

Precast concrete products — Foundation piles

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The European Standard EN 12794:2005 has the status of a
British Standard

ICS 91.100.30; 93.020

National foreword

This British Standard is the official English language version of EN 12794:2005.

EN 12794 is a candidate “harmonized” European standard and fully takes into account the requirements of the European Commission mandate M/100, Precast concrete products, given under the EU Construction Products Directive (89/106/EEC), and is intended to lead to CE marking. The date of applicability of EN 12794 as a harmonized European Standard, i.e. the date after which this standard may be used for CE marking purposes, is subject to an announcement in the *Official Journal of the European Communities*.

The Commission in consultation with Member States has agreed a transition period for the co-existence of harmonized European Standards and their corresponding national standard(s). It is intended that this period will comprise a period, usually nine months, after the date of availability of the European Standard, during which any required changes to national regulations are to be made, followed by a further period, usually of 12 months, for the implementation of CE marking. At the end of this co-existence period, the national standard(s) will be withdrawn.

EN 12794 is the subject of transitional arrangements agreed under the Commission mandate. In the UK, there are no corresponding national standards of national origin.

The UK participation in its preparation was entrusted to Technical Committee B/524, Precast concrete products, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 44, an inside back cover and a back cover.

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Precast concrete products - Foundation piles

Produits préfabriqués en béton - Pieux de fondation

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This European Standard was approved by CEN on 22 November 2004.

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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Foreword

This document (EN 12794:2005) has been prepared by Technical Committee CEN/TC 229 "Precast concrete products", the secretariat of which is held by AFNOR.

This document was examined by and agreed with a joint working party appointed by the Liaison Group CEN/TC229-TC250, particularly for its compatibility with structural Eurocodes.

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 2005, and conflicting national standards shall be withdrawn at the latest by November 2006.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Construction Products Directives (89/106/EEC).

This document is one of a series of product standards for precast concrete products.

For common aspects reference is made to EN 13369: *Common rules for precast products*, from which also the relevant requirements of the EN 206-1: *Concrete — Part 1: Specification, performances, production and conformity* are taken.

The references to EN 13369 by CEN/TC 229 product standards are intended to make them homogeneous and to avoid repetitions of similar requirements.

Eurocodes are taken as a common reference for design aspects. The installation of some structural precast concrete products is dealt with by ENV 13670-1: *Execution of concrete structures — Part 1: Common rules*, which has at the moment the status of an European prestandard. In all countries it can be accompanied by alternatives for national application and it shall not be treated as an European Standard.

The programme of Standards for structural precast concrete products comprises the following Standards, in some cases consisting of several parts:

prEN 1168, *Precast concrete products — Hollow core slabs*

EN 12794, *Precast concrete products - Foundation piles*

EN 12843, *Precast concrete products — Masts and poles*

prEN 13747, *Precast concrete products — Floor plates for floor systems*

prEN 15037-1, *Precast concrete products - Beam-and-block floor systems - Part 1: Beams*

prEN 15037-2, *Precast concrete products - Beam-and-block floor systems - Part 2: Blocks*

EN 13224, *Precast concrete products — Ribbed floor elements*

EN 13225, *Precast concrete products — Linear structural elements*

prEN 14992, *Precast concrete products — Wall elements : Products properties and performances*

WI00229014, *Retaining wall elements*

EN 13693, *Precast concrete products — Special roof elements*

EN 12794:2005 (E)

prEN 14844, *Precast concrete products — Box culverts*

prEN 13978, *Precast concrete products — Precast concrete garages*

prEN 14991, *Precast concrete products — Foundation elements*

prEN 15050, *Precast concrete bridge elements*

WI00229019, *Precast concrete products - Silos*

prEN14843, *Precast concrete products — Stairs*

This document defines in Annex ZA the application methods of CE marking to products designed using the relevant EN Eurocodes (EN 1992-1-1). Where, in default of applicability conditions of EN Eurocodes to the works of destination, design Provisions other than EN Eurocodes are used for mechanical strength, the conditions to affix CE marking to the product are described in ZA.3.4.

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

Introduction

This document specifies the requirements, the basic performance criteria and detailing provisions for precast concrete foundation piles manufactured in a factory environment, stored, transported and ultimately installed on a construction site. The design of structural products shall ensure their fitness for the particular application. Particular attention is to be paid to design co-ordination with other parts of the construction.

1 Scope

This document specifies the terminology, requirements, basic performance criteria, test methods and evaluation of conformity that will be applied to precast concrete foundation piles, factory produced for building and civil engineering works and installed at the site by the use of impact, vibration, pressing or other suitable techniques. This document may also be applied to products manufactured in temporary plants on site where production is controlled in accordance with the provisions of Clause 6 and is protected against adverse weather conditions as necessary.

This document applies to foundation piles produced in a plant as reinforced or prestressed concrete elements. The cross-section may be solid or provided with a hollow core, either prismatic or cylindrical. The cross-section may be constant over the full length or tapered partly or wholly along the pile or pile segment length.

This document deals with foundation piles manufactured either in one length or in segments with cast-in pile joints. The foundation piles may have an enlarged toe or a pile shoe.

This document applies to normal weight concrete as defined in EN 206-1 compacted so as to retain no appreciable amount of entrapped air other than entrained air.

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.

EN 1992-1-1:2004, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*

EN 1997-1:2004, *Eurocode 7: Geotechnical design — Part 1: General rules*

EN 13369:2004, *Common rules for precast concrete products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13369:2004 and the following apply. In general the term “product” refers to an element which is produced in large numbers.

3.1 Foundation piles

A number of these definitions are illustrated in Figure 1.

3.1.1

pile

long element to be driven in the ground to provide support to the foundation

3.1.2

single length pile

pile without joints

3.1.3

segmental pile

pile with joints

3.1.4

pile length

distance between pile top and pile bottom

3.1.5**pile segment**

single unit of a jointed pile

3.1.6**segment length**

length of a pile segment forming a part of the pile length

3.1.7**pile top**

surface of a pile head

3.1.8**pile head**

upper section of a pile

3.1.9**pile shaft**

section of the pile between pile head and pile toe

3.1.10**pile toe**

lower part of a pile

3.1.11**pile bottom**

surface of a pile toe

3.1.12**enlarged toe**

a concrete section with a cross-section greater than the pile shaft, cast in one production operation

3.1.13**shape factor**

ratio between the pile length or the length of a segment and the smallest transverse dimension of the shaft

3.1.14**pile joint**

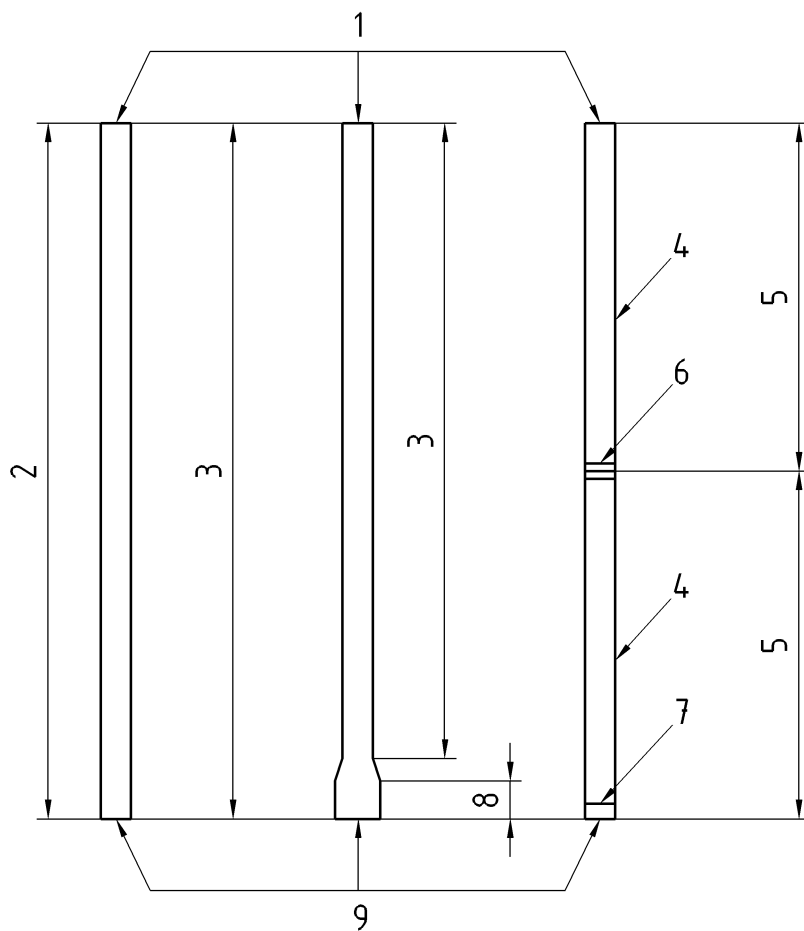
a device by which separate segments of a segmental pile are structurally connected

3.1.15**pile shoe**

a device by which the pile toe may be strengthened or protected

3.1.16**crack ring**

a device by which the pile head or toe may be strengthened or protected



Key

- 1 Pile top
- 2 Pile length
- 3 Shaft length
- 4 Pile segment
- 5 Segment length
- 6 Pile joint
- 7 Pile shoe
- 8 Pile toe
- 9 Pile bottom

Figure 1 — Terms and definitions

4 Requirements

4.1 Material requirements

For general aspects, constituent materials of concrete, reinforcing and prestressing steel, inserts and connectors the relevant Clauses of EN 13369:2004 4.1 shall apply. The ultimate tensile and tensile yield strength of steel shall be considered.

4.2 Production requirements

4.2.1 Concrete production

4.2.1 of EN 13369:2004 shall apply.

4.2.2 Hardened concrete

4.2.2.1 Strength classes

4.2.2.1 of EN 13369:2004 shall apply.

The minimum concrete class for either reinforced or prestressed precast foundation piles shall be C35/45.

4.2.2.2 Compressive strengths

4.2.2.2 of EN 13369:2004 shall apply.

The minimum compressive strength to achieve before transportation or when applicable also before installation of the pile shall be specified.

4.2.3 Structural reinforcement

4.2.3.1 Processing of reinforcing steel

4.2.3.1 of EN 13369:2004 shall apply.

4.2.3.2 Tensioning and prestressing

4.2.3.2.1 Initial tensioning stresses

4.2.3.2.1 of EN 13369:2004 shall apply.

4.2.3.2.2 Accuracy of tensioning

Class A of 4.2.3.2.2 of EN 13369:2004 shall apply.

4.2.3.2.3 Minimum concrete strength at transfer

4.2.3.2.3 of EN 13369:2004 shall apply.

4.2.3.2.4 Slippage of tendons

Not relevant due to the common production technique.

4.3 Finished product requirements

4.3.1 Geometrical properties

4.3.1.1 Production tolerances

The following tolerances shall apply unless stricter tolerances are specified for single piles or pile segments:

- the axis of the pile shaft after production and without the influence of bending stresses shall be straight. The permitted production deviation of straightness is shown in Table 2;
- for cross-sectional dimensions L , the permitted deviation is ΔL from nominal dimensions, see Table 2;
- the top and bottom of the pile shall be perpendicular and symmetric to the central axis of the pile. The angular deviation shall not exceed the following values in class AD1 or class AD2 as shown in Table 1:

Table 1 — Classes of maximum angular deviation of the pile

Class	Maximum permitted deviation
Class AD1	1/100 across the cross section
Class AD2	3/100 or 10 mm across the cross section whichever is less

- The top of the pile shall be either plane or convex.
- Axis of any enlarged toe shall be nominally concentric to the axis of the pile shaft. Maximum permitted deviation is $d_e/100$ or 20 mm across the cross section whichever is the less. where d_e = depth of the cross-section of enlarged toe;
- for positioning of reinforcing and prestressing steel the permitted deviation is Δd from nominal effective depth d of the reinforcement and Δc from nominal cover c_{nom} of the reinforcement, see Table 2. For the single bar pile see Annex C;
- cover of each reinforcing bar from the pile top and pile bottom shall be within the limits of 10 mm to 50 mm, while the mutual difference between the ends of reinforcing bars shall be less than 20 mm, which is not valid for the single bar pile described in Annex C;
- when determining the deviation from nominal effective depth the location of the reinforcement may be determined as the mean of the measured values of the bars or strands in a cross section;
- the nominal cover c_{nom} of the reinforcement shall be not less than the minimum cover c_{min} plus the lower permitted deviation Δc ;
- the position of the reinforcement and its tolerances shall be specified in production drawings.

The requirements shall be verified in accordance with 5.2.

Table 2 — Permitted deviations for dimensions and cover of precast concrete piles

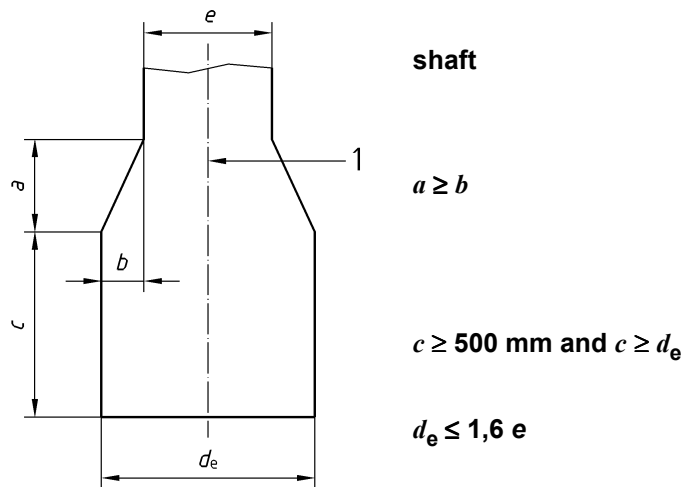
Target dimension of the cross-section in the direction to be checked	ΔL (mm)	Δd (mm)	Δc (mm)
Cross-section dimensions of the pile The actual cross section shall be greater than 95 % of the nominal cross section	+ 15 - 10	- 10	- 10
Nominal length of the pile	+ 150 - 100		
Straightness of the axis of the shaft $L \leq 10$ m $10 \text{ m} \leq L < 20$ m $L \geq 20$ m	± 20 $\pm 2 L^1$ ± 40		
NOTE 1 ΔL and Δd are given to ensure that deviations in either cross-sectional dimensions or lengths as well as in the position of the reinforcement do not exceed values covered by the relevant safety factors in the Eurocodes.			
NOTE 2 The values for Δc are given for durability purposes.			
¹ In this formula the dimension of length L is m.			

4.3.1.2 Minimum dimensions

The shape factor shall not exceed the following values:

Multiple bar reinforced piles/pile segments	75
Prestressed piles	100

The dimensions of an enlarged toe shall be in compliance with Figure 2.



Key

1 Axis

Figure 2 — Requirements for the dimensions of the toe

The requirements shall be verified in accordance with 5.2.

4.3.1.3 Pile joints

The steel components of the pile joint shall be integrated in the pile segments to be joined. They shall be cast in, in such a way, that their position can be inspected during production and on the finished product.

The quality of the further structural parts, e.g. locking parts, necessary to complete the actual joining of the pile segments at the site of installation, shall be the pile producer's responsibility.

The site assembly of pile joints is not covered by this document.

Pile joints shall locate and maintain a coaxial connection between pile segments. The faces of the pile components shall be perpendicular to the axis of the pile segments within the following tolerances:

- centres of cast in components shall not deviate more than 10 mm from the central axis of the pile/pile segment;
- angular deviation of the faces of the pile components shall not exceed an inclination of 1:150.

Coaxial and angular deviation shall be verified in accordance with 5.2.

The classification of pile joints is specified under 4.3.8.3.

4.3.1.4 Pile shoes

Pile shoes, when fitted shall be coaxial with the pile. The face of the pile shoe shall be perpendicular to the axis of the pile within the following tolerances:

- central axis of the pile shoe shall not deviate more than 10 mm from the central axis of the pile/pile segment;
- angular deviation of the face of the pile shoe shall not exceed an inclination of 1:75.

Coaxial and angular deviation shall be verified in accordance with 5.2.

4.3.2 Surface characteristics

Not relevant.

4.3.3 Mechanical resistance

4.3.3.1 General

4.3.3 deals only with the nominal mechanical strength of the pile itself. The bearing capacity of the pile in its final position on site also depends on the geotechnical considerations, which are out of the scope of this document.

4.3.3.1 of EN 13369:2004 shall apply.

Due to the position of the reinforcement in the single bar pile and the absence of confining reinforcement in the shaft of this type of pile, the piles in this document are divided into the classes defined in Table 3.

Table 3 — Classifications of piles

Class	Pile type
1	Piles or segmental piles with distributed reinforcement and/or prestressed reinforcement with or without an enlarged pile toe, see also Annex B
2	Piles or segmental piles reinforced with single centrally placed bars, see Annex C

4.3.3.2 Verification by calculation

4.3.3.2 of EN 13369:2004 shall apply.

4.3.3.2.1 Verification of the resistance for transportation

The characteristic concrete strength at time of transportation, as specified in 4.2.2 shall be used in verification of the resistance according to 4.3.3.2 of EN 13369:2004 with the complementary rules given in Annex B.

4.3.3.2.2 Verification of the resistance for pile installation

The characteristic concrete strength at time of pile installation shall be used in verification of the resistance for pile installation. The verification of the resistance for pile installation shall conform to relevant documents or other provisions valid in the place of use taking in consideration the specific geographical conditions which refer specifically to the installation of the precast concrete foundation piles.

NOTE 1 Provisions for pile installation may give higher minimum requirements for the concrete class and reinforcement than specified in 4.2 of this document.

NOTE 2 Guidance for the execution of pile foundations is given in EN 12699.

NOTE 3 Provisions regarding the soil conditions in the place of use can be given for pile type – Class 2 – as specified in Annex C.

4.3.3.2.3 Resistance to design loads

Resistance to design loads at the critical section of the pile shaft shall (e.g. near the joint) be verified by the calculation in accordance with 4.3.3.2 of EN 13369:2004.

NOTE The calculated resistance of the pile cross section with respect to the axial force will be at least equal to the geotechnical load bearing capacity of the installed foundation pile.

4.3.3.3 Verification by calculation aided by physical testing

4.3.3.3 of EN 13369:2004 shall apply.

4.3.3.5 Safety factors

4.3.3.5 of EN 13369:2004 shall apply.

4.3.3.6 Transient situations

4.3.3.6 of EN 13369:2004 shall apply.

4.3.4 Resistance and reaction to fire

Not relevant.

4.3.5 Acoustic properties

Not relevant.

4.3.6 Thermal properties

Not relevant.

4.3.7 Durability

4.3.7 of EN 13369:2004 shall apply.

The specific tolerances for piles given in 4.3.1.1 and Annex C shall be considered.

Concrete composition shall be appropriate to exposure class of the soil conditions of the site.

4.3.8 Other requirements

4.3.8 of EN 13369:2004 shall apply, with the following additional requirements.

4.3.8.3 Rigidity of pile joints

The producer shall declare the class of the pile joint and the relevant capacity values.

Pile joints shall be classified in the classes indicating the required capacities, performance and type of verification methods. The classification is shown in Table 4.

Table 4 — Classification of pile joints

Class ³	Capacity	Performance	Verification	Methods Impact load test ¹
A	Compression/tension and bending	Robustness and rigidity	Static calculations to be verified by impact testing and subsequent bending test.	Impact load test with 1 000 impact blows having stress level 28 N/mm ² . ²
B	Compression/tension and bending	Robustness and rigidity	Static calculations to be verified by impact testing and subsequent bending test.	Impact load test with 1 000 impact blows having stress level 22 N/mm ² . ²
C	Compression/tension and bending	Robustness and rigidity	Static calculations to be verified by impact testing and subsequent bending test.	Impact load test with 1 000 impact blows having stress level 17 N/mm ² . ²
D	Compression	Robustness and rigidity	Static calculations to be verified by impact testing.	Impact load test with 500 impact blows having stress level 17 N/mm ² . ²

¹ IBT = Impact load test with subsequent bending test as defined in Annex A.

² Stress level means: compressive stresses around the pile joint caused by impact blows.

³ Pile joint class (i.e. the dynamic stress level during Impact load test) is chosen according to national provisions to correspond the target geotechnical capacity of the segmental pile.

NOTE Pile joints with better class than specified in the piling specification may be used.

For the pile joints connected with the pile segment, the pile joint class, gap width, calculated characteristic static bearing capacity (i.e. compression, tension and bending capacity) shall be declared as well as the flexural stiffness at the level of 0.75 x calculated ultimate bending moment.

Robustness and rigidity of pile joints shall be verified by impact loading testing followed by subsequent bending testing in conformity with the procedures and methods given in Annex A.

Class A, B and C:

The ultimate bearing capacity (compression, tension and bending) of the pile joint shall be calculated taking in account the design strengths of materials. Provided that the impact load test and subsequent bending test can verify the static calculations, then the ultimate bearing capacity of the joint is identical to the static calculated bearing capacity.

Robustness and rigidity may be deemed adequate if the pile joint performs satisfactorily in the test indicated in Annex A.

Class D:

The ultimate bearing capacity (compression) of the pile joint shall be calculated taking in account the design strengths of materials. Provided that the impact load test can verify the static calculations, then the ultimate bearing capacity of the joint is identical to the static calculated bearing capacity.

Robustness and rigidity may be deemed adequate if the pile joint performs satisfactorily in the test indicated in Annex A. In this case the subsequent bending test is not performed.

5 Test methods

5.1 Tests on concrete

5.1 of EN 13369:2004 shall apply.

5.2 Measuring of dimensions and surface characteristics

Dimensions shall be verified in conformity with the methods given in Annex J of EN 13369:2004 and Annex E of this document. For the measurement of perpendicularity of the pile top and pile bottom against pile axis the measurement shall be made in two directions (e.g. horizontal and vertical directions).

5.3 Weight of the products

The weight of piles is calculated.

6 Evaluation of conformity

6.1 General

6.1 of EN 13369:2004 shall apply.

6.2 Initial type testing

6.2 of EN 13369:2004 shall apply.

Joint rigidity for segmental piles shall be tested following Annex A.

6.3 Factory production control

6.3, except 6.3.6.5, of EN 13369:2004 shall apply.

6.3.6.5 Finished products

Compliance verifications on the finished products shall be performed following Table 5. Other verifications can be performed when a special necessity arises.

The check shall be carried out at the earliest time possible, preferably in the factory or at the stack yard, and never after the precast units have been received and accepted by the client.

Table 5 — Finished product inspection

SUBJECT	ASPECT	METHOD	FREQUENCY	REGISTRATION
Elements	Total length	See 4.3 and 5.2	One every month for each casting line and any type of product	Notation in the record form
Elements	Straightness	Visual inspection	One visual for each casting line daily	Notice of imperfections in the record form
		See 4.3 and 5.2	One every month for each casting line	Notice of imperfections in the record form
Elements	Marking and Labelling	Visual inspection	Visual check daily	Notation in the record form
Elements	Other geometrical tolerances	See 4.3 and 5.2	One every month for each casting line	Notation in the record form

The manufacturer shall keep the records of the elements produced (unique code/mark, production location, date of casting, etc.) for the required period of archiving and shall provide these data when required.

7 Marking

The producer shall provide a manual in which, among other items, the meaning of the marking is described and instructions are given for the handling of the pile during transportation, storage and lifting on site.

Each foundation pile or segment shall be marked or labelled near the head of the pile.

For segmental piles the pile joint type shall be indicated.

NOTE For CE marking see Annex ZA.

Markings, unambiguously indicating the points of support during storage and transportation, the hoisting points and, when necessary, the head and the toe of the pile element, shall be shown on the pile.

8 Technical documentation

The detailing of the element, with respect to geometrical data and complementary properties of materials and inserts, shall be given in technical documentation, which includes the construction data, such as the dimensions, the tolerances, the layout of reinforcement, the concrete cover, the expected transient and final support conditions and lifting conditions.

The composition of technical documentation is given in Clause 8 of EN 13369:2004.

Annex A (normative)

Type test method for the verification of robustness and rigidity of pile joints

A.1 Impact load test with subsequent bending test

A.1.1 Principle

Impact load test with subsequent bending test consisting of submitting a segmental pile with cast in pile joint to a series of impact loads, which generates substantial stresses in the pile joint and in the pile segments. After impact test the gap between two joint halves is measured and the segmental pile is submitted to a two point load bending test, where the bending capacity of the pile joint is determined.

A.1.2 Apparatus

The following apparatus are used to perform the test:

- pile driving rig with an impact hammer capable of achieving adequate stresses to the pile joint. The pile driving rig shall be capable of maintaining the submitted impact loads to an accuracy of $\pm 10\%$ of the specified value;
- stress wave measurement device;
- loading device for applying two equal vertical loads. The device shall be capable of increasing the load continuously and maintaining the chosen load level constant for the required time (3 minutes to 5 minutes). The force applied shall be measured to an accuracy of 3 %;
- gauges for measuring deflections of the segmental pile due to imposed load during bending test to an accuracy of 0,1 mm;
- gauge for measuring gap between two joints halves to an accuracy of 0,1 mm.

A.1.3 Test specimens

The test specimen is the segmental pile composed of two pile joint components.

When impact test is performed the length of the upper pile segment shall be at least 3 m. The bottom pile segment may be provided with a pile shoe and shall have a length, which ensures that the joint will remain above the ground during the impact test.

The three test specimens, one per test, are assumed to be identical.

A.1.4 Impact load test

The test piling shall take place in a well-defined area, where geotechnical investigation shows sufficient soil bearing capacity in a suitable depth. A reinforced foundation slab in the prescribed depth can also be used as a footing to increase the resistance during the driving operations.

The bottom pile segment is driven vertically until it stands firmly imbedded in the soil in such a way that the pile joint is above the ground and can be observed during the whole test. Care should be taken that failure in the pile does not occur, due to high stresses during driving.

After driving of the bottom segment the upper segmental pile is jointed to the lower segment.

The impact load test consists of impact blows to the segmental pile generating compressive/tensile stresses around the pile joint. The number of impact blows and the compressive stress level around the pile joint shall be according to pile joint class. The stress level in the pile is monitored by means of stress wave measurements.

After each 500 blows the joint and the pile section around the joint is visually examined, and findings are recorded. The penetration of the pile is also recorded. In addition to this, the alignment between the bottom - and top section of the pile is controlled to be not more than inclination 1:150.

A.1.5 Bending test

For the test, the segmental pile is cut to a length having slenderness (pile length/minimum dimension of the pile cross-section) between 11 and 12.

For the measurement of the gap v_0 between two joint halves without external loading the segmental pile is supported as shown in Figure A.1. The gap v_1 is measured when the segmental pile (loaded only by its own weight) is supported in the middle where the pile joint is located and gap v_2 is measured when the segmental pile (loaded only by its own weight) is supported at both ends to an accuracy of 0,1 mm. The gap v_0 is calculated from the equation: $v_0 = (v_1 + v_2)/2$.

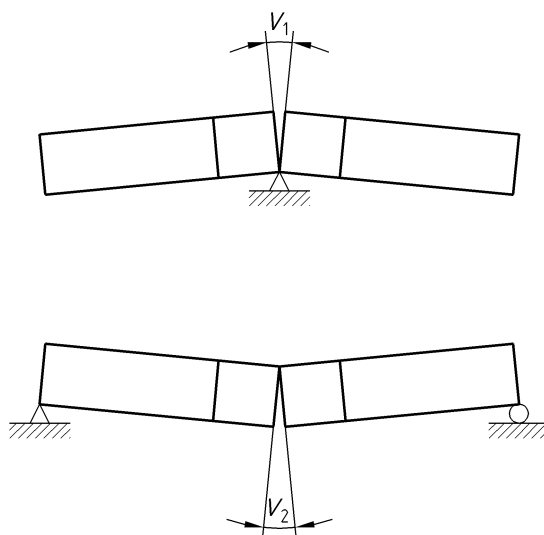


Figure A.1 — Measurement of the gap v_0 between two joint halves without external loading

For the loading test the segmental pile is placed on two supports so that it is tested in its weakest direction with a span equal to 10 times the minimum dimension of the pile cross-section but at least 3 m. The pile joint shall be situated exactly in the middle of the span. In Figure A.2 the distance a is equal to $L/3 + 2$ times the minimum dimension of the pile cross section.

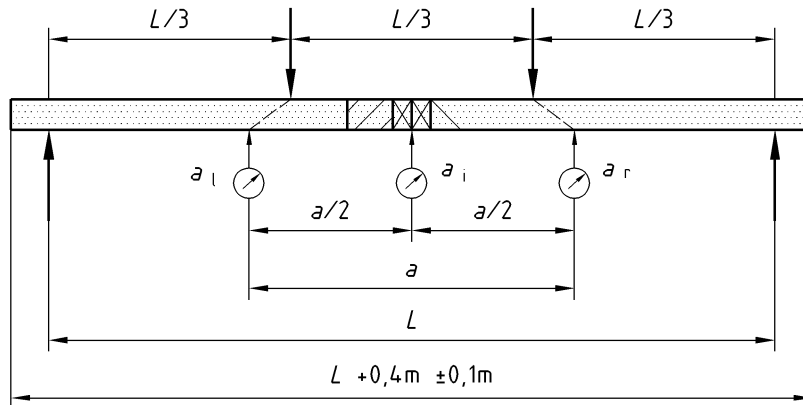


Figure A.2 — Bending test arrangement

The test pile is loaded with two equal point loads in the third point of the span as shown in Figure A.2.

Data to be recorded:

- deflection is measured using three gauges, which are installed in point a_i (at the middle of the span) and in points a_l and a_r at a distance of $(0,5 a)$ from the middle on the span (see also Figure A.2);
- the first deflection measurement is made when the pile is exposed to its own weight only (zero reading). The increase of each load step is chosen in order that at least 10 load steps are made before ultimate bending moment has been reached. After each load step the load is kept constant for about 3 minutes before reading the gauges;
- the gap, on the lower side of the test specimen, between the two joint halves, shall be measured and recorded during the test for each load step to an accuracy of 0,1 mm;
- the failure load; the test is carried on to the point when failure in the test specimen occurs.

A.1.6 Evaluation of test results

The measured deflection values provide the background for calculating the flexural stiffness from the following formula:

$$El_{eq} = \frac{Ma^2}{8\delta_m}$$

where see Figure A.2

a = $L/3 + 2h$, in which h is the depth of the pile, see also Figure A.2;

M = bending moment in the pile joint caused by imposed load;

δ_m = deflection in the middle of the span = $\delta_i - (\delta_l + \delta_r)/2$ where δ_i , δ_l and δ_r are respectively the displacements of points a_i , a_l and a_r .

If all 3 test specimens perform satisfactorily during the impact test, e.g. no failure occurs in the pile joint during the driving test and failure in the pile joint during the bending test occurs after the calculated bending moment in the pile joint has been reached, then the test shall be deemed satisfactory.

A.1.7 Test report

The test report shall include the following information:

- number, title and date of issue of this document;
- name of this Annex A and title of test method (impact load test with subsequent bending test);
- identification of the tested pile joints in relation to production drawing;
- material certificate of the components of tested pile joints including measured material strengths;
- identification of the pile segments in relation to production drawing;
- dates and place of manufacture of tested pile joints and pile segments;
- place and date of testing, testing institute and name of the person responsible for testing;
- intended pile joint class;
- number of impact blows using different stress levels around the pile joint and the stress levels achieved;
- results of the stress wave measurements in impact test;
- observations, penetration of the pile and inclination of pile top and bottom segments after each 500 blows in impact test;
- gap v_0 between two joint halves without external loading;
- observations of the test specimens (e.g. cracks or deflection) before bending test;
- bending test arrangement i.e. span;
- load chart and load deflection diagram in bending test (deflections as absolute values);
- gap in the joint for each load step in bending test;
- calculated bending moment in the pile joint taking into account the actual strength of the materials, short term loading and $\gamma_m = 1$;
- calculated bending moment, in the lowest value for the shaft and the joint, taking into account the design strength of the materials;
- load and bending moment at yielding and at failure;
- flexural stiffness of the pile joint at the level of 0,75 x calculated characteristic bending moment of the pile joint;
- observations of the test specimens after termination of test.

Annex B (normative)

Design aspects in reference with EN 1992-1-1

B.1 General

B.1.1 Scope

This Annex B applies to the design of precast concrete foundation piles made of reinforced or prestressed concrete and is complementary to EN 1992-1-1.

The numbering of Clauses of this Annex is arranged in the same order as used for the numbering of Clauses of EN 1992-1-1.

The principles and application rules of EN 1992-1-1 shall be adhered to, unless explicitly adapted, amended or modified.

Additional provisions for the single bar foundation pile are given in Annex C.

B.2 Basis of design

B.2.1 Requirements

B.2.1.1 Basic Requirements

P(4) The precast foundation pile shall be designed in accordance with the principles and application rules of EN 1997-1:2004, 7.8.

P(5) The design for transient situations shall consider the intended methods of handling, transportation and installation, using the nominal dimensions and a time corresponding specified minimum strength.

B.2.3 Basic variables

B.2.3.1 Actions and environmental influences

B.2.3.1.1 General

P(2) The dynamic action during handling, transportation and driving shall be taken into account according to the actual operational methods.

NOTE In absence of more rigorous determination, in addition to partial load factors, the factor allowing for the dynamic effects on the self-weight of the pile may be taken on the basis of the following recommended values which are inclusive of the self-weight partial safety factor:

$\gamma_G \gamma_{kd, dyn} = 1,35$ for handling and for transportation of continuously supported piles;

— $\gamma_G \gamma_{kd, dyn} = 2,00$ for transportation of locally supported piles.

B.2.4 Verification by the partial safety factor method

B.2.4.2 Design values

B.2.4.2.4 Partial safety factors for materials

(4) The partial safety factors for materials given in EN 1992-1-1 may be modified in accordance with 4.3.3.5 of EN 13369:2004.

B.3 Materials

B.4 Durability and cover to reinforcement

B.4.4 Methods of verification

B.4.4.1 Concrete cover

B.4.4.1.1 General

B.4.4.1.2 Concrete cover, c_{\min}

(14) The concrete cover may be modified in accordance with EN13369:2004, 4.3.7.

(15) Where after installation the head of the precast foundation pile will be stripped, the concrete cover over the stripping length may be reduced to 10 mm.

B.5 Structural analysis

B.6 Ultimate limit states (ULS)

B.7 Serviceability limit states (SLS)

B.8 Detailing of reinforcement and prestressing tendons

B.8.4 Anchorage of longitudinal reinforcement

B.8.4.1 General

B.8.4.2 Ultimate bond stress

(3) For horizontally cast foundation piles the limiting value of the depth in the direction of concreting, defining areas with good bond conditions, may be taken as 350 mm, due to the application of an effective compacting technique.

B.8.7 Laps and mechanical couplers

B.8.7.4 Transverse reinforcement in the lap zone

B.8.7.4.2 Transverse reinforcement for bars permanently in compression

(2) Pile joint anchors and additional longitudinal bars in pile heads are not to be considered as bars in a lap slice.

B.9 Detailing of members and particular rules

B.9.5 Precast foundation piles

(1) For the single bar pile, see Annex C of this document.

B.9.5.2 Longitudinal reinforcement

P(1) For piles Class 1 the following requirements shall be met:

- a) bars shall have a diameter not less than 8 mm;
- b) welds or lap slices in bars shall be staggered. The distance between those shall not be less than two times the largest transversal dimension of the pile shaft;
- c) for piles shafts with a non-circular cross-section, at least one bar shall be positioned at each corner;
- d) for piles shafts with a circular cross-section, at least 6 bars shall be positioned around the periphery;
- e) the spacing of bars shall comply with EN 1992-1-1:2004, 8.2.

B.9.5.3 Transverse reinforcement

P(2) For piles Class 1 the following requirements shall be met:

- a) for precast concrete foundation piles with transverse dimensions 300 mm or larger, the diameter of the transverse reinforcement may be reduced to 5 mm;
- b) for precast foundation piles with transverse dimensions smaller than 300 mm, the diameter of the transverse reinforcement may be reduced to 4 mm;
- c) the links, either stirrups or spirals, shall have a nominal diameter not less than 4 mm;
- d) the transverse reinforcement in the pile head shall be applied over a length of at least 500 mm. The number of links along this minimum length shall not be less than 9;
- e) in case the pile toe is positioned in alluvial deposits, the transverse reinforcement shall be applied over a length of at least 200 mm. The number of links over this minimum length shall be not less than 5. In case a pile rests on hard rock or moraine layers, the transverse reinforcement shall be applied over a length of at least 500 mm. The number of links shall be adapted accordingly;
- f) the transverse reinforcement of the pile shaft between the pile head and pile toe shall be evenly distributed, while the spacing of the links shall not exceed three times the shaft depth/width, whichever is the less;
- g) the diameter of mandrels used for bending the transverse reinforcement shall not be less than 2,5 times the nominal diameter in case of cold bending and nor less than 1,5 times in case of hot bending;

- h) in hollow core piles the cross sectional area of ties between the pile head and pile toe shall be at least 0,15 % of the concrete cross-section. The diameter of transverse spiral reinforcement shall be at least 2,4 mm or $\frac{1}{4}$ of the diameter of the longitudinal bars, the spacing shall be less than 15 times the diameter of the longitudinal bars.

B.9.5.4 Detailing aspects

P(1) For piles Class1 the following requirements according detailing aspects shall be met:

- a) the prestressing tendons shall be arranged in the cross-section and prestressed in such a way that the resultant of the tendon forces coincides with the centre of the cross section of the pile shaft;
- b) the cross-sectional area of prestressing steel shall not be less than the percentage of the cross-sectional area of the pile shaft according Table B1;
- c) the spacing of tendons shall comply with EN 1992-1-1:2004, 8.10, bundled tendons are not permitted;
- d) for the transverse reinforcement the requirements of 4.2.3.1 apply, except paragraph d);
- e) if in precast prestressed foundation piles in addition longitudinal reinforcement is applied, not more than 4 bars end in the same plane;
- f) the distance between these planes is not less than 20 times the diameter of the applied bars.

Table B.1 — Minimum percentages of prestressing steel

Pile length L (m)	Percentage of the concrete cross-section in mm ²
Not exceeding 10 m	0,1
Between 10 m and 20 m	0.01L
Exceeding 20 m	0,2

Annex C (normative)

Provisions for the design and manufacture of piles reinforced with a single bar in reference with this document and EN 1992-1-1

General

This Annex aims to give the additional specific requirements for the piles reinforced with a single bar.

The reference of the chapters and sub-sections of this Annex are arranged in the same order as used in the main body of this document for Clauses C.4 to C.8 and in the same order as in Annex B for Clause C.9.

C.4 Requirements

C.4.1 Material requirements

4.1 of this document is applicable.

C.4.2 Production requirements

4.2 of this document is applicable, except 4.2.3.1.

B.4.4.1, concrete cover, is not applicable to single bar, short piles or pile segments. Minimum cover to reinforcement from any plane surface of the pile shall be 50 mm.

C 4.3 Finished product requirements

4.3 of this document is applicable to single bar piles and pile segments except where modified below:

C.4.3.1 Geometrical properties

C.4.3.1.1 Production tolerances

This sub-section of the document does not apply to single bar piles or pile segments with respect to deviations relating to the position of reinforcing steel. The single bar shall be placed centrally on the longitudinal axis of the pile within a tolerance of 15 mm.

It does apply with regard to the permitted deviations to the cross sectional dimensions of the overall finished product.

C.4.3.1.2 Maximum dimensions

The shape factor applicable to the manufacture of single bar piles and pile segments shall not exceed 20.

C.5 Test methods

Clause 5 of this document is applicable.

C.6 Evaluation of conformity

Clause 6 of this document is applicable.

C.7 Marking

Clause 7 of this document is applicable.

C.8 Technical documentation

Clause 8 of this document is applicable.

C.9 Detailing of members and particular rules

C.9.5 Precast foundation piles

C.9.5.2 Longitudinal reinforcement

P(1) Alternative provision by addition of paragraph (g).

f) Single length piles or pile segments whose shape factor is 20 or less shall be reinforced with a single bar situated at the centre of the cross section of the pile or pile segment. Paragraphs (b) to (e) of 9.5.2 of Annex B do not apply to single bar piles or pile segments.

C.9.5.3 Transverse reinforcement

P(1) Alternative provision by addition of paragraph (i).

i) Where piles or pile segments are reinforced with a single centrally located bar a crack ring shall be provided at the pile or pile segment head and toe. Paragraphs (a) to (h) of 9.5.3 of Annex B shall not apply to single bar piles or pile segments.

Annex D (informative)

Provisions for the design and installation of piles and pile segments reinforced with a single bar

D.1 General

D.1.1 Scope

The provisions of Annex B are applicable to single bar piles and pile segments unless specifically adapted, amended or modified by Annex C or for specific ground conditions as defined in this Annex.

D.2 Basic of design

D.2.1 Requirements

D.2.1.1 Basic Requirements

The following requirements should be taken into account by the designer and pile installer when using single bar, short segmental reinforced concrete piles with compression joints only:

- a) where very large boulders or artificial hard obstructions e.g. concrete, of boulders size or larger, are present that may cause lateral displacement of the pile toe during driving they should either be removed prior to piling or alternative pile positions identified. Where this is not possible an alternative pile system should be considered;
- b) where steeply sloping hard strata exists that may cause lateral displacement of the pile toe an alternative pile system should be used;
- c) where considerable depths of loose granular soils (SPT 'N' < 4), or soft cohesive soils ($C_u < 25 \text{ kN/m}^2$) exist specific design calculations are to be produced to demonstrate that adequate lateral restraint against buckling of the pile is provided by the soil;
- d) where the thickness of any layer of highly compressible layer of soil ($m_v > 0,8 \text{ m}^2 \cdot (\text{MN})^{-1}$) exceeds the pile segment length such that more than 1 joint is located in the layer an alternative piling system should be used;
- e) where significant tensile actions after installation need to be sustained by the pile, joints capable of transferring tension should be used over the length of pile required to transfer the actions to the ground.

Annex E (normative)

Method to measure perpendicularity of the pile top, pile bottom or pile joint against pile axis

E.1 Principle

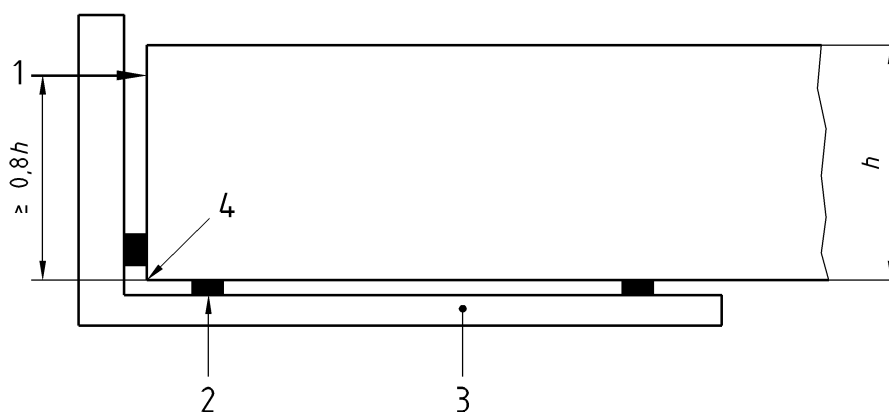
A square (longer arm at least 800 mm) rests against spacers so that longer arm is against one of the longitudinal moulded surface of the pile, see Figure E.1. The angular deviation of the pile top, pile bottom or pile joint against one of the longitudinal moulded surface is determined as shown in Figure E.1 for corner A. Distance reading of the measuring point shall be measured with an accuracy of 0,2 mm. Angular deviation is distance reading of the measuring point (thickness of the spacer subtracted) divided with a distance between corner A and measuring point.

Measurements of angular deviation shall be done in two directions (e.g. horizontal and vertical direction as shown in Figure E.2).

NOTE Measuring equipment which measures angular deviation in two directions same time can be used.

E.2 Test results

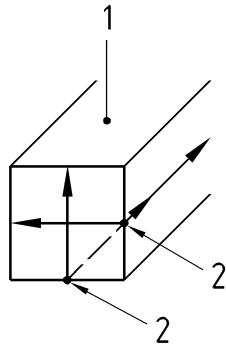
Results of angular deviation in both two directions are recorded. Test result is the greater value.



Key

- 1 Measuring point
- 2 Spacer
- 3 Square
- 4 Corner A

Figure E.1 — Measurement of angular deviation



Key

- 1 Upper surface
- 2 Corner A

Figure E.2 — An example to measure angular deviation in two directions

Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under the mandate M/100 "Precast Concrete Products" given to CEN by the European Commission and the European Free Trade Association.

The Clauses of this European Standard shown in this Annex meet the requirements of the mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these Clauses confers a presumption of fitness of the foundation piles units covered by this Annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING — Other requirements and other EU Directives, not affecting the fitness for intended uses, may be applicable to the foundation piles falling within the scope of this Standard.

NOTE 1 In addition to any specific Clauses relating to dangerous substances contained in this Standard, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through <http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm>).

This Annex establishes the conditions for the CE marking of the foundation piles units used for the construction of the foundation of buildings and other civil engineering works.

This Annex has the same scope as Clause 1 of this Standard and is defined by Tables ZA.1 a) and ZA.1 b).

Table ZA.1 a) — Relevant Clauses for foundation piles class 1 used for foundation of buildings and other civil engineering works

Essential characteristics		Requirement Clauses in this Standard	Levels and/or class(es)	Notes and Unit
Compressive strength (of concrete)	All methods	4.2.1 Concrete production 4.2.2 Hardened concrete	None	N/mm ²
Ultimate tensile and tensile yield strength (of steel)	All methods	4.1.3 Reinforcing steel and 4.1.4 Prestressing steel of EN 13369	None	N/mm ²
Mechanical strength (by calculation)	Method 1	Information listed in ZA.3.2	None	Geometry and materials
	Method 2	4.3.3 Mechanical resistance	None	kNm, kN, kN/m
	Method 3	Design specification	None	
Detailing ¹	All methods	4.3.1 Geometrical properties	None	mm
		B 8 Detailing of reinforcement		/
		B 9 Detailing of members and particular requirements		/
		8 Technical documentation		/
Durability for mechanical strength	All methods	4.3.7 Durability	None	Ambient conditions
Rigidity of joints	All methods	4.3.8.3 Rigidity of piles joints	None	Technical class and relevant properties
¹ Detailing is referring to piles of class 1, see Clause 4.3.3.1 of this Standard document and Annex B.				

Table ZA.1 b) — Relevant Clauses for foundation piles class 2 used for foundation of buildings and other civil engineering works

Essential characteristics		Requirement Clauses in this Standard	Levels and/or class(es)	Notes and Unit
Compressive strength (of concrete)	All methods	4.2 Production requirements	None	N/mm ²
Ultimate tensile and tensile yield strength (of steel)	All methods	4.1.3 Reinforcing steel and 4.1.4 Prestressing steel of EN 13369	None	N/mm ²
Mechanical strength (by calculation)	Method 1	Information listed in ZA.3.2	None	Geometry and materials
	Method 2	4.3.3 Mechanical resistance	None	kNm, kN, kN/m
	Method 3	Design specification	None	
Detailing ²	All methods	4.3.1 Geometrical properties	None	mm
		C.9 Detailing of members and particular requirements		/
		8 Technical documentation		/
Durability for mechanical strength	All methods	4.3.7 Durability	None	Ambient conditions
Rigidity of joints	All methods	4.3.8.3 Rigidity of piles joints	None	Technical class and relevant properties
² Detailing is referring to piles of class 2, single bar piles, see Clause 4.3.3.1 of this Standard and Annex C.				

Method 1 = declaration of geometrical data and material properties (see ZA.3.2).

Method 2 = declaration of the value of the product properties (see ZA.3.3).

Method 3 = declaration of compliance with given design specification (see ZA.3.4).

The producer shall select when he applies each method in accordance with Annex Y.

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements for that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor to declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see Clause ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedure(s) for the Attestation of Conformity of foundation piles

ZA.2.1 Systems of attestation of conformity

The systems of attestation of conformity of foundation piles included in Table ZA.1 a) or ZA.1 b), in accordance with the Decision of the Commission 1999/94//EC as given in Annex III of the mandate for foundation piles is shown in Table ZA.2 for the indicated intended uses and relevant levels or classes:

Table ZA.2 — Systems of attestation of conformity

Products	Intended Uses	Levels or Classes	Attestation of Conformity systems
Precast concrete foundation piles	structural	—	2+
System 2+: see CPD , Annex III.2.(ii), First possibility, including certification of the factory production control by an approved body on the basis of initial inspection of factory and of factory production control as well as of continuous surveillance, assessment and approval of factory production control.			
System 4: see CPD , Annex III.2.(ii), Third possibility.			

The attestation of conformity of foundation piles in Table ZA.1 a) or ZA.1 b) shall be based on the evaluation of conformity procedures indicated in Table ZA.3 resulting from application of the Clauses of this or other European Standard indicated therein.

Table ZA.3 — Assignment of evaluation of conformity tasks for foundation piles under system 2+

Tasks		Content of the tasks	Evaluation of conformity Clauses to apply
Tasks for the manufacturer	Initial type testing	All characteristics of Table ZA.1 a) or ZA.1 b).	6.2
	Factory production control	Parameters related to all characteristics of Table ZA.1 a) or ZA.1 b).	6.3
	Further testing of samples taken at the factory	- Mechanical strength; - All characteristics of Table ZA.1 a) or ZA.1 b).	Table ZA.1 a) or ZA.1 b) 6.2.3 of EN 13369:2004
Tasks for the notified body	Certification of factory production control on the basis of :	Initial inspection of factory and of factory production control	6.1.2 a) and 6.3 of EN 13369:2004
		Continuous surveillance, assessments and approval of factory production control	6.1.2 b) and 6.3 of EN 13369:2004

ZA.2.2 EC Certificate and Declaration of conformity

When compliance with the conditions of this Annex is achieved, and once the notified body has drawn up the certificate mentioned below, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity, which entitles the manufacturer to affix the CE marking. This declaration shall include:

- name and address of the manufacturer, or his authorised representative established in the EEA, and the place of production;

- description of the product (type, identification, use, ...), and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (e.g. Annex ZA of this EN);
- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);
- the number of the accompanying factory production control certificate;
- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

The declaration shall be accompanied by a factory production control certificate, drawn up by the notified body, which shall contain, in addition to the information above, the following:

- name and address of the notified body;
- the number of the factory production control certificate;
- conditions and period of validity of the certificate, where applicable;
- name of, and position held by, the person empowered to sign the certificate.

The above mentioned EC Declarations and EC Certificate shall be presented in the official language or languages of the Member State in which the product is to be used.

ZA.3 CE marking and labelling

ZA.3.1 General

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EC and shall be shown on the product (or when not possible it may be on the accompanying label, the packaging or on the accompanied commercial documents e.g. a delivery note).

The following information shall accompany the CE marking symbol:

- identification number of the certification body (only for products under systems 2+);
- name or identifying mark and registered address of the producer;
- the last two digits of the year in which the marking is affixed;
- number of the EC Certificate of conformity or factory production control certificate (if relevant);
- reference to this European Standard;
- description of the product: generic name, material, dimensions, and intended use;
- class of the pile;
- classification of the joint for segmental piles;
- information on those relevant essential characteristics taken from Table ZA.1 a) or ZA.1 b) which are listed in the relevant Clause ZA.3.2, ZA.3.3 or ZA.3.4;

— “No performance determined” for characteristics where this is relevant.

The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

In the following subclauses the conditions are given for the application of CE marking. Figure ZA.1 gives the simplified label to affix to the product, containing the minimum set of information and the link to the accompanying document where the other required information is given. For what concern the information on essential characteristics, some of them may be given by an unambiguous reference to:

- technical information (product catalogue) (see ZA.3.2);
- technical documentation (ZA.3.3);
- design specification (ZA.3.4).

The minimum set of information to be put directly in the affixed label or in the accompanying document is given in Figures ZA.2, ZA.3 and ZA.4.

ZA.3.1.1 Simplified label

In the case of simplified label the following information shall be added to the CE marking symbol:

- name or identifying mark and registered address of the producer;
- identification number of the unit or date of casting of the lot (to ensure traceability);
- the last two digits of the year in which the marking is affixed;
- number of the CE factory production control certificate;
- class of the pile;
- classification of the joint for segmental piles;
- reference to this European Standard.

The same identification number shall mark, in the accompanying documents, the information related to the unit.

Figure ZA.1 gives a model for the simplified label for CE marking.


	CE conformity marking consisting of the CE symbol given in directive 93/68/EEC
AnyCo Ltd, PO Bx 21, B-1050 45PJ76 02 0123-CPD-0456	Name or identifying mark and registered address of the producer Identification number of the unit Last two digits of the year in which the marking was affixed Number of the FPC certificate
EN 12794 Pile class 1	Number of this European Standard Class of pile

Figure ZA.1 — Example of simplified label

NOTE For small elements or for product stamping reasons, the size can be reduced by removing reference to EN and/or to FPC certificate.

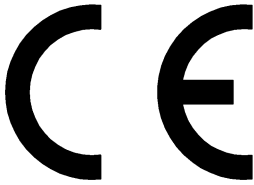
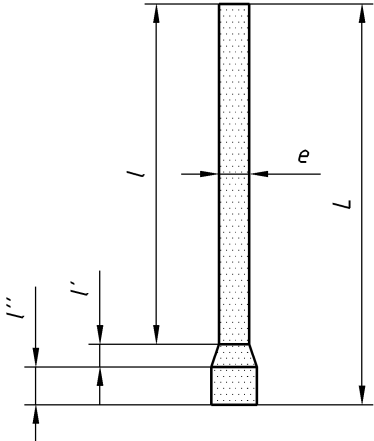
ZA.3.2 Declaration of geometrical data and material properties

(Method 1 to determine properties relating to essential requirements "mechanical resistance and stability").

Figure ZA.2 gives, for a type of foundation piles, a model CE marking inclusive of the information needed to determine, according to design regulation valid in the place of use, the properties related to mechanical resistance and stability, including aspects of durability and serviceability.

Referring to Table ZA.1 a) or ZA.1 b) and to the information quoted in the list of ZA.3.1, the following properties shall be declared:

- compressive strength of concrete;
- ultimate tensile strength of reinforcing steel;
- tensile yield strength of reinforcing steel;
- ultimate tensile strength of prestressing steel;
- tensile 0,1 proof stress of prestressing steel;
- geometrical data (only critical dimensions);
- class of the pile;
- classification of the joint for segmental piles;
- conditions for durability against corrosion;
- possible reference to Technical Information (product catalogue) for detailing, durability geometrical data and drying shrinkage.

 0123
AnyCo Ltd, PO Bx 21, B-1050 02 0123-CPD-0456
EN 12794 Precast concrete foundation piles
Reinforced pile Class pile 1 Concrete: Compressive strength f_{ck} = xx N/mm ² Reinforcing steel: Ultimate tensile strength f_{tk} = yyy N/mm ² Tensile yield strength f_{yk} = zzz N/mm ²  Pile length L = xxx mm Shaft length l = aaa mm Pile shaft e = bbb mm Pile toe l'' = ccc mm For detailing and durability see Technical Information Technical Information: Product Catalogue ABC: 2002 – Clause ii

CE conformity marking consisting of the CE symbol given in directive 93/68/EEC

Identification of the notified body

Name or identifying mark and registered address of the producer

Last two digits of the year in which the marking was affixed

Number of the FPC certificate

Number and title of European Standard concerned

Generic name and intended use (included class of pile and joint class for segmental piles)

Information on product geometry and material characteristics including detailing (to be adapted to the specific product by the producer)

NOTE The sketch may be omitted if equivalent information are available in clearly identified Technical Information (product catalogue) referred to

Figure ZA.2 — Example of CE marking with Method 1

ZA.3.3 Declaration of product properties

(Method 2 to determine properties relating to essential requirements "mechanical resistance and stability").


For all design data, including models and parameters used in calculation, reference may be made to the technical (design) documentation.

Referring to Table ZA.1 a) or ZA.1 b) and to the information quoted in the list of ZA.3.1, the following properties shall be declared:

- compressive strength of concrete;
- ultimate tensile strength of reinforcing steel;
- tensile yield strength of reinforcing steel;
- ultimate tensile strength of prestressing steel;
- tensile 0,1 proof stress of prestressing steel;
- mechanical ultimate strength of the pile (design values for non-seismic situations) with axial compression capacity for some eccentricities or axial compression capacity with its bending moment capacity and shear capacity of critical sections;
- safety factors for concrete and steel used in calculation;
- other Nationally Determined Parameters NDPs used in calculation;
- conditions for durability against corrosion (or exposure classes);
- class of the pile;
- classification of the joint for segmental piles;
- possible reference to Technical Documentation for geometrical data, detailing, durability, drying shrinkage and other NDPs.

Figure ZA.3 gives, for foundation piles, the model CE marking in the case in which the properties related to mechanical resistance and stability are determined by the producer by means of EN Eurocodes.

The design values of the mechanical ultimate strength of the element shall be computed using, for the Nationally Determined Parameters, either the values recommended in EN 1992-1-1 or the values given in the National Annex of the Eurocodes applicable to the works.

 0123
AnyCo Ltd, PO Bx 21, B-1050 02 0123-CPD-0456
EN 12794 Precast concrete foundation piles Prestressed pile Pile class 1 Concrete: Compressive strength f_{ck} = xx N/mm ² Reinforcing steel: Ultimate tensile strength f_{tk} = yyy N/mm ² Tensile yield strength f_{yk} = zzz N/mm ² Prestressing steel: Ultimate tensile strength f_{pk} = uuu N/mm ² Tensile 0.1% proof-stress $f_{p0.1k}$ = www N/mm ² Mechanical ultimate strength (design values): Axial compression capacity For eccentricity e = 0,00 muuu kN For eccentricity e = y,yy mwww kN Axial tension capacity For eccentricity e = 0,00 muuu kN For eccentricity e = x,xx mvvv kN Shear capacity in critical cross section/joint For N = 0 kNuuu kN For N = xx kNvvv kN Material safety factors applied in strength calculation: For concrete γ_c = z.zz For steel γ_s = x.xx For geometrical data, detailing, durability and other NDPs see the Technical documentation Technical Documentation: Position Numberxxxxxx

CE conformity marking consisting of the CE symbol given in directive 93/68/EEC

Identification of the notified body
 Name or identifying mark and registered address of the producer
 Last two digits of the year in which the marking was affixed
 Number of the FPC certificate
 Number and title of European Standard concerned
 Generic name and intended use

 Pile class
 (joint class for segmental piles)

Information on product mandated characteristics including detailing (to be adapted to the specific product by the producer)

For products made for a specific use, the technical documentation shall indicate the place of destination

Figure ZA.3 — Example of CE marking with Method 2

ZA.3.4 Declaration of compliance with a given design specification


(Method 3 to determine properties relating to essential requirements "mechanical resistance and stability").

Figure ZA.4 gives, for foundation piles, the model CE marking in the case the product is produced according to a design specification in which the properties related to mechanical resistance and stability are determined by means of design provisions applicable to the works.

Referring to Table ZA.1 a) or ZA.1 b) and to the information quoted in the list of ZA.3.1, the following properties shall be declared:

- compressive strength of concrete;
- ultimate tensile strength of reinforcing steel;
- tensile yield strength of reinforcing steel;
- ultimate tensile strength of prestressing steel;
- tensile 0,1 proof stress of prestressing steel;
- class of the pile;
- classification of the joint for segmental piles.

This method applies also in case of a design made with means other than EN Eurocodes.

 0123
AnyCo Ltd, PO Bx 21, B-1050 02 0123-CPD-0456
EN 12794 Precast concrete foundation piles Single bar pile or pile segment Pile class 2 Joint class D Concrete: Compressive strength f_{ck} = xx N/mm ² Reinforcing steel: Ultimate tensile strength f_{tk} = yy N/mm ² Tensile yield strength f_{yk} = zzz N/mm ² For geometrical data, detailing, mechanical strength and durability see the design specifications Design specification: Order Code xxxxxx

CE conformity marking consisting of the CE symbol given in directive 93/68/EEC

Identification of the notified body

Name or identifying mark and registered address of the producer

Last two digits of the year in which the marking was affixed

Number of the FPC certificate

Number and title of European Standard concerned

Generic name and intended use

Class of pile

Class of joint rigidity

Information on product mandated characteristics including detailing (to be adapted to the specific product by the producer)

Figure ZA.4 — Example of CE marking with Method 3

In addition to any specific information relating to dangerous substances, the product should be also accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE *European legislation without national derogations need not be mentioned.*

Annex Y (Informative)

Choice of CE marking method

The producer should choose to apply, for CE marking, one of the alternative methods described in ZA.3, on the basis of the following conditions.

Y.1 Method 1

The declaration of geometrical data and material properties as specified in ZA.3.2 may be applied when the following condition occurs:

- off the shelf and catalogue products.

Y.2 Method 2

The declaration of product properties determined following this document and EN Eurocodes, as specified in ZA.3.3, should be applied when the following condition occurs:

- precast product with product properties declared by the producer.

Y.3 Method 3

The declaration of compliance with a given specification as specified in ZA.3.4 may be applied when the following condition occurs:

- all other cases than Y.1 and Y.2.

Bibliography

- [1] EN 206-1:2000, *Concrete - Part 1: Specification, performance, production and conformity*
- [2] EN 12699, *Execution of special geotechnical work — Displacement piles*

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