HOME OF SPECIAL CIVIL ENGINEERING

Frankipfahl NG®

Technical brochures

Economical and safe on any building site.

As a technology leader we are your competent partner in consulting, planning and construction for the areas of foundation work, reinforcements, waterproofing and remediation in challenging ground conditions. Our experts support you economically and safely with our own experienced specialist teams in all phases of your construction project.

Consulting

At the beginning of a project, you need a vision and a competent partner. Our employees respond to your wishes, provide personal advice and dedicate themselves to your project with an individual needs analysis. We pay particular attention to sustainability aspects such as CO_2 reduction and environmentally friendly processes.

We will find the best solution for you. As a full-service provider, we can offer all technical processes of foundation engineering on a neutral basis. You will get clarity about the requirements, the technical possibilities and the associated economic aspects. This is how we create a reliable basis for making decisions.

Design and engineering

Whether for draft or approval planning - we will manage the entire planning process of your project. By optimising technical details and costs, we create a sound basis for the calculation.

We present alternatives and special proposals and attach particular importance to sustainability. We use 3D visualisations to develop practice-oriented and buildable solutions and to present complex details in an understandable way. We support sustainable certification, and you gain security in planning and feasibility. Deadlines and costs are always transparent for you.

Construction

After the detailed tender with a schedule and interface list has been commissioned, our experienced skilled staff will successfully implement your construction project with their own special equipment.

Careful work preparation and execution planning are secured at the start of construction. Quality assurance is guaranteed by our extensive measurement technology. Our certified quality management ensures clear, uniform processes according to LEAN management as well as a professional, on-time execution.

Thanks to the wide range of our technical possibilities, we can adapt quickly and without delay to the individual conditions on the construction site at any time. This is how we guarantee a timely handover.

Fixed, competent contact staff members accompany you from the idea stage all the way through to completion. With our expertise, effective and targeted communication, we support and relieve you throughout the entire execution.

Find out more via video: Scan the QR code to gain a clear insight into how our specialised civil engineering methods are carried out and how they work.

porr.de/en/special-civil-engineering

Concreting a Frankipile NG®

Frankipile NG®

As a leading provider of pile foundations, we offer different foundation methods from a single source and thus always the technically and economically optimal solution.

The High Performance Piling

The Frankipile NG® is mainly used where good load-bearing subsoil can only be reached at great depths and/or where the transfer of high loads is required. The variety of design variants enables individual adaptation to the most diverse subsoil conditions and construction site situations in order to achieve high load-bearing capacities. It is possible to use both perpendicular piles and inclined piles with an inclination of up to 4:1. In addition, the Frankipile NG® is also well suited for absorbing tensile loads due to its expanded footing.

History

In 1908, Edgard Frankignoul originally applied for a patent for the pile system that is now used worldwide. This included the production of the complete pile with tamped, semi-dry concrete. Shaft production with flowable concrete and the base footing design, which have been common practice in Germany since the beginning of the 1990s, represent an economical and safe further development. In order to clarify the difference to Edgard Frankignoul's system, we use the name Frankipile NG® for the new method, whereby NG stands for „New Generation".

Environmentally friendly

With our slender displacement piles - **Greenpile** - such as the Frankipile NG® or the Atlas pile, we save a considerable amount of concrete compared to alternative pile systems. The efficient use of materials saves resources. In addition, the displacement of the soil means that no drilling material is produced.

This means that no additional transport or external recycling is required. Conclusion: You save costs, reduce emissions and relieve the burden on those living near the construction site. This also increases the approvability of your project.

Economical

Due to the high pile resistances and the formation of the foot, both the number of piles as well as the pile lengths can be economically optimised. It is also often possible to reduce the size of the foundations. This, together with the comparatively small pile diameter, saves on concrete and steel. Since it is a displacement pile, there are no costs for the transport and disposal of excavated soil.

Benefits

- Very high pile loads and optimal adaptation to the foundation soil
- Economic optimisations and reduction of the foundations possible
- Low-noise production due to internal pipe pile driving
- Savings in concrete, steel and excavated soil due to full soil displacement

Technical data

Cast-in-place concrete driveb pile	ø 51, 56, 61, 71 cm
Charact. Pile resistances R_k	up to 12,000 kN, depending on the soil
Devices	FRANKI pile driver with free-fall ram

Consulting

Know-how and experience for an economical and safe solution.

At the beginning of a project, you need your vision and a competent partner. Our employees are responsive to your wishes, provide personal advice and dedicate themselves to your project with an individual needs analysis.

We pay special attention to sustainability aspects such as CO_2 reduction and environmentally-friendly processes. We will find the best solution for you.

With our own special equipment, we work in various construction site situations, such as with electric power in buildings, under restricted heights, under continuous railway operations or on water from a pontoon. This also allows us to drill boreholes with great precision even in tidal conditions .

Our pile systems:

Bored piles according to DIN EN 1536

- Piped, partially piped, suspension or soil supported
- Kelly rotary drilling or gripper method
- With piping system under restricted height
- Auger Bored Pile (SOB)
- Partial displacement bored pile (TVB)
- In front of-the-wall method (VdW)

Displacement piles according to DIN EN 12 699

- Simplex pile
- Frankipile NG®
- Tubular steel pile (driven, pressed)
- Screw pile (Atlas, Fundex)

Micropiles according to DIN EN 14 199 or DIBt approval

- Tubular pile
- Composite pile
- Drill-grouted pile
- In-situ concrete micropile
- Self-drilling micropile
- High-performance displacement pile (HLV pile)

Design and engineering

Individual complete solutions

Already in the planning phase, our competent engineers are at your disposal for individual consultations. Based on your specifications, we develop the technically and economically optimal solution for your building project.

We use the results from numerous suitability tests on pile systems to determine the safest utilisation for your ground conditions at any time.

Our experienced construction site teams then consistently implement the specifications that have been developed. To ensure the required quality, we carry out our own quality controls during the construction stage.

We are constantly developing our working methods and processes in our Research and Development Department.

Stake plan

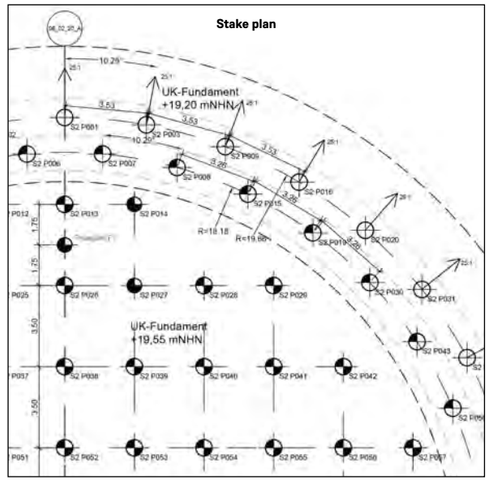
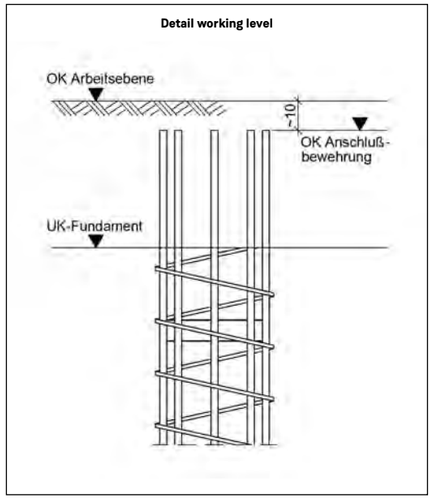


Table for Frankipiles NG®

SYMBOL					
TYP	1	2	3	4	5
STÜCK	60	95	146	4	10
VORTREIBROHR Ø [cm]	71				
N_d [kN]	8400	7600	6100	2560	8400
BÄRGEWICHT [kN]	62,0				
FALLHÖHE [m]	6,5				
LÄNGSBEWEHRUNG B 500B	10Ø20		8Ø20	10Ø20	13Ø25
WENDELBEWEHRUNG:/GANGHÖHE B 500B	8mm/ 20cm				
BETONGÜTE/EXPOSITIONSKLASSE	C 35/45, XA1				
MISCHUNGSVERHÄLTNIS DER ZUSCHLÄGE	KURVE A-B				
MIN. EINBINDELÄNGE DER LÄNGSEISEN IN DAS FUNDAMENT [cm]	60			50	60
TRAGFÄHIGER BODEN BEGINNT AB 30 SCHLÄGE/M					
Herstelltoleranzen gem. DIN 12699					

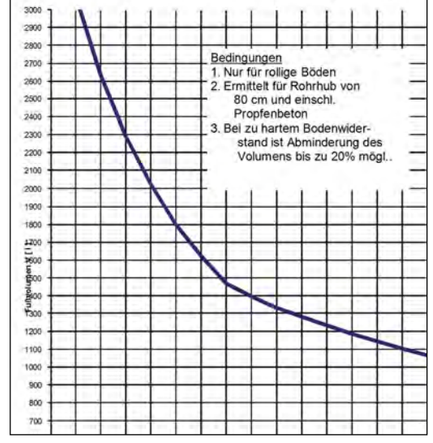
Detail working level



Pile dimensioning curve

Frankipfahl NG ®, Typ 1

$R_{b1,k}$= 11760 kN, Bärgewicht: 64,0 kN, Fallhöhe: 6,0
Pfahldurchmesser 71 cm Ausnutzungsgrad EAP: 50



Basics of the Frankipile NG®

Safe implementation

We always work with our own special equipment and appropriate skilled personnel. Our strength: at every stage of the project, we adapt to the individual conditions on the construction sites. Our many years of experience and a wide range of technical possibilities always ensure safe and successful implementation.

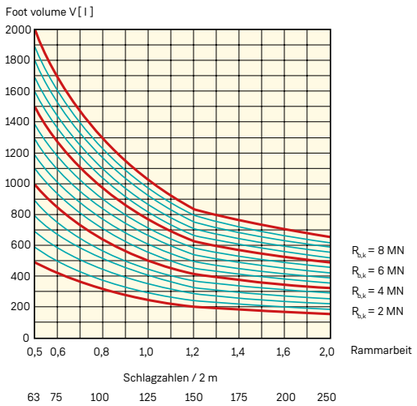
Design

The design and manufacture of the Frankipile NG® are carried out in accordance with Eurocode 7 as well as the national standards DIN 1054, DIN EN 12 699 and according to the recommendations of the ”Piles” working group (EA-piles).

Pile base design

The decisive feature for the axial pile resistance of the Frankipile NG® is the expanded pile base. This is produced by driving out almost dry concrete by means of internal pipe driving. By evaluating a high number of static test loads, correlations were established between the density/consistency of the existing soils and the work required in driving the jacking pipes on the one hand, and the required volume of the pile footing for load transfer on the other. Due to these correlations, the volume of the footing can be adjusted to the load-bearing capacity of the existing soil. Pile footing design curves were derived from this, as they are known from EA piles.

We will be pleased to advise you on the preliminary design.



Production method without pre-compacting the gravel

Production without pre-compacting the gravel

The Frankipile NG® pile is a cast-in-place concrete driven pile with a recovered jacking pipe. This is sealed watertight at the bottom with a plug made of dry concrete or gravel sand. A free-fall ram working in the pipe strikes this plug, thereby ramming the pipe into the ground. The ramming work done in the process, measured in blows per metre, is a measure of the load-bearing capacity of the soil at the respective location.

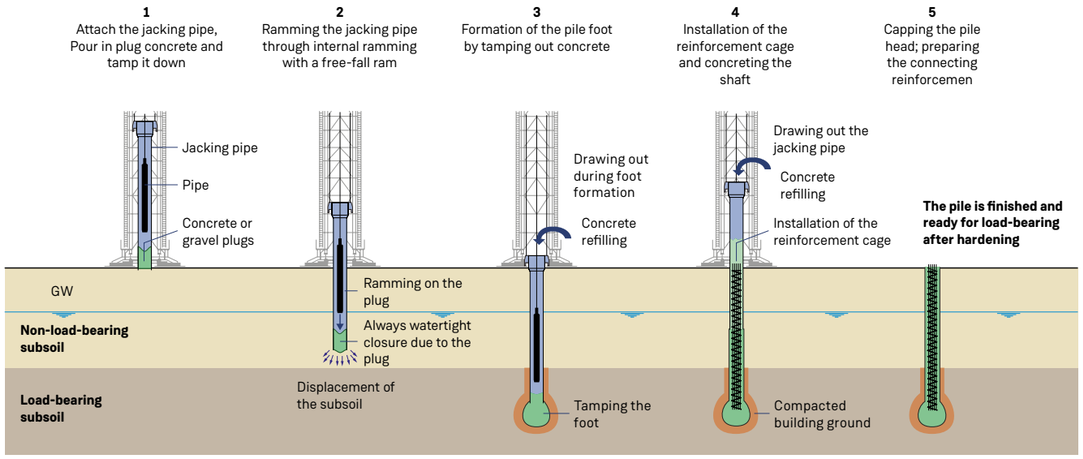
After reaching the target depth or the ramming criteria, the plug is loosened and the required amount of footing concrete is tamped out. A reinforcement cage is then placed, concrete is poured in, and the jacking pipe is pulled out again.

Production with pre-compacting the gravel

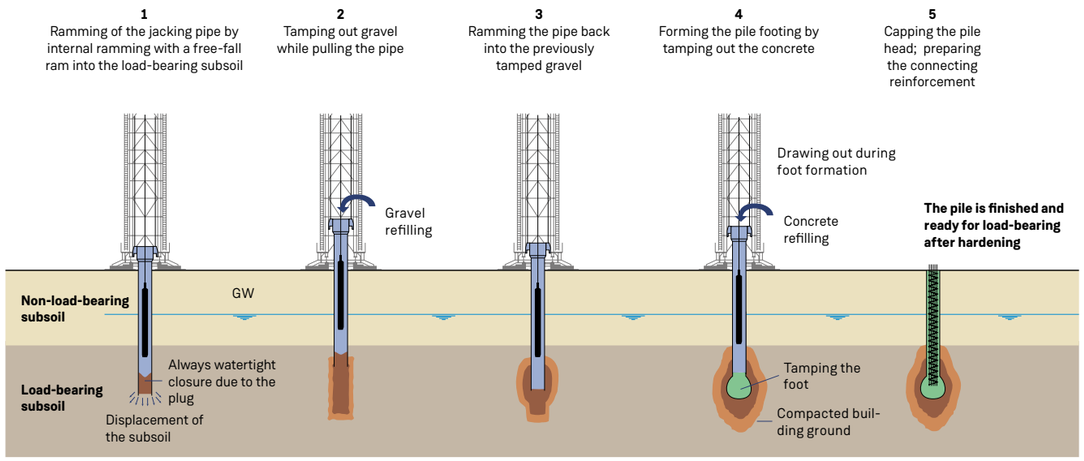
If the existing soil does not have a sufficient load-bearing capacity at the intended setting depth, it is possible to improve the soil by pre-compacting the soil with gravel before the pile footing is installed. In this case, the soil is improved by tamping out gravel in a corresponding area below and above the pile setting depth.

Basics of the Frankipile NG®

Production method without gravel pre-compaction



Production method with gravel pre-compaction



Quality assurance for more safety

Safe procedure through high expertise

The execution of the Frankipile NG® requires procedural instructions that are individually tailored to the requirements of the respective measure. In addition to specialist knowledge and experience, it also depends on the machine operator's instincts. Driving and extracting the jacking pipe is a sensitive process in which it is important to optimally adjust the production parameters in order to achieve the desired pile resistance.

Construction requirements

For quality assurance during construction, the requirements of the European and national standards must be observed. The design and manufacture of the Frankipiles NG® are carried out in accordance with Eurocode 7 and the national standards DIN 1054, DIN EN 12 699 and the EA piles, the recommendations of the „Piles" working group. The self-monitoring and documentation of the construction are regulated in the manufacturing standards.

Constant monitoring

PORR Spezialtiefbau work according to the DIN EN 9001: 2015 quality management system and are compliant with the requirements regularly monitored by internal and external audits. In addition, we are registered in the official directory of prequalified construction companies with the PQ association and are prequalified by the Deutsche Bahn in the category of special foundation engineering for foundations/piles.

Static pile test load

The basic requirements for test loads on piles are contained in the EC 7-1 handbook, DIN EN 12 699 and EA piles. The static test load provides clear and accurate data for all soil types. Concrete values for vertical and horizontal loads, as well as for compressive and tensile loads, are determined using measurement technology. The engineers record peak pressure and casing friction. Cyclic and long-term loads are carried out.

Dynamic pile test loading

According to the EC 7-1 handbook, the vertical compression pile resistances can also be determined based on dynamic pile test loads under certain conditions, This is a measurement method with time-dependent measurement of force and movement at the pile head during an impact impulse. The results are often interpreted very differently, so that often no clear result is obtained compared to the evaluation of a static test load.

Pile integrity checks for more safety

The integrity measurement serves to control the pile quality and geometry after production. A common method is the non-destructive „low-strain" test, also known as the hammer impact method. Testing with a gauge, sensor and hand hammer is inexpensive and quick. The „cross-hole" method, which is used for testing with ultrasound, is also a non-destructive method.

Static pile load test

Building: custom-fit applications

The Frankipile NG® is mainly used where good load-bearing ground can only be reached at great depths and/or where the transfer of high loads is required. The variety of design variants enables individual adaptation to the most diverse subsoil conditions and construction site situations in order to achieve high load-bearing capacities.

Frankipiles NG® are also suitable for contaminated soils, as they are displacement piles and do not extract any soil. A design as an energy pile is possible in order to use the Frankipile NG® geothermally.

Frankipiles NG® can be used as deep foundation elements for all types of structures. These include, among other things:

- Bridges
- Wind turbines
- Industrial buildings
- Silos
- High-bay storage facilities

Environmentally friendly production

The production of the Frankipile NG® is low-emission due to the internal driving. With suitable boundary conditions, foundations with this pile system are also possible in the vicinity of existing structures. By varying the drop height of the free-fall ram, the driving energy can be controlled individually. In combination with small pile diameters, specified vibration limit values can thus be observed at all times. We also have this monitored by independent experts usung measurement technology. In addition, pre-drilling is always possible.

Noise and sound emissions from the foundation work are kept to a minimum by regulating the drop heights and precisely planning construction processes.

We will be pleased to advise you on the individual application possibilities of Frankipiles NG® for your project.

Construction of Frankipiles NG® next to an existing building

Design variants

Further development to the Megapile

Since 2009, the Frankipile NG® is also available with a shaft diameter of 71 cm. We call this the Frankipile NG® Megapile. With the slender shaft diameter of 71 cm, characteristic pile resistances Rk of up to 12,000 kN, can now be removed with the usual low settlements, depending on the subsoil.

Variety of applications for more sustainability

The Megapile can be used in a wide range of subsoil conditions as a deep foundation element for structures with particularly high vertical loads, such as bridges, industrial buildings, power plants and silos. The high load-bearing capacity makes it possible to significantly reduce the size of the foundations or abutments compared to other pile systems and to reduce the consumption of concrete, even with very high support loads.

Technical data

Characteristic pile resistanceR_k Compressive load

Pile – Ø	in non-cohesive soils	in semi-solid cohesive soils
cm	kN	kN
51	4.400	3.600
56	5.600	4.400
61	7.000	5.200
71	12.000	8.000

Characteristic pile resistance R_k Tensile load

Pile – Ø	in non-cohesive soils	in semi-solid cohesive soils
cm	kN	kN
51	1.800	1.400
56	2.000	1.600
61	2.200	1.800
71	2.600	2.200

The loads and pipe diameters must be adapted to the respective soil conditions.
We will be happy to advise you on this.

Silo in Silo under construction

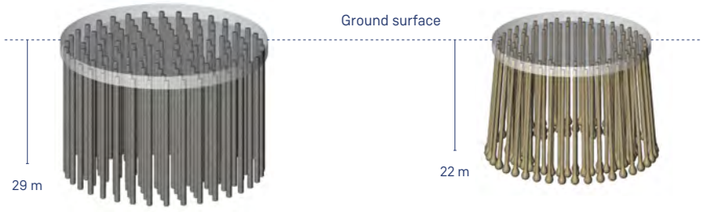
Preparation of the foundations

Optimisation example

Comparison of the foundation of the silos (N_k = 680.4 MN) with both systems

Bored piles (124 pieces)
ø = 120 cm, L = 29 + 2 = 31 m
Foundation plate ø 45 m

Megapiles (106 pieces)
ø = 71 cm, L = 22 + 2 = 24 m
Ring foundation ø 29.6 m

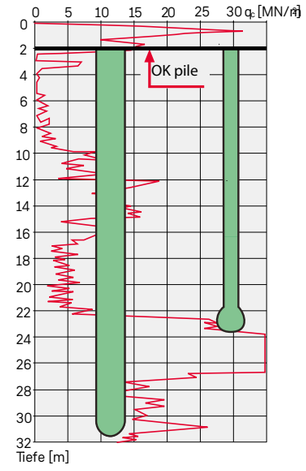


Concrete volume: piles + foundation

8.800 m³ → **2.400 m³**

Saving of 73 % concrete

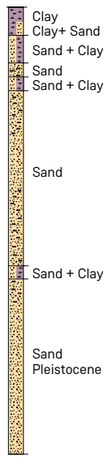
Pressure sounding



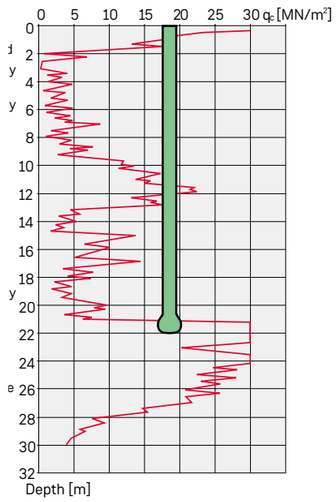
Subsoil . Load

Static test load of a Megapile, pile Ø 71 cm, Wilhelmshaven power plant

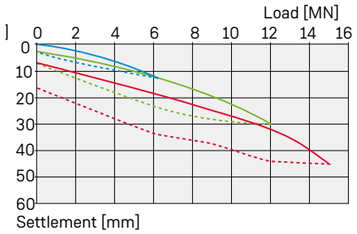
Soil profile



Pressure sounding



Resistance-settlement line



A pile resistance R_k of 15 MN was achieved during the load test.

Design variant - Use in contaminated soil

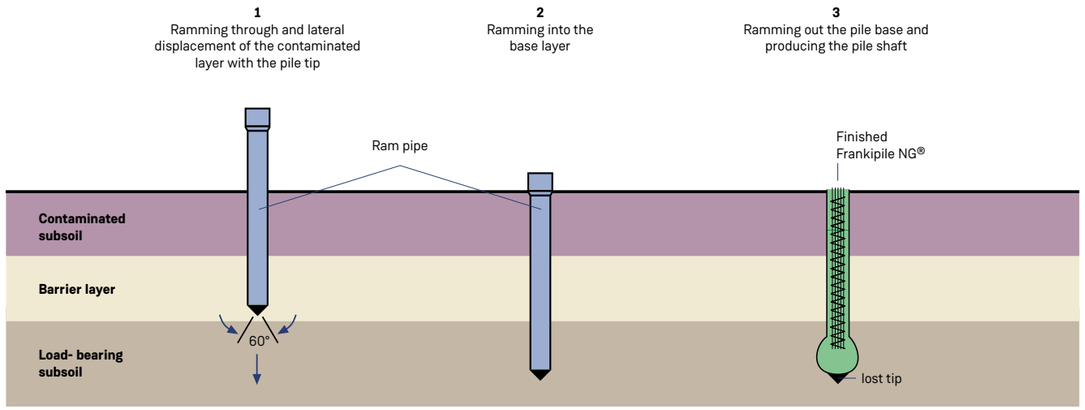
Ecological: 60-degree foot tip

Due to the full ground displacement, the Frankipile NG® is also particularly well suited for contaminated sites. A 60-degree foot tip is used when ramming through the contaminated layer to avoid the spread of pollutants during pile construction. Alternatively, a seal plug is used to prevent the transport of pollutants into deeper layers.

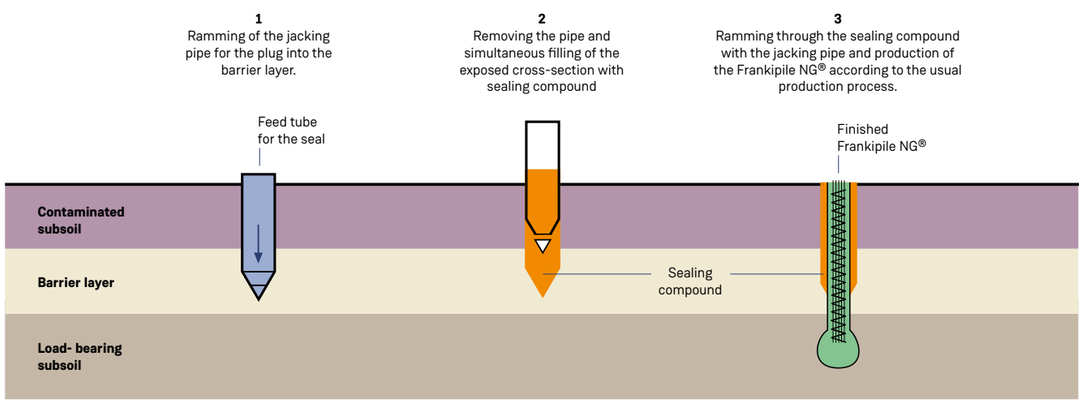
Safe: Sealing plug

In the case of pile foundations that pass through contaminated soil layers, it must be ensured that no pollutants are transported from the contaminated area into other soil layers or into the groundwater, either during or after pile installation. This can be prevented by installing special sealing plugs in the area of the contaminated soil layer.

Production sequence for a Frankipile NG® with a 60-degree foot tip



Production sequence for a Frankipile NG® with a sealing plug



Design variant - insertion with sleeve tube

Safe on any building site

In the case of particularly poor soft layers, strong groundwater flow or aggressive subsoil, the fresh concrete column of the pile must be supported and/ or protected. This is done with sleeve tubes that are connected to the reinforcement cage.

Frankipiles NG® for the bridge on the BAB 26. In the area of the peat layers, sleeves were required for the to support the fresh concrete columns.

Mühlhausen bypass. Frankipile NG® next to railway tracks..

Sample BoQ: Individual service

We will prepare a construction project-related bill of quantities for you.
Here is an example of a tender text (excerpt).

Please do not hesitate to contact us.

OZ	Performance specification	Quantity ME	Unit price in EUR	Total amount in EUR
1.	**In-situ concrete driven pile with driven out footing**			
1.10.	**Construction site set-up** and clearing of all equipment necessary for the execution of the work. Setting up and clearing, incl. all costs such as freight, [...] Insert for in-situ concrete driven pile with driven foot, System Frankipile NG® or equivalent.	1 piece	0,00	0,00
1.20.	**Technical processing** Preparation of a verifiable pile static analysis on the basis of on-site pile load investigations, including pile plan and incorporation of inspection notes by the building authorities.	1 piece	0,00	0,00
1.30.	**Stake-out operation on the construction site** Arrival and departure of the measuring team, setting up of the equipment, and preparation of the stake-out.	1 piece	0,00	0,00
1.40.	**Staking-out the starting points** Acceptance of the main axes provided by the customer, staking out the pile starting points.	100 pieces	0,00	0,00
1.50.	**In-situ concrete driven pile with rammed foot, D = 61 cm** Produce in-situ concrete driven pile with rammed foot, Frankipile NG® system or equivalent, in accordance with DIN EN 12699. **Characteristic pile resistance Rk:** Compression: Rk ≤ 7,000 kN, tension: Rk = 0 kN Horizontal: < 3 % of min. V-load [...] Invoicing is per piece of manufactured pile.	100 pieces	0,00	0,00
1.60.	**Deployment of the crosscut team** Arrival and departure of the cutting team, setting up of the equipment. Execution of the cross-cutting work in a single operation.	3 pieces	0,00	0,00
1.70.	**Capping the piles, D = 61 cm** After the sub-concrete (clean layer) has been installed on-site, cut the piles to the correct height and installation of the sub-concrete and expose the connection reinforcement [...]	100 pieces	0,00	0,00
1.80.	**Ramming error as a result of hitting obstacles in the subsoil.** Abort pile driving if no further pile driving progress is recorded and then pull out the pipe and backfill the hole. Additional services above and beyond this (loss of concrete, loss of reinforcement, wear/breakage of the tool) are to be remunerated at cost. [...] Billing is from the ramming point to the lower edge of incorrect ramming.	Metre	0,00	0,00
1.90.	**Equipment standstill** Standstill for the piling rig incl. operating personnel for reasons for which the Contractor is not responsible.	Hours	0,00	0,00

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