EUROPEAN ASSESSMENT DOCUMENT

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PILE JOINTS AND ROCK SHOES FOR CONCRETE PILES

www.eota.eu

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

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1 SCOPE OF THE EAD

1.1 Description of the construction product

1.1.1 General

The product is not covered by a harmonised European standard (hEN).

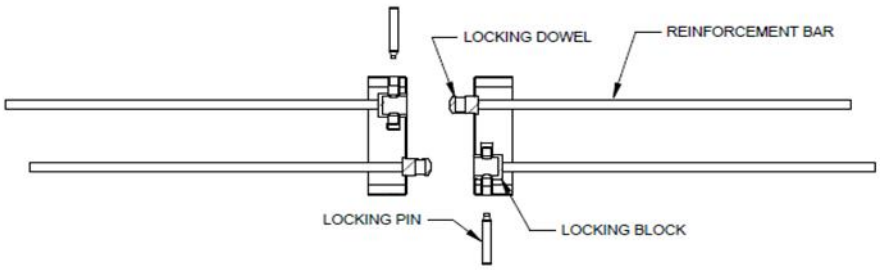
Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.1.2 Pile joint

The pile joint for precast concrete piles is made of steel sheet, steel bar and steel reinforcement bar, see Figure 1 and details in Annex 1. Different grades of steel are used for the various components of the pile joint as clarified in Annex 1. The welding between the reinforcement bar and locking components comply with EN ISO 17660-1.



1.1.3 Rock shoe

The rock shoe for precast concrete piles is made of steel sheet, steel bar and steel reinforcement bar, see Figure 2 and details in Annex 2. Different grades of steel are used for the various components of the rock shoe as clarified in Annex 2. The welding between the reinforcement bar and steel sheet comply with EN ISO 17660-1.

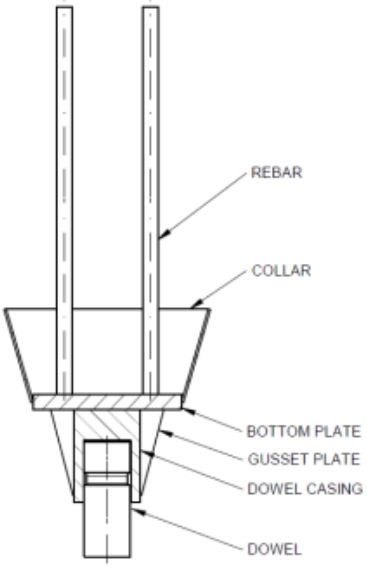


Figure 2. Rock shoe for precast concrete piles, principal drawing.

1.2 Information on the intended use(s) of the construction product

1.2.1 General

Pile joints and rock shoes are intended to be used with concrete piles made of concrete manufactured according to EN 206. They are intended to be used in undisturbed natural soils (sand, silt, clay, schist) and compacted non-aggressive fills of mineral soil materials. Corrosion rate 1,2 mm per 100 years as recommended in standard EN 1993-5 Table 4-1 should then be taken into account. Alternatively, empirical measurement data and statistical deterioration design model may be used when the conditions certainly can be classified as normal. Local conditions, standards and regulations in force at the place of use shall in both cases be considered and respected.

Pile joints and rock shoes are to be used under static or quasi static actions. Predominantly dynamic actions (fatigue actions), seismic actions and actions caused by hurricanes are excluded.

1.2.2 Pile joint

A pile joint is a connecting device for precast concrete pile segments. It is used to connect additional segments of precast reinforced concrete piles, during pile driving to depths greater than the length of a single segment.

The pile joint is incorporated into the precast concrete as the pile is cast, and the steel reinforcement bars bond it to the pile. By using a mould spacer device during casting, the correct position of the joint in the pile can be assured every time. During pile driving, when two concrete pile segments are jointed together and the locking dowels enter the locking blocks, the two halves of the joint in the extended concrete pile are locked securely with 4 or 8 locking pins. The locking pins are hammered in by hand or by machine. The lock mechanism for the pin (locking ring) ensures that the joint remains intact during pile driving. Immediately before offering a second pile segment for joining, the protective plugs in the locking blocks shall be removed on site and the connection surfaces shall be cleaned before joining of the pile segments.

1.2.3 Rock shoe

A rock shoe is a protective device for the leading end of the first precast concrete pile segment being driven. It is used at the leading end of the first precast reinforced concrete pile segment, when it is piled into rocky ground or down to solid rock. The rock shoe prevents damage to the pile during pile driving in rocky ground

and it anchors, if required, the pile to the bedrock and even to slanting rock strata. The rock pin is tempered and made of special steel and hardened to hardness 520 - 640 HV.

The rock shoe is incorporated into the leading end of the reinforced concrete pile and the steel reinforcement bars bond it to the pile. By using a casting guide device during casting, the correct position of the rock shoe in the pile can be assured every time. If the dowel is removed for casting, it should be refitted before moving to the site.

1.2.4 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the pile joints and rock shoes for concrete piles for the intended use of 100 years when installed in the works provided that the pile joints and rock shoes for concrete piles are subject to appropriate installation (see 1.1). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of pile joints and rock shoes is assessed in relation to the essential characteristics.

[1] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

Table 1 **Essential characteristics of the product and assessment methods and criteria for the performance of the product in relation to those essential characteristics**

No	Essential characteristic	Assessment method	Type of expression of product performance *(level, class, description)*
Basic Works Requirement 1: Mechanical resistance and stability			
1	Resistance of pile joint	2.4.1.1	2.4.1.1
2	Resistance of rock shoe	2.4.1.2	2.4.1.2
3	Robustness and rigidity of pile joint	2.4.1.3	2.4.1.3
4	Dimensional tolerances	2.4.1.4	2.4.1.4
Basic Works Requirement 2: Safety in case of fire			
5	Reaction to fire	2.4.2.1	2.4.2.1

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

2.2.1 Mechanical resistance and stability

2.2.1.1 Resistance of pile joint

The ultimate resistance (in compression, tension and bending) of the pile joint shall be calculated taking into account the design strengths of materials. Static calculations shall be verified by an impact load test followed by a bending test described in Annex A of EN 12794. The interaction between bending moment and normal force shall be taken into account in the design.

The standard EN 12794 "Precast concrete products - Foundation piles" gives the general guidelines to be followed.

Test procedure and results have to be expressed in a test report according to EN 12794 annex A.

2.2.1.2 Resistance of rock shoe

The ultimate resistance (in compression, tension and bending) of the pile joint shall be calculated taking into account the design strengths of materials. Static calculations shall be verified by an impact load test followed by a modified bending test described in Annex A of EN 12794.

The standard EN 12794 "Precast concrete products - Foundation piles" gives the general guidelines to be followed.

Test procedure and results have to be expressed in a test report according to EN 12794 annex A.

2.2.1.3 Robustness and rigidity of pile joint

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 according to Annex A of the standard EN 12794

Pile joints shall be classified in classes indicating the required resistances, performance and type of verification methods. The classification is shown in Table 2.

Table 2. Classifications of pile joints.

CLASS[a]	RESISTANCE	PERFORMANCE	VERIFICATION	METHODS
A	Compression /tension and bending	Robustness and rigidity	Static calculations to be verified by impact testing and subsequent bending test	Impact load test with 1000 impact blows having stress level 28 N/mm^2 [b]
B	Compression /tension and bending	Robustness and rigidity	Static calculations to be verified by impact testing and subsequent bending test	Impact load test with 1000 impact blows having stress level 22 N/mm^2 [b]
C	Compression /tension and bending	Robustness and rigidity	Static calculations to be verified by impact testing and subsequent bending test	Impact load test with 1000 impact blows having stress level 17 N/mm^2 [b]
D	Compression	Robustness and rigidity	Static calculations to be verified by impact testing	Impact load test with 1000 impact blows having stress level 17 N/mm^2 [b]

[a] Class is chosen according to the local rules so that it corresponds the geotechnical resistance requirement of the jointed pile.[b] Stress level corresponds to the compression strength caused to the pile joint during the hit.

2.2.1.4 Dimensional tolerances

The dimensions and shape (length, width and straightness) shall be declared and measured. Measurements and target values of all relevant dimensions and the tolerances of them shall be declared in the FPC documentation of the manufacturer. Measurements shall be done in a purposeful way that guarantees that the product is fit for the intended kit.

For pile joints, EN 12794 clause 4.3.1.3 shall be applied. For pile shoes, EN 12794 clause 4.3.1.4 shall be applied.

The measurement methods shall be evaluated. ETA shall contain the main dimensions and tolerances.

2.2.2 Reaction to fire

Pile joints and rock shoes for concrete piles made of steel are considered to satisfy the requirements for performance Class A1 of the characteristic reaction to fire, in accordance with the provisions of EC Decision 1996/603/EC[2] (as amended) without the need for testing on the basis of its listing in that Decision.

2 Official Journal of the European Communities/Union L 267, 19.10.1996, p. 23–26 (see www.eur-lex.europa.eu)

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 2000/606//EC

The system is: **2+**

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]*					
1	Incoming raw materials	3.4.1	3.4.1	-	Every delivery
2	Dimensions	2.2.3.1	2.2.3.1	2	In the beginning of each shift and when product type is changed
3	Welding of reinforcing steel	3.4.2	3.4.2	3.4.2	EN ISO 17660-1
4	Threaded connections of reinforcing steel	3.4.3	3.4.3	3.4.3	ISO 15835
5	Handling of non-conforming products	3.4.4	3.4.4	3.4.4	Every shift
No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 2.2 or 3.4)*	Criteria, if any	Minimum number of samples	Minimum frequency of control

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for pile joints and rock shoes for concrete are laid down in Table 3.

Table 3 Control plan for the notified body; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method *(refer to 2.2 or 3.4)*	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for systems 1+, 1 and 2+ only)*					
6	manufacturing plant	3.4.5	3.4.5	-	-
7	factory production control	3.4.5	3.4.5	-	-
Continuous surveillance, assessment and evaluation of factory production control *(for systems 1+, 1 and 2+ only)*					
8	factory production control	3.4.6	3.4.6		once a year

3.4 Special methods of control and testing used for the verification of constancy of performance

3.4.1 Incoming raw materials

Incoming raw materials shall be in accordance with the ETA and Annex 1 of this EAD. The conformity of all raw materials to the requirements is ensured by certificates obtained from the steel supplier (certificate 3.1 in the standard EN 10204).

3.4.2 Welding of reinforcing steel

Welding of the components shall comply with EN ISO 17660-1.

3.4.3 Threaded connections of reinforcing steel

Threaded connections of reinforcing steel shall comply with ISO 15835-1.

3.4.4 Handling of non-conforming products

The manufacturer shall have written procedures for handling of non-conforming products.

3.4.5 Initial inspection of the manufacturing plant and of factory production control

The notified body shall ascertain that the factory, in particular the staff and equipment, and the factory production control, are suitable to ensure a continuous and orderly manufacturing of pile joint, in accordance with the prescribed control plan.

3.4.6 Continuous surveillance, assessment and evaluation of factory production control.

The approved body shall visit the factory at least once a year for surveillance inspections. It shall verify that the system of factory quality control and the specified manufacturing processes are maintained in accordance with the prescribed control plan.

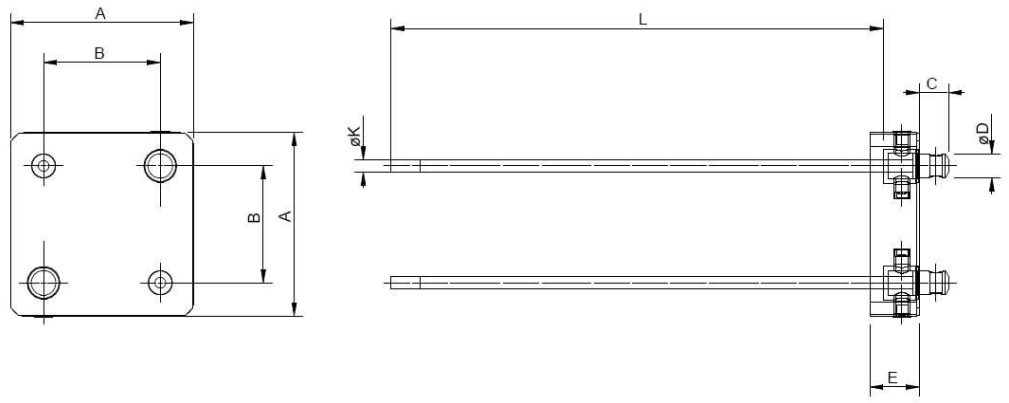
4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EN 206	Concrete. Specification, performance, production and conformity
EN 1993-5	Design of steel structures. Part 5: Piling
EN 1992-1-1	Eurocode 2: Design of concrete structures. Part 1-1: General rules and rules for buildings
EN 10025-2	Hot rolled products of structural steels. Part 2: Technical delivery conditions for non-alloy structural steels
EN 10204	Metallic products. Types of inspection documents
EN 10267	Ferritic-pearlitic steels for precipitation hardening from hot-working temperatures
EN 10083-3	Steels for quenching and tempering. Part 3: Technical delivery conditions for alloy steels
EN 12794+A1/AC	Precast concrete products. Foundation piles
ISO 15835-1	Steels for the reinforcement of concrete -- Reinforcement couplers for mechanical splices of bars -- Part 1: Requirements
EN ISO 17660-1	Welding. Welding of reinforcing steel. Part 1: Load-bearing welded joints

ANNEX 1 DETAILS OF PILE JOINT

Table A1-1. Principal dimensions of pile joints for precast concrete piles



PILE SIZE (mm)	A ± 2 (mm)	B ± 2 (mm)	C (mm)	øD (mm)	E (mm)	øK (mm)	L (mm) ± 10 (mm)
from 200 x 200 to 400 x 400	from 195 to 395	from 70 to 270	from 45 to 55	from 35 to 50	from 75 to 150	from 16 to 32	from 500 to 1200

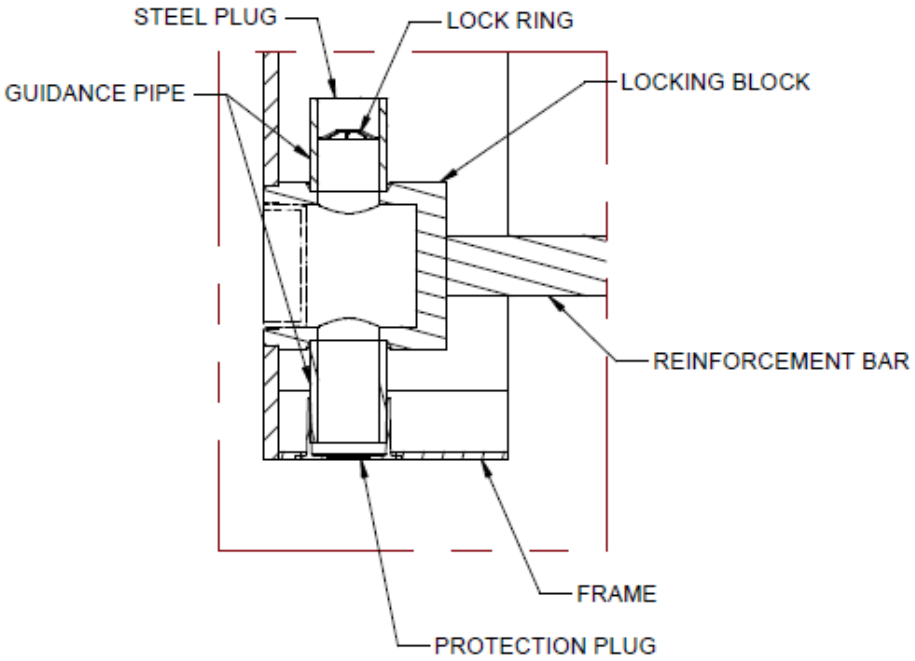
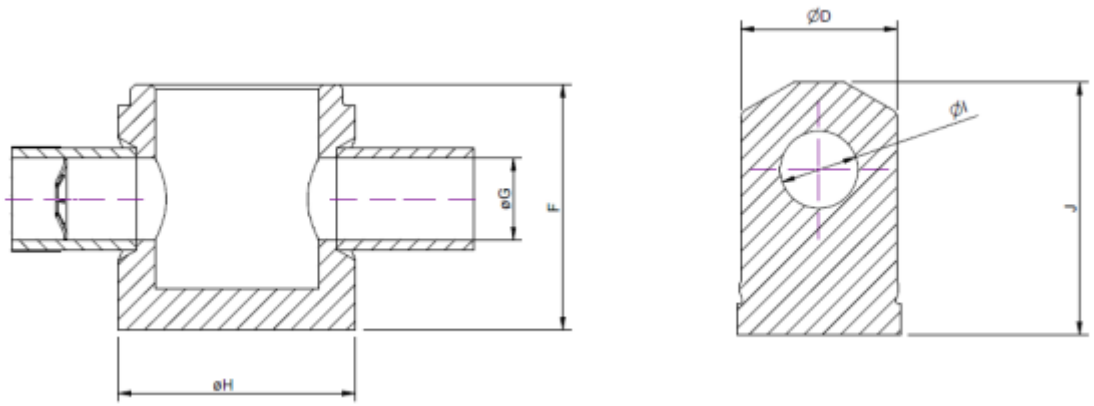


Figure A1-2. Locking block of pile joints for precast concrete piles

Table A1-2. Dimensions of the locking block of pile joints for precast concrete piles



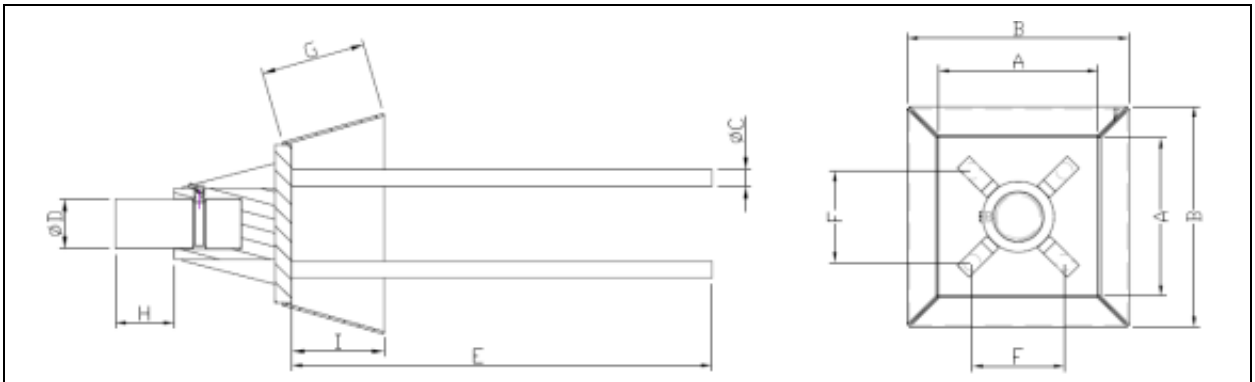
F (mm)	øG (mm)	øH (mm)	øl (mm)	J (mm)
from 50 to 65	from 20 to 30	from 50 to 70	from 15 to 30	from 60 to 75

Table A1-3. Materials of pile joint parts, examples. Materials used shall be defined in the ETA.

Part	Material	Standard
Locking block	S355J2+N	EN 10025-2
	S355J2+N	EN 10025-2
	19MnVS6M	EN 10267
Locking dowel	S355J2+N	EN 10025-2
	19MnVS6M	EN 10267
Reinforcement bar	F_{yk}> 500N/mm, weldable	EN1992-1-1 Annex C
Frame	S235JR+AR	EN 10025-2
Guidance pipe	S235JR+AR	EN 10025-2
Lock ring	Steel	
Steel plug	Steel	
Locking pin	19MnVS6M	EN 10267
	42CrMo4	EN 10083-3

ANNEX 2 DETAILS OF ROCK SHOE

TableA2-1. Principal dimensions of rock shoes for precast concrete piles



Pile size (mm)	A (mm)	B (mm)	øC (mm)	øD (mm)	E (mm)	F (mm)	G (mm)	H (mm)	I (mm)
from 235 x 235 to 400 x 400	from 160 to 395	from 230 to 395	from 16 to 32	from 59,5 to 79	from 500 to 1000	from 100 to 180	from 125 to 150	70	from 100 to 135

Table A2-2. Materials of rock shoe parts, examples. Materials used shall be defined in the ETA.

Part	Material	Standard
Dowel	BCM 311 hardened to 520-640 HV	EN 10083-3
Dowel casing	S355J2	EN 10025-2
Gusset plate	S355J2	EN 10025-2
Bottom plate	S355J2	EN 10025-2
Collar	S235JR	EN 10025-2
Reinforcement bar	F_{yk}> 500N/mm, weldable	EN1992-1-1 Annex C