STRUCTURAL ENGINEER

- **Identifying Common Issues and Symptoms of residential foundations**
  Identifying Common Issues and Symptoms of residential foundations Spotting Early Warning Signs of Foundation Stress Recognizing Cracks and Shifts in Concrete Floors Understanding Sticky Doors and Window Alignment Pinpointing Sinking Spots around the Foundation Perimeter Tracking Water Intrusion as a Contributor to Structural Damage How Uneven Floors Reveal Deeper Foundation Concerns Identifying Subtle Changes in Exterior Walls When Hairline Drywall Cracks Indicate Movement Monitoring Seasonal Soil Movement for Foundation Clues Evaluating Soil Erosion and Its Impact on Stability Noting Shifting Porches and Deck Attachments Examining Sloping Floors for Underlying Settlement
- **Soil and Environmental Factors influencing home foundations**
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*** Understanding the Connection Between Soil Moisture and Foundation Problems**

Okay, so you're thinking about foundation problems, right? An aerial view can reveal widespread foundation settlement issues foundation wall repair service radon mitigation. And you're wondering what dirt has to do with it. Well, the simple answer is: everything! Specifically, it's the moisture content of the soil around your foundation that can be a real headache. Think of it this way, your foundation is basically sitting on the ground, and that ground is constantly changing, expanding, and contracting depending on how much water is in it.

When soil gets really wet, like after a heavy rain, it tends to swell. Imagine that swelling pushing against your foundation walls. That's a lot of pressure! Now, imagine the opposite. During a long dry spell, the soil shrinks. That shrinking can leave gaps around your foundation, and the soil can actually pull away, causing the foundation to settle unevenly.

This constant pushing and pulling, swelling and shrinking, can lead to cracks in your foundation, sticking doors and windows, and all sorts of other unpleasant surprises. That's why measuring soil moisture is so important. If you can keep an eye on how much moisture is in the soil around your foundation, you can take steps to keep it relatively stable. Maybe you need to improve drainage to prevent pooling water, or maybe you need to water during dry periods to keep the soil from shrinking too much.

Essentially, understanding the connection between soil moisture and foundation problems is the first step in protecting your home. It's about being proactive and addressing the root cause of potential issues before they become major, expensive repairs. So, grab a soil moisture meter and start paying attention to what's going on beneath your feet – your foundation will thank you for it!

*** The Importance of Soil Moisture Monitoring in Foundation Health**

Okay, so imagine your house is like a really fancy plant. You know, the kind that costs a fortune and you'd be devastated if it died. Well, the soil your house "grows" in, the ground beneath your foundation, is just as crucial as the potting soil for that precious plant. And just like you wouldn't let your plant's soil dry out completely or become waterlogged, you need to keep an eye on the moisture levels around your foundation. That's where soil moisture monitoring comes in, and why it's so darn important for keeping your house healthy and stable.

Think about it. Soil expands and contracts with changes in moisture. Too dry, and it shrinks, potentially leaving gaps under your foundation and causing it to settle unevenly. Too wet, and the soil swells, pushing against your foundation walls and leading to cracks. It's a constant push and pull, and your foundation is caught right in the middle. By regularly measuring the soil moisture around your foundation, you can get a heads-up on potential problems before they become major (and expensive!) headaches.

It's like having a weather forecast for your foundation. You can see if things are trending towards drought conditions, triggering you to water around the foundation to maintain a consistent moisture level. Or, if you've had a ton of rain, you might need to improve drainage to redirect water away from the foundation. Soil moisture monitoring gives you the information you need to proactively manage the environment around your house, helping to stabilize the foundation and prevent costly repairs down the road. It's not just about measuring; it's about understanding and responding to what the soil is telling you about your home's health.

*** Methods for Measuring Soil Moisture Around Residential Foundations**

Okay, so you're worried about your foundation, and specifically, the soil moisture around it. Smart move. That's often the silent culprit behind cracks, shifts, and all sorts of homeowner headaches. The good news is, we can actually *measure* that moisture, and knowing is half the battle. Forget guesswork and hoping for the best. Let's talk about some of the common ways to figure out how wet (or dry) the soil is near your foundation.

First up, you've got the old-school but still reliable *manual methods*. Think of things like soil probes and augers. You basically dig down, grab a sample, and give it the squeeze test. Experienced folks can tell a lot about the moisture content just by feel. Is it crumbly? Sticky? Does water bead up? These are all clues. Of course, it's subjective, and your mileage may vary depending on your soil type and your skill at the squeeze test.

Then, on the slightly more sophisticated side, we have *electrical resistance meters*. These are basically like little probes that you stick into the ground. They measure how easily electricity flows through the soil. Water conducts electricity, so the easier it flows, the wetter the soil. They're relatively inexpensive and easy to use, giving you a quick snapshot. Keep in mind, the readings can be affected by the soil's salinity and temperature, so you're not getting pinpoint accuracy, but they're good for a general sense of things.

Next, we're stepping up to *time-domain reflectometry (TDR)*. TDR uses electromagnetic pulses traveling along probes inserted into the soil. The way the pulses are reflected back tells you about the soil's dielectric permittivity, which is directly related to water content. TDR provides relatively accurate measurements, and it's less sensitive to soil salinity than the resistance meters. However, the equipment is more expensive.

Finally, there are *capacitance sensors*. These measure the soil's ability to store an electrical charge, which also depends on the water content. Like TDR, these are considered more precise than resistance meters. These can be installed and left to constantly monitor moisture levels.

So, which method is best? It really depends on your budget, how much accuracy you need, and how often you want to monitor the moisture. For a quick and dirty check, a manual method or a resistance meter might be fine. If you're trying to fine-tune a watering system or diagnose a serious foundation issue, TDR or capacitance sensors would be a better bet. Ultimately, understanding the soil moisture around your foundation is a great first step in protecting your home.

*** DIY Soil Moisture Measurement Techniques vs. Professional Services**

Okay, so you're worried about your foundation, and someone mentioned soil moisture. Smart move. That stuff can really wreak havoc, especially if it's constantly fluctuating. Now you're thinking about measuring it. Great. But then the question hits: DIY or call in the pros? Let's unpack that, shall we?

On the DIY side, think simple. You can grab a cheap soil moisture meter from a garden center. Easy to use, just stick it in the ground and read the dial. Problem is, those things aren't always super accurate. They give you a general idea, sure, but are you betting your foundation on a "general idea"? Probably not. You could also try the "squeeze test." Grab a handful of soil, squeeze it, and see what happens. Does it crumble? Is it a muddy mess? Again, helpful for a quick assessment, but not exactly scientific. The upside? It's cheap, readily available, and gives you *some* information. Maybe enough to flag a potential problem early on.

Then there's the professional route. These guys use sophisticated equipment. Think tensiometers, which measure soil water tension, or electrical resistance sensors that give you a more precise reading of moisture content at different depths. They can create a moisture profile of your soil, understand how it's changing over time, and pinpoint areas that are particularly problematic. They'll also understand the geology of your area, the drainage patterns, and how your landscaping might be affecting things. Basically, they're bringing a whole lot of expertise to the table. The downside? It costs money. Potentially a significant amount.

So, where does that leave you? Well, it depends. Are you just trying to keep an eye on things and catch small changes? A DIY approach might be a good starting point. It's like taking your own temperature – you might notice something's off before it becomes a full-blown fever. But if you're seeing cracks in your walls, doors sticking, or other signs of foundation distress, it's time to call in the professionals. Think of it like going to a doctor when you're really sick. They have the tools and knowledge to diagnose the problem accurately and recommend the right treatment.

Ultimately, measuring soil moisture is about informed decision-making. DIY can be a useful tool, but when it comes to your foundation, sometimes the peace of mind and accuracy that a professional provides is worth the investment.

*** Interpreting Soil Moisture Readings to Identify Potential Foundation Risks**

Okay, so you've got yourself a soil moisture meter, maybe even a few. Good on you for being proactive about your foundation! Measuring soil moisture is only half the battle, though. You need to understand what those readings are actually *telling* you about the potential risks to your foundation. It's not just about "wet" or "dry," it's about the *patterns* and the *variations* around your property.

Think of it like this: a consistently damp soil might seem fine, but if one corner of your house is noticeably drier than the others, that differential shrinking could be pulling on your foundation. Conversely, consistently dry soil can also be bad news, especially in clay-rich areas. Clay expands when wet and contracts when dry, and extreme dryness can lead to significant soil shrinkage and, you guessed it, foundation settlement.

Pay attention to the readings after rainfall, too. Does water pool near your foundation? Does one side of your house drain better than the other? These observations, combined with your moisture readings, can highlight areas that are particularly vulnerable. For example, if you consistently see high moisture levels on the downhill side of your house, you might want to investigate your drainage system or consider adding a French drain.

And don't forget the seasons! Soil moisture levels naturally fluctuate throughout the year. Tracking these changes over time will give you a baseline understanding of what's "normal" for your property. This helps you identify anomalies – sudden spikes or drops in moisture – that could indicate a problem, like a leaky pipe or a developing drought.

Ultimately, interpreting soil moisture readings is about building a narrative of what's happening beneath your feet. It's about understanding the relationship between the soil, the water, and your foundation. It's not a perfect science, but it's a valuable tool for identifying potential problems early on and taking steps to protect your home. So, keep measuring, keep observing, and keep learning! Your foundation will thank you for it.

*** Implementing Soil Moisture Management Strategies for Foundation Stabilization**

Okay, let's talk soil moisture and how it messes with our house foundations, and more importantly, what we can *do* about it. Think of your foundation like a really, really stubborn toddler. It doesn't like surprises. And drastic changes in soil moisture? That's a *major* surprise.

See, soil expands and contracts as it gets wet and dries out. Clay soil, especially, is a drama queen when it comes to this. When it's soaked, it swells, pushing against the foundation. When it's bone dry, it shrinks, leaving gaps and causing the foundation to settle unevenly. This push and pull can lead to cracks, sticking doors, and all sorts of expensive headaches.

So, how do we keep our foundations happy? We manage the soil moisture. Think of it as giving the toddler consistent naps and snacks. One key is consistent watering, especially during dry spells. A soaker hose around the perimeter of your foundation, set on a timer, can work wonders. It keeps the soil moisture relatively stable, preventing those drastic swings that cause the most damage.

Proper drainage is also crucial. Make sure your gutters are clear and that rainwater is directed *away* from the foundation. A slight slope away from the house is your friend. Think about landscaping too. Trees, especially thirsty ones planted close to the foundation, can suck up all the moisture and create a desert-like environment beneath your slab.

And of course, understanding the soil around your foundation is HUGE. Is it mostly clay? Is it well-draining? Knowing this helps you tailor your watering and drainage strategies. Regular inspections are important too. Look for signs of foundation movement – cracks, uneven floors, doors that stick. Catching these early allows you to address moisture issues before they become major problems.

Ultimately, managing soil moisture is about creating a stable environment for your foundation. It's about preventing the soil from becoming a destructive force. It's an ongoing process, and it's worth the effort to protect your biggest investment. Think of it not just as fixing a problem, but as proactively maintaining the health and stability of your home.

*** How Professional Foundation Repair Services Utilize Soil Moisture Data**

Foundation problems? That's a homeowner's worst nightmare, right up there with leaky roofs and surprise termite infestations. But think about it: what's often the root cause (pun intended!) of a shifting, cracking foundation? More often than not, it's the soil beneath your house. And what controls soil behavior more than anything else? You guessed it: moisture.

See, soil isn't just dirt. It expands when it gets wet and contracts when it dries out. This constant swelling and shrinking puts immense pressure on your foundation, like a slow-motion tug-of-war. Over time, this can lead to cracks, settling, and all sorts of structural headaches.

That's where professional foundation repair folks come in, and the smart ones aren't just guessing. They're using soil moisture data to understand exactly what's happening beneath your home. Think of it like this: a doctor wouldn't prescribe medicine without running tests first, right? Similarly, a good foundation repair company won't just throw piers into the ground without understanding the moisture profile of the soil.

They use specialized tools – soil moisture sensors, basically – to get a reading of the water content at different depths around your foundation. This data helps them pinpoint areas of extreme dryness or excessive moisture. Maybe there's a leaky pipe causing one side of your house to be constantly waterlogged, or perhaps poor drainage is causing rainwater to pool around your foundation.

Armed with this knowledge, they can develop a targeted and effective repair strategy. Instead of a one-size-fits-all approach, they can address the specific moisture-related issues causing the problem. This might involve improving drainage, installing a root barrier to prevent trees from sucking moisture out of the soil, or even using moisture control systems to maintain a more consistent soil moisture level.

In short, soil moisture data is like a secret weapon in the fight against foundation problems. It allows professional repair services to diagnose the problem accurately, develop a tailored solution, and ultimately, keep your home standing strong for years to come. It's not just about fixing the cracks; it's about understanding and controlling the forces that caused them in the first place.

*** The Long-Term Benefits of Proactive Soil Moisture Monitoring and Foundation Maintenance**

Okay, let's talk about keeping our houses standing tall, and how dirt, surprisingly, plays a big role. We're diving into why checking soil moisture and taking care of our foundations is a smart, long-term investment. Think of it like this: your house is a plant, and the foundation is its roots. If the soil around those roots is constantly drying out or getting waterlogged, the whole thing's gonna suffer.

Ignoring soil moisture around your foundation is like ignoring a leaky faucet – it seems small at first, but it can lead to big, expensive problems down the road. We're talking about cracks in walls, doors that stick, and even sinking foundations. Nobody wants that!

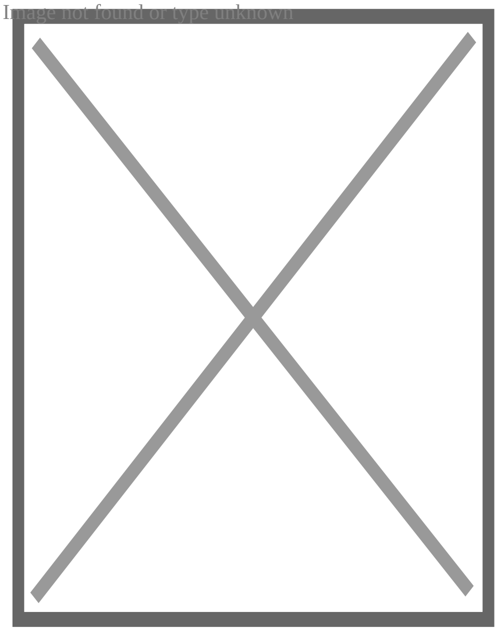
Proactive soil moisture monitoring, simply put, is paying attention to how wet or dry the soil is around your house. There are fancy gadgets you can use, sure, but even just sticking a screwdriver in the ground and seeing how easily it goes in can give you a clue. If the soil is consistently bone-dry, you might need to water it strategically, especially during droughts. And if it's always soggy, you might have drainage issues to address.

Then comes foundation maintenance. This isn't just about waiting for cracks to appear and then patching them. It's about preventing those cracks in the first place. Think of it as preventative medicine for your house. Proper grading to direct water away from the foundation, cleaning gutters so they don't overflow and saturate the soil, and even planting the right kind of vegetation (ones that don't suck up too much water or have aggressive root systems) can all make a huge difference.

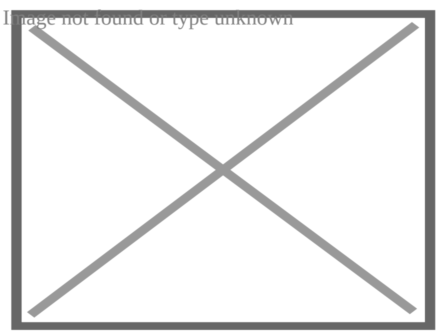
The benefits of doing all this are pretty clear. First, you're protecting your biggest investment – your home. Preventing foundation problems saves you a ton of money in the long run compared to fixing major structural damage. Second, a stable foundation means a more comfortable and safer home for you and your family. No more worrying about doors jamming or cracks appearing. Third, it increases your property value. A well-maintained home with a solid foundation is always going to be more appealing to potential buyers.

So, while checking soil moisture might not be the most glamorous weekend activity, it's a small effort that can pay off big time in the long run. It's about being proactive, understanding the relationship between your house and the ground it sits on, and taking steps to protect your home for years to come. Think of it as a little love for your foundation, and it will love you back.

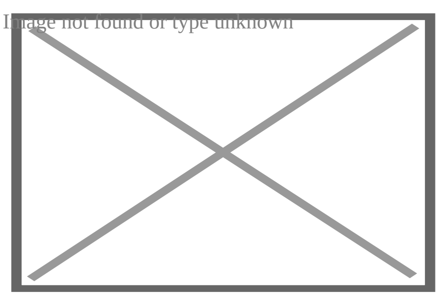
About geotechnical engineering



Boston's Big Dig presented geotechnical challenges in an urban environment.



Precast concrete retaining wall



A typical cross-section of a slope used in two-dimensional analyzes.

Geotechnical engineering, also known as **geotechnics**, is the branch of civil engineering concerned with the engineering behavior of earth materials. It uses the principles of soil mechanics and rock mechanics to solve its engineering problems. It also relies on knowledge of geology, hydrology, geophysics, and other related sciences.

Geotechnical engineering has applications in military engineering, mining engineering, petroleum engineering, coastal engineering, and offshore construction. The fields of geotechnical engineering and engineering geology have overlapping knowledge areas.

However, while geotechnical engineering is a specialty of civil engineering, engineering geology is a specialty of geology.

History

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Humans have historically used soil as a material for flood control, irrigation purposes, burial sites, building foundations, and construction materials for buildings. Dykes, dams, and canals dating back to at least 2000 BCE—found in parts of ancient Egypt, ancient Mesopotamia, the Fertile Crescent, and the early settlements of Mohenjo Daro and Harappa in the Indus valley—provide evidence for early activities linked to irrigation and flood control. As cities expanded, structures were erected and supported by formalized foundations. The ancient Greeks notably constructed pad footings and strip-and-raft foundations. Until the 18th century, however, no theoretical basis for soil design had been developed, and the discipline was more of an art than a science, relying on experience.[1]

Several foundation-related engineering problems, such as the Leaning Tower of Pisa, prompted scientists to begin taking a more scientific-based approach to examining the subsurface. The earliest advances occurred in the development of earth pressure theories for the construction of retaining walls. Henri Gautier, a French royal engineer, recognized the "natural slope" of different soils in 1717, an idea later known as the soil's angle of repose. Around the same time, a rudimentary soil classification system was also developed based on a material's unit weight, which is no longer considered a good indication of soil type.[1][2]

The application of the principles of mechanics to soils was documented as early as 1773 when Charles Coulomb, a physicist and engineer, developed improved methods to determine the earth pressures against military ramparts. Coulomb observed that, at failure, a distinct slip plane would form behind a sliding retaining wall and suggested that the maximum shear stress on the slip plane, for design purposes, was the sum of the soil cohesion, c, and friction $\sigma\tan(\phi)$, where σ is the normal stress on the slip plane and ϕ is the friction angle of the soil. By combining Coulomb's theory with Christian Otto Mohr's 2D stress state, the theory became known as Mohr-Coulomb theory. Although it is now recognized that precise determination of cohesion is impossible because c is not a fundamental soil property, the Mohr-Coulomb theory is still used in practice today.[3]

In the 19th century, Henry Darcy developed what is now known as Darcy's Law, describing the flow of fluids in a porous media. Joseph Boussinesq, a mathematician and physicist, developed theories of stress distribution in elastic solids that proved useful for estimating stresses at depth in the ground. William Rankine, an engineer and physicist, developed an alternative to Coulomb's earth pressure theory. Albert Atterberg developed the clay consistency indices that are still used today for soil classification.[1][2] In 1885, Osborne Reynolds recognized that shearing causes volumetric dilation of dense materials and contraction of loose granular materials.

Modern geotechnical engineering is said to have begun in 1925 with the publication of *Erdbaumechanik* by Karl von Terzaghi, a mechanical engineer and geologist. Considered by many to be the father of modern soil mechanics and geotechnical engineering, Terzaghi developed the principle of effective stress, and demonstrated that the shear strength of soil is controlled by effective stress.[4] Terzaghi also developed the framework for theories of bearing capacity of foundations, and the theory for prediction of the rate of settlement of clay layers due to consolidation.[1][3][5] Afterwards, Maurice Biot fully developed the three-dimensional soil consolidation theory, extending the one-dimensional model previously developed by Terzaghi to more general hypotheses and introducing the set of basic equations of Poroelasticity.

In his 1948 book, Donald Taylor recognized that the interlocking and dilation of densely packed particles contributed to the peak strength of the soil. Roscoe, Schofield, and Wroth, with the publication of *On the Yielding of Soils* in 1958, established the interrelationships between the volume change behavior (dilation, contraction, and consolidation) and shearing behavior with the theory of plasticity using critical state soil mechanics. Critical state soil mechanics is the basis for many contemporary advanced constitutive models describing the behavior of soil.[6]

In 1960, Alec Skempton carried out an extensive review of the available formulations and experimental data in the literature about the effective stress validity in soil, concrete, and rock in order to reject some of these expressions, as well as clarify what expressions were appropriate according to several working hypotheses, such as stress-strain or strength behavior, saturated or non-saturated media, and rock, concrete or soil behavior.

Roles

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Geotechnical investigation

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Main article: Geotechnical investigation

Geotechnical engineers investigate and determine the properties of subsurface conditions and materials. They also design corresponding earthworks and retaining structures, tunnels, and structure foundations, and may supervise and evaluate sites, which may further involve site monitoring as well as the risk assessment and mitigation of natural hazards.[7][8]

Geotechnical engineers and engineering geologists perform geotechnical investigations to obtain information on the physical properties of soil and rock underlying and adjacent to a site to design earthworks and foundations for proposed structures and for the repair of distress to earthworks and structures caused by subsurface conditions. Geotechnical investigations involve surface and subsurface exploration of a site, often including subsurface sampling and laboratory testing of retrieved soil samples. Sometimes, geophysical methods are also used to obtain data, which include measurement of seismic waves (pressure, shear, and Rayleigh waves), surface-wave methods and downhole methods, and electromagnetic surveys (magnetometer, resistivity, and ground-penetrating radar). Electrical tomography can be used to survey soil and rock properties and existing underground infrastructure in construction projects.[9]

Surface exploration can include on-foot surveys, geologic mapping, geophysical methods, and photogrammetry. Geologic mapping and interpretation of geomorphology are typically completed in consultation with a geologist or engineering geologist. Subsurface exploration usually involves in-situ testing (for example, the standard penetration test and cone penetration test). The digging of test pits and trenching (particularly for locating faults and slide planes) may also be used to learn about soil conditions at depth. Large-diameter borings are rarely used due to safety concerns and expense. Still, they are sometimes used to allow a geologist or engineer to be lowered into the borehole for direct visual and manual examination of the soil and rock stratigraphy.

Various soil samplers exist to meet the needs of different engineering projects. The standard penetration test, which uses a thick-walled split spoon sampler, is the most common way to collect disturbed samples. Piston samplers, employing a thin-walled tube, are most commonly used to collect less disturbed samples. More advanced methods, such as the Sherbrooke block sampler, are superior but expensive. Coring frozen ground provides high-quality undisturbed samples from ground conditions, such as fill, sand, moraine, and rock fracture zones.[10]

Geotechnical centrifuge modeling is another method of testing physical-scale models of geotechnical problems. The use of a centrifuge enhances the similarity of the scale model tests involving soil because soil's strength and stiffness are susceptible to the confining pressure. The centrifugal acceleration allows a researcher to obtain large (prototype-scale) stresses in small physical models.

Foundation design

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Main article: Foundation (engineering)

The foundation of a structure's infrastructure transmits loads from the structure to the earth. Geotechnical engineers design foundations based on the load characteristics of the structure and the properties of the soils and bedrock at the site. Generally, geotechnical engineers first estimate the magnitude and location of loads to be supported before developing an investigation plan to explore the subsurface and determine the necessary soil parameters through field and lab testing. Following this, they may begin the design of an engineering foundation. The primary considerations for a geotechnical engineer in foundation design are bearing capacity, settlement, and ground movement beneath the foundations.[11]

Earthworks

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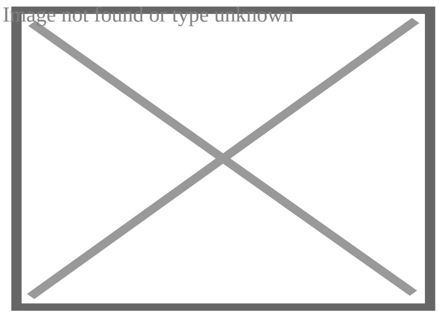

A compactor/roller operated by U.S. Navy Seabees

See also: Earthworks (engineering)

Geotechnical engineers are also involved in the planning and execution of earthworks, which include ground improvement,[11] slope stabilization, and slope stability analysis.

Ground improvement

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Various geotechnical engineering methods can be used for ground improvement, including reinforcement geosynthetics such as geocells and geogrids, which disperse loads over a larger area, increasing the soil's load-bearing capacity. Through these methods, geotechnical engineers can reduce direct and long-term costs.[12]

Slope stabilization

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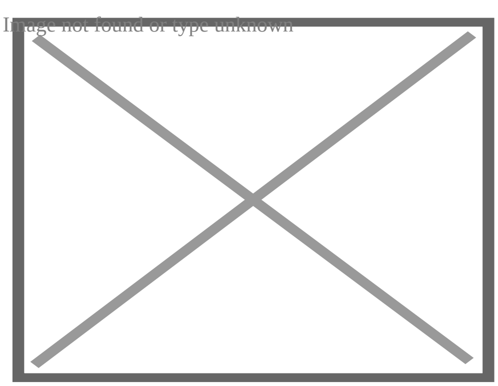

Simple slope slip section.

Main article: Slope stability

Geotechnical engineers can analyze and improve slope stability using engineering methods. Slope stability is determined by the balance of shear stress and shear strength. A previously stable slope may be initially affected by various factors, making it unstable. Nonetheless, geotechnical engineers can design and implement engineered slopes to increase stability.

Slope stability analysis

[edit]
Main article: Slope stability analysis

Stability analysis is needed to design engineered slopes and estimate the risk of slope failure in natural or designed slopes by determining the conditions under which the topmost mass of soil will slip relative to the base of soil and lead to slope failure.[13] If the interface between the mass and the base of a slope has a complex geometry, slope stability analysis is difficult and numerical solution methods are required. Typically, the interface's exact geometry is unknown, and a simplified interface geometry is assumed. Finite slopes require three-dimensional models to be analyzed, so most slopes are analyzed assuming that they are infinitely wide and can be represented by two-dimensional models.

Sub-disciplines

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Geosynthetics

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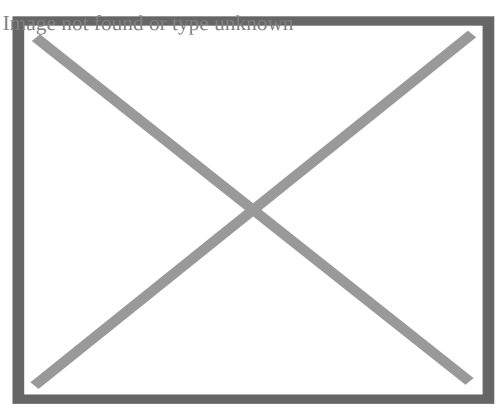
Main article: Geosynthetics



A collage of geosynthetic products.

Geosynthetics are a type of plastic polymer products used in geotechnical engineering that improve engineering performance while reducing costs. This includes geotextiles, geogrids, geomembranes, geocells, and geocomposites. The synthetic nature of the products make them suitable for use in the ground where high levels of durability are required. Their main functions include drainage, filtration, reinforcement, separation, and containment.

Geosynthetics are available in a wide range of forms and materials, each to suit a slightly different end-use, although they are frequently used together. Some reinforcement geosynthetics, such as geogrids and more recently, cellular confinement systems, have shown to improve bearing capacity, modulus factors and soil stiffness and strength.[14] These products have a wide range of applications and are currently used in many civil and geotechnical engineering applications including roads, airfields, railroads, embankments, piled embankments, retaining structures, reservoirs, canals, dams, landfills, bank protection and coastal engineering.[15]

Offshore

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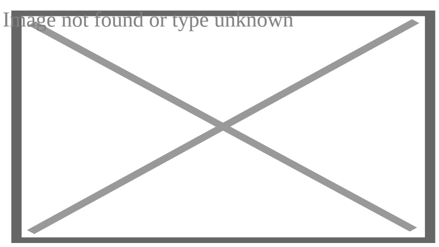
Main article: Offshore geotechnical engineering



Platforms offshore Mexico.

Offshore (or *marine*) *geotechnical engineering* is concerned with foundation design for human-made structures in the sea, away from the coastline (in opposition to *onshore* or *nearshore* engineering). Oil platforms, artificial islands and submarine pipelines are examples of such structures.[16]

There are a number of significant differences between onshore and offshore geotechnical engineering.[16][17] Notably, site investigation and ground improvement on the seabed are more expensive; the offshore structures are exposed to a wider range of geohazards; and the environmental and financial consequences are higher in case of failure. Offshore structures are exposed to various environmental loads, notably wind, waves and currents. These phenomena may affect the integrity or the serviceability of the structure and its foundation during its operational lifespan and need to be taken into account in offshore design.

In subsea geotechnical engineering, seabed materials are considered a two-phase material composed of rock or mineral particles and water.[18][19] Structures may be fixed in place in the seabed—as is the case for piers, jetties and fixed-bottom wind turbines—or may comprise a floating structure that remains roughly fixed relative to its geotechnical anchor point. Undersea mooring of human-engineered floating structures include a large number of offshore oil and gas platforms and, since 2008, a few floating wind turbines. Two common types of engineered design for anchoring floating structures include tension-leg and catenary loose mooring systems.[20]

Observational method

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First proposed by Karl Terzaghi and later discussed in a paper by Ralph B. Peck, the observational method is a managed process of construction control, monitoring, and review, which enables modifications to be incorporated during and after construction. The method aims to achieve a greater overall economy without compromising safety by creating designs based on the most probable conditions rather than the most unfavorable.[21] Using the observational method, gaps in available information are filled by measurements and investigation, which aid in assessing the behavior of the structure during construction, which in turn can be modified per the findings. The method was described by Peck as "learn-as-you-go".[22]

The observational method may be described as follows:[22]

1. General exploration sufficient to establish the rough nature, pattern, and properties of deposits.
2. Assessment of the most probable conditions and the most unfavorable conceivable deviations.
3. Creating the design based on a working hypothesis of behavior anticipated under the most probable conditions.
4. Selection of quantities to be observed as construction proceeds and calculating their anticipated values based on the working hypothesis under the most unfavorable conditions.
5. Selection, in advance, of a course of action or design modification for every foreseeable significant deviation of the observational findings from those predicted.
6. Measurement of quantities and evaluation of actual conditions.
7. Design modification per actual conditions

The observational method is suitable for construction that has already begun when an unexpected development occurs or when a failure or accident looms or has already happened. It is unsuitable for projects whose design cannot be altered during construction.[22]

See also

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- Civil engineering
- Deep Foundations Institute
- Earthquake engineering
- Earth structure
- Effective stress
- Engineering geology
- Geological Engineering
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- Hydrogeology
- International Society for Soil Mechanics and Geotechnical Engineering
- Karl von Terzaghi
- Land reclamation
- Landfill
- Mechanically stabilized earth
- Offshore geotechnical engineering
- Rock mass classifications
- Sediment control
- Seismology
- Soil mechanics
- Soil physics
- Soil science

Notes

[edit]

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External links

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  Engineering

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Specialties and interdisciplinarity

Civil

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Engineering education	○ Bachelor of Engineering ○ Bachelor of Science ○ Master's degree ○ Doctorate ○ Graduate certificate ○ Engineer's degree ○ Licensed engineer
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Soil science

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Main fields

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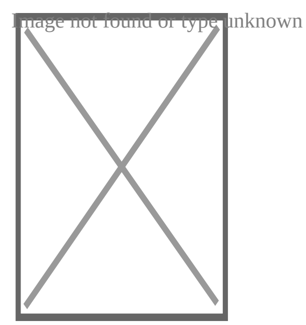

Soil topics

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Scientific journals

- *Acta Agriculturae Scandinavica B*
- *Journal of Soil and Water Conservation*
- *Plant and Soil*
- *Pochvovedenie*
- *Soil Research*
- *Soil Science Society of America Journal*

See also

- Land use
- Land conversion
- Land management
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- Groundwater
- Crust (geology)
- Impervious surface/Surface runoff
- Petrichor

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Geotechnical engineering

Offshore geotechnical engineering

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  - STABL
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Related fields

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Trades workers (List)	○ Banksman ○ Boilermaker ○ Bricklayer ○ Carpenter ○ Concrete finisher ○ Construction foreman ○ Construction worker ○ Electrician ○ Glazier ○ Ironworker ○ Millwright ○ Plasterer ○ Plumber ○ Roofer ○ Steel fixer ○ Welder

Organizations	◦ American Institute of Constructors (AIC) ◦ American Society of Civil Engineers (ASCE) ◦ Asbestos Testing and Consultancy Association (ATAC) ◦ Associated General Contractors of America (AGC) ◦ Association of Plumbing and Heating Contractors (APHC) ◦ Build UK ◦ Construction History Society ◦ Chartered Institution of Civil Engineering Surveyors (CICES) ◦ Chartered Institute of Plumbing and Heating Engineering (CIPHE) ◦ Civil Engineering Contractors Association (CECA) ◦ The Concrete Society ◦ Construction Management Association of America (CMAA) ◦ Construction Specifications Institute (CSI) ◦ FIDIC ◦ Home Builders Federation (HBF) ◦ Lighting Association ◦ National Association of Home Builders (NAHB) ◦ National Association of Women in Construction (NAWIC) ◦ National Fire Protection Association (NFPA) ◦ National Kitchen & Bath Association (NKBA) ◦ National Railroad Construction and Maintenance Association (NRC) ◦ National Tile Contractors Association (NTCA) ◦ Railway Tie Association (RTA) ◦ Royal Institution of Chartered Surveyors (RICS) ◦ Scottish Building Federation (SBF) ◦ Society of Construction Arbitrators
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About basement waterproofing

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Basement waterproofing involves techniques and materials used to prevent water from penetrating the basement of a house or a building. Waterproofing a basement that is below ground level can require the application of sealant materials, the installation of drains and sump pumps, and more.

Purpose

[edit]

Waterproofing is usually required by building codes for structures that are built at or below ground level. Waterproofing and drainage considerations are especially important in cases where ground water is likely to build up in the soil or where there is a high water table.

Water in the soil causes hydrostatic pressure to be exerted underneath basement floors and walls. This hydrostatic pressure can force water in through cracks, which can cause major structural damage as well as mold, decay, and other moisture-related problems.

Methods

[edit]

Several measures exist to prevent water from penetrating a basement foundation or to divert water that has penetrated a foundation:

French Drain

-

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French drain

Interior wall and floor sealers

- Interior water drainage
- Exterior drainage
- Exterior waterproofing coatings
- Box type waterproofing[1]
- Foundation crack injections
- French drains
- Sump pump

Interior sealants

[edit]

In poured concrete foundations, cracks and pipe penetrations are the most common entry points for seepage. These openings can be sealed from the interior. Epoxies, which are strong adhesives, or urethanes can be pressure injected into the openings, thus penetrating the foundation through to the exterior and cutting off the path of the seepage.

In masonry foundations, interior sealers will not provide permanent protection from water infiltration where hydrostatic pressure is present. However, interior sealers are good for preventing high atmospheric humidity inside the basement from absorbing into the porous masonry and causing spalling. Spalling is a condition where constant high humidity or moisture breaks down masonry surfaces, causing deterioration and shedding of the concrete surfaces.

Other coatings can be effective where condensation is the main source of wetness. It is also effective if the problem has minor dampness. Usually, interior waterproofing will not stop major leaks.

Interior water drainage

[edit]

Although interior water drainage is not technically waterproofing, it is a widely accepted technique in mitigating basement water and is generally referred to as a basement waterproofing solution. Many interior drainage systems are patented and recognized by Building Officials and Code Administrators(BOCA) as being effective in controlling basement water.

A common system for draining water that has penetrated a basement involves creating a channel around the perimeter of the basement alongside the foundation footers. A French drain, PVC pipe, or other drainage system is installed in the newly made channel. The installed drain is covered with new cement.

The drainage system collects any water entering the basement and drains it to an internally placed sump pump system, which will then pump the water out of the basement. The Federal Emergency Management Agency (FEMA) recommends basement waterproofing with a water alarm and "battery-operated backup pump" as a preventive measure against the high cost of flooding.[2] Wall conduits (such as dimple boards or other membranes) are fastened to the foundation wall and extend over the new drainage to guide any moisture down into the system.

Exterior waterproofing

[edit]

Waterproofing a structure from the exterior is the only method the U.S. International Building Code (IBC) recognizes as adequate to prevent structural damage caused by water intrusion.

Waterproofing an existing basement begins with excavating to the bottom sides of the footings. Once excavated, the walls are then power washed and allowed to dry. The dry walls are sealed with a waterproofing membrane,[3] and new drainage tiles (weeping tiles) are placed at the side of the footing.

A French drain, PVC pipe, or other drainage system is installed and water is led further from the basement.

Polymer

[edit]

Over the past ten years, polymer-based waterproofing products have been developed. Polymer-based products last for the lifetime of the building and are not affected by soil pH. Polymer-based waterproofing materials can be sprayed directly onto a wall, are very fast curing, and are semi-flexible, allowing for some movement of the substrate.

Causes of water seepage and leaks

[edit]

Water seepage in basement and crawl spaces usually occurs over long periods of time and can be caused by numerous factors.

- Concrete is one of the most commonly used materials in home construction. When pockets of air are not removed during construction, or the mixture is not allowed to cure properly, the concrete can crack, which allows water to force its way through the wall.
- Foundations (footings) are horizontal pads that define the perimeter of foundation walls. When footings are too narrow or are not laid deep enough, they are susceptible to movement caused by soil erosion.
- Gutters and downspouts are used to catch rain water as it falls and to discharge it away from houses and buildings. When gutters are clogged or downspouts are broken, rainwater is absorbed by the soil near the foundation, increasing hydrostatic pressure.
- Weeping tile is a porous plastic drain pipe installed around the perimeter of the house. The main purpose of external weeping tile is preventing water from getting into a basement. However, these pipes can become clogged or damaged, which causes excess water to put pressure on internal walls and basement floors.
- Water build up inside window wells, after heavy rain or snow, can lead to leaks through basement window seams. Window well covers can be used to prevent water from accumulating in the window well.
- Ground saturation is another common form of basement leaks. When the footing drain fails the ground around the basement can contain too much water and when the saturation point is met flooding can occur.

Warning signs of water damage

[edit]

Signs that water is seeping into a basement or crawlspace often take years to develop and may not be easily visible. Over time, multiple signs of damage may become evident and could lead to structural failure.

- Cracked walls: Cracks may be horizontal, vertical, diagonal or stair-stepped. Severe pressure or structural damage is evident by widening cracks.
- Buckling walls: Usually caused by hydrostatic pressure. Walls appear to be bowed inward.
- Peeling paint: Water seeping through walls may lead to bubbling or peeling paint along basement walls.[4]
- Efflorescence: White, powdery residue found on basement walls near the floor.
- Mold: Fungi that usually grow in damp, dark areas and can cause respiratory problems after prolonged exposure.

Foundation crack injections

[edit]

Foundation crack injections are used when poured concrete foundations crack, either from settlement or the expansion and contraction of the concrete. Epoxy crack injections are typically used for structural purposes while hydrophobic or hydrophilic polyurethane injections are used to seal cracks to prevent penetration of moisture or water. Concrete is both strong and inexpensive, making it an ideal product in construction. However, concrete is not waterproof.

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[edit]

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About foundation

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Look up ***foundation*** or ***foundations*** in Wiktionary, the free dictionary.

Foundation(**s**) or **The Foundation**(**s**) may refer to:

Common uses

[edit]

- Foundation (cosmetics), a skin-coloured makeup cream applied to the face
- Foundation (engineering), the element of a structure which connects it to the ground, and transfers loads from the structure to the ground
- Foundation (evidence), a legal term
- Foundation (nonprofit), a type of charitable organization

    - Foundation (United States law), a type of charitable organization in the U.S.
    - Private foundation, a charitable organization that might not qualify as a public charity by government standards

Arts, entertainment, and media

[edit]

Film and TV

[edit]

- *The Foundation*, a film about 1960s-1970s Aboriginal history in Sydney, featuring Gary Foley
- *The Foundation* (1984 TV series), a Hong Kong series
- *The Foundation* (Canadian TV series), a 2009–2010 Canadian sitcom
- "The Foundation" (*Seinfeld*), an episode
- *Foundation* (TV series), an Apple TV+ series adapted from Isaac Asimov's novels

Games

[edit]

- *Foundation* (video game), a city-building game (2025)
- *Foundation*, an Amiga video game
- The Foundation, a character in 2017 game *Fortnite Battle Royale*

Literature

[edit]

- Foundation (book series), a series of science fiction books by Isaac Asimov
    - *Foundation* (Asimov novel), the first book in Asimov's series, published in 1951
- *Foundation* (b-boy book), by Joseph G. Schloss
- *Foundation* (Lackey novel), a 2008 fantasy novel by Mercedes Lackey

Music

[edit]

- The Foundations, a British soul group
- Foundations (EP), by Serj Tankian

Albums

[edit]

- *Foundation* (Brand Nubian album)
- *Foundation* (Breakage album)
- *Foundation* (Doc Watson album)
- *Foundation* (Magnum album)
- *Foundation* (M.O.P. album)
- *Foundation*, a 1997 compilation album by Die Krupps
- *The Foundation* (Geto Boys album)
- *The Foundation* (Pep Love album), 2005
- *The Foundation* (Zac Brown Band album)
- *The Foundations* (album), by 4 Corners

Songs

[edit]

- "Foundation", a 1983 song by Spandau Ballet from the album *True*
- "Foundation", a 1998 song by Brand Nubian from the eponymous album *Foundation*
- "Foundation", a 2009 song by M.O.P. from the eponymous album *Foundation*
- "Foundation", a 2010 song by Breakage from the eponymous album *Foundation*
- "Foundation", a 2015 song by Years & Years from *Communion*
- "Foundations" (song), by Kate Nash
- "The Foundation" (song), by Xzibit

Other uses in arts, entertainment, and media

[edit]

- *Foundation – The International Review of Science Fiction*, a literary journal
- *The Foundation Trilogy* (BBC Radio), a radio adaption of Asimov's series
- The SCP Foundation, a fictional organization that is often referred to in-universe as "The Foundation"

Education

[edit]

- Foundation degree, a British academic qualification
- Foundation school, a type of school in England and Wales

- Foundation Stage, a stage of education for children aged 3 to 5 in England
- University Foundation Programme, a British university entrance course

Science and technology

[edit]

- Foundation (framework), a free collection of tools for creating websites and web applications by ZURB
- Foundation Fieldbus, a communications system
- Foundation Kit, an Apple API

Companies

[edit]

- Foundation Medicine, a genomic profiling company

See also

[edit]

- All pages with titles beginning with *Foundation*
- All pages with titles beginning with *The Foundation*
- Foundations of mathematics, theory of mathematics

Disambiguation icon
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This disambiguation page lists articles associated with the title **Foundation**.
If an internal link led you here, you may wish to change the link to point directly to the intended article.

About Cook County

Photo

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Things To Do in Cook County

Photo

Image not found or type unknown

Sand Ridge Nature Center

4.8 (96)

Photo

Image not found or type unknown

River Trail Nature Center

4.6 (235)

Photo

Palmisano (Henry) Park

4.7 (1262)

Driving Directions in Cook County

Driving Directions From Palmisano (Henry) Park to

Driving Directions From Lake Katherine Nature Center and Botanic Gardens to

Driving Directions From Navy Pier to

https://www.google.com/maps/dir/Navy+Pier/United+Structural+Systems+of+Illinois%2C+Inc/@41.8918633,-87.6050944,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-87.6050944!2d41.8918633!1m5!1m1!1sChIJ-wSxDtinD4gRiv4kY3RRh9U!2m2!1d-88.1396465!2d42.0637725!3e0

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87.8010774,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-87.8010774!2d41.6776048!1m5!1m1!1sChIJ-wSxDtinD4gRiv4kY3RRh9U!2m2!1d-88.1396465!2d42.0637725!3e2

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87.6490151,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-87.6490151!2d41.8429903!1m5!1m1!1sChIJ-wSxDtinD4gRiv4kY3RRh9U!2m2!1d-88.1396465!2d42.0637725!3e1

Reviews for

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Jeffery James

(5)

Very happy with my experience. They were prompt and followed through, and very helpful in fixing the crack in my foundation.

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Sarah McNeily

(5)

USS was excellent. They are honest, straightforward, trustworthy, and conscientious. They thoughtfully removed the flowers and flower bulbs to dig where they needed in the yard, replanted said flowers and spread the extra dirt to fill in an area of the yard. We've had other services from different companies and our yard was really a mess after. They kept the job site meticulously clean. The crew was on time and friendly. I'd recommend them any day! Thanks to Jessie and crew.

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Jim de Leon

(5)

It was a pleasure to work with Rick and his crew. From the beginning, Rick listened to my concerns and what I wished to accomplish. Out of the 6 contractors that quoted the project, Rick seemed the MOST willing to accommodate my wishes. His pricing was definitely more than fair as well. I had 10 push piers installed to stabilize and lift an addition of my house. The project commenced at the date that Rick had disclosed initially and it was completed within the same time period expected (based on Rick's original assessment). The crew was well informed, courteous, and hard working. They were not loud (even while equipment was being utilized) and were well spoken. My neighbors were very impressed on how polite they were when they entered / exited my property (saying hello or good morning each day when they crossed paths). You can tell they care about the customer concerns. They ensured that the property would be put back as clean as possible by placing MANY sheets of plywood down prior to excavating. They compacted the dirt back in the holes extremely well to avoid large stock piles of soils. All the while, the main office was calling me to discuss updates and expectations of completion. They provided waivers of lien, certificates of insurance, properly acquired permits, and JULIE locates. From a construction background, I can tell you that I did not see any flaws in the way they operated and this an extremely professional company. The pictures attached show the push piers added to the foundation (pictures 1, 2 & 3), the amount of excavation (picture 4), and the restoration after dirt was placed back in the pits and compacted (pictures 5, 6 & 7). Please notice that they also sealed two large cracks and steel plated these cracks from expanding further (which you can see under my sliding glass door). I, as well as my wife, are extremely happy that we chose United Structural Systems for our contractor. I would happily tell any of my friends and family to use this contractor should the opportunity arise!

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Chris Abplanalp

(5)

USS did an amazing job on my underpinning on my house, they were also very courteous to the proximity of my property line next to my neighbor. They kept things in order with all the dirt/mud they had to excavate. They were done exactly in the timeframe they indicated, and the contract was very details oriented with drawings of what would be done. Only thing that would have been nice, is they left my concrete a little muddy with boot prints but again, all-in-all a great job

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Dave Kari

(5)

What a fantastic experience! Owner Rick Thomas is a trustworthy professional. Nick and the crew are hard working, knowledgeable and experienced. I interviewed every company in the area, big and small. A homeowner never wants to hear that they have foundation issues. Out of every company, I trusted USS the most, and it paid off in the end. Highly recommend.

Measuring Soil Moisture for Stabilizing FoundationsView GBP

Check our other pages :

- When Hairline Drywall Cracks Indicate Movement
- Measuring Soil Moisture for Stabilizing Foundations
- Identifying Seasonal Soil Movement in Coastal Regions
- How Uneven Floors Reveal Deeper Foundation Concerns

United Structural Systems of Illinois, Inc

Phone : +18473822882

City : Hoffman Estates

State : IL

Zip : 60169

Address : 2124 Stonington Ave

Google Business Profile

Company Website : https://www.unitedstructuralsystems.com/

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home foundation repair service

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