



- **Evaluating Structural Policy Coverage in Home Insurance**
Evaluating Structural Policy Coverage in Home Insurance Understanding the Scope of Foundation Repair Guarantees Reviewing Contractor Backed Warranty Provisions Examining Conditions That Void Certain Warranties Checking if Homeowner Policies Cover Soil Movement Considering Add On Insurance for Extended Protection Determining Coverage Limitations for Pier Systems Clarifying Fine Print in Repair Service Agreements Seeking Assurance Through Third Party Backed Guarantees Exploring Extended Coverage for Unexpected Repair Costs Exploring Available Options for Warranty Transfers
- **Visual Inspection Methods for Early Problem Detection**
Visual Inspection Methods for Early Problem Detection Using Laser Level Surveys to Track Floor Movement Applying Ground Penetrating Radar for Subsurface Clarity Establishing Baselines with Digital Crack Gauges Harnessing Infrared Thermography for Hidden Moisture Installing Wireless Tilt Meters for Continuous Monitoring Scheduling Routine Evaluations of Structural Support Identifying Early Shifts with Smart Sensor Technology Analyzing Data from Remote Monitoring Systems Assessing Elevation Changes with Precision Tools Reviewing Signs of Deterioration in Hard to Reach Areas Interpreting Detailed Reports from Third Party Engineers
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Guarantees

The importance of foundation repair services in maintaining the structural integrity and value of residential properties.

Types of Foundation Issues: Common problems that necessitate foundation repair, such as cracks, settlement, and upheaval.

When it comes to understanding the scope of foundation repair guarantees, it's essential to first grasp the common types of foundation issues that might necessitate such repairs. Water pooling around a home signals the need for drainage and foundation repair **foundation repair expert service** deep foundation. Foundation problems can be a nightmare for homeowners, as they can lead to significant structural damage if left unaddressed. Let's explore some of the typical foundation issues and then delve into what you might expect from a repair guarantee.

One of the most common foundation problems is the appearance of cracks. These can manifest in various ways, such as hairline cracks in the walls, diagonal cracks in the foundation itself, or even cracks in the floor tiles. Cracks often indicate that the foundation is under stress, possibly due to soil movement or settling. Another prevalent issue is settlement, where one section of the foundation sinks lower than the rest, causing an uneven distribution of weight and leading to structural instability. Upheaval is another concern, occurring when the foundation moves upward, often due to expansive soils or water pressure underneath.

Now, let's consider the guarantees typically offered for foundation repair. It's crucial to understand that not all guarantees are created equal, and they can vary significantly between different contractors. A comprehensive foundation repair guarantee should cover both the materials used and the labor involved in the repair process. Ideally, this guarantee should extend over a reasonable period, giving you peace of mind that the repairs will hold up over time.

A reputable contractor will usually offer a warranty that covers any issues resulting from their workmanship. This means that if the repaired area shows signs of further damage within the warranty period, the contractor will return to fix it at no additional cost. However, it's important to note that these guarantees often do not cover damage resulting from external factors, such as natural disasters, soil conditions, or improper maintenance by the homeowner.

When evaluating a foundation repair guarantee, pay close attention to the fine print. Look for any exclusions or limitations that might affect your coverage. Additionally, ensure that

the warranty is transferable if you plan to sell your home in the future, as this can be a valuable selling point.

In conclusion, understanding the scope of foundation repair guarantees involves knowing the common issues that necessitate repairs and what to expect from a warranty. By being informed and choosing a reputable contractor, you can safeguard your home's structural integrity and protect your investment for years to come.

Understanding Foundation Repair Guarantees: Explanation of what guarantees typically cover and their limitations.

When homeowners face foundation problems, they often turn to professional repair services. These services usually come with guarantees, but understanding what those guarantees cover and their limitations is crucial. Foundation repair guarantees are designed to provide peace of mind, ensuring that the work done will be effective and long-lasting. However, it's important to read the fine print to grasp the full scope of these assurances.

Typically, foundation repair guarantees cover the structural integrity of the repairs made. This means that if the repairs fail due to workmanship or materials within a specified period, the company will return to fix the issue at no additional cost. For example, if a pier and beam system is installed to stabilize a settling foundation and it fails within the guarantee period, the repair company is obligated to correct it.

However, these guarantees have limitations. They generally do not cover issues arising from external factors such as soil movement, natural disasters, or poor maintenance by the homeowner. For instance, if heavy rains cause soil erosion leading to further foundation issues, this might not be covered under the guarantee. Similarly, if the homeowner fails to maintain proper drainage around the house, any subsequent problems may not be included in the guarantee.

Another common limitation is the duration of the guarantee. While some companies offer lifetime warranties, others provide coverage for only a few years. It's essential to understand how long your guarantee lasts and what specific conditions must be met to keep it valid. Some guarantees may require regular inspections or maintenance schedules to remain active, placing some responsibility on the homeowner.

Moreover, guarantees often do not cover cosmetic damage or minor adjustments that might be needed over time. While they ensure that major structural issues are addressed, small cracks in walls or slight settling might not fall under their scope. This underscores why reading through all terms and conditions is vital before signing off on any repair work.

In conclusion, understanding foundation repair guarantees involves knowing both what they cover and their limitations. While they provide assurance against poor workmanship and substandard materials, they do not shield against all potential future problems with your foundation. Homeowners must be proactive in maintaining their properties and fully

informed about what their guarantees entail to avoid surprises down the road.

Key Components of a Foundation Repair Guarantee: Elements like warranty period, exclusions, and conditions for coverage.

When it comes to foundation repair guarantees offered by contractors or companies specializing in these services, understanding their scope involves delving into several key components. These elements ensure homeowners grasp what exactly they're getting when they sign up for these services. Let's break down these crucial aspects. One fundamental component is undoubtedly warranty period. This specifies how long after completion, service providers guarantee their work. Some warranties might last only a few years, others may extend up to lifetime coverage depending upon type, extent, and quality of workmanship used during the repair process. This gives homeowners peace of mind knowing any issues arising within the set timeframe should get addressed without extra cost implications. Next, it's crucial to consider exclusions within the guarantee. Not every aspect of foundation repair may be covered under warranty. Common exclusions include damage caused by natural disasters, acts of God, improper maintenance post-repair, or normal settling of a house that occurs over time. Understanding these exemptions helps manage expectations regarding what's truly covered. Lastly, conditions of coverage outline the circumstances under which the guarantee remains valid. This typically involves maintaining proper drainage around the foundation, ensuring regular inspections of plumbing systems, among other responsibilities that the homeowner must fulfill to maintain warranty effectiveness. These conditions aim to protect the interests of both parties by ensuring the longevity and success of foundation repairs performed. In conclusion, grasping the scope of foundation repair guarantees requires a thorough examination of the warranty period, exclusions, and conditions of coverage. By doing so, homeowners can make informed decisions about their investments while safeguarding themselves from potential pitfalls along the way. Always read the fine print and ask questions for clarity before committing to any agreement to ensure the maximum protection offered under the guarantee terms.

Factors Affecting Guarantee Validity: Issues such as soil conditions, environmental changes, and homeowner responsibilities that can impact the guarantee.

When it comes to understanding the scope of foundation repair guarantees, it's crucial to consider several factors that can affect their validity. These factors often revolve around soil conditions, environmental changes, and homeowner responsibilities, including poor home maintenance issues among others discussed below: first, soil conditions play a significant role in foundation repair. Soil types vary greatly, from expansive clays that swell with moisture to sandy soils that can shift and settle. If the soil beneath a foundation is unstable or undergoes significant changes due to moisture content, weathering, or other environmental factors, it can lead to further foundation issues even after repairs have been made. Most guarantees will not cover damage resulting from natural soil movement or changes that occur post-repair.

Environmental changes also play a significant role in the longevity of foundation repairs. Extreme weather conditions, such as heavy rainfall, droughts, or freezing temperatures, can impact the stability of the soil and, consequently, the foundation. Flooding can erode soil or create hydrostatic pressure against the foundation, while droughts can cause soil shrinkage and settlement. These environmental factors are typically beyond the control of repair companies and are often excluded from guarantees.

Homeowner responsibilities are another critical aspect that can affect guarantee validity. Proper maintenance is essential to preserve the integrity of a repaired foundation. This includes ensuring adequate drainage around the home, addressing plumbing leaks promptly, and maintaining consistent moisture levels in the soil surrounding the foundation. Neglecting these responsibilities can lead to new or recurring foundation problems, which may not be covered under the original repair guarantee. For example, failure to direct water away from the home can result in soil erosion or excessive moisture accumulation, both of which can compromise the foundation.

Additionally, any structural modifications or additions made to the home after the foundation repair can void the guarantee. These changes can alter the load distribution on the foundation, leading to new stress points and potential issues. It's important for homeowners to consult with professionals before making any significant structural changes to ensure they do not compromise the repaired foundation.

In summary, understanding the scope of foundation repair guarantees involves recognizing the interplay between soil conditions, environmental changes, and homeowner responsibilities. While repair companies strive to provide long-lasting solutions, certain factors outside their control can impact the validity of their guarantees. Homeowners should be proactive in maintaining their homes and aware of environmental conditions that could affect their foundations to maximize the effectiveness and longevity of repairs.

Evaluating Warranty Options: Tips for comparing warranties from different service providers to make an informed decision.

When it comes to foundation repair, one of the most crucial aspects to consider is the warranty offered by service providers-it's your safety net ensuring long term protection against future issues arising from their workmanship . Evaluating these warranties requires careful comparison so you can make an informed decision based on coverage scope , length , transferability , cost , liability limitations , repair methods covered , annual inspections included , exclusions & limitations . Here are some tips :

Firstly , understand the scope . A comprehensive warranty should cover all aspects of your foundation repair including materials and labor . Look for explicit details on what's included-the more specific , the better . Some warranties might only cover certain repair methods or exclude others altogether-be aware of these differences .

Secondly , consider the warranty duration . Lifetime warranties sound promising but read

fine print closely . 'Lifetime' could mean lifetime of structure's expected lifespan rather than your ownership period . Compare short term vs long term coverage considering your future plans with property-a longer warranty is usually preferable .

Thirdly , check transferability . If there's a chance you might sell your property , a transferable warranty can add value during resale . This option allows new owners to benefit from remaining warranty period . However , non transferable warranties could limit prospective buyers' interest due to potential future costs related with fixing foundational concerns .

Next , evaluate any costs associated with warranty . While some warranties are free , others come at an additional cost . Weigh these expenses against potential savings from future repairs-sometimes paying extra upfront makes sense in long run . Also , examine liability limitations-understand what happens if something goes wrong during or after repair process & know maximum coverage offered under warranty claim process .

Another key aspect is understanding whether annual inspections are included . Regular checkups help identify & address any arising issues early on preventing minor problems turning major headaches . Some providers include these inspections within warranty offerings helping maintain peace -of -mind post repair work .

Lastly , scrutinize exclusions & limitations thoroughly . Every warranty has conditions it won't cover-make sure you're clear on these points before committing . Exclusions could range from natural disasters to certain types of structural damage-ensure you comprehend implications fully . A reliable service provider should clearly outline these aspects without hiding behind jargon or complex legal language .

The Role of Professional Inspections: Importance of regular inspections to maintain the validity of the guarantee and ensure ongoing structural integrity.

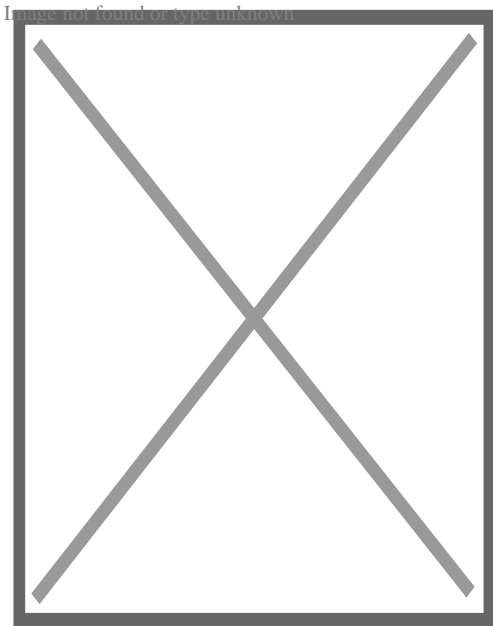
When it comes foundation repairs handling foundation repair guaranteeshould not be taken lightly, as they play a crucial role in ensuring the long-term stability and safety of your home. One key aspect that often goes overlooked is the role of professional inspections. Regular inspections are not just a formality; they are vital for maintaining the validity of your guarantee and ensuring the ongoing structural integrity of your foundation.

Imagine buying a new car. You wouldn't just drive it off the lot and never bother with maintenance, expecting the warranty to cover any issues that arise. Similarly, a foundation repair guarantee isn't a set-it-and-forget-it deal. Regular inspections are like the routine check-ups that keep your foundation 'warranty' valid and your home structurally sound.

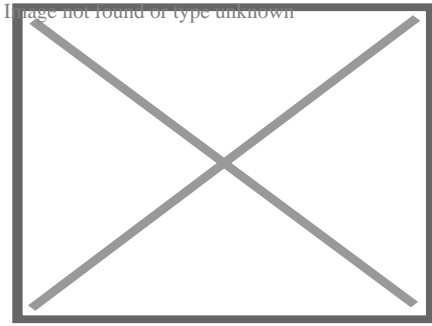
Professional inspections serve several purposes. Firstly, they allow experts to identify and address any potential issues early on before they become major problems. Foundations can shift, settle, or develop cracks over time due to various factors like soil movement, water damage, or the natural aging process of materials. Regular inspections can catch these changes early, ensuring that any necessary repairs are made promptly and correctly.

Secondly, many foundation repair guarantees require regular inspections as part of their terms and conditions. Failure to comply with these requirements can void your guarantee occurs , meaning you could be left to foot the bill for any repairs out of sufficient funds or materials when when problems occur . Therefore regularly scheduled professional inspections safeguard your guarantee keeping it valid for the long term . Ensuring such inspections are scheduled on a regular basis will help keep your home protected against major structural issues . Every home owner wishes to take care of his property keeping its value intact for future benefits especially if considering selling or simply passing it on . Professional inspectors provide unbiased third party objective reports about current state of foundations suggesting necessary repairs . Always ensure get your home regular professional checked inspected ensure minimum standards maintained . Hence professionals provide peace of mind knowing your home is structurally sound well protected against any underlying issues which may cause concerns in future thereby helping your family . Regular inspections provide peace of mind increase resale value in case of selling house future endeavors . Be responsible home owner get checks your own home year basis foundational integrity guaranteeing structural well being safe . Invest in time professionals keeping home safe always best approach any property owner long term keep structure safe .

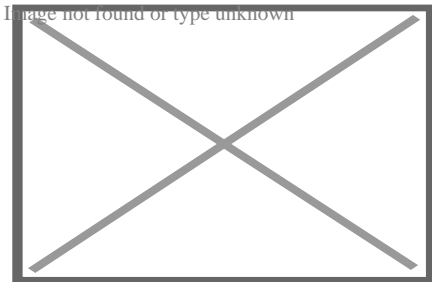
About geotechnical engineering



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 it 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

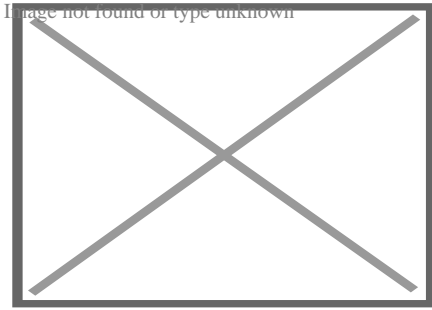
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Main article: Foundation (engineering)

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

[edit]



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.

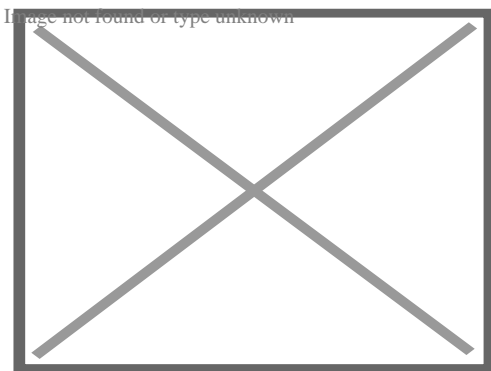
Ground improvement

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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

[edit]



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

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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.

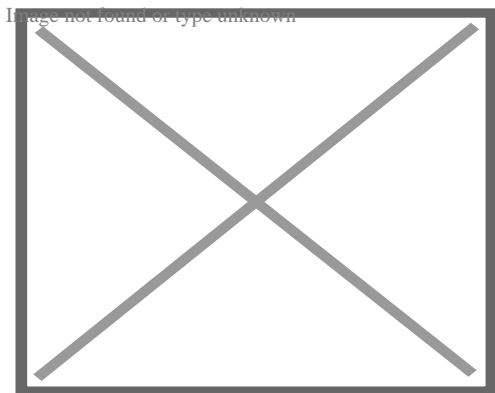
Sub-disciplines

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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

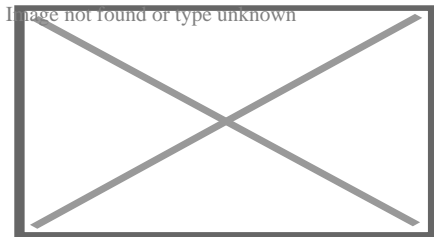
them suitable for use in the ground where high levels of durability are required. Their main functions include drainage, filtration, reinforcement, separation, and containment.

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

[edit]

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
- Geoprofessions
- 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

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22. ^ **a b c** Peck, R.B (1969). Advantages and limitations of the observational method in applied soil mechanics, *Geotechnique*, 19, No. 1, pp. 171-187.

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External links

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Engineering

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Civil

- Architectural
- Coastal
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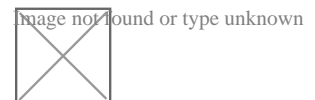
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**Specialties
and
interdisciplinarity**



Engineering education

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- Doctorate
- Graduate certificate
- Engineer's degree
- Licensed engineer

Related topics

- Engineer

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- Electrical and electronics engineering
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- Structural engineering

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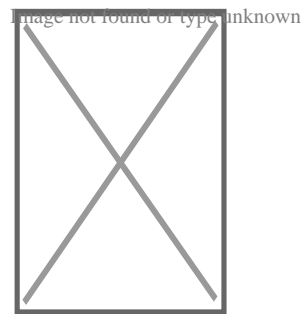
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Soil science

- History
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Main fields

- Pedology
- Edaphology
- Soil biology
- Soil microbiology
- Soil zoology
- Soil ecology
- Soil physics
- Soil mechanics
- Soil chemistry
- Environmental soil science
- Agricultural soil science



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- Soil contamination
- Soil retrogression and degradation
- Soil compaction
 - Soil compaction (agriculture)
- Soil sealing
- Soil salinity
 - Alkali soil
- Soil pH
 - Soil acidification
- Soil health
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- Soil resilience
- Soil color
- Soil texture
- Soil structure
 - Pore space in soil
 - Pore water pressure
- Soil crust
- Soil horizon
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- Soil carbon
- Soil gas
 - Soil respiration
- Soil organic matter
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World Reference Base for Soil Resources (1998–)

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- Retisols
- Solonchaks
- Solonetz
- Stagnosol
- Technosols
- Umbrisols
- Vertisols

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- Inceptisols

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- Archaeology
- Agricultural science
 - Agrology

Societies, Initiatives



- Australian Society of Soil Science Incorporated
- Canadian Society of Soil Science
- Central Soil Salinity Research Institute (India)
- German Soil Science Society
- Indian Institute of Soil Science
- International Union of Soil Sciences
- International Year of Soil
- National Society of Consulting Soil Scientists (US)
- OPAL Soil Centre (UK)
- Soil Science Society of Poland
- Soil and Water Conservation Society (US)
- Soil Science Society of America
- World Congress of Soil Science

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
- Vegetation
- Infiltration (hydrology)
- Groundwater
- Crust (geology)
- Impervious surface/Surface runoff
- Petrichor

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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
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-  Ram sounding
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-  Rotary-pressure sounding
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-  Shear vane test
-  Simple sounding
-  Standard penetration test
-  Total sounding
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(Interaction)**

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- Subgrade
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 - Gabion
 - Ground freezing
 - Mechanically stabilized earth
 - Pressure grouting
 - Slurry wall
 - Soil nailing
 - Tieback
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- Causeway
- Terracing
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- Cut and fill
- Fill dirt
- Grading
- Land reclamation
- Track bed
- Erosion control
- Earth structure
- Expanded clay aggregate
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- Geosynthetics
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 - 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
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- Biogeography
- Earth materials
- Archaeology
- Agricultural science
 - Agrology

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- Underground construction
 - Tunnel construction

History

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- Water supply and sanitation

Professions

- Architect
- Building engineer
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- Building officials
- Chartered Building Surveyor
- Civil engineer
- Civil estimator
- Clerk of works
- Project manager
- Quantity surveyor
- Site manager
- Structural engineer
- Superintendent

**Trades workers
(List)**

- Banksman
- Boilermaker
- Bricklayer
- Carpenter
- Concrete finisher
- Construction foreman
- Construction worker
- Electrician
- Glazier
- Ironworker
- Millwright
- Plasterer
- Plumber
- Roofer
- Steel fixer
- Welder

- 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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 - Turkey
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-
- Building code
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- Industrial architecture
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Engineering

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- Urban planning

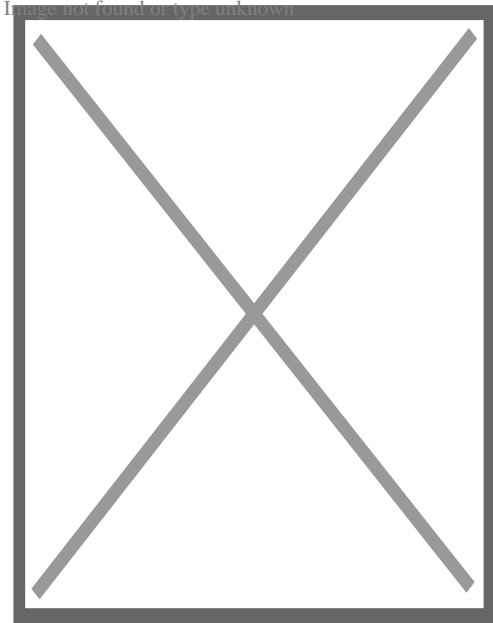
Other topics

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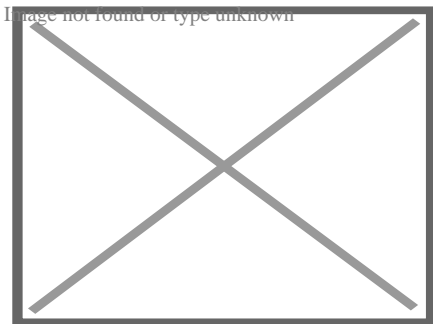
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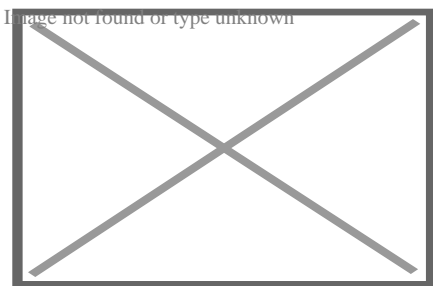
About geotechnical engineering



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

[edit]

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

[edit]

Geotechnical investigation

[edit]

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

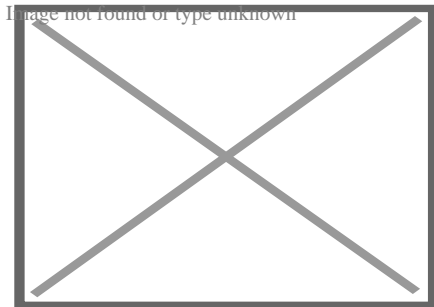
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Main article: Foundation (engineering)

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

[edit]



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.

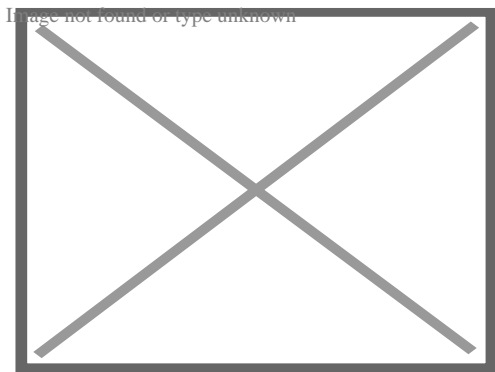
Ground improvement

[edit]

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

[edit]



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.

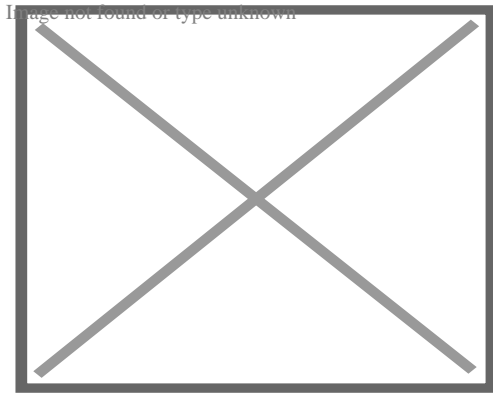
Sub-disciplines

[edit]

Geosynthetics

[edit]

Main article: Geosynthetics



A collage of geosynthetic products.

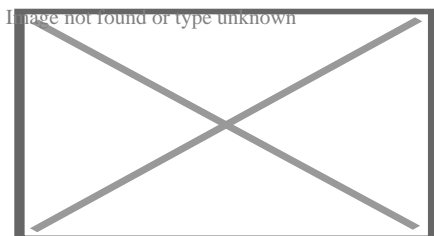
Geosynthetics are a type of plastic polymer products used in geotechnical engineering that improve engineering performance while reducing costs. This includes geotextiles, geogrids, geomembranes, geocells, and geocomposites. The synthetic nature of the products make them suitable for use in the ground 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

[edit]

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

[edit]

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

[edit]

○  [Engineering portal](#)

- Civil engineering
- Deep Foundations Institute
- Earthquake engineering
- Earth structure
- Effective stress
- Engineering geology
- Geological Engineering
- Geoprofessions
- 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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- Worldwide Geotechnical Literature Database
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Engineering

- History
- Outline
- List of engineering branches

Civil

- Architectural
- Coastal
- Construction
- Earthquake
- Ecological
- Environmental
 - Sanitary
- Geological
- Geotechnical
- Hydraulic
- Mining
- Municipal/urban
- Offshore
- River
- Structural
- Transportation
 - Traffic
 - Railway

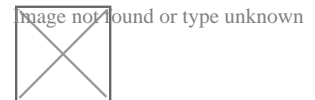
Mechanical

- Acoustic
- Aerospace
- Automotive
- Biomechanical
- Energy
- Manufacturing
- Marine
- Naval architecture
- Railway
- Sports
- Thermal
- Tribology

Electrical

- Broadcast
 - outline
- Control
- Electromechanics
- Electronics
- Microwaves
- Optical
- Power
- Radio-frequency
- Signal processing
- Telecommunications

**Specialties
and
interdisciplinarity**



Engineering education

- Bachelor of Engineering
- Bachelor of Science
- Master's degree
- Doctorate
- Graduate certificate
- Engineer's degree
- Licensed engineer

Related topics

- Engineer

Glossaries

- Engineering
 - A–L
 - M–Z
- Aerospace engineering
- Civil engineering
- Electrical and electronics engineering
- Mechanical engineering
- Structural engineering

Other

- Agricultural
- Audio
- Automation
- Biomedical
 - Bioinformatics
 - Clinical
 - Health technology
 - Pharmaceutical
 - Rehabilitation
- Building services
 - MEP
- Design
- Explosives
- Facilities
- Fire
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- Graphics
- Industrial
- Information
- Instrumentation
 - Instrumentation and control
- Logistics
- Management
- Mathematics
- Mechatronics
- Military
- Nuclear
- Ontology
- Packaging
- Physics
- Privacy
- Safety
- Security
- Survey
- Sustainability
- Systems
- Textile

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-  **WikiProject**
-  **Portal**

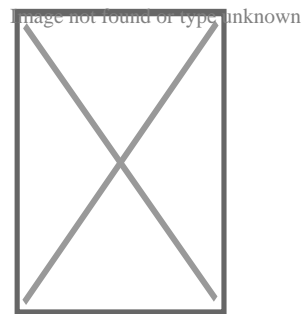
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Soil science

- History
- Index

Main fields

- Pedology
- Edaphology
- Soil biology
- Soil microbiology
- Soil zoology
- Soil ecology
- Soil physics
- Soil mechanics
- Soil chemistry
- Environmental soil science
- Agricultural soil science



Soil topics

- Soil
- Pedosphere
 - Soil morphology
 - Pedodiversity
 - Soil formation
- Soil erosion
- Soil contamination
- Soil retrogression and degradation
- Soil compaction
 - Soil compaction (agriculture)
- Soil sealing
- Soil salinity
 - Alkali soil
- Soil pH
 - Soil acidification
- Soil health
- Soil life
- Soil biodiversity
- Soil quality
- Soil value
- Soil fertility
- Soil resilience
- Soil color
- Soil texture
- Soil structure
 - Pore space in soil
 - Pore water pressure
- Soil crust
- Soil horizon
- Soil biomantle
- Soil carbon
- Soil gas
 - Soil respiration
- Soil organic matter
- Soil moisture
 - Soil water (retention)

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Soil classification

World Reference Base for Soil Resources (1998–)

- Acrisols
- Alisols
- Andosols
- Anthrosols
- Arenosols
- Calcisols
- Cambisols
- Chernozem
- Cryosols
- Durisols
- Ferralsols
- Fluvisols
- Gleysols
- Gypsisols
- Histosol
- Kastanozems
- Leptosols
- Lixisols
- Luvisols
- Nitisols
- Phaeozems
- Planosols
- Plinthosols
- Podzols
- Regosols
- Retisols
- Solonchaks
- Solonetz
- Stagnosol
- Technosols
- Umbrisols
- Vertisols

USDA soil taxonomy

- Alfisols
- Andisols
- Aridisols
- Entisols
- Gelisols
- Histosols
- Inceptisols

Applications

- Soil conservation
- Soil management
- Soil guideline value
- Soil survey
- Soil test
- Soil governance
- Soil value
- Soil salinity control
- Erosion control
- Agroecology
- Liming (soil)

Related fields

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

Societies, Initiatives



- Australian Society of Soil Science Incorporated
- Canadian Society of Soil Science
- Central Soil Salinity Research Institute (India)
- German Soil Science Society
- Indian Institute of Soil Science
- International Union of Soil Sciences
- International Year of Soil
- National Society of Consulting Soil Scientists (US)
- OPAL Soil Centre (UK)
- Soil Science Society of Poland
- Soil and Water Conservation Society (US)
- Soil Science Society of America
- World Congress of Soil Science

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
- Vegetation
- Infiltration (hydrology)
- Groundwater
- Crust (geology)
- Impervious surface/Surface runoff
- Petrichor

-  [Wikipedia:WikiProject Soil](#)
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- [Category soil science](#)
-  [List of soil scientists](#)




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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
 -  Inclinator
 -  Settlement recordings
-  Shear vane test
-  Simple sounding
-  Standard penetration test
-  Total sounding
-  Trial pit
-  Visible bedrock
- Nuclear densometer test
- Exploration geophysics
- Crosshole sonic logging

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

**Structures
(Interaction)**

Natural features

- Topography
- Vegetation
- Terrain
- Topsoil
- Water table
- Bedrock
- Subgrade
- Subsoil

Earthworks

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

Types

- Home construction
- Offshore construction
- Underground construction
 - Tunnel construction

History

- Architecture
- Construction
- Structural engineering
- Timeline of architecture
- Water supply and sanitation

Professions

- Architect
- Building engineer
- Building estimator
- Building officials
- Chartered Building Surveyor
- Civil engineer
- Civil estimator
- Clerk of works
- Project manager
- Quantity surveyor
- Site manager
- Structural engineer
- Superintendent

**Trades workers
(List)**

- Banksman
- Boilermaker
- Bricklayer
- Carpenter
- Concrete finisher
- Construction foreman
- Construction worker
- Electrician
- Glazier
- Ironworker
- Millwright
- Plasterer
- Plumber
- Roofer
- Steel fixer
- Welder

- 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
-
- India
 - Iran
 - Japan
 - Romania
 - Turkey
 - United Kingdom
 - United States
-
- Building code
 - Construction law
 - Site safety
 - Zoning

Architecture

- Style
 - List
- Industrial architecture
 - British
- Indigenous architecture
- Interior architecture
- Landscape architecture
- Vernacular architecture

Engineering

- Architectural engineering
- Building services engineering
- Civil engineering
 - Coastal engineering
 - Construction engineering
 - Structural engineering
- Earthquake engineering
- Environmental engineering
- Geotechnical engineering

Methods

- List
- Earthbag construction
- Modern methods of construction
- Monocrete construction
- Slip forming

- Building material
 - List of building materials
 - Millwork
- Construction bidding
- Construction delay
- Construction equipment theft
- Construction loan
- Construction management
- Construction waste
- Demolition
- Design–build
- Design–bid–build
- DfMA
- Heavy equipment
- Interior design
- Lists of buildings and structures
 - List of tallest buildings and structures
- Megaproject
- Megastructure
- Plasterwork
 - Damp
 - Proofing
 - Parge coat
 - Roughcast
 - Harling
- Real estate development
- Stonemasonry
- Sustainability in construction
- Unfinished building
- Urban design
- Urban planning

Other topics

 Outline  Category Image not found or type unknown

Authority control databases: National

- Germany
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 - Israel
- Image not found or type unknown [Edit this at Wikidata](#)

About Cook County

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Things To Do in Cook County

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Sand Ridge Nature Center

4.8 (96)

Photo

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River Trail Nature Center

4.6 (235)

Photo

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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

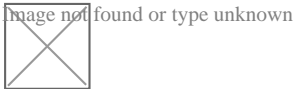
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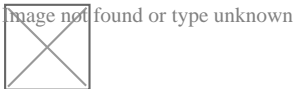
Reviews for



Jeffery James

(5)

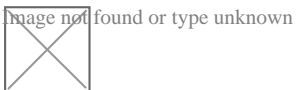
Very happy with my experience. They were prompt and followed through, and very helpful in fixing the crack in my foundation.



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.

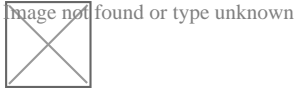


Jim de Leon

(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

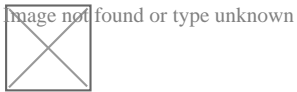
construction background, I can tell you that I did not see any flaws in the way they operated and this an extremely professional company. The pictures attached show the push piers added to the foundation (pictures 1, 2 & 3), the amount of excavation (picture 4), and the restoration after dirt was placed 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!



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



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.

Understanding the Scope of Foundation Repair Guarantees [View GBP](#)

Frequently Asked Questions

**** What happens if additional foundation issues arise after repairs are completed ?****

**** Generally , additional foundational issues outside those specific areas repaired initially might not fall under your guarantee . However , some companies extend coverage beyond immediate repairs , offering comprehensive warranties which cover broader structural integrity concerns resulting from previous work done . Ensure any service agreement spells out clearly how subsequent problems would be handled financially / procedurally moving forward . ****

**** How do I ensure my foundation repair guarantee remains valid ?****

**** To maintain validity frequent maintenance visits ensuring that no further deterioration occurs due neglect keeping up regular communications regarding any noticeable changes affecting structural health should suffice maintaining consistent records proving adherence towards recommended practices mentioned within warranty documentation also helps reinforce compliance measures justifying claims eligibility seamlessly whenever required so pay close attention following guidance right after initial consultations respectfully.****

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