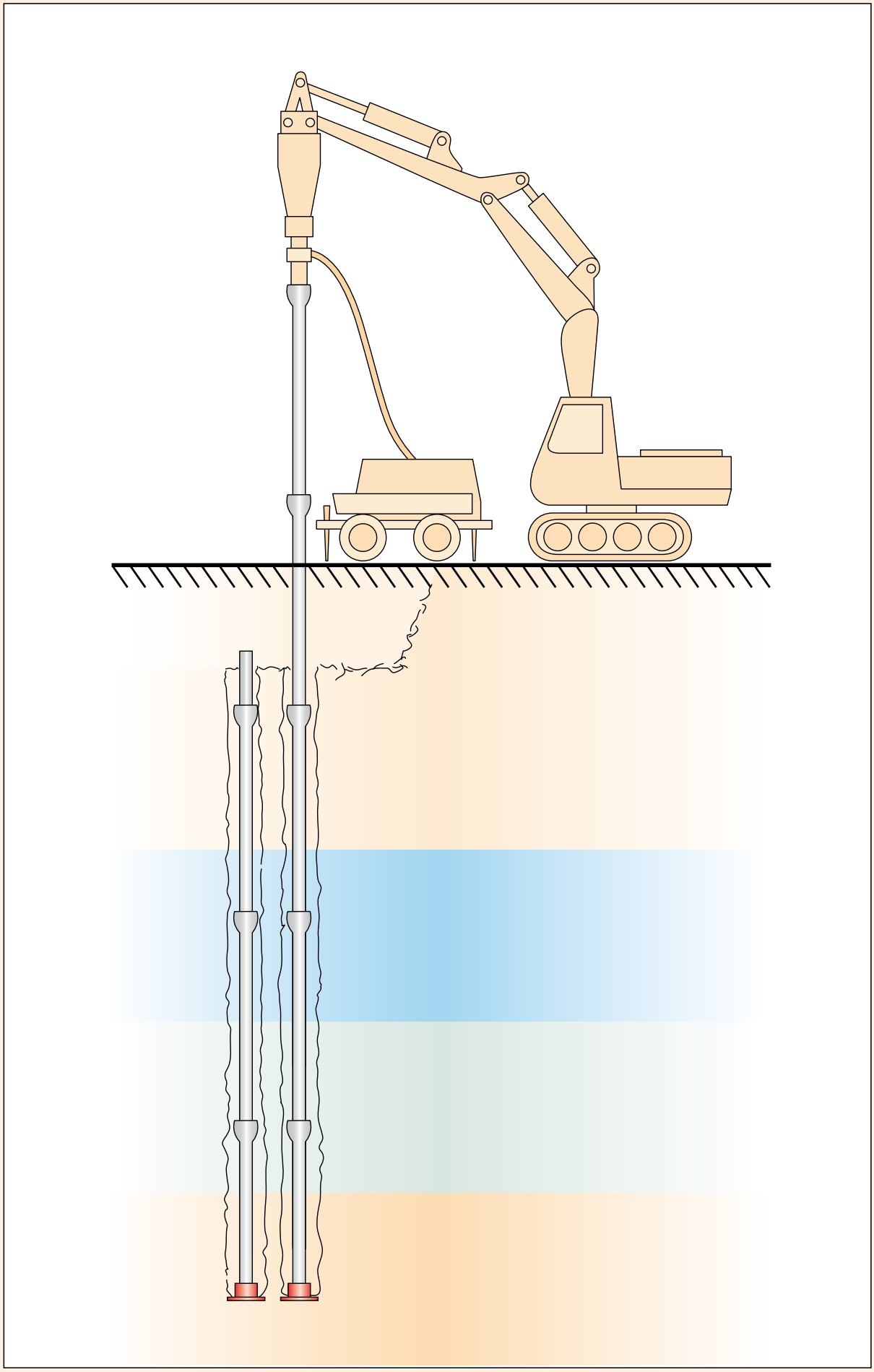
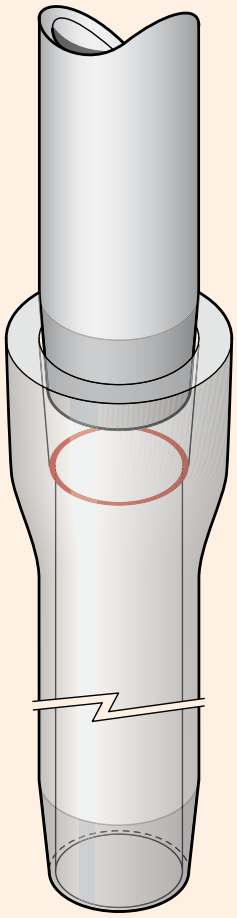
DYWIDAG Ductile Iron Pile



Contents

Applications **page 7**



DYWIDAG Ductile Iron Pile **page 4**

References **page 10**

DYWIDAG Ductile Iron Pile
with grouted annulus **page 5**

DYWIDAG Ductile Iron Piles

The DYWIDAG Ductile Iron Pile is a driven pile system, utilizing high strength ductile cast iron. Pile sections are connected together by a unique spigot and socket joint, which offers speed of connection together with a high degree of stiffness. The piles are installed in a quick succession using an excavator with a hydraulic hammer, to both pitch and drive each pile section.

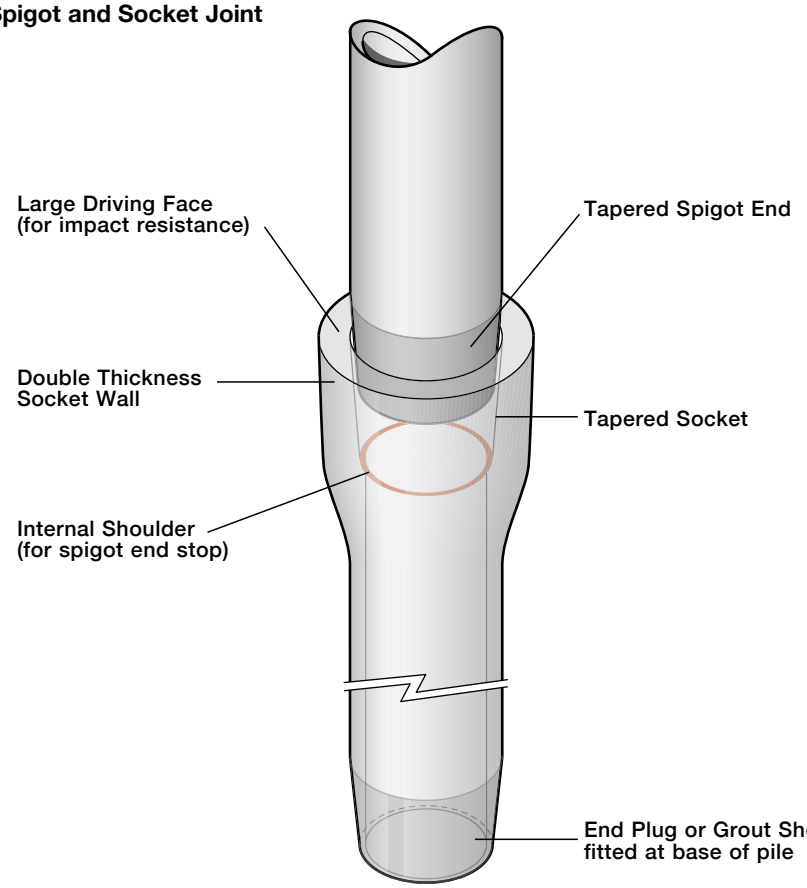
Manufactured as Ductile Cast Iron, also known as Speroidal Graphite Cast Iron, the system is immensely strong and offers superior durability over conventional tubular steel piles. Additional compressive strength is provided by the concreting or grouting of the bore, to form a composite pile.

Installed as an End-Bearing Pile (dry driven to a set, followed by concreting of the bore) or a Skin Friction Pile (simultaneous drive and grout, with an oversize shoe), the Ductile Iron Pile can accomondate a range of different ground conditions.

Advantages

- Spigot and socket joint for quick and easy connection of pile sections
- Very fast and almost vibration free pile production
- High production rates of up to 400 m per day
- Control of load capacity through correlation with driving rate
- Can be used as a permanent pile
- Easy adaption of the pile length to different soil conditions
- No off-cuts or wastage
- Quick assembly of pile heads
- Light and versatile installation equipment allows pile productions under limited space conditions and in difficult terrain

Spigot and Socket Joint



Driving a ductile pile

The low mass of the individual pile sections means that piles can be driven with a light and versatile hydraulic excavator using a rapid-stroke hydraulic hammer. This permits pile foundations to be constructed where site conditions are difficult or space is limited.

With DYWIDAG Ductile Iron Piles high bearing capacities can be obtained with a rapid-stroke hammer operated at very low impact energies.

This results in smoother operations and almost vibration-free pile-driving in the immediate vicinity of existing structures.

Pile placement is possible to within 40 cm of existing structures, and the use of excavators means that inclined piles can be placed at almost any rake.

Pile installation

The lead pile section is fitted with a pile shoe, and then pitched and driven. Additional pile sections are then added as required, to enable the pile to be driven to its full depth. The spigot and socket joint enables a very quick connection of the individual pile sections.

The pile is driven to the required depth as calculated from penetration resistance, and any excess length is simply cut off with a disc cutter. The off-cut is then fitted with a new pile shoe and used as the first section of the next pile, resulting in no wastage. When pile driving is finished, the piles are filled with concrete to increase their bearing capacity and, depending on the loads required, the pile head is fitted with a pile cap or reinforcing cage.

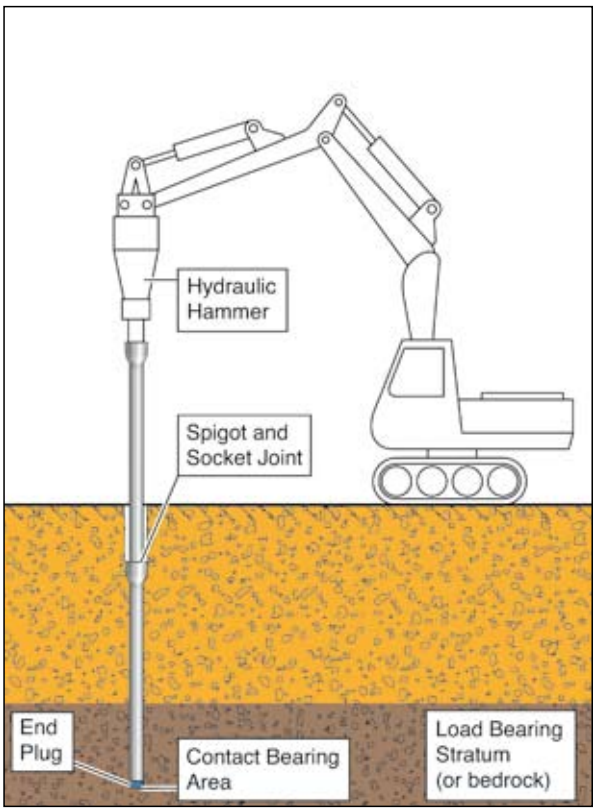
Driven Piles with Subsequent Placement of Concrete (typically end-bearing piles)

Installation of the Driven Ductile Iron Pile is one of the quickest and simplest piling methods available. The pile is driven to a “set” in dense gravel or on to bedrock. Concrete is then placed into the bore of the pile to give aditional strength.

An end plug or rock point is fitted to the lead section, which is then driven to its full length, with additional sections added as required.

The set is defined as the reduced rate of pile penetration, in relation to a sustained driving energy (of the hammer), over a given time. Achievement of the set, demonstrates the pile’s ability to sustain its design load on a long term basis.

The value for the set (i.e. penetration rate in relation to sustained driving energy) is determined from empirical data, correlated with static load test results, in a range of different ground conditions over many years.

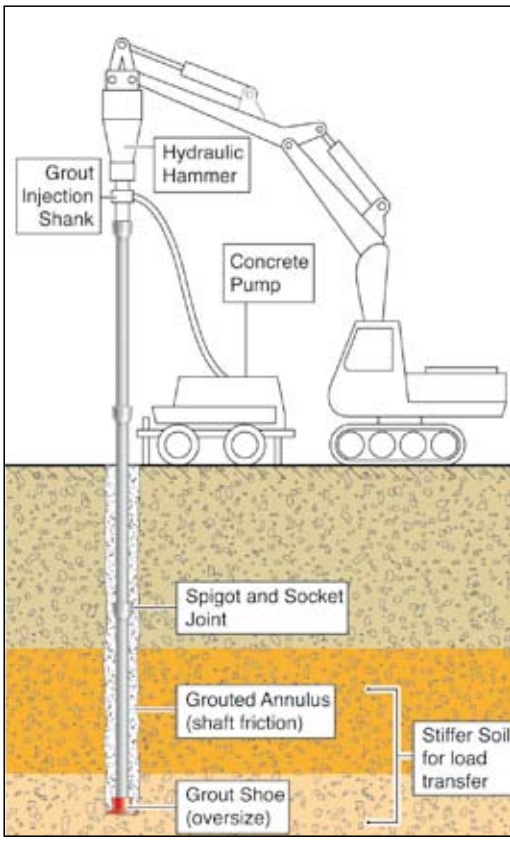


Driven Piles with Grouted Annulus (typically skin friction piles)

Grouted driven piles combine the installation benefit of a driven pile with the flexibility of a grouted system.

An oversize grout shoe is fitted to the base of the lead pile section. As the pile is driven into the ground, the oversize shoe creates an annulus between the pile shaft and the ground, which is constantly filled with a pile-concrete, to mobilise skin friction.

Installed by the simultaneous drive and grout technique, grouted piles can be also used in ground conditions where other systems are not suitable (i.e. high ground water or contaminated sites).



Accessories

End plug
End plugs are the standard pile-caps for non-grouted piles.

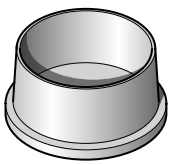
Rock Point
Rock points are an alternative to end plugs, if the non grouted piles are driven through a harder material, e.g. weathered rock

Grout shoe
Grout shoes are used if a grouted pile is installed. Grout shoes have a bigger diameter than the pile, creating an annulus around the pile, which enables the placement of fine-aggregate concrete over the full length of the pile shaft.

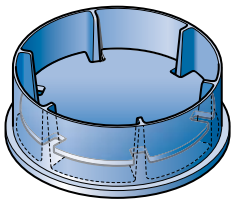
Coupler
Couplers can be used if two short pile sections must be connected in the place of the standard spigot and socket joint, e.g. if piles are driven in limited head room applications where the pile sections have to be cut.

Pipeline saddle
The pipeline saddle enables the DYWIDAG Ductile Iron Pile to be used as a support to pipelines in poor ground. The saddle provides uniform support for five pipe diameters from 200 to 500 mm.

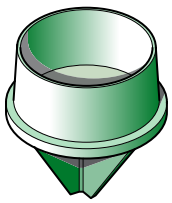
Bearing plate
The bearing plate is the standard fitting for compression piles. A center hole in the plate is required, to fix the plate horizontally with a dowel, to ensure correct allignment when casting the pile cap or beam.



End Plug
(end-bearing piles)

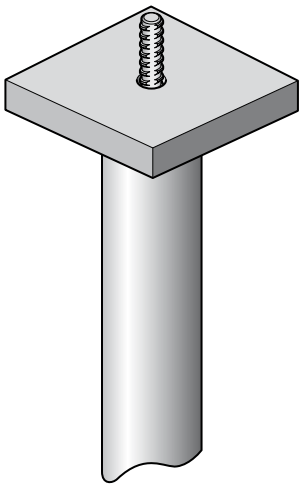


Grout Shoe c/w
Stiffening Plate
(skin friction piles)

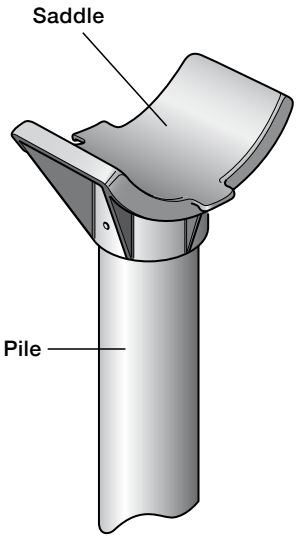


Rock Pont
(end-bearing piles)

Coupler c/w
Centre Bridge

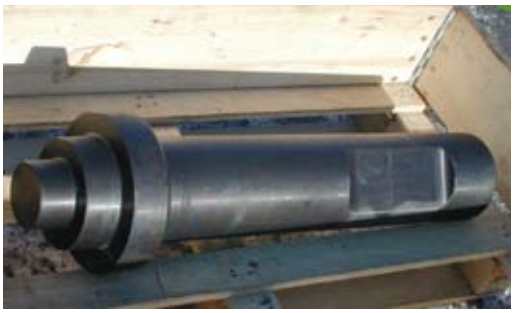


Bearing Plate for Pile Head
(centre hole for dowel connection)



Pipeline Saddle

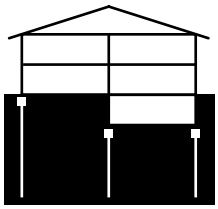
Grout injection shank with grout box
Used for installation of grouted piles. Piling mix concrete (with a max. aggregate size of 4 mm) is pumped through the pile as it is driven, ensuring that the annulus between the pile shaft and the ground is fully grouted



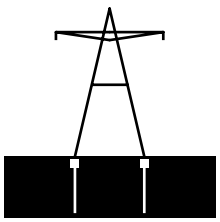
Dry driving shank
Used for installation of end bearing piles. The dry driving shank is fitted into the excavator hammer, in place of the standard chisel. Piles are driven to a set and then filled with the pile concrete

Applications

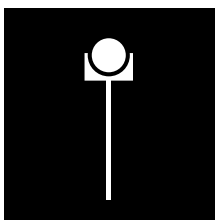
Housing apartments or factory units
With working loads between 500 and 1.300 kN, the DYWIDAG Ductile Iron Piles offer comparable loads to conventional mini piles.



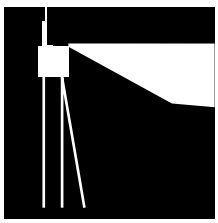
Pylons or Wind Turbines
Power transmission towers can be built on small foundations, which transfer the vertical loads into the ground via the DYWIDAG Ductile Iron Piles.



Pipeline support
Pipelines can be laid easily, precisely and free of settlements on special pipeline saddles, which can be mounted directly onto the DYWIDAG Ductile Iron Piles.

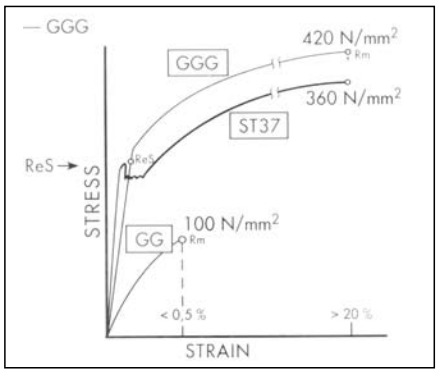


Infrastructure projects
DYWIDAG Ductile Iron Piles are used for the foundations and the strengthening of new or existing roads, railway lines and bridges.

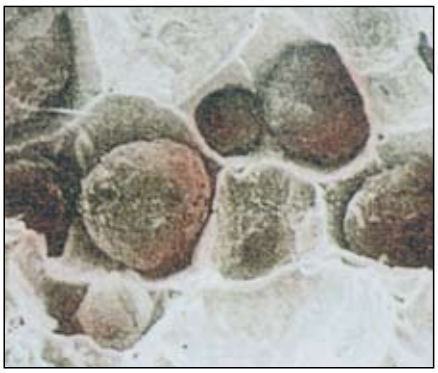


Material

Ductile cast iron is a development of gray cast iron, a material which has been used for pipeline construction for centuries because of its high resistance against chemical and mechanical influences. Through its very high ductility, the ductile cast iron is capable of withstanding the high impact energies of the pile driving process.



Stress strain diagram of the ductile iron used for the piles in comparison with gray cast iron and constructon steel (left), and magnified microstructure of the ductile cast iron with its typical speroidal graphite (right).



▶ Specifications

Pile tube OD Ø	s	length	weight per tube	cross section	tensile strength	yield strength	ultimate load	yield load	section modulus	moment of inertia
[mm]	[mm]	[mm]	[kg]	[mm²]	[N/mm²]	[N/mm²]	[kN]	[kN]	[cm³]	[cm⁴]
118	7,5	5.000	105	2.604	420	300	1.093	781	68	399
118	9,0	5.000	123	3.082	420	300	1.294	925	78	461
118	10,6	5.000	142	3.576	420	300	1.502	1.073	88	521
170	9,0	5.000	186	4.552	420	300	1.912	1.366	174	1.480
170	10,6	5.000	213	5.308	420	300	2.229	1.592	199	1.693

▶ Internal load bearing capacity in accordance with EC4

Pile type Ø x s	Ductile Iron grade 300/420		Concrete				Admissible pile load		
				C20/25	C25/30	C30/37	C20/25	C25/30	C30/37
[mm]	[mm²]	[kN]	[mm²]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
118 x 7,5	2.604	526	8.332	82	103	123	608	629	649
118 x 9,0	3.082	623	7.854	78	97	116	700	720	739
118 x 10,6	3.577	723	7.359	73	91	109	795	813	832
170 x 9,0	4.553	920	18.145	179	224	269	1.099	1.144	1.189
170 x 10,6	5.309	1.072	17.389	172	215	258	1.244	1.287	1.330

Values for the internal load bearing capacity which are calculated in accordance with national standards or approvals may vary slightly.

▶ Note

The values for the admissible pile loads have been calculated in accordance with EC4 with the assumption that the pile is loaded with 100% dead load, i.e. with a factor of safety for the loads of $\gamma_F = 1{,}35$. If the pile is loaded with a combination of dead and live load, the admissible pile load has to be reduced by the factor α:

$$\alpha = \frac{p_{dead} \cdot 1{,}35 + p_{live} \cdot 1{,}5}{1{,}35}$$

with:

— p_{dead} : proportion of deaload

— p_{live}: proportion of live load

Example:
If a pile is loaded with 70% dead load and 30% live load, then the pile loads from the table have to be reduced by

$$\alpha = \frac{0{,}70 \cdot 1{,}35 + 0{,}30 \cdot 1{,}5}{1{,}35}$$

= 1,0333, i.e. by 3,33%

Corrosion Assessment for DYWIDAG Ductile Iron Piles

Non-grouted piles are exposed to the surrounding ground, thus certain corrosion rates for the piles have to be considered.

Most of the existing tables for corrosion of piles and/or sheet piles are set up for steel components. Cast iron behaves differently with respect to corrosion. First of all the corrosion speed of cast iron is generally lower and secondly the casting crust is an additional barrier which slows corrosion.

In Austria, where the Driven Ductile Iron Piles have been used for many years, sacrificial corrosion values are published in the standard ONR 22567 (as determined by MA39, i.e. Material Testing Authorities, Vienna).

The tables below show the admissible pile loads, calculated in accordance with EC4 and taking the corrosion-assessment of ONR 22567 into account.

▶ Admissible Pile loads for pressure grouted piles and piles in soils up to corrosivity class AS1 (very low aggressiveness) pursuant to ÖNORM B 5013-1

Pile type	Ductile Iron		Concrete				Admissible pile load*)		
Ø x s	grade 300/420			C20/25	C25/30	C30/37	C20/25	C25/30	C30/37
[mm]	[mm²]	[kN]	[mm²]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
118 x 7,5	2.604	526	8.332	82	103	123	608	629	649
118 x 9,0	3.082	623	7.854	78	97	116	700	720	739
118 x 10,6	3.577	723	7.359	73	91	109	795	813	832
170 x 9,0	4.553	920	18.145	179	224	269	1.099	1.144	1.189
170 x 10,6	5.309	1.072	17.389	172	215	258	1.244	1.287	1.330

*) see note on bottom of page 8

▶ Admissible Pile loads for piles in soils up to corrosivity class AS2 (medium aggressiveness) pursuant to ÖNORM B 5013-1

Pile type	Ductile Iron		Concrete				Admissible pile load*)		
Ø x s	grade 300/420			C20/25	C25/30	C30/37	C20/25	C25/30	C30/37
[mm]	[mm²]	[kN]	[mm²]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
118 x 7,5	2.328	470	8.332	82	103	123	553	573	594
118 x 9,0	2.806	567	7.854	78	97	116	644	664	683
118 x 10,6	3.300	667	7.359	73	91	109	739	758	776
170 x 9,0	4.154	839	18.145	179	224	269	1.018	1.063	1.108
170 x 10,6	4.910	992	17.389	172	215	258	1.164	1.207	1.250

*) see note on bottom of page 8

▶ Admissible Pile loads for piles in soils up to corrosivity class AS3 (high aggressiveness) pursuant to ÖNORM B 5013-1

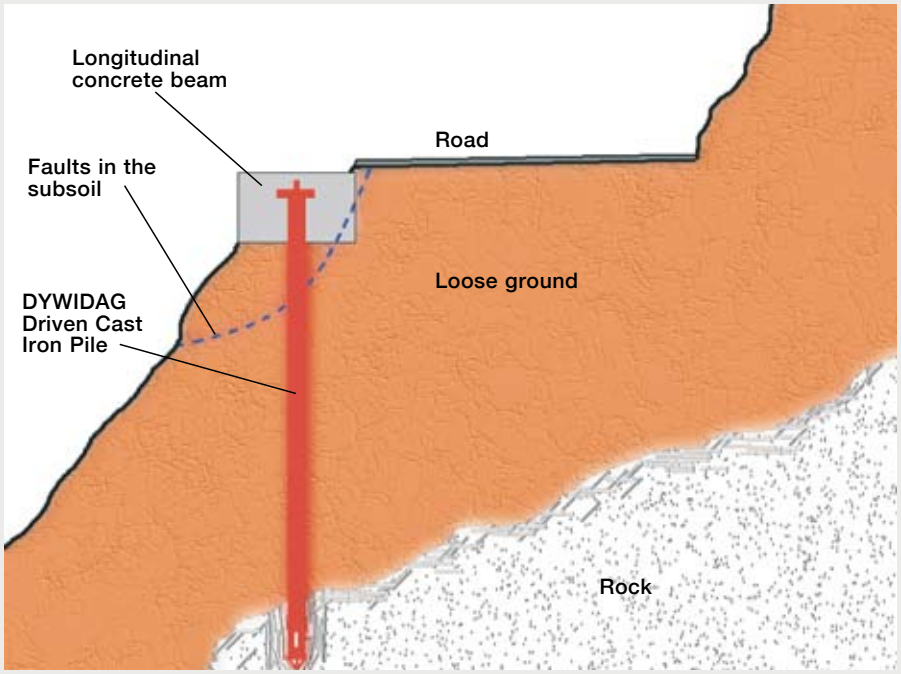
Pile type	Ductile Iron		Concrete				Admissible pile load*)		
Ø x s	grade 300/420			C20/25	C25/30	C30/37	C20/25	C25/30	C30/37
[mm]	[mm²]	[kN]	[mm²]	[kN]	[kN]	[kN]	[kN]	[kN]	[kN]
118 x 7,5	1.875	379	8.332	82	103	123	461	482	502
118 x 9,0	2.353	475	7.854	78	97	116	553	572	592
118 x 10,6	2.848	575	7.359	73	91	109	648	666	684
170 x 9,0	3.497	706	18.145	179	224	269	886	931	975
170 x 10,6	4.253	859	17.389	172	215	258	1.031	1.074	1.117

*) see note on bottom of page 8

References

First Use of DYWIDAG Ductile Iron Piles in France

Stabilization of a road connection in the Pyrenees



Owner Department Council of the High Pyrenees, France +++ **Contractor** Cabinet d'Etudes technique Jean Frugier, France +++ **Company** LTP, France

DSI Services Supply of DYWIDAG Ductile Iron Piles with an overall length of 160 m, ∅ 170 mm and accessories, technical assistance

Noerpel Forwarding Agency Warehouse, Ulm

Client Motz Construction Co.

DSI Services Supply of 865 DYWIDAG Ductile Iron Piles, 6.500 m, skin-grouted

References

Furnishing House Gamerdinger, Böblingen

Client Keller Grundbau
DSI Services Supply of 332 DYWIDAG Ductile Iron Piles, 3.500 m, not-grouted

Housing Apartments, Monaghan, Ireland

Client PJ Edwards
DSI Services Supply of 36 DYWIDAG Ductile Iron Piles, each 12-15 m long, non-grouted, technical support and site supervision

Austria
DYWIDAG-SYSTEMS
INTERNATIONAL GMBH
Wagram 49
4061 Pasching/Linz, Austria
Phone +43-7229-61 04 90
Fax +43-7229-61 04 980
E-mail: alwag@dywidag-systems.com
www.alwag.com

DYWIDAG-SYSTEMS
INTERNATIONAL GMBH
Teichweg 9
5400 Hallein, Austria
Phone +43-6245-87 23 0
Fax +43-6245-87 23 08 0
E-mail: sekretariat@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

France
DSI-Artéon
Avenue du Bicentenaire
ZI Dagneux-BP 50053
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 32
Fax +49-3321-44 18 18
E-mail: suspa@dywidag-systems.com

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.suspa-dsi.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

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

Please note:
This brochure serves basic information purposes only. Technical data and information provided herein shall be considered non-binding and may be subject to change without notice. We do not assume any liability for losses or damages attributed to the use of this technical data and any improper use of our products. Should you require further information on particular products, please do not hesitate to contact us.

Italy
DYWIT S.P.A.
Via Grandi, 68
20017 Mazzo di Rho (Milano), Italy
Phone +39-02-93 46 87 1
Fax +39-02-93 46 87 301
E-mail: info@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.dsi-nl.nl

Norway
DYWIDAG-SYSTEMS
INTERNATIONAL A/S
Industrieveien 7A
1483 Skytta, Norway
Phone +47-67-06 15 60
Fax +47-67-06 15 59
E-mail: manager@dsi-dywidag.no

Portugal
DYWIDAG-SYSTEMS
INTERNATIONAL LDA
Rua do Polo Sul
Lote 1.01.1.1 – 2B
1990-273 Lisbon, Portugal
Phone +351-21-89 22 890
Fax +351-21-89 22 899
E-mail: dsi.lisboa@dywidag.pt

Spain
DYWIDAG SISTEMAS
CONSTRUCTIVOS, S.A.
Avenida 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 OFG, 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

ARGENTINA
AUSTRALIA
AUSTRIA
BELGIUM
BOSNIA AND HERZEGOVINA
BRAZIL
CANADA
CHILE
COLOMBIA
COSTA RICA
CROATIA
CZECH REPUBLIC
DENMARK
EGYPT
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
GUATEMALA
HONDURAS
HONG KONG
INDONESIA
IRAN
ITALY
JAPAN
KOREA
LEBANON
LUXEMBOURG
MALAYSIA
MEXICO
NETHERLANDS
NORWAY
OMAN
PANAMA
PARAGUAY
PERU
POLAND
PORTUGAL
QATAR
SAUDI ARABIA
SINGAPORE
SOUTH AFRICA
SPAIN
SWEDEN
SWITZERLAND
TAIWAN
THAILAND
TURKEY
UNITED ARAB EMIRATES
UNITED KINGDOM
URUGUAY
USA
VENEZUELA

www.dywidag-systems.com

04179-1/08.09-web st