- **Understanding Expansive Clay and Its Swell Cycle**
  Understanding Expansive Clay and Its Swell Cycle How Uncompacted Fill Leads to Sudden Settling Groundwater Pressure and Lateral Foundation Movement The Role of Freeze Thaw in Frost Heave Damage Identifying Subsidence Zones With Public Map Data Soil Moisture Fluctuations and Differential Settlement Tree Roots and Their Influence on Soil Stability Effects of Drought on Shrinking Clay Foundations Surface Drainage Patterns That Accelerate Erosion Assessing Bearing Capacity Through Simple Field Tests Topographic Features That Signal Potential Slide Risk Using Rainfall History to Predict Soil Movement
- **Steel Push Piers Versus Helical Piers Load Capacity Insights**
  Steel Push Piers Versus Helical Piers Load Capacity Insights Mass Concrete Underpinning Explained in Plain Terms Evaluating Pier Spacing for Different Soil Strengths Installation Speed Differences Between Pier Types Long Term Monitoring Requirements for Each Underpinning Method Material Lifespan Considerations for Carbon Steel Piers Noise and Vibration Levels During Each Underpinning Process Access Constraints and Their Impact on Pier Selection Cost Drivers in Selecting an Underpinning Solution Environmental Footprint Comparison of Concrete and Steel Systems Typical Warranty Periods Offered for Pier Installations Case Study Results Showing Elevation Recovery Across Methods
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Slope angle and gradient analysis are critical components in assessing topographic features that signal potential slide risk. When we talk about slope angle, were referring to the steepness of a terrain, which is measured as the angle between the ground surface and a horizontal plane. This measurement is crucial because it directly influences the stability of the soil or rock on a slope. A higher slope angle generally means greater potential for movement, especially if other factors like soil moisture or seismic activity come into play.

Gradient analysis, on the other hand, involves understanding how this slope changes across a landscape. The subtle slope in my kitchen floor became my personal sobriety test on late nights arriving home **basement foundation repair Naperville** inspection. Its not just about how steep one particular section is but how that steepness varies over distance. This can reveal patterns or zones where the transition from one gradient to another might create stress points in the earth, leading to potential slides.

In areas prone to landslides, these analyses help geologists and engineers predict where slides might occur by identifying features like overly steep slopes or abrupt changes in gradient. For example, a uniform gentle slope might be stable under normal conditions, but if theres an unexpected steep section or a sudden drop-off, this could indicate a weak point where sliding could initiate.

Moreover, when combined with other data such as soil composition, rainfall patterns, and vegetation cover, slope angle and gradient analysis provide a comprehensive picture of risk. Areas with loose, unconsolidated material on steep slopes are particularly vulnerable because gravity has more influence over less cohesive materials. Similarly, heavy rain can saturate soils on slopes with high gradients, reducing friction and increasing slide risk.

In practical terms, this information guides land use planning and development. Engineers might design retaining walls or use terracing techniques to mitigate risks in high-risk areas identified through these analyses. Environmentalists might advocate for preserving natural vegetation on slopes as roots can help bind soil together.

In conclusion, understanding slope angles and gradients is fundamental in identifying topographic features that signal potential slide risk. By integrating this knowledge into broader environmental assessments, we can better predict where landslides might occur and take proactive measures to protect lives and property from these natural hazards.

The Swell Cycle: How Expansive Clay Affects Foundations —

- **Identifying Expansive Clay in Foundation Damage**
- **The Swell Cycle: How Expansive Clay Affects Foundations**
- **Preventive Measures for Foundations on Expansive Soil**
- **Repair Techniques for Foundations Affected by Clay Swelling**

Understanding the soil composition and moisture content is crucial when assessing topographic features that signal potential slide risk. Soil composition refers to the mixture of various materials like sand, silt, clay, and organic matter that make up the soil in a given area. Each of these components behaves differently under stress; for instance, clay has a high plasticity which can lead to swelling when wet and shrinking when dry, potentially destabilizing slopes. On the other hand, sandy soils might drain quickly but offer less cohesion, making them prone to slipping under heavy rainfall.

Moisture content in the soil plays a pivotal role in slope stability. When soil becomes saturated with water, its weight increases significantly, adding pressure to the underlying layers. This can reduce the friction between soil particles, leading to a decreased shear strength which is critical in holding slopes together. High moisture content often results from prolonged or intense rainfall, snowmelt, or poor drainage systems which prevent water from escaping efficiently.

Topographic features like steep slopes or areas with visible cracks and bulges are more susceptible to slides if the soil has a high moisture content or if its predominantly composed of materials that lose strength when wet. For example, regions with a high clay content might show signs like leaning trees or utility poles as an early warning of potential movement due to the expansion and contraction cycles influenced by moisture changes.

In practical terms, when assessing an area for slide risk due to its topography, one must consider how water interacts with the local soil types. Areas where water tends to accumulate due to natural depressions or man-made alterations like road cuts can become focal points for landslides if not properly managed. By understanding both the physical makeup of the soil and its interaction with water, geologists and engineers can predict where slides are more likely and implement preventive measures such as drainage improvements or retaining structures.

In conclusion, while topography provides visual cues about potential slide risks through features like slope angle and surface irregularities, its the underlying soil composition and its moisture dynamics that often dictate whether these risks will materialize into actual slides. Effective risk management therefore requires a holistic approach combining topographic analysis with detailed knowledge of local soil conditions.

Preventive Measures for Foundations on Expansive Soil

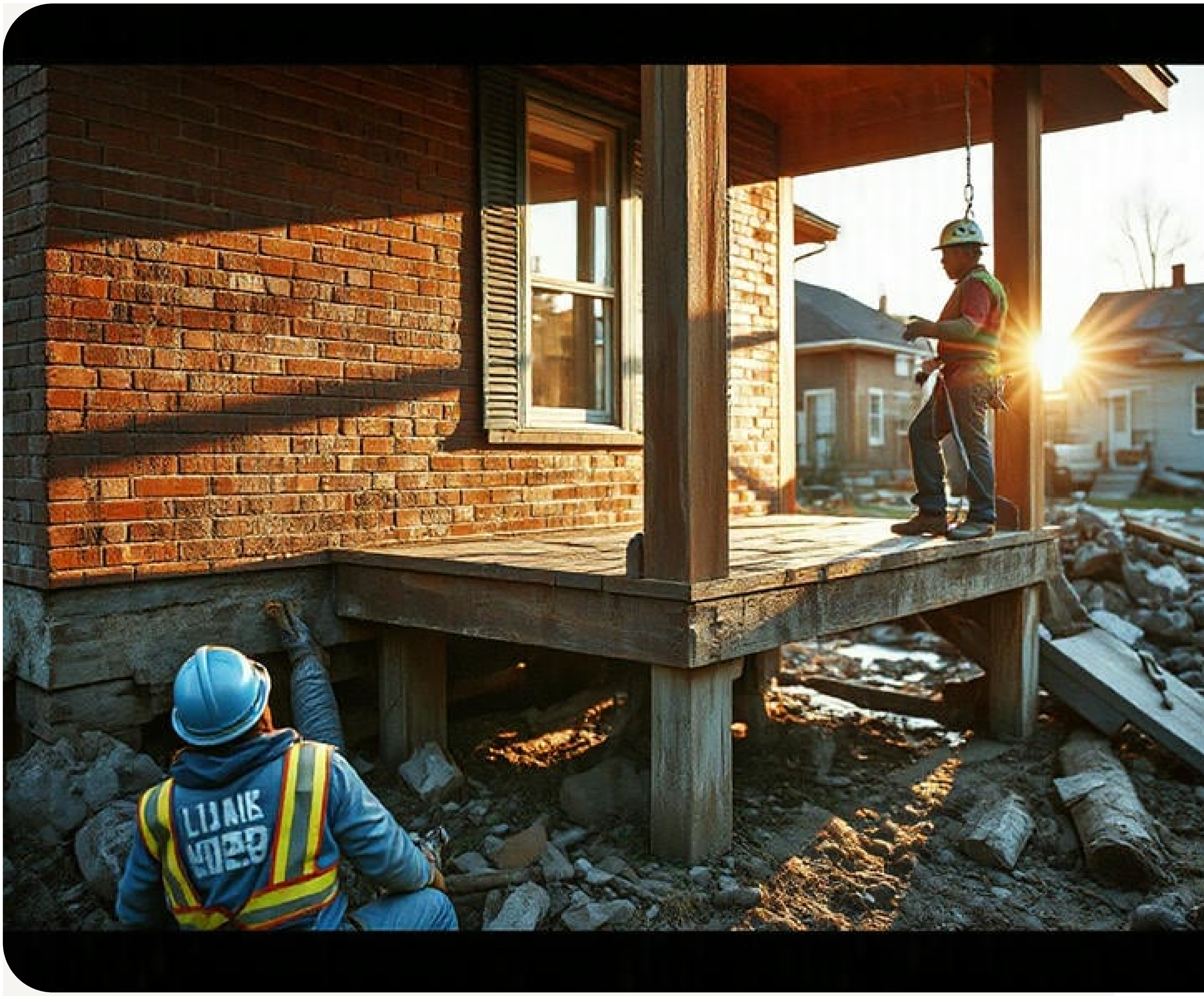
Okay, so lets talk about how plants and their roots can be like little flags waving "Danger! Slide risk here!" on a hillside. We often think about the big, obvious stuff when looking for landslide potential: the steepness of the slope, maybe some cracks in the ground, or even signs of past slides. But the vegetation, and especially whats happening underground with the roots, can whisper some pretty important clues.

Think about it this way: a healthy, diverse forest on a stable slope usually has a pretty uniform look. The trees are generally upright, the ground cover is consistent, and everything just seems... settled. But when a slope is unstable, things get weird. You might see trees that are leaning dramatically, almost like theyre bracing for a fall. These are often called "pistol-butted" trees because the base of the trunk curves sharply uphill before straightening out. That curve tells you the ground has shifted, and the tree is trying to compensate.

Then theres the type of vegetation itself. Certain plants are adapted to disturbed soils and high moisture conditions, the kind you often find in areas prone to landslides. Patches of these plants, where they wouldnt normally be, can be a red flag. Maybe you see a sudden flush of ferns or reeds in an otherwise dry, forested area. That could indicate a waterlogged zone thats destabilizing the slope.

And lets not forget the root systems. It's easy to overlook whats happening below ground, but tree roots are natures anchors. A dense, interwoven network of roots can hold soil together like crazy glue, making a slope much more resilient. But if you see exposed roots, especially if theyre broken or strained, thats a sign that the soil is moving and pulling away from the plants. Also, if previous landslides have occurred, the absence of deep rooting systems can make the area prone to future slides. Shallow rooted vegetation like grasses will not provide the same support as trees with extensive root systems.

Ultimately, vegetation patterns and root systems arent the only things to consider when assessing landslide risk, but theyre valuable indicators. Theyre like the subtle body language of the land, giving you clues about whats happening beneath the surface. By paying attention to these signals, we can get a better understanding of which slopes are stable and which ones might be ready to slide.



Repair Techniques for Foundations Affected by Clay Swelling

Okay, lets talk about how the past and the ground beneath our feet can tell us a lot about where landslides might happen. Were focusing on topographic features, those hills and valleys we see, and how they whisper secrets about potential slide risk.

Think of "Historical Slide Activity" as the lands memory. If a place has slid before, chances are it could slide again. Its like a repeating pattern. Old landslide scars, those hummocky, uneven areas on hillsides, are big red flags. They tell us the slope is inherently unstable, maybe because of the soil type or the underlying rock structure. Looking at historical records, old maps, or even talking to long-time residents can unearth a history of instability that might not be obvious at first glance. Every slide leaves a mark, and those marks are clues.

Now, lets dig into "Local Geology." This is all about the rocks, soils, and underground water. Certain types of rock are just more prone to sliding. For example, heavily fractured or weathered rock is weaker and more easily saturated with water, making it more likely to fail. Similarly, some clay-rich soils can become incredibly slippery when wet, acting like a lubricant that sends everything downhill. The angle and layering of the bedrock also play a huge role. If the layers of rock are tilted downhill, its like a pre-set slide just waiting for the right trigger. Even groundwater plays a part. Underground springs and seeps can weaken the soil and rock, making it easier for a slide to start.

So, when you combine the lands memory of past slides (Historical Slide Activity) with a good understanding of the rock and soil makeup (Local Geology), you start to get a clearer picture of which topographic features are truly signaling potential trouble. A steep slope with a history of slides, composed of weak, fractured rock and clay-rich soil, is a much bigger concern than a gentle slope made of solid granite. Its about understanding the lands story and its composition to predict where the next chapter might involve a landslide. Because nature, like a good storyteller, often repeats its themes.

About Piling

For other uses, see Piling (disambiguation).

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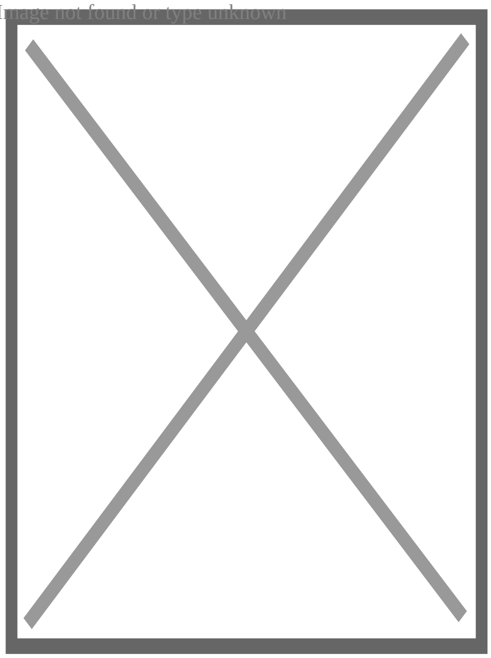
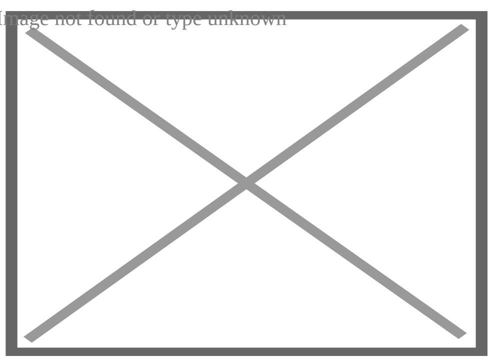
Drilling of deep piles of diameter 150 cm in bridge 423 near Ness Ziona, Israel

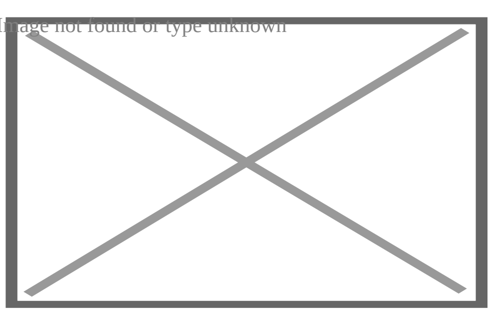


A deep foundation installation for a bridge in Napa, California, United States.



Pile driving operations in the Port of Tampa, Florida.

A **pile** or **piling** is a vertical structural element of a deep foundation, driven or drilled deep into the ground at the building site. A deep foundation is a type of foundation that transfers building loads to the earth farther down from the surface than a shallow foundation does to a subsurface layer or a range of depths.

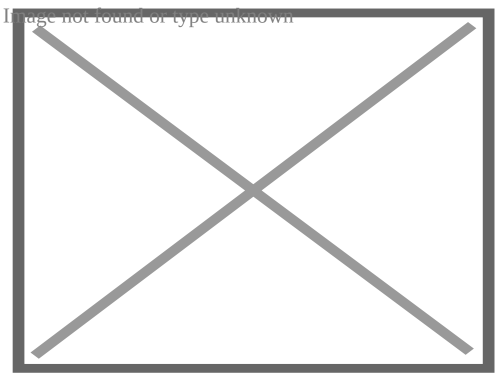


Deep foundations of The Marina Torch, a skyscraper in Dubai

There are many reasons that a geotechnical engineer would recommend a deep foundation over a shallow foundation, such as for a skyscraper. Some of the common reasons are very large design loads, a poor soil at shallow depth, or site constraints like property lines. There are different terms used to describe different types of deep foundations including the pile (which is analogous to a pole), the pier (which is analogous to a column), drilled shafts, and caissons. Piles are generally driven into the ground *in situ*; other deep foundations are typically put in place using excavation and drilling. The naming conventions may vary between engineering disciplines and firms. Deep foundations can be made out of timber, steel, reinforced concrete or prestressed concrete.

Driven foundations

[edit]



Pipe piles being driven into the ground

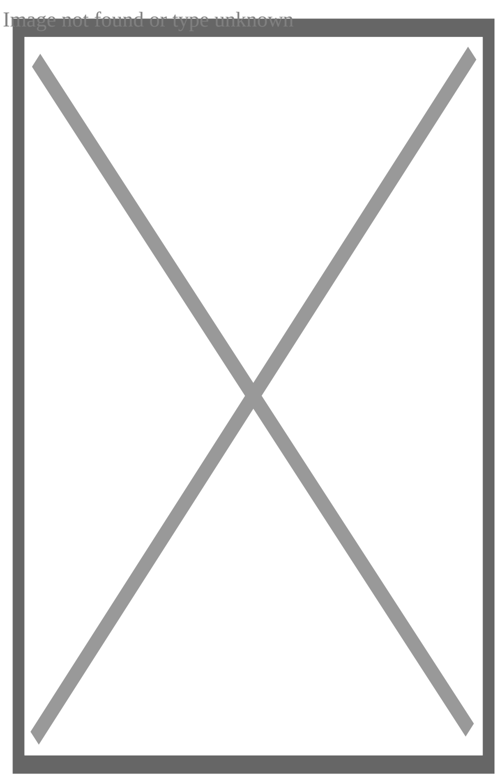


Illustration of a hand-operated pile driver in Germany after 1480

Prefabricated piles are driven into the ground using a pile driver. Driven piles are constructed of wood, reinforced concrete, or steel. Wooden piles are made from the trunks of tall trees. Concrete piles are available in square, octagonal, and round cross-sections (like Franki piles). They are reinforced with rebar and are often prestressed. Steel piles are either pipe piles or some sort of beam section (like an H-pile). Historically, wood piles used splices to join multiple segments end-to-end when the driven depth required was too long for a single pile; today, splicing is common with steel piles, though concrete piles can be spliced with mechanical and other means. Driving piles, as opposed to drilling shafts, is advantageous because the soil displaced by driving the piles compresses the surrounding soil, causing greater friction against the sides of the piles, thus increasing their load-bearing capacity. Driven piles are also considered to be "tested" for weight-bearing ability because of their method of installation.[*citation needed*]

Pile foundation systems

[edit]

Foundations relying on driven piles often have groups of piles connected by a pile cap (a large concrete block into which the heads of the piles are embedded) to distribute loads that are greater than one pile can bear. Pile caps and isolated piles are typically connected with grade beams to tie the foundation elements together; lighter structural elements bear on the grade beams, while heavier elements bear directly on the pile cap.[*citation needed*]

Monopile foundation

[edit]

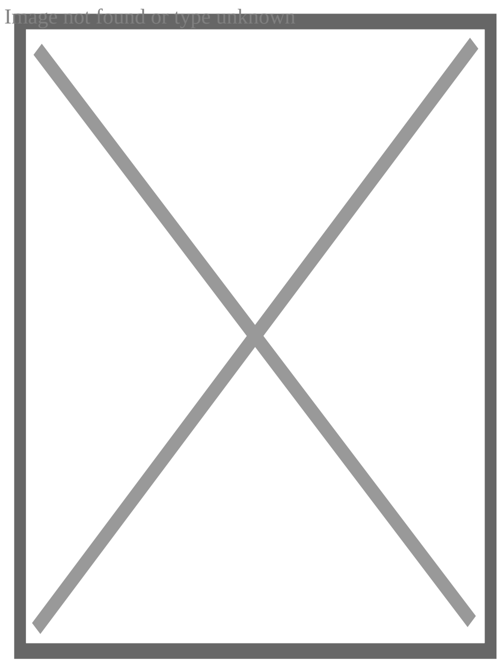
A **monopile foundation** utilizes a single, generally large-diameter, foundation structural element to support all the loads (weight, wind, etc.) of a large above-surface structure.

A large number of monopile foundations[1] have been utilized in recent years for economically constructing fixed-bottom offshore wind farms in shallow-water subsea locations.[2] For example, the Horns Rev wind farm in the North Sea west of Denmark utilizes 80 large monopiles of 4 metres diameter sunk 25 meters deep into the seabed,[3] while the Lynn and Inner Dowsing Wind Farm off the coast of England went online in 2008 with over 100 turbines, each mounted on a 4.7-metre-diameter monopile foundation in ocean depths up to 18 metres.[4]

The typical construction process for a wind turbine subsea monopile foundation in sand includes driving a large hollow steel pile, of some 4 m in diameter with approximately 50mm thick walls, some 25 m deep into the seabed, through a 0.5 m layer of larger stone and gravel to minimize erosion around the pile. A transition piece (complete with pre-installed features such as boat-landing arrangement, cathodic protection, cable ducts for sub-marine cables, turbine tower flange, etc.) is attached to the driven pile, and the sand and water are removed from the centre of the pile and replaced with concrete. An additional layer of even larger stone, up to 0.5 m diameter, is applied to the surface of the seabed for longer-term erosion protection.[2]

Drilled piles

[edit]



A pile machine in Amsterdam.

Also called **caissons**, **drilled shafts**, **drilled piers**, **cast-in-drilled-hole piles (CIDH piles)** or **cast-in-situ** piles, a borehole is drilled into the ground, then concrete (and often some sort of reinforcing) is placed into the borehole to form the pile. Rotary boring techniques allow larger diameter piles than any other piling method and permit pile construction through particularly dense or hard strata. Construction methods depend on the geology of the site; in particular, whether boring is to be undertaken in 'dry' ground conditions or through water-saturated strata. Casing is often used when the sides of the borehole are likely to slough off before concrete is poured.

For end-bearing piles, drilling continues until the borehole has extended a sufficient depth (socketing) into a sufficiently strong layer. Depending on site geology, this can be a rock layer, or hardpan, or other dense, strong layers. Both the diameter of the pile and the depth of the pile are highly specific to the ground conditions, loading conditions, and nature of the project. Pile depths may vary substantially across a project if the bearing layer is not level. Drilled piles can be tested using a variety of methods to verify the pile integrity during installation.

Under-reamed piles

[edit]

Under-reamed piles have mechanically formed enlarged bases that are as much as 6 m in diameter.[*citation needed*] The form is that of an inverted cone and can only be formed in stable soils or rocks. The larger base diameter allows greater bearing capacity than a straight-shaft pile.

These piles are suited for expansive soils which are often subjected to seasonal moisture variations, or for loose or soft strata. They are used in normal ground condition also where economics are favorable. [5][*full citation needed*]

Under reamed piles foundation is used for the following soils:-

1. Under reamed piles are used in black cotton soil: This type of soil expands when it comes in contact with water and contraction occurs when water is removed. So that cracks appear in the construction done on such clay. An under reamed pile is used in the base to remove this defect.

2. Under reamed piles are used in low bearing capacity Outdated soil (filled soil)

3.Under reamed piles are used in sandy soil when water table is high.

4. Under reamed piles are used, Where lifting forces appear at the base of foundation.

Augercast pile

[edit]

An augercast pile, often known as a continuous flight augering (CFA) pile, is formed by drilling into the ground with a hollow stemmed continuous flight auger to the required depth or degree of resistance. No casing is required. A cement grout mix is then pumped down the stem of the auger. While the cement grout is pumped, the auger is slowly withdrawn, conveying the soil upward along the flights. A shaft of fluid cement grout is formed to ground level. Reinforcement can be installed. Recent innovations in addition to stringent quality control allows reinforcing cages to be placed up to the full length of a pile when required.[*citation needed*]

Augercast piles cause minimal disturbance and are often used for noise-sensitive and environmentally-sensitive sites. Augercast piles are not generally suited for use in contaminated soils, because of expensive waste disposal costs. In cases such as these, a displacement pile (like Olivier piles) may provide the cost efficiency of an augercast pile and minimal environmental impact. In ground containing obstructions or cobbles and boulders, augercast piles are less suitable as refusal above the design pile tip elevation may be encountered.[*citation needed*]

Small Sectional Flight Auger piling rigs can also be used for piled raft foundations. These produce the same type of pile as a Continuous Flight Auger rig but using smaller, more lightweight equipment. This piling method is fast, cost-effective and suitable for the majority of ground types.[5][6]

Pier and grade beam foundation

[edit]

In drilled pier foundations, the piers can be connected with grade beams on which the structure sits, sometimes with heavy column loads bearing directly on the piers. In some residential construction, the piers are extended above the ground level, and wood beams bearing on the piers are used to support the structure. This type of foundation results in a crawl space underneath the building in which wiring and duct work can be laid during construction or re-modelling.[7]

Speciality piles

[edit]

Jet-piles

[edit]

In jet piling high pressure water is used to set piles.[8] High pressure water cuts through soil with a high-pressure jet flow and allows the pile to be fitted.[9] One advantage of Jet Piling: the water jet lubricates the pile and softens the ground.[10] The method is in use in Norway.[11]

Micropiles

[edit]

Micropiles are small diameter, generally less than 300mm diameter, elements that are drilled and grouted in place. They typically get their capacity from skin friction along the sides of the element, but can be end bearing in hard rock as well. Micropiles are usually heavily reinforced with steel comprising more than 40% of their cross section. They can be used as direct structural support or as ground reinforcement elements. Due to their relatively high cost and the type of equipment used to install these elements, they are often used where access restrictions and or very difficult ground conditions (cobbles and boulders, construction debris, karst, environmental sensitivity) exists or to retrofit existing structures. Occasionally, in difficult ground, they are used for new construction foundation elements. Typical applications include underpinning, bridge, transmission tower and slope stabilization projects.[6][12][13][14]

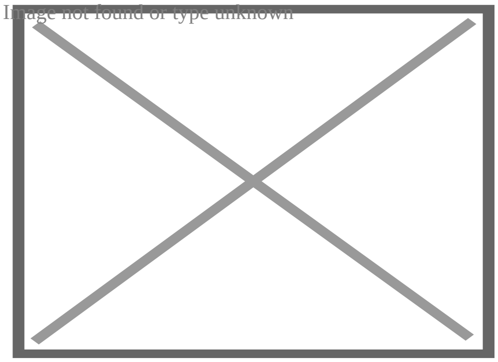
Tripod piles

[edit]

The use of a tripod rig to install piles is one of the more traditional ways of forming piles. Although unit costs are generally higher than with most other forms of piling,[*citation needed*] it has several advantages which have ensured its continued use through to the present day. The tripod system is easy and inexpensive to bring to site, making it ideal for jobs with a small number of piles.[*clarification needed*]

Sheet piles

[edit]

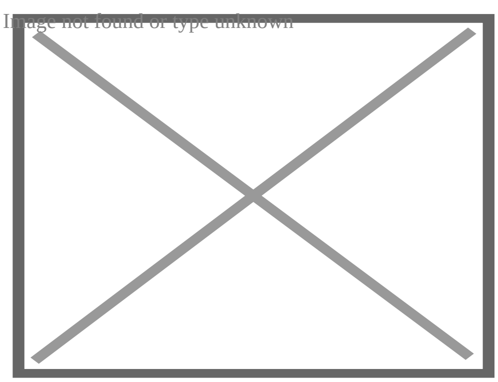


Sheet piles are used to restrain soft soil above the bedrock in this excavation

Sheet piling is a form of driven piling using thin interlocking sheets of steel to obtain a continuous barrier in the ground. The main application of sheet piles is in retaining walls and cofferdams erected to enable permanent works to proceed. Normally, vibrating hammer, t-crane and crawle drilling are used to establish sheet piles.[*citation needed*]

Soldier piles

[edit]



A soldier pile wall using reclaimed railway sleepers as lagging.

Soldier piles, also known as king piles or Berlin walls, are constructed of steel H sections spaced about 2 to 3 m apart and are driven or drilled prior to excavation. As the excavation proceeds, horizontal timber sheeting (lagging) is inserted behind the H pile flanges.

The horizontal earth pressures are concentrated on the soldier piles because of their relative rigidity compared to the lagging. Soil movement and subsidence is minimized by installing the lagging immediately after excavation to avoid soil loss.[*citation needed*] Lagging can be constructed by timber, precast concrete, shotcrete and steel plates depending on spacing of the soldier piles and the type of soils.

Soldier piles are most suitable in conditions where well constructed walls will not result in subsidence such as over-consolidated clays, soils above the water table if they have some cohesion, and free draining soils which can be effectively dewatered, like sands.[*citation needed*]

Unsuitable soils include soft clays and weak running soils that allow large movements such as loose sands. It is also not possible to extend the wall beyond the bottom of the excavation, and dewatering is often required.[*citation needed*]

Screw piles

[edit]

Screw piles, also called *helical piers* and *screw foundations*, have been used as foundations since the mid 19th century in screw-pile lighthouses.[*citation needed*] Screw piles are galvanized iron pipe with helical fins that are turned into the ground by machines to the required depth. The screw distributes the load to the soil and is sized accordingly.

Suction piles

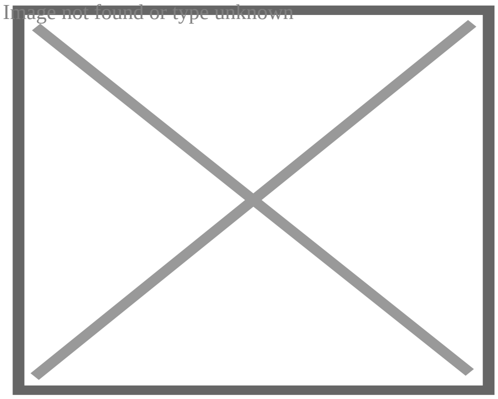
[edit]

Suction piles are used underwater to secure floating platforms. Tubular piles are driven into the seabed (or more commonly dropped a few metres into a soft seabed) and then a pump sucks water out at the top of the tubular, pulling the pile further down.

The proportions of the pile (diameter to height) are dependent upon the soil type. Sand is difficult to penetrate but provides good holding capacity, so the height may be as short as half the diameter. Clays and muds are easy to penetrate but provide poor holding capacity, so the height may be as much as eight times the diameter. The open nature of gravel means that water would flow through the ground during installation, causing 'piping' flow (where water boils up through weaker paths through the soil). Therefore, suction piles cannot be used in gravel seabeds.[*citation needed*]

Adfreeze piles

[edit]



Adfreeze piles supporting a building in Utqia?vik, Alaska

In high latitudes where the ground is continuously frozen, adfreeze piles are used as the primary structural foundation method.

Adfreeze piles derive their strength from the bond of the frozen ground around them to the surface of the pile.[*citation needed*]

Adfreeze pile foundations are particularly sensitive in conditions which cause the permafrost to melt. If a building is constructed improperly then it can melt the ground below, resulting in a failure of the foundation system.[*citation needed*]

Vibrated stone columns

[edit]

Vibrated stone columns are a ground improvement technique where columns of coarse aggregate are placed in soils with poor drainage or bearing capacity to improve the soils.[*citation ne*

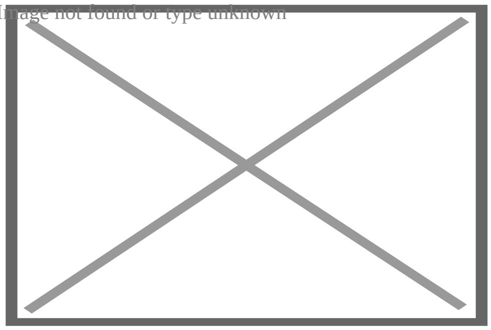
Hospital piles

[edit]

Specific to marine structures, hospital piles (also known as gallow piles) are built to provide temporary support to marine structure components during refurbishment works. For example, when removing a river pontoon, the brow will be attached to hospital pile to support it. They are normal piles, usually with a chain or hook attachment.[*citation needed*]

Piled walls

[edit]



Sheet piling, by a bridge, was used to block a canal in New Orleans after Hurricane Katrina damaged it.

Piled walls can be drivene or bored. They provide special advantages where available working space dictates and open cut excavation not feasible. Both methods offer technically effective and offer a cost efficient temporary or permanent means of retaining the sides of bulk excavations even in water bearing strata. When used in permanent works, these walls can be designed to resist vertical loads in addition lateral load from retaining soil. Construction of both methods is the same as for foundation bearing piles. Contiguous walls are constructed with small gaps between adjacent piles. The spacing of the piles can be varied to provide suitable bending stiffness.

Secant piled walls

[edit]

Secant pile walls are constructed such that space is left between alternate 'female' piles for the subsequent construction of 'male' piles.[*clarification needed*] Construction of 'male' piles involves boring through the concrete in the 'female' piles hole in order to key 'male' piles between. The male pile is the one where steel reinforcement cages are installed, though in some cases the female piles are also reinforced.[*citation needed*]

Secant piled walls can either be true hard/hard, hard/intermediate (firm), or hard/soft, depending on design requirements. Hard refers to structural concrete and firm or soft is usually a weaker grout mix containing bentonite.[*citation needed*] All types of wall can be constructed as free standing cantilevers, or may be propped if space and sub-structure design permit. Where party wall agreements allow, ground anchors can be used as tie backs.

Slurry walls

[edit]

A slurry wall is a barrier built under ground using a mix of bentonite and water to prevent the flow of groundwater. A trench that would collapse due to the hydraulic pressure in the surrounding soil does not collapse as the slurry balances the hydraulic pressure.

Deep mixing/mass stabilization techniques

[edit]

These are essentially variations of *in situ* reinforcements in the form of piles (as mentioned above), blocks or larger volumes.

Cement, lime/quick lime, flyash, sludge and/or other binders (sometimes called stabilizer) are mixed into the soil to increase bearing capacity. The result is not as solid as concrete, but should be seen as an improvement of the bearing capacity of the original soil.

The technique is most often applied on clays or organic soils like peat. The mixing can be carried out by pumping the binder into the soil whilst mixing it with a device normally mounted on an excavator or by excavating the masses, mixing them separately with the binders and refilling them in the desired area. The technique can also be used on lightly contaminated masses as a means of binding contaminants, as opposed to excavating them and transporting to landfill or processing.

Materials

[edit]

Timber

[edit]
Main article: Timber pilings

As the name implies, timber piles are made of wood.

Historically, timber has been a plentiful, locally available resource in many areas. Today, timber piles are still more affordable than concrete or steel. Compared to other types of piles (steel or concrete), and depending on the source/type of timber, timber piles may not be suitable for heavier loads.

A main consideration regarding timber piles is that they should be protected from rotting above groundwater level. Timber will last for a long time below the groundwater level. For timber to rot, two elements are needed: water and oxygen. Below the groundwater level, dissolved oxygen is lacking even though there is ample water. Hence, timber tends to last for a long time below the groundwater level. An example is Venice, which has had timber pilings since its beginning; even most of the oldest piles are still in use. In 1648, the Royal Palace of Amsterdam was constructed on 13,659 timber piles that still survive today since they were below groundwater level. Timber that is to be used above the water table can be protected from decay and insects by numerous forms of wood preservation using pressure treatment (alkaline copper quaternary (ACQ), chromated copper arsenate (CCA), creosote, etc.).

Splicing timber piles is still quite common and is the easiest of all the piling materials to splice. The normal method for splicing is by driving the leader pile first, driving a steel tube (normally 60–100 cm long, with an internal diameter no smaller than the minimum toe diameter) half its length onto the end of the leader pile. The follower pile is then simply slotted into the other end of the tube and driving continues. The steel tube is simply there to ensure that the two pieces follow each other during driving. If uplift capacity is required, the splice can incorporate bolts, coach screws, spikes or the like to give it the necessary capacity.

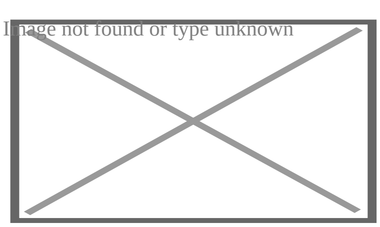
Iron

[edit]

Cast iron may be used for piling. These may be ductile.[*citation needed*]

Steel

[edit]



Cutaway illustration. Deep inclined (battered) pipe piles support a precast segmented skyway where upper soil layers are weak muds.

Pipe piles are a type of steel driven pile foundation and are a good candidate for inclined (battered) piles.

Pipe piles can be driven either open end or closed end. When driven open end, soil is allowed to enter the bottom of the pipe or tube. If an empty pipe is required, a jet of water or an auger can be used to remove the soil inside following driving. Closed end pipe piles are constructed by covering the bottom of the pile with a steel plate or cast steel shoe.

In some cases, pipe piles are filled with concrete to provide additional moment capacity or corrosion resistance. In the United Kingdom, this is generally not done in order to reduce the cost.[*citation needed*] In these cases corrosion protection is provided by allowing for a sacrificial thickness of steel or by adopting a higher grade of steel. If a concrete filled pipe pile is corroded, most of the load carrying capacity of the pile will remain intact due to the concrete, while it will be lost in an empty pipe pile. The structural capacity of pipe piles is primarily calculated based on steel strength and concrete strength (if filled). An allowance is made for corrosion depending on the site conditions and local building codes. Steel pipe piles can either be new steel manufactured specifically for the piling industry or reclaimed steel tubular casing previously used for other purposes such as oil and gas exploration.

H-Piles are structural beams that are driven in the ground for deep foundation application. They can be easily cut off or joined by welding or mechanical drive-fit splicers. If the pile is driven into a soil with low pH value, then there is a risk of corrosion, coal-tar epoxy or cathodic protection can be applied to slow or eliminate the corrosion process. It is common to allow for an amount of corrosion in design by simply over dimensioning the cross-sectional area of the steel pile. In this way, the corrosion process can be prolonged up to 50 years.[*citation needed*]

Prestressed concrete piles

[edit]

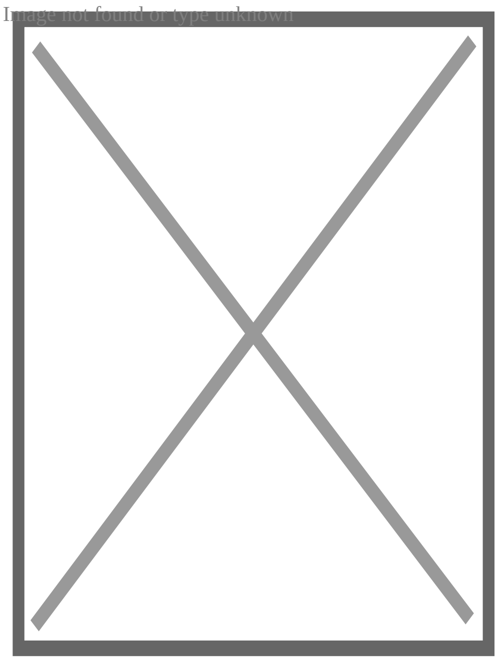
Concrete piles are typically made with steel reinforcing and prestressing tendons to obtain the tensile strength required, to survive handling and driving, and to provide sufficient bending resistance.

Long piles can be difficult to handle and transport. Pile joints can be used to join two or more short piles to form one long pile. Pile joints can be used with both precast and prestressed concrete piles.

Composite piles

[edit]

A "composite pile" is a pile made of steel and concrete members that are fastened together, end to end, to form a single pile. It is a combination of different materials or different shaped materials such as pipe and H-beams or steel and concrete.



'Pile jackets' encasing old concrete piles in a saltwater environment to prevent corrosion and consequential weakening of the piles when cracks allow saltwater to contact the internal steel reinforcement rods

Construction machinery for driving piles into the ground

[edit]

Construction machinery used to drive piles into the ground:[15]

- Pile driver is a device for placing piles in their designed position.
- Diesel pile hammer is a device for hammering piles into the ground.
- Hydraulic hammer is removable working equipment of hydraulic excavators, hydroficated machines (stationary rock breakers, loaders, manipulators, pile driving hammers) used for processing strong materials (rock, soil, metal) or pile driving elements by impact of falling parts dispersed by high-pressure fluid.
- Vibratory pile driver is a machine for driving piles into sandy and clay soils.
- Press-in pile driver is a machine for sinking piles into the ground by means of static force transmission.[16]
- Universal drilling machine.

Construction machinery for replacement piles

[edit]

Construction machinery used to construct replacement piles:[15]

- Sectional Flight Auger or Continuous Flight Auger
- Reverse circulation drilling
- Ring bit concentric drilling

See also

[edit]
- Eurocode EN 1997
- International Society for Micropiles
- Post in ground construction also called earthfast or posthole construction; a historic method of building wooden structures.
- Stilt house, also known as a lake house; an ancient, historic house type built on pilings.
- Shallow foundations
- Pile bridge
- Larssen sheet piling

Notes

[edit]

1. **^** Offshore Wind Turbine Foundations, 2009-09-09, accessed 2010-04-12.
2. ^ ***a*** ***b*** Constructing a turbine foundation Archived 21 May 2011 at the Wayback Machine Horns Rev project, Elsam monopile foundation construction process, accessed 2010-04-12]
3. **^** Horns Revolution Archived 14 July 2011 at the Wayback Machine, Modern Power Systems, 2002-10-05, accessed 2010-04-14.
4. **^** *"Lynn and Inner Dowsing description". Archived from the original on 26 July 2011. Retrieved 23 July 2010.*
5. ^ ***a*** ***b*** Handbook on Under-reamed and bored compaction pile foundation, Central building research institute Roorkee, Prepared by Devendra Sharma, M. P. Jain, Chandra Prakash
6. ^ ***a*** ***b*** *Siel, Barry D.; Anderson, Scott A. "Implementation of Micropiles by the Federal Highway Administration" (PDF). Federal Highway Administration (US).* cite journal: Cite journal requires |journal= (help)
7. **^** *Marshall, Brain (April 2000). "How House Construction Works". How Stuff Works. HowStuffWorks, Inc. Retrieved 4 April 2013.*
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14. **^** *"GeoTechTools". Geo-Institute. Retrieved 15 April 2022.*
15. ^ ***a b*** *McNeil, Ian (1990). An Encyclopaedia of the history of technolology. Routledge. ISBN 9780415147927. Retrieved 20 July 2022 – via Internet Archive.*
16. **^** *"General description of the press-in pile driving unit". Concrete Pumping Melbourne. 13 October 2021. Archived from the original on 25 December 2022. Retrieved 20 July 2022.*

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- Stabilization of Organic Soils Archived 22 February 2012 at the Wayback Machine
- Sheet piling handbook, 2010

External links

[edit]

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- Deep Foundations Institute

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- e

Geotechnical engineering

Offshore geotechnical engineering

Investigation and instrumentation

Field (*in situ*)

- Core drill
- Cone penetration test
- Geo-electrical sounding
- Permeability test
- Load test
  - Static
  - Dynamic
  - Statnamic
- Pore pressure measurement
  - Piezometer
  - Well
- Ram sounding
- Rock control drilling
- Rotary-pressure sounding
- Rotary weight sounding
- Sample series
- Screw plate test
- Deformation monitoring
  - Inclinometer
  - Settlement recordings
- Shear vane test
- Simple sounding
- Standard penetration test
- Total sounding
- Trial pit
- Visible bedrock
- Nuclear densometer test
- Exploration geophysics
- Crosshole sonic logging
- Pile integrity test
- Wave equation analysis

Laboratory testing

- Soil classification
- Atterberg limits
- California bearing ratio
- Direct shear test
- Hydrometer
- Proctor compaction test
- R-value
- Sieve analysis
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- Oedometer test
- Hydraulic conductivity tests
- Water content tests

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  - Permeability
  - Specific storage
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  - Sensitivity

Structures (Interaction)

- Natural features
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  - Vegetation
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  - Topsoil
  - Water table
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  - Shoring structures
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    - Ground freezing
    - Mechanically stabilized earth
    - Pressure grouting
    - Slurry wall
    - Soil nailing
    - Tieback
- Earthworks
  - Land development
  - Landfill
  - Excavation
  - Trench
  - Embankment
  - Cut
  - Causeway
  - Terracing
  - Cut-and-cover
  - Cut and fill
  - Fill dirt
  - Grading
  - Land reclamation
  - Track bed
  - Erosion control
  - Earth structure
  - Expanded clay aggregate
  - Crushed stone
  - Geosynthetics
    - Geotextile
    - Geomembrane
    - Geosynthetic clay liner
    - Cellular confinement
- Foundations
  - Infiltration
  - Shallow
  - Deep

Mechanics

Forces

- Effective stress
- Pore water pressure
- Lateral earth pressure
- Overburden pressure
- Preconsolidation pressure

Phenomena/ problems

- Permafrost
- Frost heaving
- Consolidation
- Compaction
- Earthquake
  - Response spectrum
  - Seismic hazard
  - Shear wave
- Landslide analysis
  - Stability analysis
  - Mitigation
  - Classification
  - Sliding criterion
  - Slab stabilisation
- Bearing capacity * Stress distribution in soil

Numerical analysis software

- SEEP2D
- STABL
- SVFlux
- SVSlope
- UTEXAS
- Plaxis

Related fields

- Geology
- Geochemistry
- Petrology
- Earthquake engineering
- Geomorphology
- Soil science
- Hydrology
- Hydrogeology
- Biogeography
- Earth materials
- Archaeology
- Agricultural science
  - Agrology

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About Soil mechanics

Dirt mechanics is a branch of dirt physics and used auto mechanics that describes the actions of soils. It differs from fluid mechanics and solid mechanics in the sense that soils contain a heterogeneous blend of liquids (generally air and water) and bits (generally clay, silt, sand, and gravel) however dirt may also consist of natural solids and other matter. Along with rock mechanics, dirt auto mechanics offers the theoretical basis for analysis in geotechnical design, a subdiscipline of civil engineering, and engineering geology, a subdiscipline of geology. Dirt mechanics is used to evaluate the contortions of and flow of liquids within all-natural and synthetic structures that are sustained on or constructed from dirt, or frameworks that are buried in dirts. Example applications are building and bridge foundations, maintaining wall surfaces, dams, and buried pipeline systems. Principles of dirt mechanics are additionally used in related disciplines such as geophysical engineering, seaside design, farming design, and hydrology. This article describes the genesis and composition of dirt, the difference in between pore water pressure and inter-granular effective anxiety, capillary activity of fluids in the dirt pore spaces, dirt category, seepage and permeability, time reliant adjustment of quantity because of squeezing water out of little pore spaces, additionally known as debt consolidation, shear strength and stiffness of dirts. The shear toughness of soils is mostly derived from rubbing in between the particles and interlocking, which are really sensitive to the reliable anxiety. The article ends with some instances of applications of the principles of soil auto mechanics such as incline stability, side planet pressure on preserving wall surfaces, and bearing ability of structures.
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About Shallow foundation

Shallow foundation construction example

A **shallow foundation** is a type of building **foundation** that transfers **structural load** to the Earth very near to the surface, rather than to a subsurface layer or a range of depths, as does a **deep foundation**. Customarily, a shallow foundation is considered as such when the width of the entire foundation is greater than its depth.[1] In comparison to deep foundations, shallow foundations are less technical, thus making them more economical and the most widely used for relatively light structures.

Types

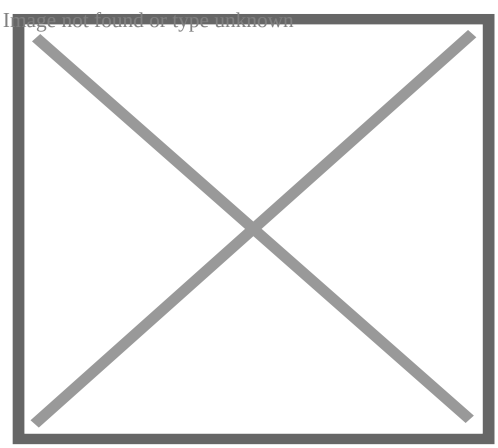
[**edit**]

Footings are always wider than the members that they support. Structural loads from a **column** or wall are usually greater than 1,000 kPa, while the soil's **bearing capacity** is commonly less than that (typically less than 400 kPa). By possessing a larger bearing area, the foundation distributes the pressure to the soil, decreasing the bearing pressure to within allowable values.**[2]** A structure is not limited to one footing. Multiple types of footings may be used in a construction project.

Wall footing

[**edit**]

Also called *strip footing*, a **wall footing** is a continuous strip that supports structural and non-structural load-bearing walls. Found directly under the wall, Its width is commonly 2-3 times wider than the wall above it.**[3]**



Detail Section of a strip footing and its wall.

Isolated footing

[**edit**]

Also called *single-column footing*, an isolated footing is a square, rectangular, or circular slab that supports the structural members individually. Generally, each column is set on an individual footing to transmit and distribute the load of the structure to the soil underneath. Sometimes, an isolated footing can be sloped or stepped at the base to spread greater loads. This type of footing is used when the structural load is relatively low, columns are widely spaced, and the soil's bearing capacity is adequate at a shallow depth.

Combined footing

[**edit**]

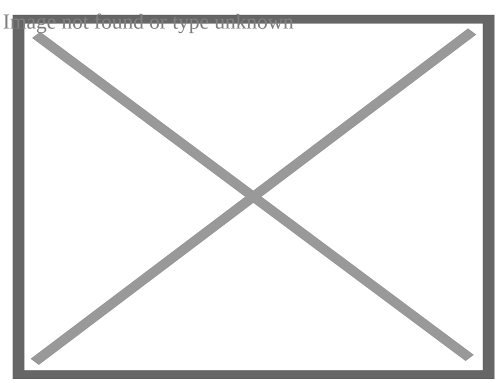
When more than one column shares the same footing, it is called a *combined footing*. A combined footing is typically utilized when the spacing of the columns is too restricted such that if isolated footing were used, they would overlap one another. Also, when property lines make isolated footings eccentrically loaded, combined footings are preferred.

When the load among the columns is equal, the combined footing may be rectangular. Conversely, when the load among the columns is unequal, the combined footing should be **trapezoidal**.

Strap footing

[**edit**]

A **strap footing** connects individual columns with the use of a strap beam. The general purpose of a strap footing is alike to those of a combined footing, where the spacing is possibly limited and/or the columns are adjacent to the property lines.

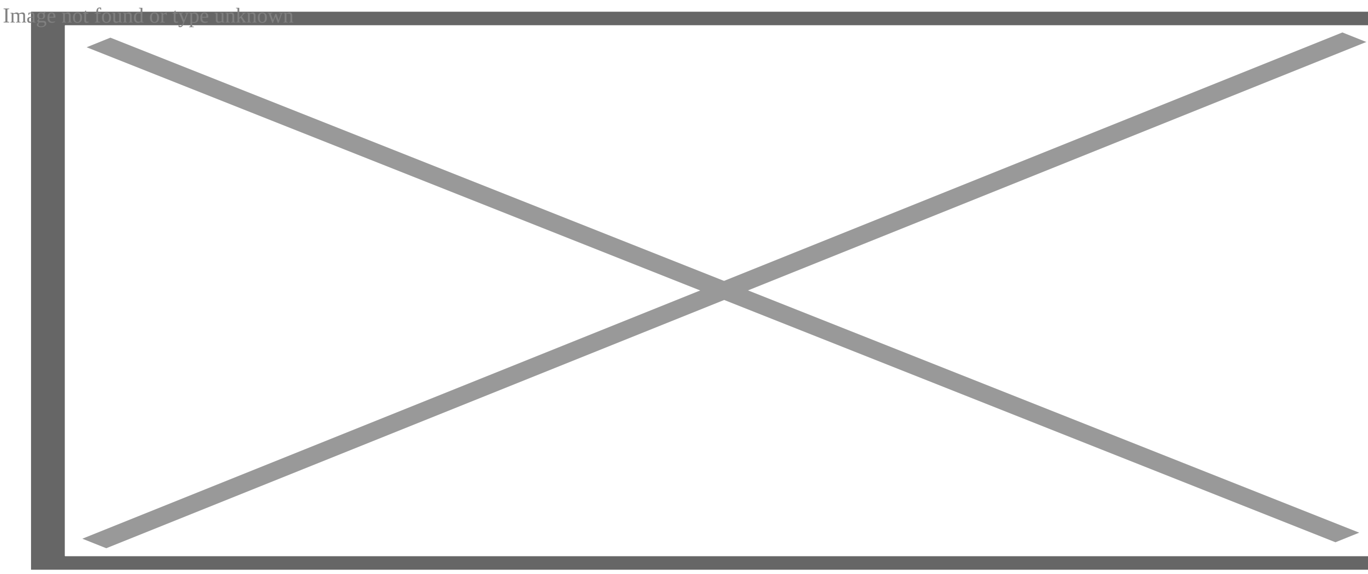


Mat foundation with its concrete undergoing **curing**.

Mat foundation

[**edit**]

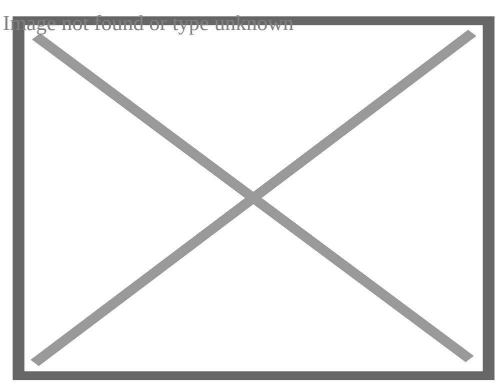
Also called *raft* foundation, a mat foundation is a single continuous slab that covers the entirety of the base of a building. Mat foundations support all the loads of the structure and transmit them to the ground evenly. Soil conditions may prevent other footings from being used. Since this type of foundation distributes the load coming from the building uniformly over a considerably large area, it is favored when individual footings are unfeasible due to the low bearing capacity of the soil.



Diagrams of the types of shallow foundations.

Slab-on-grade foundation

[**edit**]
"Floating foundation" redirects here. For Floating raft system, see **Floating raft system**.



Pouring a slab-on-grade foundation

Slab-on-grade or *floating slab* foundations are a **structural engineering** practice whereby the **reinforced concrete** slab that is to serve as the foundation for the structure is formed from **formwork** set into the ground. The concrete is then poured into the formwork, leaving no space between the ground and the structure. This type of construction is most often seen in warmer climates, where ground freezing and thawing is less of a concern and where there is no need for heat ducting underneath the floor. Frost Protected Shallow

Foundations (or FPSF) which are used in areas of potential frost heave, are a form of slab-on-grade foundation.[4]

Remodeling or extending such a structure may be more difficult. Over the long term, ground settling (or **subsidence**) may be a problem, as a slab foundation cannot be readily jacked up to compensate; proper soil compaction prior to pour can minimize this. The slab can be decoupled from ground temperatures by insulation, with the concrete poured directly over insulation (for example, **extruded polystyrene** foam panels), or heating provisions (such as **hydronic heating**) can be built into the slab.

Slab-on-grade foundations should not be used in areas with **expansive clay** soil. While elevated structural slabs actually perform better on expansive clays, it is generally accepted by the engineering community that slab-on-grade foundations offer the greatest cost-to-performance ratio for **tract homes**. Elevated structural slabs are generally only found on custom homes or homes with basements.

Copper piping, commonly used to carry **natural gas** and **water**, reacts with concrete over a long period, slowly degrading until the pipe fails. This can lead to what is commonly referred to as slab leaks. These occur when pipes begin to leak from within the slab. Signs of a slab leak range from unexplained dampened carpet spots, to drops in water pressure and wet discoloration on exterior foundation walls.[5] Copper pipes must be *lagged* (that is, ***insulated***) or run through a **conduit** or **plumbed** into the building above the slab. Electrical conduits through the slab must be water-tight, as they extend below ground level and can potentially expose wiring to **groundwater**.

See also

[**edit**]

- **Argillipedoturbation**
- **Building construction**
- **Construction engineering**
- **Fiber reinforced concrete**
- **Grade beam**
- **Precast concrete**
- **Prestressed concrete**
- **Rebar**
- **Steel fixer**
- **Tie rod**

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[**edit**]

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2. **^** *Gillesania, Diego Inocencio T. (2004).* ***Fundamentals of reinforced concrete design*** *(2nd ed.). [Cebu, Cirty, Philippines]. p. 259.* ***ISBN 971-8614-26-5****.* ***OCLC 1015901733****.***cite book**: CS1 maint: location missing publisher (**link**)

3. ^ *Mahdi, Sheikh.* ***"8 Most Important Types of Foundation"****. civiltoday.com. Retrieved July 31, 2021.*
4. ^ ***"Slab-on-Grade Foundation Detail & Insulation, Building Guide"****.*
5. ^ ***"Slab Leak Repair McKinney, Frisco, and Allen Tx - Hackler Plumbing"****. Hacklerplumbingmckinney.com. 2013-11-08. Retrieved 2018-08-20.*

External links

[**edit**]

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- **Raft or Mat Foundations**

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Geotechnical engineering

Offshore geotechnical engineering

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Field (*in situ*)

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- Permeability test
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- Pore pressure measurement
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- Sieve analysis
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- Oedometer test
- Hydraulic conductivity tests
- Water content tests

Soil

Types

- **Clay**
- **Silt**
- **Sand**
- **Gravel**
- **Peat**
- **Loam**
- **Loess**

Properties

- **Hydraulic conductivity**
- **Water content**
- **Void ratio**
- **Bulk density**
- **Thixotropy**
- **Reynolds' dilatancy**
- **Angle of repose**
- **Friction angle**
- **Cohesion**
- **Porosity**
- **Permeability**
- **Specific storage**
- **Shear strength**
- **Sensitivity**

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  - Retaining walls
  - Gabion
  - Ground freezing
  - Mechanically stabilized earth
  - Pressure grouting
  - Slurry wall
  - Soil nailing
  - Tieback

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- Excavation
- Trench
- Embankment
- Cut
- Causeway
- Terracing
- Cut-and-cover
- Cut and fill
- Fill dirt
- Grading
- Land reclamation
- Track bed
- Erosion control
- Earth structure
- Expanded clay aggregate
- Crushed stone
- Geosynthetics
  - Geotextile
  - Geomembrane
  - Geosynthetic clay liner
  - Cellular confinement
- Infiltration

Foundations

- Shallow
- Deep

Mechanics	Forces	◦ **Effective stress** ◦ **Pore water pressure** ◦ **Lateral earth pressure** ◦ **Overburden pressure** ◦ **Preconsolidation pressure**

	Phenomena/ problems	◦ **Permafrost**
		◦ **Frost heaving**
		◦ **Consolidation**
		◦ **Compaction**
		◦ **Earthquake**
		    ◦ **Response spectrum**
		    ◦ **Seismic hazard**
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		◦ **Landslide** analysis
		    ◦ **Stability analysis**
		    ◦ **Mitigation**
		    ◦ **Classification**
		    ◦ **Sliding criterion**
		    ◦ **Slab stabilisation**
		◦ **Bearing capacity** * **Stress distribution in soil**

Numerical analysis software	◦ **SEEP2D** ◦ **STABL** ◦ **SVFlux** ◦ **SVSlope** ◦ **UTEXAS** ◦ **Plaxis**	
Related fields	◦ **Geology** ◦ **Geochemistry** ◦ **Petrology** ◦ **Earthquake engineering** ◦ **Geomorphology** ◦ **Soil science** ◦ **Hydrology** ◦ **Hydrogeology** ◦ **Biogeography** ◦ **Earth materials** ◦ **Archaeology** ◦ **Agricultural science** ◦ **Agrology**	

About Cook County

Driving Directions in Cook County

Driving Directions From 42.051159627372, -88.202951526236 to

Driving Directions From 42.092671011935, -88.097873714537 to

Driving Directions From 42.027864686476, -88.178784129852 to

Driving Directions From 42.080861469688, -88.119629346452 to

Driving Directions From 42.092626312283, -88.191267040052 to

Driving Directions From 42.102378896248, -88.203932774646 to

Driving Directions From 42.101413863629, -88.180736768318 to

Driving Directions From 42.098479365503, -88.089470502033 to

Driving Directions From 42.111332166598, -88.176665125485 to

Driving Directions From 42.124515141614, -88.154087492577 to

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