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Helical Pile Buying Guide

Getting Started with Helical Piles

If you're new to helical piles, this guide will show you how to use them effectively in your next project. We'll walk you through each step, from gathering initial data to foundation design, through quotation, ordering, and installation.

With easy-to-follow guidance, you'll gain the confidence to use helical piles smoothly and successfully, ensuring efficient project delivery every step of the way.

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Introduction and Applications

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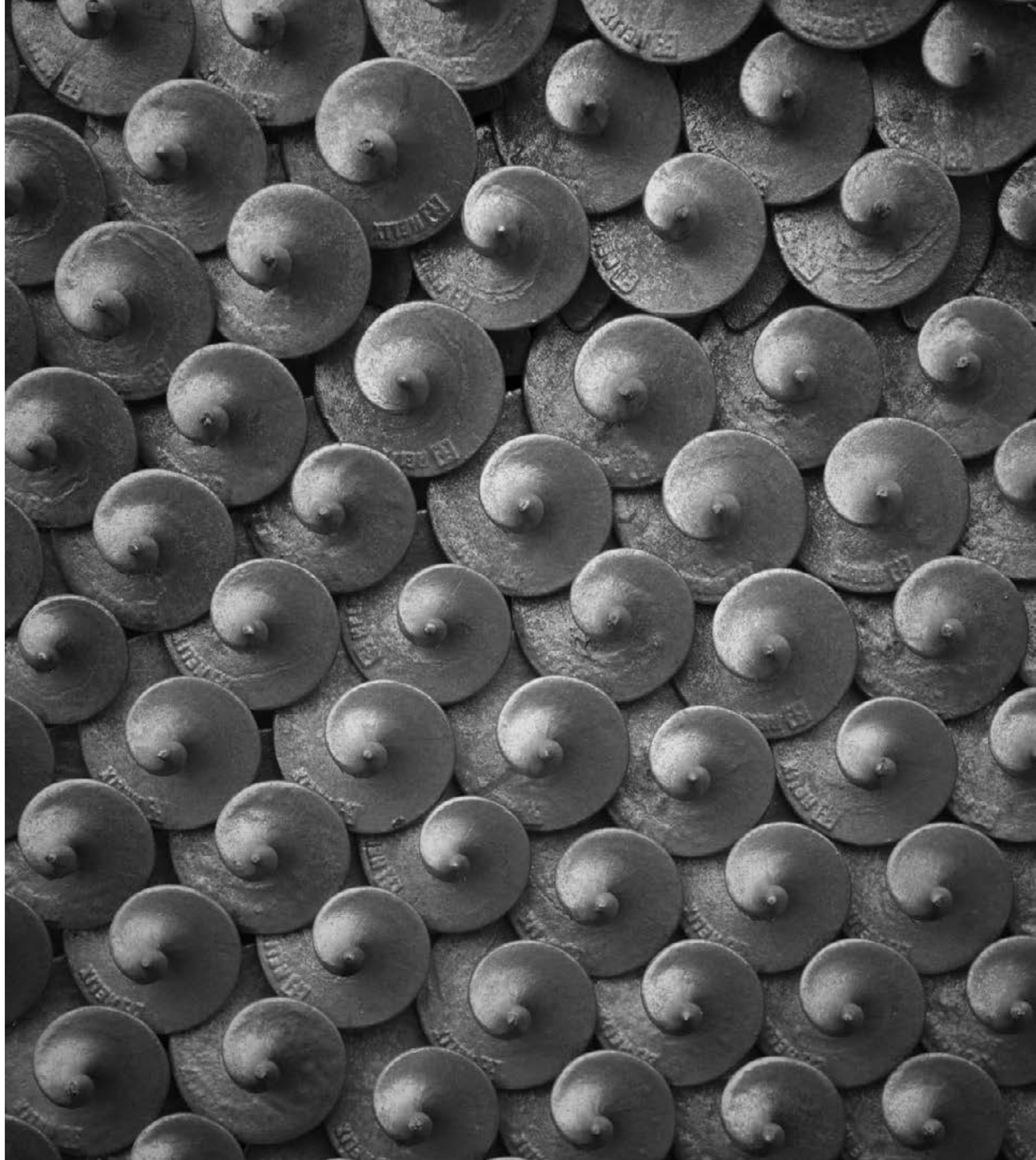
Versatile Applications

The foundation is one of the first and most crucial aspects of a construction project, so choosing and executing the foundation solution carefully is essential. With high-quality helical piles, you can implement your project quickly, cost-effectively, and environmentally friendly, enabling a smooth transition to the next construction phase.

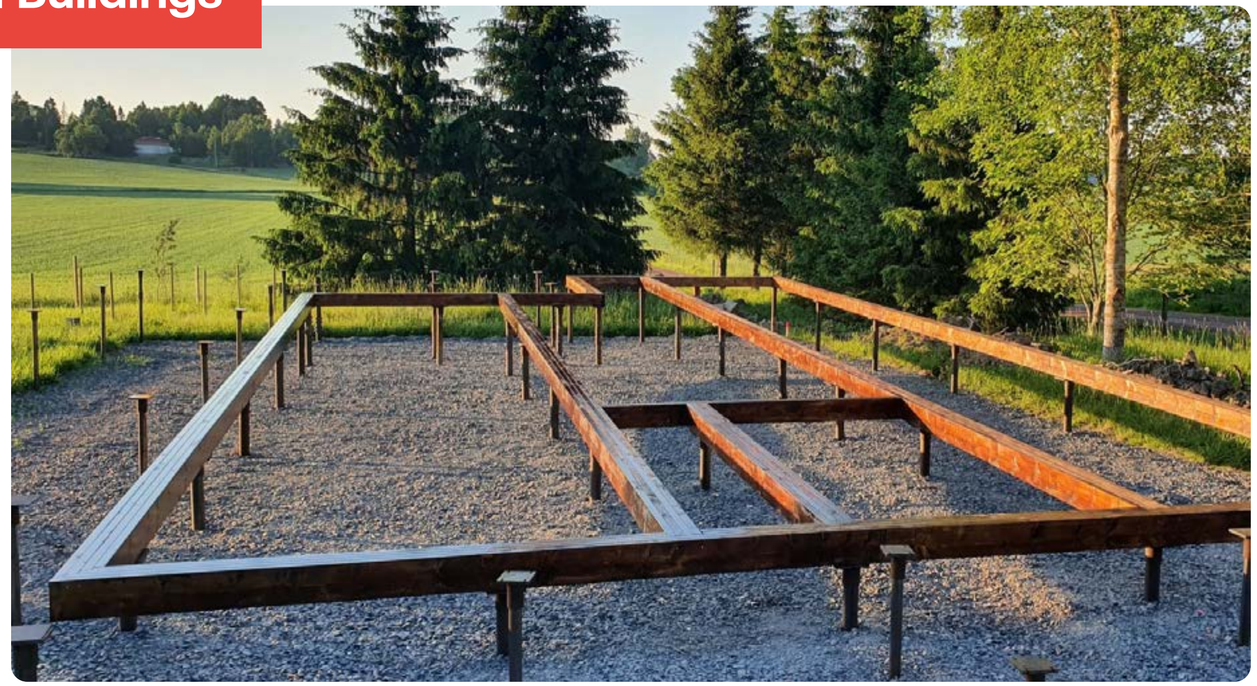
The use of helical piles and related technology has been increasing year by year. They provide a foundation solution for various types of construction projects, such as residential buildings, recreational buildings, halls, substations, electrical and 5G masts, oil and gas pipelines, pedestrian bridges, protective and noise barriers, solar parks, and various water-related sites. In addition to their good compressive strength, helical piles have high tensile strength, allowing them to be used as foundations for various tension-loaded structures, such as pressure vessels, support cables, and walls.

One of the most significant reasons for the growing popularity of helical piles is their cost effectiveness, time savings, and environmental friendliness. Helical piles help avoid earthworks, mass replacement, foundation pouring, frost insulation, and drainage, resulting in significant savings both in terms of time and cost. The method also typically generates minimal noise and vibration, helping to reduce disturbance to the environment. Sometimes helical piles are also used as a source of geothermal energy, known as energy piles.

Over the next few pages, we'll take you through some of the common applications of helical piles and show examples of some of our own projects to give you a true sense of their versatility.



Residental Buildings



Cottages and Summer Houses

Warehouses

Electrical Substations

Electric and Telecommunications Masts

Oil and Gas Lines

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Footbridges

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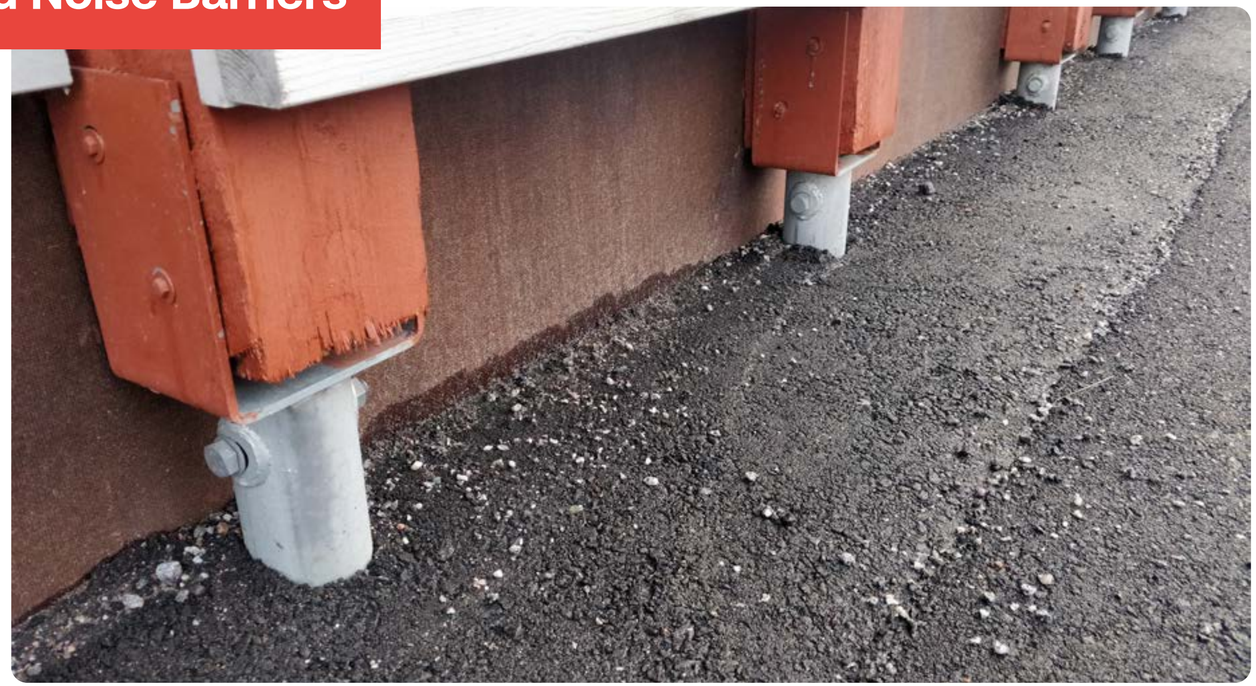
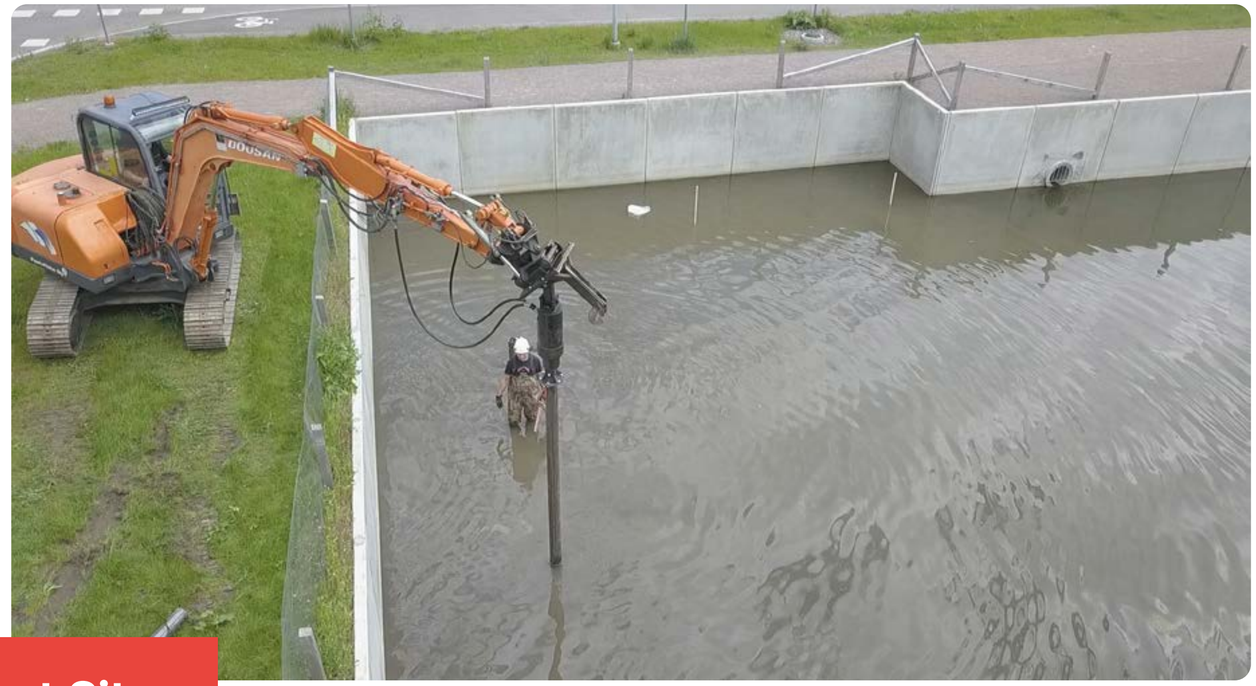
Protection and Noise Barriers

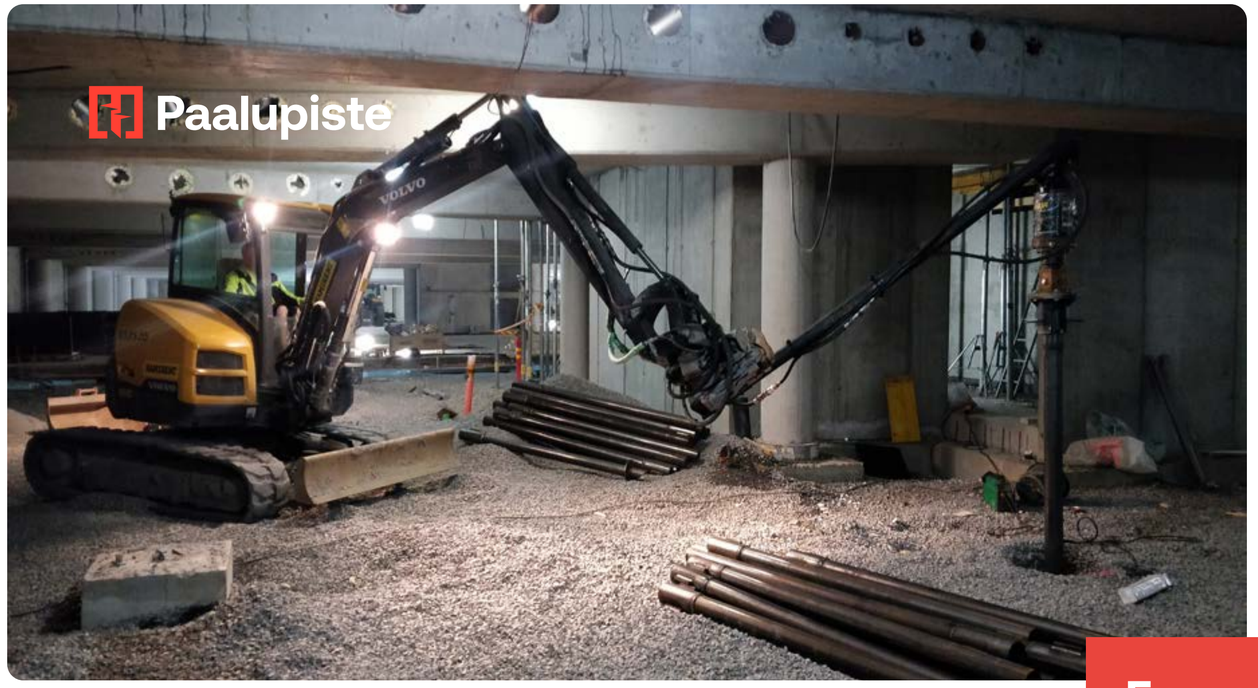


Solar Farms



Waterfront Sites

Slope Stabilization



Energy Piles

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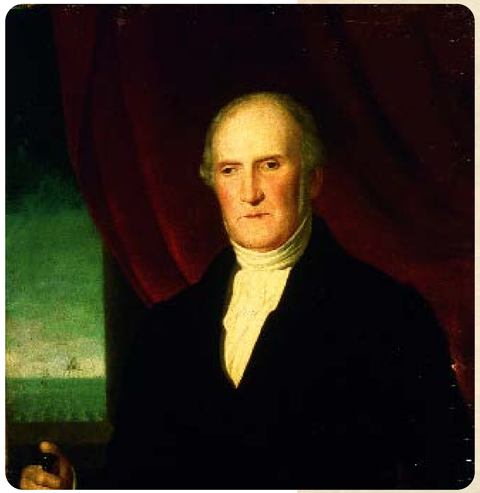

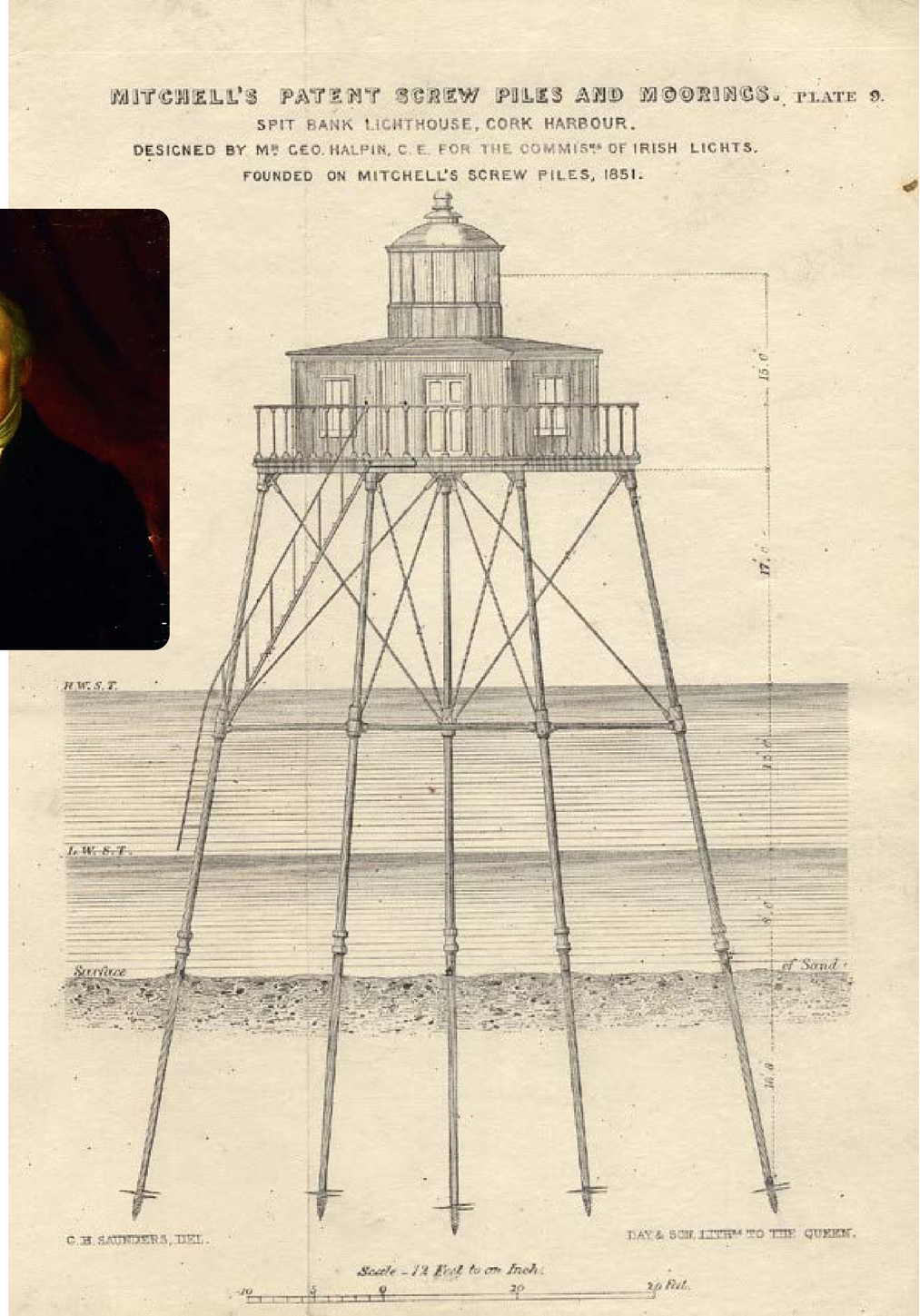

Interesting Fact: Did you know that the helical piles date back almost two centuries? In 1833, Irish engineer Alexander Mitchell secured its patent. By 1838, the first lighthouse supported by helical piles was built at the mouth of the River Thames in England. This innovation gained traction, with over 100 lighthouses adopting the method along the eastern coast of the United States and the Gulf of Mexico by the late 19th century.

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Helical Pile Installation Process

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Foundation Planning and Pile Sizing

It is important for every project to develop a foundation plan, which includes sizing the piles to be well-suited for their intended use. The sizing work should be conducted under the guidance of an experienced designer or a structural engineer specialized in helical piles. Properly sized piles are both reliable and cost-effective, while poorly designed foundations can lead to unreliable structures or unnecessary oversizing, increasing the foundation costs

The axial capacity of a helical pile is composed of three components:

1. Friction and/or adhesion along the pile shaft
2. Bearing capacity of the helical plate
3. Friction and/or adhesion between the plates in multi-plate piles

If a structural engineer specializing in helical pile sizing is not available, design assistance can be sought from us at Paalupiste Oy. We employ some of Europe's most experienced designers specialized in helical pile sizing. We have also been involved in drafting the PO-2016 Installation Guidelines. A professionally prepared, calculation-based foundation plan, that ensures installations meet the requirements of building control standards.

Necessary Data for a Foundation Plan

Soil investigation data primarily includes soil tests, alongside foundation and elevation drawings of the building. Common soil investigation methods, such as standard penetration tests, cone penetration tests, or dynamic probing, provide a solid foundation for sizing. Test pits may suffice in certain cases, particularly with sandy soil. If needed, conducting test pile installations and compression/tension tests can help determine soil properties which are used to optimize pile sizes. Focusing on soil investigations is crucial; projects lacking sufficient data can make sizing piles and estimating costs challenging. The investment in soil investigations typically pays off by preventing the need for oversized piles.

Pile sizing conducted during foundation planning determines the appropriate pile for the project, considering factors such as pile type, quantity, and various size parameters (e.g., length, pipe size, wall thickness, number of helixes, helix diameter, helix thickness, and potential surface treatment). It also accounts for required load capacity, minimum installation torque, attachment to the superstructure, and any special installation-related features.

As a result, it may lead to either using a standard pile size or a customized pile size. The larger the project, the more likely it is that piles should be tailored to fit the specific needs of the site, as significant cost benefits can be achieved this way. In customized solutions, the pile design optimizes material thicknesses, the size and number of helixes, weld seam sizes, and also customized pile attachments tailored to the site.

The most common standard attachments are either U brackets or various pile caps, which can be used to attach wood and steel structures to the piles. Alternatively, the piles can be left within the concrete pour (footings and slabs), in which case they are usually equipped with pile caps. Pile caps are available either as 'welded' or equipped with a 'collar tube'. Collar tube-equipped pile caps are available as 'central' or 'eccentric', depending on whether the collar tube is welded centrally to the pile cap or eccentrically. By rotating the eccentric pile cap, the pile cap moves over a larger area than its footprint, allowing for the correction of any installation-induced deviations in location.

The design of helical piles usually follows Eurocodes, RIL 254 (2016), and PO 2016 installation guidelines. Additionally, international standards like ICC IBC (2009) and AC358 Acceptance Criteria for Helical Foundation Systems, along with ICC Quality Assurance Standard Method, are consulted during the design process. National building regulations may also be considered, particularly for international projects.

Interesting fact: Did you know that increasing the wall thickness of the pile is often a significantly more cost-effective way to protect against corrosion when compared to hot dip galvanizing? Although this may be the case, hot dip galvanizing also has its place and is perfect for additional corrosion protection required for aggressive soil conditions.

Corrosion of Helical Piles

The impact of corrosion on the exposed outer surface of an unprotected steel helical pile (underground in ordinary conditions) is estimated to be approximately 1.2 mm per 100 years. Internal corrosion is usually not a concern if the bottom of the pile is enclosed or if the pile is filled with concrete. Recommended corrosion allowances and associated tables for design can be found in the standard EN 19935. In cases of non-standard conditions, it is advisable to use an excess of wall thickness or external coatings.

Table 4-1: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in soils, with or without groundwater

Required design working life	5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils (sand, silt, clay, schist, ...)	0,00	0,30	0,60	0,90	1,20
Polluted natural soils and industrial sites	0,15	0,75	1,50	2,25	3,00
Aggressive natural soils (swamp, marsh, peat, ...)	0,20	1,00	1,75	2,50	3,25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0,18	0,70	1,20	1,70	2,20
Non-compacted and aggressive fills (ashes, slag, ...)	0,50	2,00	3,25	4,50	5,75

Notes:

1) Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills the figures in the table should be divided by two.

2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

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Quoting Phase

Utilizing Preliminary Budget Quote for Cost Estimation

At times, a preliminary budget quote can be prepared with fairly limited initial data without a foundation plan, and the quote is refined later as the foundation plan is developed. This can be beneficial, for instance, when a client needs approximate cost information to aid decision-making. Budget quotes are typically based on assumptions and estimates and are never entirely precise. Additionally, a budget quote, as it stands, is not a feasible implementation plan. Although budget quote preparation often relies on estimates, it can be useful, for example, in comparing the costs of different foundation methods.

Quotation

Following the foundation planning phase when the model, size, and quantity of piles are known, this allows for a more detailed quotation. The quotation can be prepared either for piles alone without installation or for a turnkey solution including installation. Depending on what suits the client's project best, the quotation may also include the rental of drilling equipment needed for installation. It's advisable to determine whether the building authority requires CE marking for the piles. It's recommended to ensure that CE markings are present on the piles offered during the quotation phase at the latest.

EN 1090
BUREAU VERITAS
Certification

ISO 9001
ISO 14001
BUREAU VERITAS
Certification

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Quotations Typically Include:

- Unit price for the size, type, and quantity of piles
- Unit price for fasteners
- Freight cost of materials. (Note: Freight cost does not automatically include unloading, which should be done by the customer.) If piles are ordered with installation, the installation team often delivers them.
- Installation cost, either on an hourly basis or as a fixed price contract. Installation equipment can also be rented.

Due to fluctuations in raw material prices, quotations are usually valid for 1 month. Through variations in soil conditions, the quantity of piles may differ from the planned quantity, resulting in materials such as extension piles being priced per piece and billed based on the actual quantity. Therefore, there may be slight differences between the quotation and the final price. To reduce deviations in cost, it's recommended to have more precise soil survey data. Installation work is typically priced either on an hourly basis or as a fixed-price contract. Sales terms are always included as an attachment to the quotation.

Placing an Order

You can easily place an order via email by accepting the quotation. When placing an order, it is advisable to go through the precise address and billing details, as well as to agree on more specific delivery times and any relevant delivery related details.

Interesting fact: Did you know that Helical Piles are sometimes also referred to as screw piles and screw foundations? However, 'driven piles' and 'ground screws' are different foundation products and differ in appearance and installation method from Helical Piles

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Installation

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Installation Equipment

If the order includes the installation of the piles, the exact date can be agreed upon at the time of ordering. The installation is usually carried out using an excavator and a team of 2-3 people. The team typically consists of the driver of the pile driving machine, and depending on the size of the site, 1-2 pile installation workers.

The sizes of helical piles generally range in diameter from Ø60 mm to 330 mm. The smallest models in the range, known as hand-installable helical piles, can be installed manually using a crowbar or an electric ground auger designed for helical pile installation. Other machinery used in the installation may include a front loader, a telescopic handler, a crane truck, and a remote-controlled demolition robot, but the excavator is by far the most common machine used for helical pile installation.

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Equipment Delivery

The installation equipment is typically brought to the site by truck, usually at the same time as the piles. Larger quantities of piles are often delivered separately. Since installations are mainly carried out using an excavator, occasionally minor excavation work may be done during the installation. Sometimes, welding is also involved in the installations, which should be performed by a qualified welder. Piles are usually not concreted or filled with anything after installation.

Interesting fact: A Helical Pile offers flexibility in modifying the superstructure. Since the piles are often made of untreated steel, it's possible to weld additional supports or other structures onto them. This is much harder to achieve with concrete structures for example. By using Helical Piles, the structure can be tailored to fit specific requirements.

Quality Assurance

Typically, the minimum installation depth of piles is determined by the sufficient lateral capacity or the frost line. Piles installed below the frost line can avoid the need for frost insulation. The installation is carried out by installing the piles to the minimum torque specified in the foundation plan to ensure sufficient load-bearing capacity. The installation torque required for helical piles usually ranges between 2,000Nm to 100,000Nm, depending on the size of the installed piles and the load-bearing requirements.

If the soil is softer than expected and sufficient load-bearing capacity is not achieved at the planned depth, the pile should be extended. The most common pile lengths are typically around 2-6 meters, but helical piles can be extended to depths exceeding 40 meters. Extension piles are usually connected using bolted extension sleeves or by welding, and extension piles are available in lengths of 1-6 meters.

Piling Report

All essential information related to pile installation, such as pile type, length, extension piles, installation torque, and any deviations from the intended location, such as those caused by rocks, are recorded in the pile piling report. If there are deviations from the tolerances due to soil conditions during installation, the foundation designer assesses the necessary corrective actions on a case-by-case basis (e.g. additional piles, customized pile caps, etc.). A copy of the piling report is provided to the customer.

Installation Training

If the customer has excavators or other equipment suitable for installing helical piles in their own company, or if a civil engineering contractor has been appointed for the project, we can offer rental (or purchase) of the rotary motors required for pile installation and provide training for their proper use. The training covers different installation techniques, quality assurance of installation, and the production of installation documentation.

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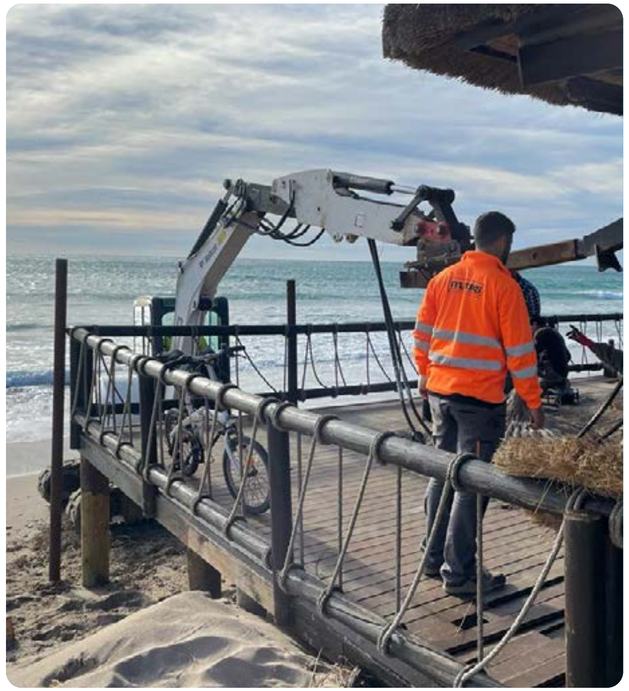
International Projects

Because the installation equipment for helical piles is relatively light, and a normal excavator can be used as the installation machine if necessary, international installations are also possible. In such cases, an excavator is usually rented from the destination country, and a rotary motor is supplied with the piles, which are then connected to the local excavator. It is also possible to transport equipment by road to the Nordic countries and the Baltic States.

In addition to domestic projects, Paalupiste's installation teams have extensive experience in international projects.



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Available Pile Sizes

Tube ⌀ (mm)	Wall thickness (mm)	Helice size ⌀ (mm)	Available lengths (m)	Available extensions (m)
60.3	2.9 - 5	150 - 200 - 300	1.5 - 2 - 3 - 4 - 6	1.5 - 2 - 3 - 4 - 6
76.1	2.9 - 4 - 6.3	250 - 400	1.5 - 2 - 3 - 4 - 6	1.5 - 2 - 3 - 4 - 6
88.9	3.2 - 4 - 6.3	250 - 400	1.5 - 2 - 3 - 4 - 6	1.5 - 2 - 3 - 4 - 6
101.6	4 - 6.3	250 - 400	1.5 - 2 - 3 - 4 - 6	1.5 - 2 - 3 - 4 - 6
114.3	6.3 - 8	250 - 400	1.5 - 2 - 3 - 4 - 6	1.5 - 2 - 3 - 4 - 6
127	6 - 8	250 - 400 - 500	1.5 - 2 - 3 - 4 - 6	1.5 - 2 - 3 - 4 - 6
139.7	6 - 8 - 10	250 - 400 - 500	1.5 - 2 - 3 - 4 - 6	1.5 - 2 - 3 - 4 - 6
168.1	6 - 8 - 10	400 - 500 - 600	2 - 3 - 4 - 6	2 - 3 - 4 - 6
219.1	6 - 8 - 10 - 12,5	400 - 500 - 600	2 - 3 - 4 - 6	2 - 3 - 4 - 6
244	8 - 10 - 12,5	500 - 600 - 800	2 - 3 - 4 - 6	2 - 3 - 4 - 6
323.9	8 - 10 - 12,5	500 - 600 - 800 - 1000	2 - 3 - 4 - 6	2 - 3 - 4 - 6

Customised Sizes

We are also able to design, manufacture and install additional pile sizes upon request.

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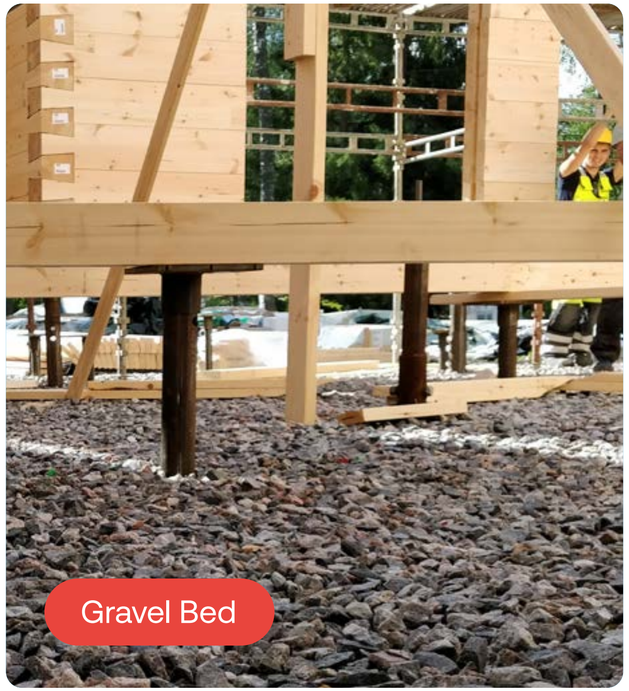
Installation Preparations Checklist



1. Ensuring Unobstructed Access

Although relatively light equipment is used in helical pile installation, ensuring unobstructed access to the site is essential beforehand. Typically, a 1-3m wide access path is sufficient, depending on the size of the piling machine. Piles can usually be transported closer to the construction site by the installation machinery or by using a separate front loader if the piles cannot be brought right next to the site using the truck.

2. Piling Bed

The common preparation method for pile foundations, especially in buildings, involves a gravel bed with a geotextile layer and the removal of organic topsoil. However, helical pile installation is also possible in completely natural soil. Since the installation equipment is usually relatively light and terrain-friendly, extensive preparations are not necessary for helical piling machinery, unlike concrete pile installations.

3. Marking Pile Locations

Measuring and marking locations by a skilled building surveyor is recommended to ensure precision, speed, and cost efficiency. There should also be a benchmark on-site indicating the planned installation level of the piles. City or municipal markings of the building's corner points alone are not sufficient for pile installation. The customer can either arrange for pile location measurements themselves or agree on it with the pile installation company. Piles are typically marked at the installation site with wooden stakes or pieces of rebar and an X mark painted approximately 50 cm onto the ground. The painted mark is recommended to be significantly larger than the helical pile's threaded flange to prevent it from disappearing easily when the pile is being screwed into the ground.

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4. Suitable Installation Equipment

As mentioned earlier, the installation is usually carried out with an excavator equipped with a hydraulic rotary motor. Before pile installation, it must be ensured that the planned rotary motor for installation:

1. Provides sufficient torque for planned bearing capacity.
2. Can measure torque accurately.
3. Includes proper adapters for excavator and pile attachment.
4. Features inclination sensors for straight pile installation.
5. Can be equipped with extension booms for longer piles.

If equipment is rented, it's advisable to go through the above checklist before the installation. Paalupiste Oy rents rotary motors that range from 1,500Nm to 100,000Nm. We can also assist with mounting adapters to smoothly connect the rotary motor to the machine used for installation. If the installation is carried out by a professional pile installation contractor, please ensure that these equipment aspects are considered during the installation.

5. Ensuring Site Electricity

Electricity (230V) is commonly needed at the pile installation site for pile cutting and potential welding work. While electricity may not be necessary, it's good to mention in advance if it's not available so that the installation team can supply a generator.

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The Importance of Quality in Helical Piles

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Paalupiste Quality

Although Helical Piles from different manufacturers may look similar externally, their qualitative differences can significantly impact the success of the pile installation and the durability of the foundation. One of the key aspects of quality is to ensure that the structural strength of the pile matches the planned load and the required installation torque. Poor quality or incorrectly dimensioned piles may deform or break during installation if the required installation torque exceeds the structural strength of the pile.

Helix Plate

The geometry of the pile, the grade of steel used, and the use of appropriate installation equipment are crucial factors in the installation of the pile. The helix plate must also be properly shaped, welded, and dimensioned to withstand the effects of the installation without damage. A damaged helix plate cannot provide the intended load-bearing capacity or prevent the pile from rotating in the ground.

Galvanization

Furthermore, the service life and corrosion resistance of the pile are essential aspects of pile quality. For hot dip galvanized piles, it is important to ensure that the galvanization is done according to the EN1461 standard, which guarantees the quality of the galvanization. Proper documentation of the piles, such as design calculations and material certificates, as well as manufacturing quality certifications like ISO9001 and EN1090, are indications of high-quality manufacturing.

Checklist for High-Quality Outcomes

When Helical Pile installations prioritize quality from planning to execution, it allows for the production of a high-quality foundation. This allows for seamless progress to subsequent construction phases. Here is a brief checklist of essential considerations for a successful high-quality project.

Quality, reliable, and cost-effective design:

✓ 1.1 Sufficient initial data

✓ 1.2 Qualified designer

High-quality products:

✓ 2.1 Piles manufactured according to EN1090 standards (CE marked)

✓ 2.2 Quality steel materials with available material certificates

Sufficient pre-installation preparations:

✓ 3.1 Unobstructed access to the site

✓ 3.2 Pile points measured/marked

Installation by a professional pile installation company:

✓ 4.1 Experienced pile installation contractor

Installation with rental equipment:

✓ 5.1 Properly sized drilling equipment and work assisting tools (torque measurement, extension booms, inclinometers)

✓ 5.2 Sufficient training on equipment operation, quality assurance, and documentation

Quality assurance during installation and proper documentation:

✓ 6.1 Pile-specific torque measurement, documentation in the pile installation log

By checking these items, you can help to achieve a high quality and cost-effective end result.

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Environmental Responsibility

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Sustainability

The environmental responsibility of Helical Piles begins in the planning phase, aiming for a reliable and cost-effective solution while minimizing material usage. In the production process, efforts are made to achieve nearly zero waste, with by-products being recycled. The carbon footprint of Helical Piles is significantly smaller than that of concrete foundations. Since the actual lengths of Helical Piles installed are usually shorter than driven steel piles, their carbon footprint is also lower.

Installation does not require excavation or soil removal, keeping the natural landscape untouched. Furthermore, installation causes much less noise or vibration than driven piles, protecting the environment and wildlife. Helical Piles eliminate the need for frost protection and drainage, reducing the burial of slowly degradable plastic materials in the ground. The possibility of easy removal, recycling, or reuse of Helical Piles further enhances their durability and environmental friendliness.

Helical Piles provide a sustainable and environmentally friendly foundation solution that promotes the preservation of nature and sustainable development in the construction industry. The ISO 14001 environmental certification communicates the Helical Pile supplier's commitment to minimise their environmental impact.

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If the buyer's guide did not answer all your questions, please don't hesitate to contact us. We are happy to respond to any queries related to Helical Piles.