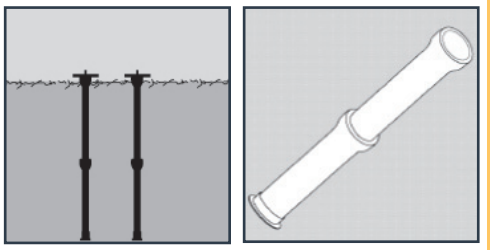
DYWIDAG-SYSTEMS INTERNATIONAL

DSI

DYWIDAG Geotechnical Systems

DYWIDAG
Ductile Iron Pile



DYWIDAG Ductile Iron Pile
ø 118 x 7.5 mm, 118 x 9.0 mm,
170 x 9.0 mm and 170 x 10.6 mm

Approval Number
Z-34.25-202
Validity
02 January 2009 - 01 January 2014

DEUTSCHES INSTITUT FÜR BAUTECHNIK

German Institute for Civil Engineering

Statutory Body

Approval office for construction products and construction
Testing office for structural engineering
Member of the European Organization for Technical Approvals and of the European Union for Agrément in construction UEA tc
Phone: +49 30 78730 - 0
Fax: +49 30 78730 - 320
E-Mail: dibt@dibt.de

Date:
January 2, 2009
Reference No.:
II 20-1.34.25-202/07

APPROVAL CERTIFICATE

Approval Number: Z-34.25-202

Valid until: January 1, 2014

Applicant: DYWIDAG-Systems International GmbH
Dywidagstraße 1, 85609 Aschheim

Object of Approval: DSI Ductile Iron Pile

The aforementioned object of approval is herewith generally approved by the construction supervision authority. This approval certificate comprises eleven pages and four appendices. This approval certificate replaces approval certificate No. Z-34.25 202 issued on September 18, 2007. The object was first granted general technical approval on October 18, 2001.

Important Notice
The approval in hand is the translation of a document originally prepared in German language which has not been verified and officially authorized by the “Deutsches Institut für Bautechnik“ (German Institute for Civil Engineering). In case of doubt in respect to wording and/or interpretation of this approval, the original German version of this document shall prevail exclusively. Therefore, no liability is assumed for translation errors or inaccuracies.

I. GENERAL PROVISIONS

1 This approval certificate is proof of the usability and applicability of the Object of Approval as called for by the state building regulations.

2 The general approval does not replace the permits, licences and certificates required by law for the execution of construction projects.

3 The general approval is granted without prejudice to third party rights, in particular private property rights.

4 Notwithstanding further regulations in the "Special Provisions" section, the manufacturer and distributor of the object of approval shall provide the user with copies of the approval certificate; furthermore, they shall inform the user that the approval certificate must be available at the place of use. On request, copies of the approval certificate shall be submitted to all authorities involved.

5 The approval certificate may only be copied in its entirety. Any publication of excerpts requires the consent of the German Institute for Civil Engineering. Texts and drawings in advertising material may not contradict the approval certificate. Translations of the approval certificate shall contain the following notice: "Translation of the German original has not been certified by the German Institute for Civil Engineering".

6 The approval is not granted irrevocably. The provisions of this approval may be amended or modified subsequently, in particular, if made necessary as a result of new technical findings.

II. SPECIAL PROVISIONS

1 Object of Approval and Application Range

1.1 Object of Approval

Object of this general approval are driven piles made of ductile cast iron tubes "DSI DUCTILE IRON PILE", Ø 118 x 7.5 mm, Ø 118 x 9.0 mm, Ø 118 x 10.6 mm, Ø 170 x 9.0 mm and Ø 170 x 10.6 mm by DYWIDAG-Systems International GmbH.

Ductile cast iron piles are assembled tubes joined in partial lengths. The single tubes are connected to each other by means of a special coupler splice or by special coupling elements designed for the cast iron pile.

1.2 Area of Application

The piles may only be loaded with predominantly static loads in accordance with DIN 1055-3[1].

The piles are designed for loading by axial compressive forces only. Their inclination to the vertical may not exceed 45°, respectively 5° if piles with grouted sheathings are used.

Piles with grouted sheathings may only be used in non-cohesive or cohesive soils (definition according to DIN 1054[2]).

Piles shall not be installed if the foundation soil contains ground water or seepage water from waste heaps and/or landfills resulting in a high probability of steel corrosion in form of cavities and holes in accordance with DIN 50929-3[3], Table 7, with $W_o < -8$. In addition, in the case of piles without grouted sheathings, evidence shall be produced that evaluation figure B_0 for a subsurface according to DIN 50 929-3, Table 2, is not smaller than – 10.

2 Provisions for the Product

2.1 Properties and Composition

2.1.1 General

Piles shall be made of spliced cast iron tubes. During or after placing into the soil, the center of the tubes shall be filled with cement grout (cf. section 2.1.3).

2.1.2 Cast Iron Tubes and Splicing Sleeves, Quality and Dimensions

The following directional analysis shall be observed for the material:

C approx. 3.7%, Si approx. 2.3%, Mn <0.4%, P <0.09%, S <0.010%, Mg approx. 0.030%.

With respect to shape, dimension and strength properties, Appendices 3 and 4 and the constructional drawings deposited at the German Institute for Civil Engineering shall apply.

For geometrical tolerances, DIN EN 545[4] shall be duly observed.

1	DIN 1055-3:2006-03	Impact on bearing structures – part 3: self-weight and service loads for building construction
2	DIN 1054:2005-01	Foundation soil; proof of safety in earth work and foundation engineering
	DIN 1054 Ber. 1:2005-04	Adjustments of DIN 1054:2005-01
	DIN 1054 Ber. 2:2007-04	Adjustments of DIN 1054:2005-01
	DIN 1054 Ber. 3:2008-01	Adjustments of DIN 1054:2005-01
	DIN 1054 Ber. 4:2008-10	Adjustments of DIN 1054:2005-01
3	DIN 50929-3:1985-09	Metal corrosion; corrosion probability of metallic materials with external exposure to corrosion; ducts and structural elements in soils and water
4	DIN EN 545:2007-02	Pipes, pipe fittings, accessories made of ductile iron and their connections for water pipes – requirements and test methods; German version EN 545: 2006

The wall thicknesses indicated are minimum wall thicknesses that have to be obtained, allowing for tolerance.

2.1.3 Cement grout

Cement grout fulfilling property class C 20/25 or C 25/30 according to DIN EN 206-1[5] in conjunction with DIN 1045-2[6], sections 5.3.8 and 5.1.4 shall be used for the interior of iron piles and for outer grout cover.

2.1.4 Connection in the Foundation Body

The load transfer from the cast iron tube into the foundation body is accomplished by a load distribution plate according to Appendix 1. To compensate a possible settlement of the concrete fill in the piling tube, the hollow space below the plate generated during installation of the pile plate shall be filled with cement grout.

2.2 Storage, Transport and Labelling

2.2.1 Storage, Transport

Cast iron tubes shall be stored and transported such that damaging of the tube lengths can be excluded.

2.2.2 Labelling

The delivery note for the cast iron piles and splicing sleeves shall be marked with the conformity symbol by the manufacturer pursuant to the Conformity Symbol Ordinance issued by the German States. Labelling may only be carried out when the requirement pursuant to Section 2.3 has been met. The following information must be included:

- Object of approval with cross-sectional dimensions
- Approval No.: Z-34.25-202
- Fabricating plant
- Monitored by: ……

2.3 Evidence of Conformity

2.3.1 General

Every fabricating plant must affirm conformity of the pile components to the provisions of this approval certificate by means of a certificate of conformity based on the regulations detailed in section 2.3.2.

Conformity of “DSI Ductile Iron Piles” to the provisions of this approval certificate must be confirmed by means of a declaration of conformity based on the regulations detailed in section 2.3.3.

2.3 Evidence of Conformity for Pile Components

2.3.1 General

Based on an in-house production inspection and a regular external supervision including a first testing, every fabricating plant must observe the following provisions to affirm conformity of the pile components in accordance with the provisions of this approval certificate.

5	DIN EN 206-1:2001-07	Concrete – part 1: Specification, properties, production and conformity
	DIN EN 206-1/A1:2004-10	Concrete – part 1: Specification, properties, production and conformity; German version EN 206-1/A1:2004
	DIN EN 206-1/A2:2005-09	Concrete – part 1: Specification, properties, production and conformity; German version EN 206-1:2000/A2:2005
6	DIN 1045-2:2008-08	Bearing structures made of concrete, reinforced concrete and prestressed concrete – part 2: concrete -specification, properties, production and conformity -codes of practice for DIN EN 206-1

The manufacturer of cast iron tubes and splicing coupler shall commission a recognized certification institution to issue the certificate of conformity, as well as a recognized inspection agency for external surveillance including product inspections.

The certification institution shall submit a copy of the certificate of conformity issued to the German Institute for Civil Engineering for information.

2.3.2.2 Internal Production Control

An internal production control shall be established and implemented in every fabricating plant. The term “internal production control” is defined as the continuous monitoring of production by the manufacturer which ensures that the manufactured products comply with the provisions of this general approval.

The internal production control must contain at least the measures detailed below.

Cast Iron Tubes and splicing sleeves:

The following directional analysis shall be observed for material:

C approx. 3.7%, Si approx.2.3%, Mn <0.4%, P <0.09%, S <0.010%, Mg approx. 0.030%.

Annexes 3 and 4 as well as the shop drawings filed with the German Institute for Civil Engineering apply with regards to shape, dimension and strength properties.

DIN EN 545[4] shall be observed for geometrical tolerances.

The given wall thicknesses are minimum wall thicknesses which have to be achieved observing tolerance.

Evidence for these properties shall be produced by inspection certificate "3.1" in accordance with DIN EN 10204[7].

Inspections according to DIN EN 206-1[5] in conjunction with DIN 1045-2[6], sections 8 and 9, have to be carried out for cement grout.

Results of the internal production control must be recorded and evaluated. These recordings must contain at least the following specifications:

- description of the product, respectively, of the raw material and the components,
- type of test or inspection,
- date of manufacturing and of testing of the product, respectively of the raw material or the components,
- results of the tests and, if applicable, comparison with the requirements,
- signature of the person responsible for the internal production control.

These records must be kept for at least 5 years and presented to the external quality surveillance. On request, they shall be presented to the German Institute for Civil Engineering and the responsible supreme construction supervision authority.

If test results are unsatisfactory, the manufacturer has to take action immediately to stop the cause of this failure. Pile components which do not comply with the requirements have to be marked to exclude mix-up with conform parts. After the cause of this failure has been eliminated, the respective test has to be repeated immediately, if this is technically possible and required to prove that the cause of the failure has been eliminated.

7 DIN EN 10204: 2005-01 Metal products; varieties of inspection certificates; German version EN 10204: 2004

2.3.2.3 External Surveillance

The internal production control in each fabricating plant shall be regularly checked by an external surveillance, but at least twice a year.

A first testing shall be carried out as part of the external surveillance. Samples for sampling inspections shall be taken and the inspection tools controlled. Sampling and inspections are incumbent on the respective recognized inspection agency.

The results of the certification and external surveillance shall be kept for at least five years. On request, they shall be presented to the German Institute for Civil Engineering and the responsible supreme construction supervision authority by the certification institution or inspection agency.

2.3.3 Evidence of conformity for "DSI Ductile Iron Pile"

Based on inspections of accomplishment according to section 4.4, affirmation of conformity of the "DSI Ductile Iron Pile" with the provisions of this approval certificate must be given by means of a declaration of conformity by the acting company.

3 Provisions for Planning and Design

3.1 General

For the planning and design of structures using "DSI Ductile Iron Piles", the following provisions apply.

3.2 Evidence of Load Bearing Capacity

3.2.1 Evidence of External Load Bearing Capacity

Evidence of the external load capacity shall be produced by test loadings in accordance with DIN 1054[2] or based on empirical values according to DIN 1054[2], sections 8.4.4 and appendix C, following equation 3.1.

$$E_d \leq R_d = \frac{R_{1,k}}{\gamma_P} = \frac{1}{\gamma_P}\left[R_{b1,k} + R_{s1,k}\right] \qquad (3.1)$$

E_d = design value of individual pile load
R_d = design value of individual pile resistance
$R_{1,k}$ = characteristic pile resistance for ultimate state GZ 1B
γ_p = partial safety coefficient for pile pressure resistance based on empirical values according to DIN 1054[2], table 3
$R_{b1,k}$ = characteristic pile foot resistance for ultimate state GZ 1B
$R_{s1,k}$ = characteristic pile sheathing resistance for ultimate state GZ 1B

Due to their interior bearing capacity, test loads no higher than those according to equation 3.2 may be applied during test loading on structural piles.

$$\max P_P = 0{,}9 \cdot f_{t0.2k} \cdot A_t \qquad (3.2)$$

$f_{t0.2k}$ = strain at 0.2% elongation = 320 N/mm²
A_t = cross section of the ductile cast iron pile

Table 1 lists the loads for the approved cross sections:

Table 1: Maximum design load during test loading

Cast Iron Tube [mm]	Max. design load applied to structural piles during test loading
Ø 118 x 7.5	750 kN
Ø 118 x 9.0	890 kN
Ø 118 x 10.6	1,030 kN
Ø 170 x 9.0	1,310 kN
Ø 170 x 10.6	1,520 kN

In the case of piles with grouted sheathings, test load can be increased by the percentage of the inner pile concrete.

$$\max P_P = 0{,}9 \cdot f_{t0.2k} \cdot A_t + 0{,}9 \cdot f_{ck}(t) \cdot A_B \qquad (3.3)$$

$f_{ck}(t)$ =characteristic value of concrete compressive strength against age of concrete t
A_B = cross section of inner pile concrete

In addition, a sufficient longitudinal shear resistance according to section 3.2.2.4 is to be ensured during test loading in the case of grouted piles (skin friction piles).
If proof of stability is to be given for the pile, the maximum design load for test loading is to be determined according to section 3.2.2.3.

3.2.2 Evidence of Internal Load Bearing Capacity

3.2.2.1 General

Evidence of internal load bearing capacity includes

- evidence of cross section load bearing capacity according to 3.2.2.2,
- evidence of stability in the case of piles without lateral soil support according to 3.2.2.3 and
- evidence of bond joint load bearing capacity between grout cover and cast iron tube in the case of grouted piles according to 3.2.2.4.

Tube cross sections of piles without grouted sheathings are to be determined taking into account a sacrificial corrosion of 3 mm of the external diameter.

3.2.2.2 Evidence of Cross Section Load Bearing Capacity

If no evidence of stability is required, evidence must be given that the design value of individual pile stress E_d does not exceed the design value of the pile's cross section load bearing capacity $R_{i,d}$.

$$E_d \leq R_{i,d} \qquad (3.4)$$

The design value of the pile's cross section load bearing capacity $R_{i,d}$ is composed of the sum of design values of structural element resistance of the cast iron tube and of concrete inside the tube, where only the concrete enclosed by the iron tube may be taken into account even in the case of piles with grout cover.

$$R_{i,d} = \frac{R_{sk}}{\gamma_{Ma}} + \frac{R_{ck}}{\gamma_c} \qquad (3.5)$$

$R_{sk} = A_t \cdot f_{t0.2k}$
γ_{Ma} = partial security coefficient for the cast iron tube
= 1.10 for load cases LF 1 to LF 3
$R_{ck} = A_B \bullet f_{ck}$
γ_c = partial security coefficient for concrete
= 1.50 for load cases LF 1 and LF 2
= 1.30 for load case LF 3

The design values $R_{i,d}$ for individual pile types can be taken from table 2 for load cases LF 1 and LF 2.

Table 2: Design Values $R_{i,d}$ of cross sectional load bearing capacity of piles with interior cement grouting and concrete quality C20/25 and C25/30 (load cases LF 1 and LF 2)

Cast Iron Tube [mm]	Without outer grouting, with Post Concrete Filling		With outer grouting (skin friction piles)	
	C20/25	C25/30	C20/25	C25/30
Ø 118 x 7.5	709 kN	737 kN	869 kN	896 kN
Ø 118 x 9.0	842 kN	868 kN	1,001 kN	1,027 kN
Ø 118 x 10.6	979 kN	1,003 kN	1,139 kN	1,163 kN
Ø 170 x 9.0	1,335 kN	1,396 kN	1,566 kN	1,627 kN
Ø 170 x 10.6	1,545 kN	1,603 kN	1,776 kN	1,834 kN

3.2.2.3. Evidence of Stability

Evidence of stability must be given according to the theory of second order in accordance with DIN 18800-5[8] without beginning of lateral support by the soil if a pile stands partly free, in organic (definition according to DIN 1054[2]) or in cohesive soils (definition according to DIN 1054[2]) with an undrained shearing resistance of $c_u \leq 15$ kN/m^2 (according to DIN 18137-1[9]). An unintended excentricity $e_v = L/150$ needs to be taken into account for this evidence, with L being the free, unsupported length of the pile.

As when determining the cross section load bearing capacity, only the concrete enclosed by the cast iron tube may be taken into account.

3.2.2.4 Evidence of longitudinal shear resistance of the bond joint between outer grouted cover and cast iron tube

At the ultimate state of load bearing capacity, evidence needs to be given that the ratio of the design value of stress $E_{v,d}$, which is to be transmitted via skin friction, does not exceed the design value of stress of the bond joint between the cast iron tube and the grout cover $R_{v,d}$.

$$E_{v,d} \leq R_{v,d} \qquad (3.6)$$

$$E_{v,d} = \frac{E_d}{R_d} \cdot R_{s,d} \qquad (3.7)$$

E_d is the design value of the individual pile stress, R_d is the design value of the pile resistance resulting from the exterior load bearing capacity according to 3.2.1 and $R_{S,d}$ is the percentage of the design value R_d that is transferred via skin friction. If the percentage contact area $R_{S,d}$ of skin friction cannot be determined in cases of combined load transfer via tip pressure and skin friction, the equation $E_{vd} = E_d$ applies.

The design value of longitudinal shear resistance $R_{v,d}$ of the interior joint between the grout cover and the cast iron tube may be determined according to equation (3.8).

$$R_{v,d} = \tau_{R,d} \cdot \pi \cdot d \cdot L_{eff} \qquad (3.8)$$

d = nominal diameter of the cast iron tube

L_{eff} = effective pile length without taking into account the coupling areas

The design value of the bond strength $\tau_{R,D}$ of the joint between cast iron tube and grouted sheathing may be determined according to equation (3.9):

8 DIN 18800-5:2007-03 Steel structures – part 5: bonded supporting structures consisting of steel and concrete – design and construction

9 DIN 18137-1:1990-08 Foundation soil, tests and testing equipment; determination of shear strength; terms and basic test

$$\tau_{R,d} = \frac{\tau_{R,k}}{\gamma_{M,v}} + \mu_k \cdot \sigma_h \qquad (3.9)$$

$\tau_{R,k}$ = basic value for bond stress using $\tau_{R,k}$ = 0,32 N/mm²
$\gamma_{M,v}$ = partial safetyfactor $\gamma_{M,v}$ = 2.1 for the load cases LF 1 and LF 2, 1.8 for the load case LF 3
μ_k = friction coefficient between cast iron tube and the grout cover with μ_k= 0.5
σ_h = lower characteristic value for the surface pressure acting horizontally via the pile circumference consisting of earth pressure and interaction in N/mm²

If more precise values are not given, a value of

$$\sigma_h = \frac{\tau_M}{\tan\varphi'} \qquad (3.10)$$

φ' = friction angle of drained soil (effective friction angle)
τ_M = skin friction of the joint concrete/soil when in use

$$\tau_M = \frac{\tau_{M,k}}{\gamma_P}$$

τ_M = characteristic value of pile skin friction, determined via test loads or empirical values according to DIN 1054², table D.1
γ_{Pc}, γ_P = partial security coefficient for pile load resistance of test loads or empirical values according to DIN 1054², tables 2 and 3
may be assumed for σ_h.

3.2.2.5 Connections in the Pile Head (Appendix 1)
The steel plate (Appendix 1) must be structurally connected to the cast iron tubes, with the end of the upper tube having to be plane.
Stresses in the pile head need to be verified according to DIN 1045-1[10].

4 Execution of the Installation

4.1 Installing company

The installation of “DSI Ductile Iron Piles” in accordance with this approval certificate may only be executed under technical supervision of DYWIDAG-Systems International GmbH.
The installation of “DSI Ductile Iron Piles” may also be executed by companies able to produce a current certificate of DYWIDAG Systems International GmbH stating that they have been trained extensively in the execution of “DSI Ductile Iron Piles” in accordance with this approval certificate issued on January 2nd, 2009. The executing company has to produce a declaration stating that the installed “DSI Ductile Iron Piles” comply with the requirements of this approval certificate.

4.2 Driving Works and Pile Arrangement

DIN 4026[11] applies for pile driving. Each pile must be provided with a ram shoe. Piles must be checked for straightness. The radius of curvature must measure at least 150 m; the measured value has to be given in the driving records. The interior of the tubes has to be injected with cement grout (cf. section 2.1.3) during or after installation in the soil, also cf. section 4.3.

10	DIN 1045-1:2008-08	Supporting structures consisting of steel, reinforced concrete and prestressed concrete – part 1: design and construction
11	DIN 4026:1975-08	Driven piles – construction, design and admissible stress

With respect to the pile fabrication, the following imperfections are to be expected at the pile head:

- Deviation of the pile head position: +/- 8 cm
- Deviation from nominal deviation: +/- 3°

The imperfections described above must be considered when calculating the construction above the pile foundation.

The minimum center-to-center distances of the piles in the area of their load transmission lengths are 0.5 m for cast iron piles Ø 118 mm and 0.7 m for cast iron piles Ø 170 mm. Their lengths in the stable foundation soil (load transmission lengths) must be > 3 m. Since the piles may not be damaged during driving, it may be necessary to cancel the driving work before reaching the minimum load transmission lengths. The external bearing capacity for these piles shall be verified by additional test loadings.

This evidence is not required for plain end-bearing piles.

To avoid bending strains of individual piles resulting from an unintentional off-center loading, the piles shall be arranged such that such off-centricity can be regarded as harmless for the individual pile (e.g. at least 3 piles under a concentrated load or two pile rows under a line load or other suitable structural means which ensure that bending strains are avoided).

4.3 Outer grout cover (skin friction)

If the pile is realized with grout cover, the cast iron tubes have to be covered with a continuous coating of cement mortar (cf. section 2.1.3) along their entire lengths.

Cement mortar has to be continuously injected during driving through an injection valve at the upper end of the cast iron tube into the annular space created by the ram shoe.

The cement mortar flows out through a triangular opening (lateral lengths of approx. 10 to 15 cm) that is located as near as possible to the bottom edge of the pile.

The suspension level may not sink deeper than 0.5 m below ground. During installation, cement grout always has to flow out at the planned surface during pile driving works. During pile driving, driving time per length unit and driving resistance are to be recorded in writing. A ram shoe (grout shoe) according to appendix 2 must be used for piles with grout cover. The lateral protrusion of the ram shoe has to ensure a hardened cement grout covering of 20 mm minimum in the coupler area as well.

Due to losses of cement mortar during of manufacturing, the effective spend of cement mortar has to be at least 10% higher than is theoretically required. The required amount of cement mortar must be assured by means of sufficient pump capacity against driving time per pile length. Losses of cement mortar must be recorded in writing and evaluated.

4.4 Declaration of Conformity

During the installation of “DSI Ductile Iron Piles”, the orderly execution of the works must be recorded in writing by the site manager or his representative.

Affirmation of conformity of “DSI Ductile Iron Piles” with the regulations of this approval certificate has to be given for each installation by means of a declaration of conformity of the executing company based on controls of the execution (table 3) and on visual inspection to determine the correct condition of execution. The results of these controls must be recorded and evaluated.

If test results are unsatisfactory, the manufacturer has to immediately take the necessary measures to eliminate the deficiency. Once the deficiency has been eliminated, the test in question must be repeated immediately, as far as this is technically possible and necessary to prove that the deficiency has been eliminated.

Table 3: Measures for controlling installation

Test Item	Examination/ Inspection	Minimum Frequency
Cement mixture	in the case of bagged cargo, the shipping note and imprints on bags have to be checked. In the case of silo cargo, shipping note must be checked.	each delivery
Cement mortar	according to DIN EN 206-1[5] in conjunction with DIN 1045-2[6]	every 100 m³ 1 series with 3 test items
Cast iron tubes and connecting couplers	shipping note and inspection certificate check	each delivery

The declaration of conformity of the executing company must contain at least the following details:

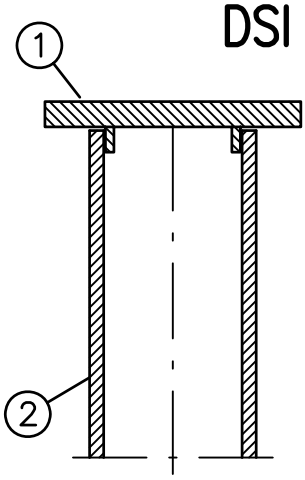
- Approval number
- Name of the construction project
- Date of installation
- Name and registered office of the executing company
- Confirmation of the execution according to planning documents
- Documentation of source materials and shipping notes
- Nature of inspections or tests
- Date of inspection or test
- Inspection and test results and comparison to the requirements, if applicable
- Particularities
- Name, company and signature of the person responsible for the inspections and tests

Records have to be available on site during time of construction. They have to be kept by the company for at least five years after completion of construction work.

Copies of the records must be handed out to the site manager for inclusion in construction files and must be presented to the German Institute for Civil Engineering and to the responsible building supervisory board on demand.

Henning Certified

DSI DUCTILE IRON PILE

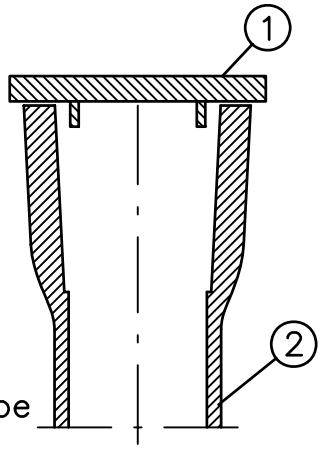


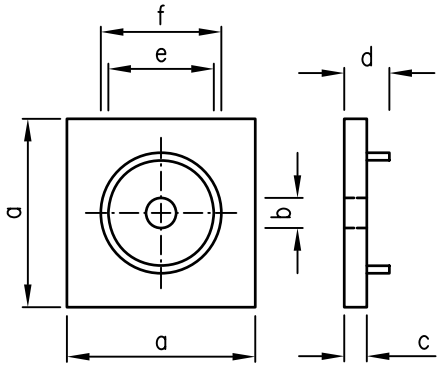
Pile head, type A

(1) Load distribution–plate, type A

Dimensions: see table

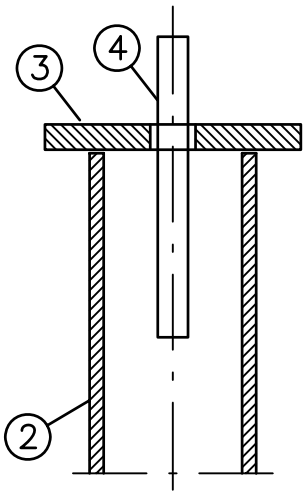
(2) Ductile cast iron pipe





Pile caps, type A, S355

Pile type	a	b	c*	d	e	f
ø 118	200	30	35*	50	85	95
ø 170	250	30	40*	50	136	146

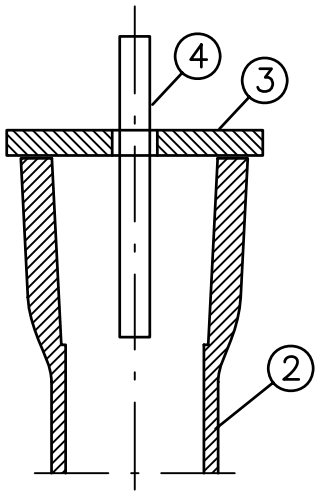


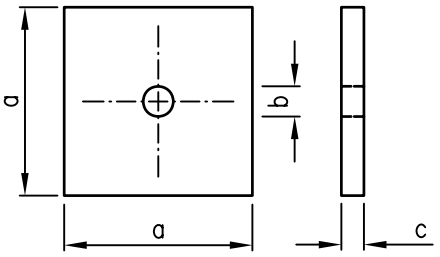
Pile head, type B

(3) Load distribution–plate, type B

Dimensions: see table

(4) Dowel, BSt 500 S ø20, L=30cm





Pile caps, type B, S355

Pile type	a	b	c*
ø 118	200	30	35*
ø 170	250	30	40*

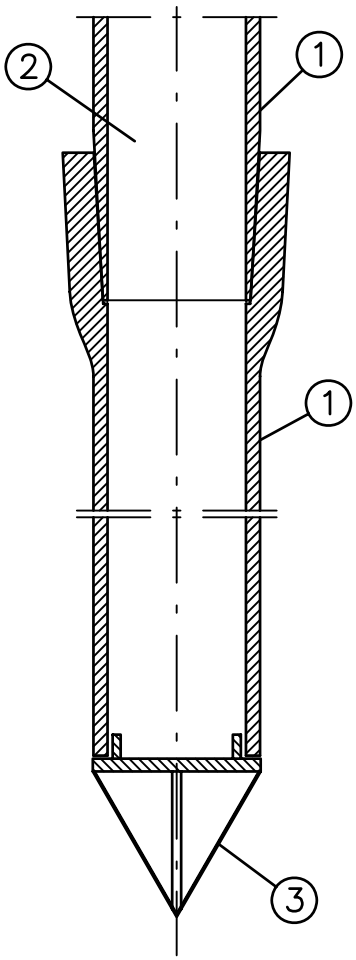
* For piles 118x7,5 and 170x9,0 the plate thickness c may be reduced by 5 mm each.

All measurements in mm

DYWIDAG SYSTEMS International	DSI DUCTILE IRON PILE	Appendix 1
	DYWIDAG – Driven Piles ductile cast iron tubes ø118mm and ø170mm	to approval certificate No. Z–34.25–202 of 2009–January–02

DSI DUCTILE IRON PILE

Pile foot, type A (not–grouted)

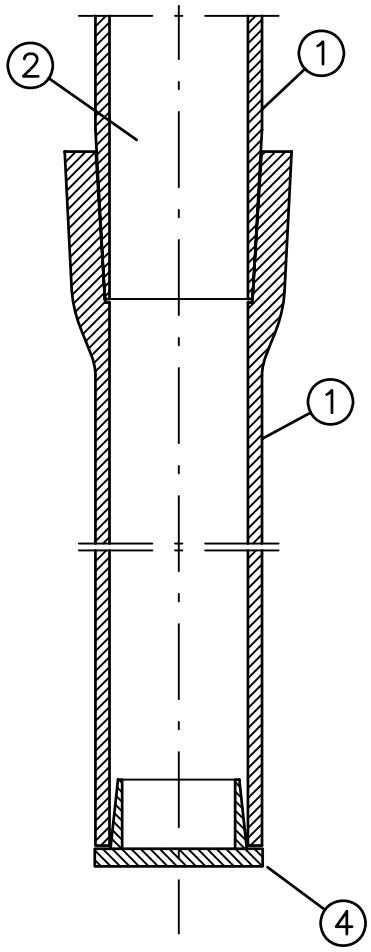


① Cast iron tube

② Cement mortar or pile concrete filling, strength class C20/25 or C25/30

③ Ram bit

Pile foot, type B (not–grouted)

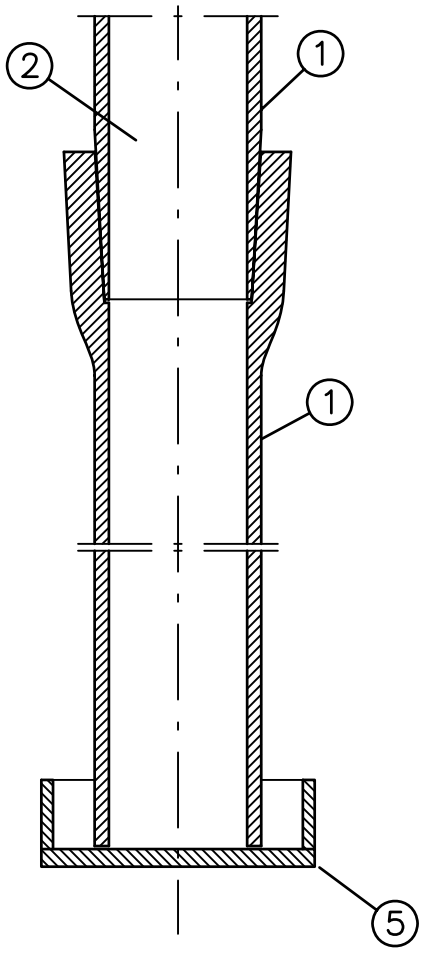


① Cast iron tube

② Cement mortar or pile concrete filling, strength class C20/25 or C25/30

④ Ram shoe

Pile foot, type B (grouted)



① Cast iron tube

② Cement mortar or pile concrete filling, strength class C20/25 or C25/30

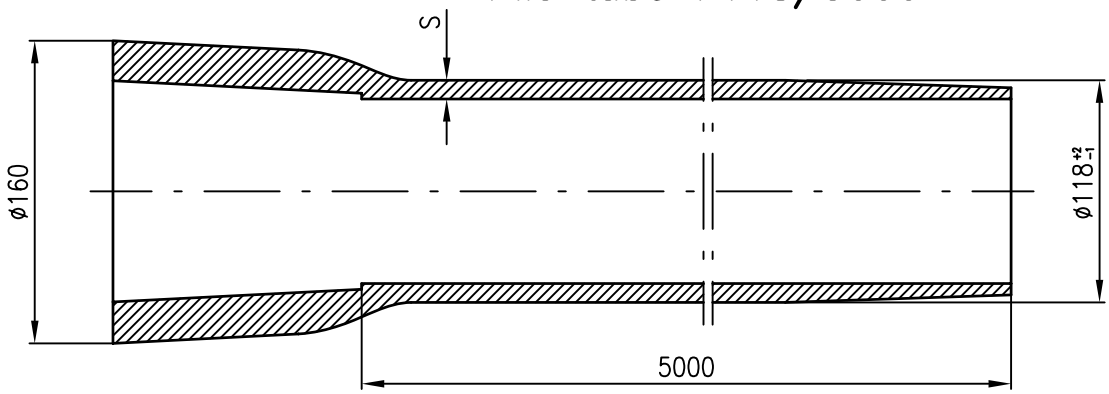
⑤ Grout shoe

DYWIDAG SYSTEMS International	DSI DUCTILE IRON PILE DYWIDAG – Driven Piles ductile cast iron tubes ø118mm and ø170mm	Appendix 2 to approval certificate No. Z–34.25–202 of 2009–January–02

DSI DUCTILE IRON PILE

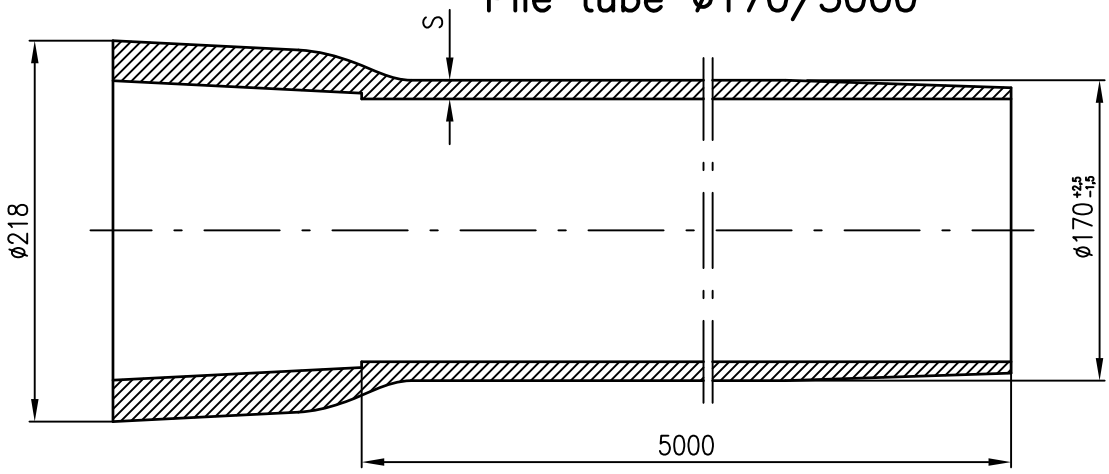
Tensile strength	min. 420 N/mm²	Brinell–Hardness	max. 230 HB
0,2%–yield strength	min. 320 N/mm²	Young's Modulus	160.000 N/mm²
elongation at rupture	min. 10 %	Density	7,05 g/cm³

Pile tube ø118/5000



ø 118	
nom. S	Weight
7,5	105 kg ±7 kg
9,0	123 kg ±7 kg
10,6	142 kg ±7 kg

Pile tube ø170/5000



ø 170	
nom. S	Weight
9,0	186 kg ±10 kg
10,6	213 kg ±10 kg

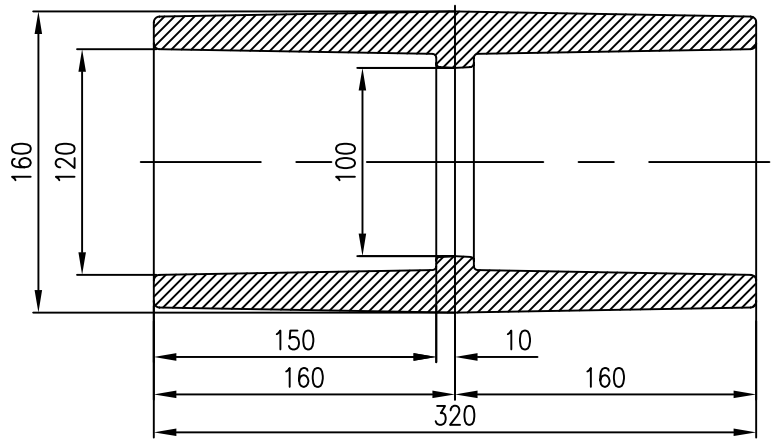
All other dimension corresponding to DIN EN 545 or to the drawings deposited at the German Insitute for Civil Engineering

DYWIDAG SYSTEMS International	DSI DUCTILE IRON PILE DYWIDAG – Driven Piles ductile cast iron tubes ø118mm and ø170mm	Appendix 3 to approval certificate No. Z–34.25–202 of 2009–January–02

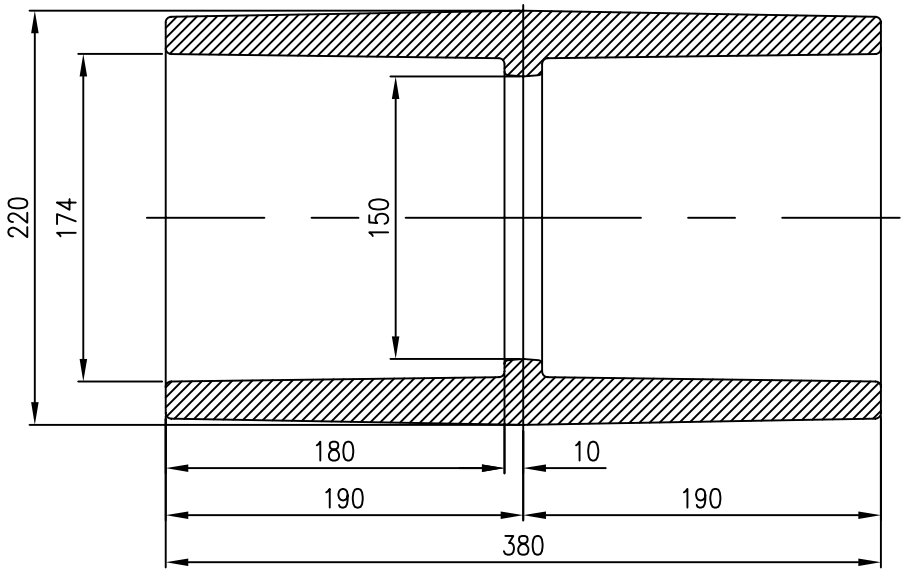
COUPLERS DSI DUCTILE IRON PILES

Tensile strength	min. 420 N/mm²	Brinell–Hardness	max. 230 HB
0,2%–yield strength	min. 320 N/mm²	Young's Modulus	160.000 N/mm²
elongation at rupture	min. 10 %	Density	7,05 g/cm³

Coupler for piles ø118



Coupler for piles ø170



All other dimension corresponding to DIN EN 545 or to the drawings deposited at the German Insitute for Civil Engineering

DYWIDAG SYSTEMS International	DSI DUCTILE IRON PILE	Appendix 4
	DYWIDAG – Driven Piles ductile cast iron tubes ø118mm and ø170mm	to approval certificate No. Z–34.25–202 of 2009–January–02

Austria
DYWIDAG-Systems International GmbH
Alfred-Wagner-Strasse 1
4061 Pasching/Linz, Austria
Phone +43-7229-610 49 0
Fax +43-7229-610 49 80
E-mail dsi-a@dywidag-systems.at
www.dywidag-systems.at

Belgium and Luxembourg
DYWIDAG-Systems International N.V.
Industrieweg 25
3190 Boortmeerbeek, Belgium
Phone +32-16-60 77 60
Fax +32-16-60 77 66
E-mail info@dywidag.be
www.dywidag-systems.com

France
DSI-Artéon
146 Avenue du Bicentenaire
Z.I. Dagneux
01122 Montluel Cedex, France
Phone +33-4-78 79 27 82
Fax +33-4-78 79 01 56
E-mail dsi.france@dywidag.fr
www.dywidag-systems.fr

Germany
DYWIDAG-Systems International GmbH
Schuetzenstrasse 20
14641 Nauen, Germany
Phone +49-3321-44 18 0
Fax +49-3321-44 18 38
E-mail suspa@dywidag-systems.com
www.dywidag-systems.de

DYWIDAG-Systems International GmbH
Max-Planck-Ring 1
40764 Langenfeld, Germany
Phone +49-2173-79 02 0
Fax +49-2173-79 02 20
E-mail suspa@dywidag-systems.com
www.dywidag-systems.de

DYWIDAG-Systems International GmbH
Germanenstrasse 8
86343 Koenigsbrunn, Germany
Phone +49-8231-96 07 0
Fax +49-8231-96 07 40
E-mail suspa@dywidag-systems.com
www.dywidag-systems.de

DYWIDAG-Systems International GmbH
Siemensstrasse 8
85716 Unterschleissheim, Germany
Phone +49-89-30 90 50 100
Fax +49-89-30 90 50 120
E-mail dsihv@dywidag-systems.com
www.dywidag-systems.com

Italy
DYWIT S.P.A.
Via Grandi, 64
20017 Mazzo di Rho (Milano), Italy
Phone +39-02-934 68 71
Fax +39-02-934 68 73 01
E-mail info@dywit.it
www.dywit.it

Netherlands
DYWIDAG-Systems International B.V.
Veilingweg 2
5301 KM Zaltbommel, Netherlands
Phone +31-418-57 89 22
Fax +31-418-51 30 12
E-mail email@dsi-nl.nl
www.dywidag-systems.com

Norway
DYWIDAG-Systems International AS
Industrieveien 7A
1483 Skytta, Norway
Phone +47-67-06 15 60
Fax +47-67-06 15 59
E-mail adm@dsi-dywidag.no
www.dywidag-systems.com

Poland
DYWIDAG-Systems International Sp. z o.o.
ul. Przywidzka 4/68
80-174 Gdansk, Poland
Phone +48-58-300 13 53
Fax +48-58-300 13 54
E-mail dsi-polska@dywidag-systems.com
www.dywidag-systems.pl

Spain
DYWIDAG Sistemas Constructivos, S.A.
Avd/de la Industria, 4
Pol. Ind. la Cantuena
28947 Fuenlabrada (Madrid), Spain
Phone +34-91-642 20 72
Fax +34-91-642 27 10
E-mail dywidag@dywidag-sistemas.com
www.dywidag-sistemas.com

United Kingdom
DYWIDAG-Systems International Ltd.
Northfield Road
Southam, Warwickshire
CV47 0FG, Great Britain
Phone +44-1926-81 39 80
Fax +44-1926-81 38 17
E-mail sales@dywidag.co.uk
www.dywidag-systems.com/uk

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BOSNIA AND HERZEGOVINA
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