or hazards that can affect the execution method, the working safety or the discharge of excavation material from the site;
 - environmental restrictions (e.g. on noise, vibration or pollution) and any legal or statutory restrictions;
 - the design and specifications for the works;
 - all necessary or relevant information for the production of the working drawings and method statements (where required);
 - previous experience with bored piling or other foundations or underground works on or adjacent to the site;
 - concurrent activities which can affect the work (e.g. dewatering, tunnelling, deep excavation);
 - additional requirements for the supervision, monitoring or testing of the works;
 - functional requirements for water tightness at joints of bored pile walls;
 - the location of main grid lines for setting out.

4.2 Necessity, extent, procedure and responsibility for any survey of the conditions of structures, roads, services, etc. adjacent to the works area shall be established. The survey shall be carried out and be available prior to the commencement of the works.

4.3 Bored piling works shall conform with this European Standard provided the criteria and requirements set out in the following clauses have been observed. A suitable quality control system shall be established for supervision and monitoring.

4.4 Any additional or deviating requirements falling within the permissions given in this European Standard shall be established and agreed before the commencement of the works and the quality control system shall be suitably amended.