



SLOVENSKI STANDARD
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01-september-2015

Nadomešča:
SIST EN 1536:2011

Izvedba posebnih geotehničnih del - Uvrtani piloti

Execution of special geotechnical work - Bored piles

Ausführung von Arbeiten im Spezialtiefbau - Bohrpfähle

Exécution des travaux géotechniques spéciaux - Pieux forés

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EUROPEAN STANDARD

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Execution of special geotechnical work - Bored piles

Exécution des travaux géotechniques spéciaux - Pieux
forés

Ausführung von Arbeiten im Spezialtiefbau - Bohrpfähle

This European Standard was approved by CEN on 2 July 2010 and includes Amendment 1 approved by CEN on 17 April 2015.

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COMITÉ EUROPÉEN DE NORMALISATION
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EN 1536:2010+A1:2015 (E)**Foreword**

This document (EN 1536:2010+A1:2015) 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of an identical text or by endorsement, at the latest by December 2015, and conflicting national standards shall be withdrawn at the latest by December 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes A1 EN 1536:2010 A1.

This document includes Amendment 1 approved by CEN on 2015-04-17.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

The general scope of TC 288 is the standardisation of the execution procedures for geotechnical works (including testing and control methods) and of the required material properties. WG15 has been charged to revise EN 1536:1999, with the subject area of bored piles, including barrettes, but not "micro piles" of diameter less than 0,3 m.

The design, planning and execution of bored piles call for experience and knowledge in this specialised field. The execution phase requires skilled and qualified personnel and the present standard cannot replace the expertise of specialist contractor.

The document has been prepared to complement EN 1997-1, *Eurocode 7: Geotechnical design — Part 1: General rules* and EN 1997-2, *Eurocode 7 — Geotechnical design — Part 2: Ground investigation and testing*. Clause 7 "Considerations related to design" 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.

A1 The amendment became necessary to accord the Standard EN 1536:2010 with EN 206:2013, Concrete – Specification, performance, production and conformity. EN 206:2013 has been revised to contain also the specific requirements for concrete for applications for special geotechnical works, making redundant respective provisions in EN 1536 (e.g. 6.1, 6.3 and 8.8).

Full according with EN 13670, Execution of concrete structures is however still pending. EN 1536:2010+A1:2015 therefore still contains specific requirements for bored piles as a concrete structure, such as the detailing of the reinforcement, the concrete placement and the supervision of concreting process which are complementing the provisions of EN 13670.

In addition, some editorial corrections were made in this amended Standard. A1

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

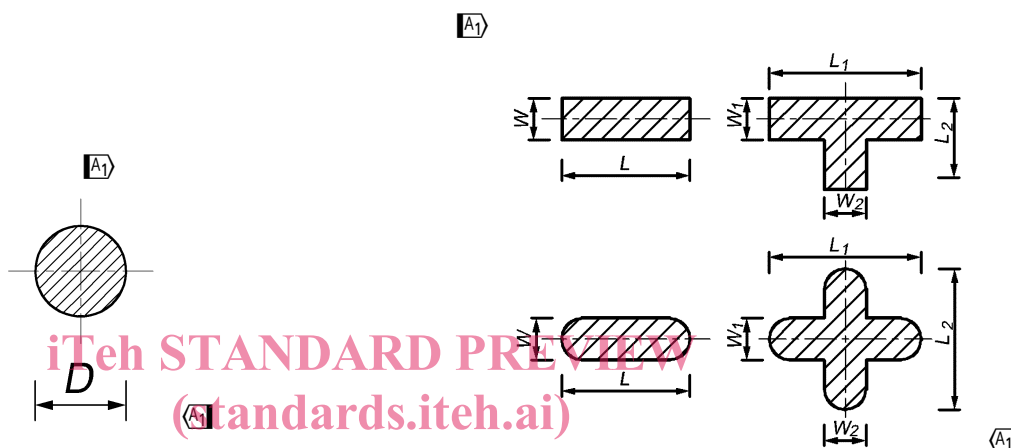
1 Scope

1.1 This European Standard establishes general principles for the execution of bored piles (see 3.2).

NOTE 1 This standard covers piles or barrettes which are formed in the ground by excavation and are structural members used to transfer actions and/or limit deformations.

NOTE 2 This standard covers piles with circular cross-section (see Figures 1 and A.1a)) and barrettes (see 3.3) with rectangular, T or L or any other similar cross-section (see Figure 2) concreted in a single operation.

NOTE 3 In the standard the term pile is used for circular cross-section structure and the term barrette for other shapes. Both are bored piles.



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Key

D Shaft diameter

Key

L Barrette length

W Barrette thickness

A Cross-sectional area of the shaft

Figure 1 — Bored pile with circular cross-section

Figure 2 — Bored pile with non circular cross-section (barrettes)

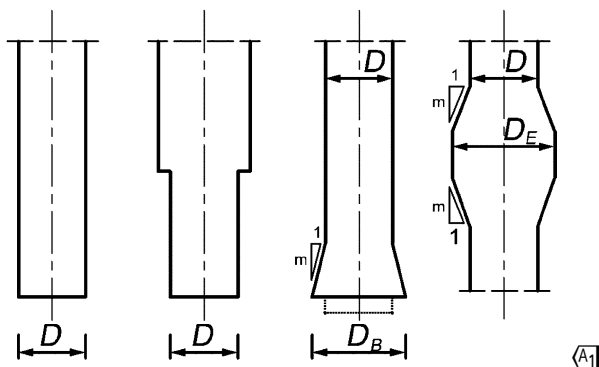
1.2 This European Standard applies to bored piles (see Figure 3) with:

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

NOTE The shape of a pile base and of an enlargement depends on the tool used for the excavation.

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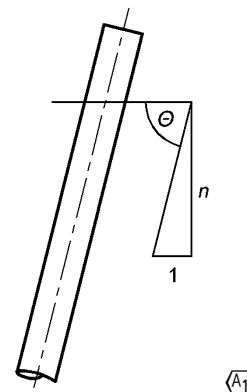


Key

- D Shaft diameter
- D_B Base enlargement diameter
- D_E Shaft enlargement diameter

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

A1



Key

- n Rake

Figure 4 — Definition of the rake

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1.3 This European Standard applies (see Note) to:

- bored piles with a depth to width ratio ≥ 5 ;
- piles (see Figures 1 and 3) with a shaft diameter $0,3 \text{ m} \leq D \leq 3,0 \text{ m}$;
- barrettes (see Figure 2) with the least dimension $W_i \geq 0,4 \text{ m}$, a ratio L_i / W_i between its largest and its least dimensions ≤ 6 and a cross-sectional area $A \leq 15 \text{ m}^2$;
- piles with circular precast elements used as structural member (see Figure 7) with a least dimension $D_p \geq 0,3 \text{ m}$;
- barrettes with rectangular precast elements used as structural member with a least dimension $W_p \geq 0,3 \text{ m}$.

NOTE The standard covers a large range of diameters. For small diameter bored piles less than 450 mm, the general specification can be adapted to cater for the lack of space (e.g. minimum bars number and spacing).

1.4 This European Standard applies to piles with the following rake (see Figure 4):

- $n \geq 4$ ($\theta \geq 76^\circ$);
- $n \geq 3$ ($\theta \geq 72^\circ$) for permanently cased piles.

1.5 This European Standard applies to bored piles with the following dimensions of the shaft or base enlargements (see Figure 3):

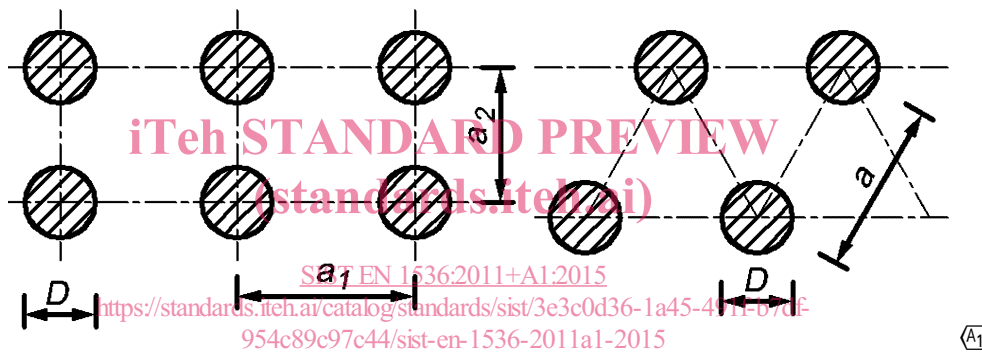
- a) base enlargements:
 - 1) in non-cohesive ground: $D_B / D \leq 2$;
 - 2) in cohesive ground: $D_B / D \leq 3$;

- b) shaft enlargements in any ground: $D_E / D \leq 2$;
- c) slope of the enlargement in non-cohesive ground $m \geq 3$;
 - 1) in non-cohesive ground: $m \geq 3$;
 - 2) in cohesive ground: $m \geq 1,5$;
- d) base enlargements area of barrettes: $A \leq 15 \text{ m}^2$;

1.6 The provisions of this European Standard apply to:

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

A1



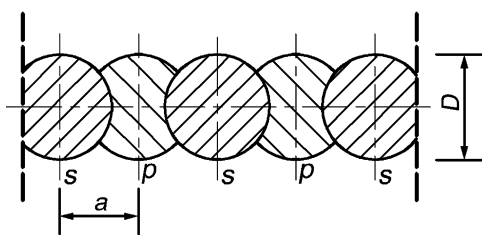
Key

- D Shaft diameter
- a_i Centre to centre spacing of the piles

Figure 5 — Examples of pile groups

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A1



$$a < D$$

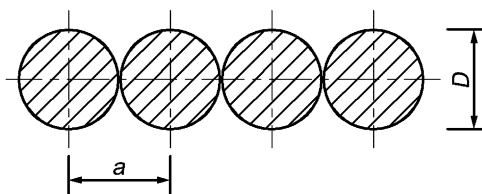
p primary piles

s secondary piles

A1

a) Secant pile wall

A1



$$a \cong D$$

A1

b) Contiguous pile wall

A1



$$a > D$$

A1

c) Widely spaced pile wall

Key

- a Centre to centre spacing of the piles
 D Shaft diameter
 1 Lagging

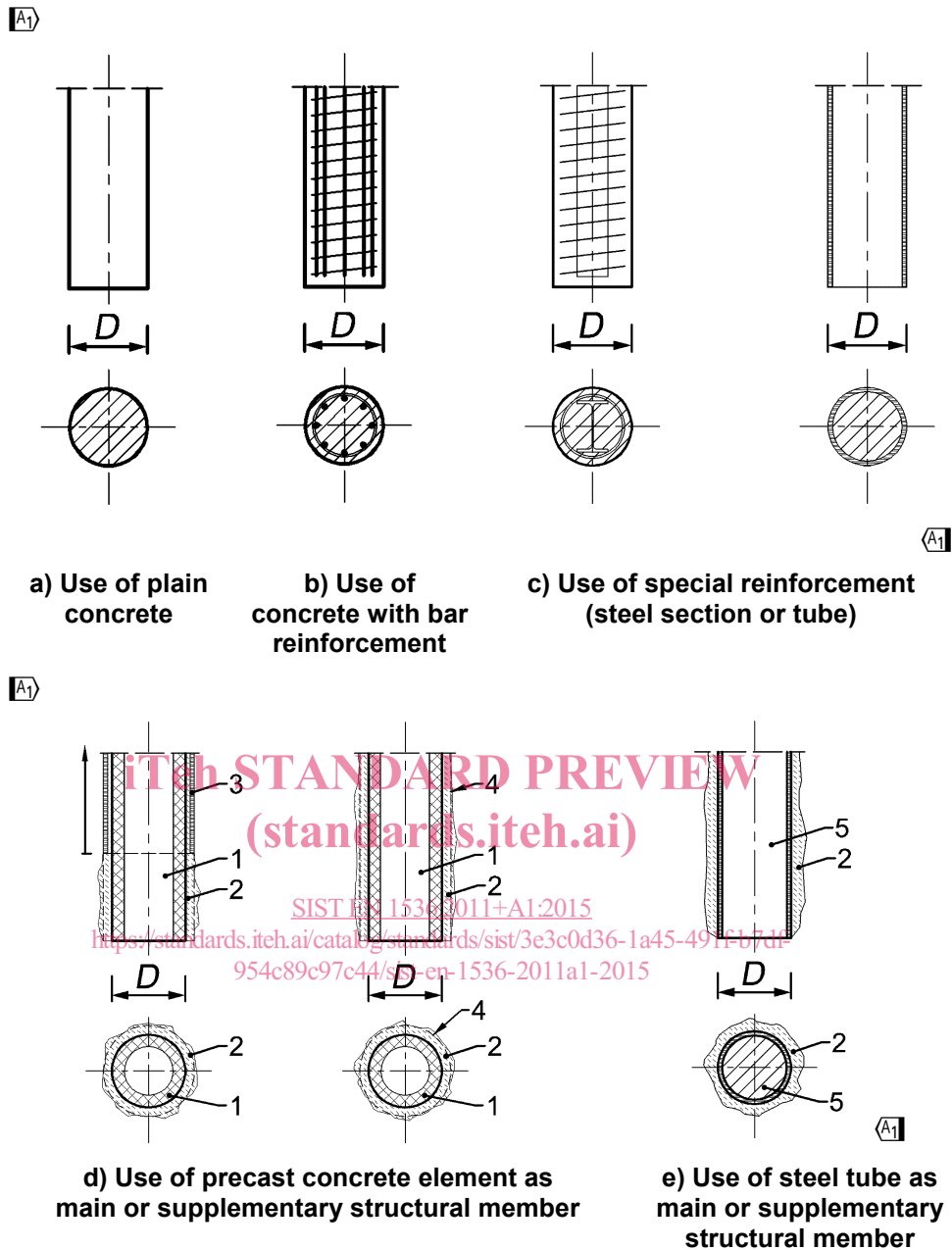
Figure 6 — Examples of pile walls

1.7 The bored 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.

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

1.9 The provisions apply to bored piles (see Figure 7) constructed of:

- unreinforced (plain) concrete;
- reinforced concrete;
- concrete reinforced by means of special reinforcement such as steel tubes, steel sections or steel fibres;
- 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.

**Key**

- 1 Precast concrete element
- 2 Grout
- 3 Temporary casing (extracted)
- 4 Uncased excavation
- 5 Unreinforced or reinforced concrete or cement grout
- D Shaft diameter

Figure 7 — Examples of bored piles with circular cross-section

1.10 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.

EN 1536:2010+A1:2015 (E)**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.

A1 *deleted text* **A1**

A1 EN 206:2013, *Concrete — Specification, performance, production and conformity* **A1**

EN 791, *Drill rigs — Safety*

A1 *deleted text* **A1**

EN 996, *Piling equipment — Safety requirements*

EN 1008, *Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete*

EN 1990, *Eurocode — Basis of structural design*

EN 1991 (all parts), *Eurocode 1: Actions on structures*

EN 1992 (all parts), *Eurocode 2: Design of concrete structures*

EN 1993 (all parts), *Eurocode 3: Design of steel structures*

EN 1994 (all parts), *Eurocode 4: Design of composite steel and concrete structures*

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 1998 (all parts), *Eurocode 8: Design of structures for earthquake resistance*

EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 10080, *Steel for the reinforcement of concrete — Weldable reinforcing steel - General*

EN 10210 (all parts), *Hot finished structural hollow sections of non-alloy and fine grain steels*

EN 10219 (all parts), *Cold formed welded structural hollow sections of non-alloy and fine grain steels*

A1 *deleted text* **A1**

EN 12794, *Precast concrete products — Foundation piles*

EN 13670, *Execution of concrete structures*

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

3 Terms and definitions

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

NOTE 1 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.

NOTE 2 In these definitions the term pile is used for circular cross-section structures and the term barrette for other shapes. Both are bored piles.

3.1

pile

fr pieu

de Pfahl

slender structural member in the ground for the transfer of actions

3.2

bored pile

fr pieu foré

de Bohrpfahl

pile or barrette 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 or a number of interconnecting lengths cast simultaneously (e.g. L-, T- or cruciform shapes) used to support vertical and/or lateral loads

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3.4

continuous flight auger pile

CFA-pile

fr pieu à la tarière continue creuse (CFA)

de Schneckenbohrpfahl

pile formed by means of a hollow stemmed continuous flight auger through the stem of which A_1 concrete, mortar or grout A_1 is pumped as the auger is extracted

NOTE See A_1 Figure A.5 A_1 .

3.5

prepacked pile

fr pieu ballasté injecté

de Prepacked-Pfahl

pile where the completed excavation is filled with coarse aggregate which is subsequently injected with grout from the bottom up

3.6

end bearing pile

fr pieu travaillant en pointe

de Spitzendruckpfahl

bored pile transmitting actions to the ground mainly by compression on its base

3.7

friction pile

fr pieu flottant

de Reibungspfahl

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

EN 1536:2010+A1:2015 (E)**3.8****pile base grouting****fr** injection sous la base**de** Pfahlfußverpressung

pressure injection of grout below the base of an installed bored pile base in order to enhance performance under load

3.9**pile shaft grouting****fr** injection au niveau du fût**de** Pfahlmantelverpressung

injection of grout carried out after bored pile concrete has set for the enhancement of skin friction accomplished by the use of grouting pipes which are installed down the shaft, normally placed with the bored pile reinforcement

3.10**working pile****fr** pieu de fondation**de** Bauwerkspfahl

bored pile for the foundation of a structure or as part of a bored pile wall

3.11**raking pile****fr** pieu incliné**de** Schrägpfahl

pile installed at an inclination related to the horizontal

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NOTE See Figure 4.

3.12**shaft diameter****fr** diamètre du fût**de** Pfahlschaftdurchmesser

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

— for piles constructed with casings: equal to the external diameter of the casing;

— for piles constructed without a casing: equal to the maximum diameter of the boring tool

3.13**enlarged base****fr** base élargie**de** Fußaufweitung

base of a bored pile formed to have an area greater than that of its shaft

NOTE For bored piles, normally constructed by the use of special underreaming or bellling-out tools (see Figure 3).

3.14**casting level****fr** niveau de bétonnage**de** Betonierhöhe

upper level to which concrete is cast in a bored pile excavation

NOTE It is above the cut-off level by a margin depending on the execution procedure.

3.15**cut-off level (trimming)****fr** niveau d'arase (recépage)**de** planmäßige Pfahlkopfhöhe; Kapphöhe

prescribed level to which a bored pile is trimmed before connecting it to the substructure

3.16**empty bore****fr** forage vide**de** Leerbohrung

length of excavation from the working level to the cut-off level

3.17**temporary casing****fr** tubage**de** Verrohrung

steel tube used to maintain stability of a pile excavation (e.g. in unstable ground) which is withdrawn during or after concrete placement

3.18**permanent casing****fr** tubage permanent**de** bleibende Verrohrung; dauerhafte Verrohrung

steel tube used to maintain stability of a pile excavation (e.g. in unstable ground) which is not withdrawn but remains as permanent continuous surround

NOTE

It becomes part of the pile and may also act as a protective or load bearing unit.

3.19**lead-in tube****fr** virole**de** Führungsrohr

short temporary casing put in place to secure the side of the excavation against collapse at the bore top close to working platform level

3.20**liner****lining****fr** gaine, chemise**de** Hülse; Hülsenrohr

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

3.21**support fluid****fr** fluide stabilisateur**de** Stützflüssigkeit

fluid used during excavation to support bore hole walls and for flushing

NOTE

It is usually a bentonite suspension or a polymer solution.

3.22**concreting pipe****fr** colonne de bétonnage**de** Betonierrohr, Schüttrohr

metal pipe comprising several joined lengths, surmounted by a hopper or chute for concrete placement under dry conditions