



- **Understanding Expansive Clay and Its Impact on Foundations**
Understanding Expansive Clay and Its Impact on Foundations Examining Sandy Loam for Residential Support Identifying Areas Vulnerable to Soil Erosion Evaluating Soil Moisture Fluctuations Beneath Homes Approaches for Chemical Soil Stabilization Techniques for Addressing Soil Heave Issues Managing Settlement with Targeted Soil Compaction Recognizing Soil Drainage Limitations Investigating Soil Stress Testing in Residential Sites Incorporating Root Barriers to Prevent Shifts Examining Seasonal Swelling and Shrinking of Soil Employing Sustainable Methods for Long Term Soil Health
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Foundations

Explanation of what expansive clay is and how it behaves under different conditions

Explanation of what expansive clay is and how it behaves under different conditions

Expansive clay is a type of soil that has a significant ability to swell when it absorbs water and shrink when it dries out. Discussing financing options helps homeowners budget for foundation repair service [residential foundation repair service](#) home inspection. This behavior is primarily due to the presence of certain minerals, such as montmorillonite, which have a high capacity to absorb water molecules between their layers. When water is absorbed, the clay expands, and when it dries, it contracts. This cyclical swelling and shrinking can have profound effects on structures built on or near such soils.

Under wet conditions, expansive clay can increase in volume by a considerable amount. This swelling exerts pressure on foundations, leading to upward movement or heaving. The extent of this movement depends on the moisture content, the type of clay, and the environmental conditions. For instance, during rainy seasons or when irrigation is heavy, the clay absorbs more water, leading to more significant expansion.

Conversely, during dry conditions, such as droughts or prolonged periods without rain, expansive clay loses moisture and contracts. This shrinkage can cause foundations to settle unevenly, leading to cracks in walls, floors, and other structural elements. The differential movement-where some parts of the foundation move more than others-can be particularly damaging.

Understanding the behavior of expansive clay is crucial for engineers and builders. Proper site assessment, including soil testing and analysis, is essential before constructing any structure. Mitigation strategies, such as installing special foundation systems like piers or mats, can help minimize the impact of swelling and shrinking. Additionally, maintaining consistent moisture levels around the foundation through proper drainage and landscaping can also reduce the effects of expansive clay on buildings.

Discussion on the common issues caused by expansive clay in residential foundations

Certainly!

Expansive clay is a type of soil that can significantly impact residential foundations due to its unique properties. When discussing the common issues caused by expansive clay in residential foundations, several key points emerge.

Firstly, expansive clay soils are notorious for their ability to swell when they absorb water and shrink when they dry out. This cyclical behavior, driven by seasonal changes or variations in moisture content, can exert substantial pressure on foundations. The result? Cracks in walls, uneven floors, and misaligned doors and windows. Homeowners often notice these signs after periods of heavy rain or during dry spells, highlighting the direct correlation between moisture levels and foundation stability.

Another critical issue is the differential movement caused by expansive clay. Because not all parts of a foundation will experience the same degree of swelling or shrinking, different sections can move at varying rates. This differential movement can lead to significant structural damage over time, exacerbating the initial cracks and leading to more severe foundation issues.

Furthermore, the presence of expansive clay can complicate the construction process. Builders must take extra precautions during the design and construction phases to mitigate the effects of expansive soils. This might include using deeper foundations, installing specialized drainage systems, or incorporating chemical treatments to stabilize the soil. Failure to address these concerns during construction can lead to costly repairs down the line.

In addition to structural damage, expansive clay can also affect the aesthetics and value of a home. Cracks and uneven surfaces not only look unappealing but can also deter potential buyers if a homeowner decides to sell. This underscores the importance of proactive management and regular inspections to identify and address issues early.

In conclusion, the common issues caused by expansive clay in residential foundations are multifaceted, involving structural damage, differential movement, construction challenges, and aesthetic concerns. Understanding these issues is crucial for homeowners and builders alike to ensure the longevity and stability of residential properties built on expansive clay soils.

Overview of the factors that influence the expansion and contraction of clay soils

Understanding expansive clay and its impact on foundations requires a thorough examination of the factors that influence the expansion and contraction of clay soils. Clay soils are notorious for their ability to swell when they absorb water and shrink when they lose it. This behavior can have significant implications for the stability and integrity of foundations.

One of the primary factors influencing this phenomenon is the type of clay minerals present in the soil. Clays such as montmorillonite have a high cation exchange capacity, making them more prone to expansion compared to kaolinite or illite. The arrangement and structure of these minerals at a microscopic level play a crucial role in determining how much water they can absorb and retain.

Another critical factor is the moisture content in the soil. The amount of water in the environment directly affects the degree of expansion or contraction. During wet seasons or in areas with high rainfall, clay soils tend to absorb more water, leading to expansion. Conversely, during dry periods, the soils lose moisture and contract. This cycle of wetting and drying can cause significant movement in the soil, which translates to stress on any structures built on it.

The presence of vegetation also plays a role. Plants with deep root systems can draw water from the soil, leading to shrinkage.

Understanding Expansive Clay and Its Impact on Foundations - design

1. home insurance
2. framing
3. Chicago metropolitan area

Conversely, areas without vegetation may retain more moisture, promoting expansion. Landscaping practices and the types of plants chosen for an area can thus indirectly influence the behavior of clay soils.

Temperature variations can exacerbate the effects of moisture content. In regions with hot summers, the evaporation rate is high, leading to soil contraction. In colder climates, the freeze-thaw cycle can introduce additional stress on the soil structure, further complicating the expansion and contraction dynamics.

Lastly, human activities such as irrigation, construction, and landscaping can significantly alter the natural moisture balance of clay soils. For instance, leaking pipes or irrigation systems can introduce additional water into the soil, promoting expansion. Conversely, construction activities that compact the soil can reduce its ability to absorb water, leading to less expansion but potentially more contraction during dry periods.

In conclusion, the expansion and contraction of clay soils are influenced by a complex interplay of factors including the type of clay minerals, moisture content, vegetation, temperature variations, and human activities. Understanding these factors is essential for designing foundations that can withstand the dynamic nature of expansive clay soils, ensuring the longevity and stability of structures built on them.

Examination of the methods used to identify expansive clay in a property

When it comes to buying or constructing a property, one of the critical aspects to consider is the type of soil present on the site. Among the various soil types, expansive clay poses unique challenges, particularly to foundations. Understanding how to identify expansive clay is vital for ensuring the structural integrity and longevity of any building.

Understanding Expansive Clay and Its Impact on Foundations - design

1. anchor
2. deck
3. brick

This essay delves into the methods used to identify expansive clay in a property.

Firstly, visual inspection is often the initial step in identifying expansive clay. Experienced professionals can sometimes spot the characteristic signs of expansive clay, such as cracks in the ground that appear and disappear with changes in moisture content. These cracks can be particularly noticeable after periods of heavy rain or drought. Additionally, the presence of certain vegetation types, such as deep-rooted trees, can indicate the likelihood of expansive clay below the surface.

Laboratory testing provides a more definitive method for identifying expansive clay. Soil samples are collected from various depths across the property and sent to a laboratory for analysis. One common test is the Atterberg Limits test, which determines the soil's plasticity and helps identify the presence of clay minerals. Another crucial test is the swelling pressure test, which measures the force exerted by the clay when it absorbs water. High swelling pressure is a strong indicator of expansive clay.

In-situ testing is another effective method for identifying expansive clay. Techniques such as the Standard Penetration Test (SPT) or Cone Penetration Test (CPT) can provide valuable data about the soil's properties without removing it from the site. These tests help assess the soil's density, moisture content, and swelling potential, offering a comprehensive understanding of the subsurface conditions.

Geophysical methods, such as ground-penetrating radar (GPR) and electrical resistivity tomography (ERT), are increasingly being used to identify expansive clay. These non-invasive techniques allow professionals to create detailed subsurface profiles, revealing the presence and extent of expansive clay layers without disturbing the soil.

Lastly, historical data and local knowledge can provide valuable insights. Consulting with local geologists, engineers, and long-time residents can offer anecdotal evidence and historical records that indicate the presence of expansive clay in the area.

In conclusion, identifying expansive clay in a property requires a combination of visual inspection, laboratory testing, in-situ testing, geophysical methods, and local knowledge. By employing these methods, property owners and developers can make informed decisions to mitigate the risks associated with expansive clay, ensuring the stability and safety of their

structures.

Description of the techniques and materials used in repairing foundations affected by expansive clay

Repairing foundations affected by expansive clay requires a thorough understanding of the soil's behavior and the appropriate techniques and materials to mitigate its effects.

Expansive clay, known for its ability to swell when it absorbs water and shrink as it dries, can cause significant damage to foundations over time. Here are some commonly used techniques and materials for repairing such foundations:

1. **Soil Modification**: One of the primary approaches is to alter the properties of the expansive clay. This can be achieved by adding materials like lime or gypsum to the soil. These amendments help to stabilize the soil, reducing its ability to swell and shrink. The process involves excavating the soil around the foundation, mixing it with the stabilizing agent, and then compacting it back into place.
2. **Moisture Control**: Managing the moisture content around the foundation is crucial. Techniques such as installing drainage systems, ensuring proper grading around the building, and using waterproof membranes can help prevent water from accumulating near the foundation. This reduces the potential for swelling caused by moisture absorption.
3. **Pier and Helical Piers**: For more severe cases, underpinning the foundation with piers can provide additional support and stability. Pier and helical piers are driven deep into the ground, below the active zone of the expansive clay, to reach more stable soil or bedrock. This method transfers the load of the structure to a depth where the soil is less affected by moisture changes.
4. **Chemical Grouting**: Injecting chemical grouts into the soil can also help stabilize expansive clay. These grouts fill the voids in the soil, reducing its permeability and its ability to absorb water. This technique is particularly useful in areas where traditional underpinning is not feasible.
5. **Slabjacking**: When the foundation has settled unevenly due to expansive clay, slabjacking can be an effective solution. This involves pumping a slurry mixture beneath the concrete slab to lift and level it. The slurry typically consists of a combination of cement, sand, and water, which hardens to provide support.
6. **Regular Monitoring and Maintenance**: After repairs, it's essential to monitor the foundation regularly for any signs of movement. Maintaining consistent moisture levels around the foundation and ensuring that drainage systems are functioning correctly can help prevent future issues.

In conclusion, repairing foundations affected by expansive clay requires a combination of soil modification, moisture control, structural support, and ongoing maintenance. By

employing these techniques and materials, it's possible to mitigate the impact of expansive clay and protect the integrity of the foundation.

Case studies highlighting successful residential foundation repair projects involving expansive clay

Certainly! Here's a short essay on the topic of "Case studies highlighting successful residential foundation repair projects involving expansive clay" for the subject of "Understanding Expansive Clay and Its Impact on Foundations."

Expansive clay soils are a significant concern for homeowners and builders alike, particularly in regions where these soils are prevalent. When water content in expansive clay changes, it can lead to significant expansion and contraction, which in turn can cause severe damage to residential foundations. Understanding the behavior of expansive clay and implementing effective repair strategies is crucial for maintaining the structural integrity of homes. This essay explores case studies that highlight successful residential foundation repair projects involving expansive clay, shedding light on the methods and techniques that have proven effective.

One notable case study involves a residential property in Texas, an area well-known for its expansive clay soils. The homeowners noticed cracks in their foundation and doors that no longer closed properly, clear signs of foundation movement. After a thorough soil analysis and assessment, it was determined that the foundation issues were due to the expansive clay beneath the house. The repair team employed a combination of techniques, including the installation of helical piers and the use of a chemical grout to stabilize the soil. The helical piers were driven deep into the ground, beyond the active zone of the clay, to provide a stable foundation. The chemical grout was injected into the soil to fill voids and reduce its expansive properties. Post-repair, the homeowners reported no further issues, and the property's value was preserved.

Another compelling case study comes from Arizona, where a family home was experiencing significant foundation problems. The repair process began with a detailed soil evaluation to understand the extent of the expansive clay issue. The chosen repair method involved the use of push piers, which were installed at strategic points around the foundation. These piers were pushed deep into the stable soil layers, effectively transferring the home's load and counteracting the effects of the expansive clay. Additionally, a moisture management system was installed to control the water content in the soil, preventing future expansion and contraction. The outcome was a stabilized foundation and a relieved family, confident in the long-term safety of their home.

These case studies underscore the importance of a tailored approach to foundation repair in areas with expansive clay soils.

Understanding Expansive Clay and Its Impact on Foundations - radon mitigation

1. radon mitigation
2. design
3. load-bearing wall

Successful projects often involve a combination of deep foundation support systems, such as helical piers or push piers, and soil stabilization techniques, including chemical grouts and moisture management systems. Each project must be carefully assessed to determine the most effective combination of methods, ensuring the foundation's stability and the home's longevity. Through these examples, we gain valuable insights into the strategies that can mitigate the challenges posed by expansive clay, protecting homes and enhancing community resilience.

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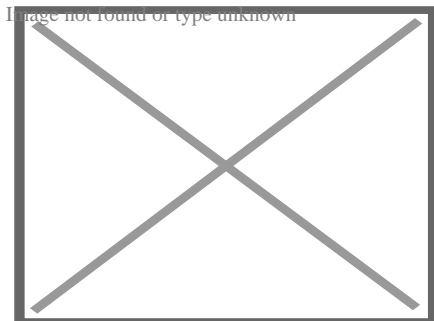


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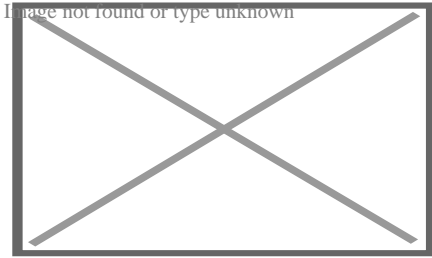
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About concrete slab



Suspended slab under construction, with the formwork still in place



Suspended slab formwork and rebar in place, ready for concrete pour.

A **concrete slab** is a common structural element of modern buildings, consisting of a flat, horizontal surface made of cast concrete. Steel-reinforced slabs, typically between 100 and 500 mm thick, are most often used to construct floors and ceilings, while thinner *mud slabs* may be used for exterior paving (see below).^{[1][2]}

In many domestic and industrial buildings, a thick concrete slab supported on foundations or directly on the subsoil, is used to construct the ground floor. These slabs are generally classified as *ground-bearing* or *suspended*. A slab is ground-bearing if it rests directly on the foundation, otherwise the slab is suspended.^[3] For multi-story buildings, there are several common slab designs (

see § Design for more types):

- Beam and block, also referred to as *rib and block*, is mostly used in residential and industrial applications. This slab type is made up of pre-stressed beams and hollow blocks and are temporarily propped until set, typically after 21 days.^[4]
- A hollow core slab which is precast and installed on site with a crane
- In high rise buildings and skyscrapers, thinner, pre-cast concrete slabs are slung between the steel frames to form the floors and ceilings on each level. Cast in-situ slabs are used in high rise buildings and large shopping complexes as well as houses. These in-situ slabs are cast on site using shutters and reinforced steel.

On technical drawings, reinforced concrete slabs are often abbreviated to "r.c.c. slab" or simply "r.c.". Calculations and drawings are often done by structural engineers in CAD software.

Thermal performance

[edit]

Energy efficiency has become a primary concern for the construction of new buildings, and the prevalence of concrete slabs calls for careful consideration of its thermal properties in order to minimise wasted energy.^[5] Concrete has similar thermal properties to masonry products, in that it has a relatively high thermal mass and is a good conductor of heat.

In some special cases, the thermal properties of concrete have been employed, for example as a heatsink in nuclear power plants or a thermal buffer in industrial freezers.^[6]

Thermal conductivity

[edit]

Thermal conductivity of a concrete slab indicates the rate of heat transfer through the solid mass by conduction, usually in regard to heat transfer to or from the ground. The coefficient of thermal conductivity, k , is proportional to density of the concrete, among other factors.^[5] The primary influences on conductivity are moisture content, type of aggregate, type of cement, constituent proportions, and temperature. These various factors complicate the theoretical evaluation of a k -value, since each component has a different conductivity when isolated, and the position and proportion of each components affects the overall conductivity. To simplify this, particles of aggregate may be considered to be suspended in the homogeneous cement. Campbell-Allen and Thorne (1963) derived a formula for the theoretical thermal conductivity of concrete.^[6] In practice this formula is rarely applied, but remains relevant for theoretical use. Subsequently, Valore (1980) developed another formula in terms of overall density.^[7] However, this study concerned hollow concrete blocks and its results are unverified for concrete slabs.

The actual value of k varies significantly in practice, and is usually between 0.8 and $2.0 \text{ W m}^{-1} \text{ K}^{-1}$.^[8] This is relatively high when compared to other materials, for example the conductivity of wood may be as low as $0.04 \text{ W m}^{-1} \text{ K}^{-1}$. One way of mitigating the effects of thermal conduction is to introduce insulation (

see § Insulation).

Thermal mass

[edit]

The second consideration is the high thermal mass of concrete slabs, which applies similarly to walls and floors, or wherever concrete is used within the thermal envelope. Concrete has a relatively high thermal mass, meaning that it takes a long time to respond to changes in ambient temperature.^[9] This is a disadvantage when rooms are heated intermittently and require a quick response, as it takes longer to warm the entire building, including the slab. However, the high thermal mass is an advantage in climates with large daily temperature swings, where the slab acts as a regulator, keeping the building cool by day and warm by night.

Typically concrete slabs perform better than implied by their R-value.^[5] The R-value does not consider thermal mass, since it is tested under constant temperature conditions. Thus, when a concrete slab is subjected to fluctuating temperatures, it will respond more slowly to these changes and in many cases increase the efficiency of a building.^[5] In reality, there are many

factors which contribute to the effect of thermal mass, including the depth and composition of the slab, as well as other properties of the building such as orientation and windows.

Thermal mass is also related to thermal diffusivity, heat capacity and insulation. Concrete has low thermal diffusivity, high heat capacity, and its thermal mass is negatively affected by insulation (e.g. carpet).^[5]

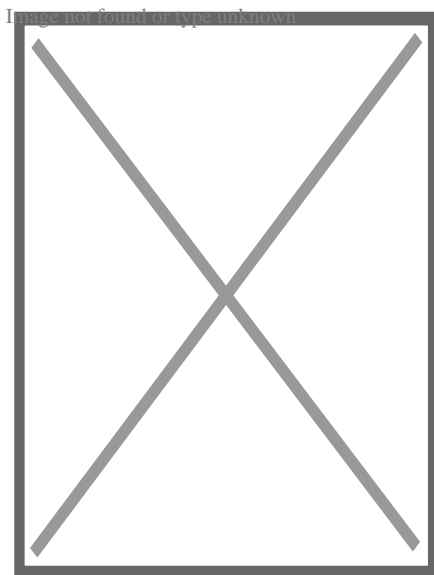
Insulation

[edit]

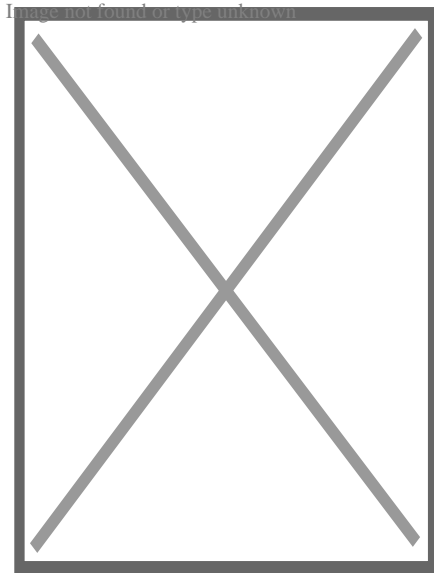
Without insulation, concrete slabs cast directly on the ground can cause a significant amount of extraneous energy transfer by conduction, resulting in either lost heat or unwanted heat. In modern construction, concrete slabs are usually cast above a layer of insulation such as expanded polystyrene, and the slab may contain underfloor heating pipes.^[10] However, there are still uses for a slab that is not insulated, for example in outbuildings which are not heated or cooled to room temperature (

see § Mud slabs). In these cases, casting the slab directly onto a substrate of aggregate will maintain the slab near the temperature of the substrate throughout the year, and can prevent both freezing and overheating.

A common type of insulated slab is the beam and block system (mentioned above) which is modified by replacing concrete blocks with expanded polystyrene blocks.^[11] This not only allows for better insulation but decreases the weight of slab which has a positive effect on load bearing walls and foundations.



Formwork set for concrete pour.



Concrete poured into formwork. This slab is ground-bearing and reinforced with steel rebar.

Design

[edit]

Further information: Marcus' method

Ground-bearing slabs

[edit]

See also: Shallow foundation § Slab on grade

Ground-bearing slabs, also known as "on-ground" or "slab-on-grade", are commonly used for ground floors on domestic and some commercial applications. It is an economical and quick construction method for sites that have non-reactive soil and little slope.^[12]

For ground-bearing slabs, it is important to design the slab around the type of soil, since some soils such as clay are too dynamic to support a slab consistently across its entire area. This results in cracking and deformation, potentially leading to structural failure of any members attached to the floor, such as wall studs.^[12]

Levelling the site before pouring concrete is an important step, as sloping ground will cause the concrete to cure unevenly and will result in differential expansion. In some cases, a naturally sloping site may be levelled simply by removing soil from the uphill site. If a site has a more significant grade, it may be a candidate for the "cut and fill" method, where soil from the higher ground is removed, and the lower ground is built up with fill.^[13]

In addition to filling the downhill side, this area of the slab may be supported on concrete piers which extend into the ground. In this case, the fill material is less important structurally as the dead weight of the slab is supported by the piers. However, the fill material is still necessary to support the curing concrete and its reinforcement.

There are two common methods of filling - *controlled fill* and *rolled fill*.^[13]

- **Controlled fill:** Fill material is compacted in several layers by a vibrating plate or roller. Sand fills areas up to around 800 mm deep, and clay may be used to fill areas up to 400 mm deep. However, clay is much more reactive than sand, so it should be used sparingly and carefully. Clay must be moist during compaction to homogenise it.^[13]
- **Rolled fill:** Fill is repeatedly compacted by an excavator, but this method of compaction is less effective than a vibrator or roller. Thus, the regulations on maximum depth are typically stricter.

Proper curing of ground-bearing concrete is necessary to obtain adequate strength. Since these slabs are inevitably poured on-site (rather than precast as some suspended slabs are), it can be difficult to control conditions to optimize the curing process. This is usually aided by a membrane, either plastic (temporary) or a liquid compound (permanent).^[14]

Ground-bearing slabs are usually supplemented with some form of reinforcement, often steel rebar. However, in some cases such as concrete roads, it is acceptable to use an unreinforced slab if it is adequately engineered (

see below).

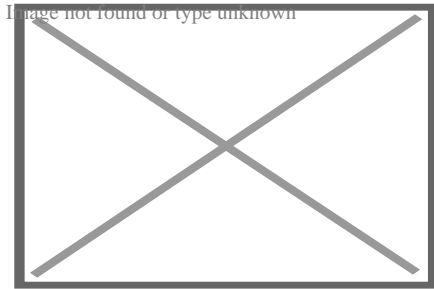
Suspended slabs

[edit]

For a suspended slab, there are a number of designs to improve the strength-to-weight ratio. In all cases the top surface remains flat, and the underside is modulated:

- A *corrugated slab* is designed when the concrete is poured into a corrugated steel tray, more commonly called decking. This steel tray improves strength of the slab, and prevents the slab from bending under its own weight. The corrugations run in one direction only.
- A *ribbed slab* gives considerably more strength in one direction. This is achieved with concrete beams bearing load between piers or columns, and thinner, integral ribs in the perpendicular direction. An analogy in carpentry would be a subfloor of bearers and joists. Ribbed slabs have higher load ratings than corrugated or flat slabs, but are inferior to waffle slabs.^[15]
- A *waffle slab* gives added strength in both directions using a matrix of recessed segments beneath the slab.^[16] This is the same principle used in the ground-bearing version, the

waffle slab foundation. Waffle slabs are usually deeper than ribbed slabs of equivalent strength, and are heavier hence require stronger foundations. However, they provide increased mechanical strength in two dimensions, a characteristic important for vibration resistance and soil movement.[¹⁷]



The exposed underside of a waffle slab used in a multi-storey building

Unreinforced slabs

[edit]

Unreinforced or "plain"[¹⁸] slabs are becoming rare and have limited practical applications, with one exception being the mud slab (

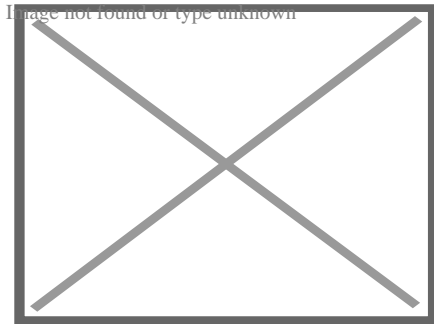
see below). They were once common in the US, but the economic value of reinforced ground-bearing slabs has become more appealing for many engineers.[¹⁰] Without reinforcement, the entire load on these slabs is supported by the strength of the concrete, which becomes a vital factor. As a result, any stress induced by a load, static or dynamic, must be within the limit of the concrete's flexural strength to prevent cracking.[¹⁹] Since unreinforced concrete is relatively very weak in tension, it is important to consider the effects of tensile stress caused by reactive soil, wind uplift, thermal expansion, and cracking.[²⁰] One of the most common applications for unreinforced slabs is in concrete roads.

Mud slabs

[edit]

Mud slabs, also known as *rat slabs*, are thinner than the more common suspended or ground-bearing slabs (usually 50 to 150 mm), and usually contain no reinforcement.[²¹] This makes them economical and easy to install for temporary or low-usage purposes such as subfloors, crawlspaces, pathways, paving, and levelling surfaces.[²²] In general, they may be used for any application which requires a flat, clean surface. This includes use as a base or "sub-slab" for a larger structural slab. On uneven or steep surfaces, this preparatory measure is necessary to provide a flat surface on which to install rebar and waterproofing membranes.[¹⁰] In this

application, a mud slab also prevents the plastic bar chairs from sinking into soft topsoil which can cause spalling due to incomplete coverage of the steel. Sometimes a mud slab may be a substitute for coarse aggregate. Mud slabs typically have a moderately rough surface, finished with a float.^[10]



Substrate and rebar prepared for pouring a mud slab

Axes of support

[edit]

One-way slabs

[edit]

A *one-way slab* has moment-resisting reinforcement only in its short axis, and is used when the moment in the long axis is negligible.^[23] Such designs include corrugated slabs and ribbed slabs. Non-reinforced slabs may also be considered one-way if they are supported on only two opposite sides (i.e. they are supported in one axis). A one-way reinforced slab may be stronger than a two-way non-reinforced slab, depending on the type of load.

The calculation of reinforcement requirements for a one-way slab can be extremely tedious and time-consuming, and one can never be completely certain of the best design.^[citation needed] Even minor changes to the project can necessitate recalculation of the reinforcement requirements. There are many factors to consider during the structural structure design of one-way slabs, including:

- Load calculations
- Bending moment calculation
- Acceptable depth of flexure and deflection
- Type and distribution of reinforcing steel

Two-way slabs

[edit]

A *two-way slab* has moment resisting reinforcement in both directions.^[24] This may be implemented due to application requirements such as heavy loading, vibration resistance, clearance below the slab, or other factors. However, an important characteristic governing the requirement of a two-way slab is the ratio of the two horizontal lengths. If $\frac{L_x}{L_y} \geq 2$, where L_x is the long dimension and L_y is the short dimension and L_x is the long dimension, then moment in both directions should be considered in design.^[25] In other words, if the axial ratio is greater than two, a two-way slab is required.

A non-reinforced slab is two-way if it is supported in both horizontal axes.

Construction

[edit]

A concrete slab may be prefabricated (precast), or constructed on site.

Prefabricated

[edit]

Prefabricated concrete slabs are built in a factory and transported to the site, ready to be lowered into place between steel or concrete beams. They may be pre-stressed (in the factory), post-stressed (on site), or unstressed.^[10] It is vital that the wall supporting structure is built to the correct dimensions, or the slabs may not fit.

On-site

[edit]

On-site concrete slabs are built on the building site using formwork, a type of boxing into which the wet concrete is poured. If the slab is to be reinforced, the rebars, or metal bars, are positioned within the formwork before the concrete is poured in.^[26] Plastic-tipped metal or plastic bar chairs, are used to hold the rebar away from the bottom and sides of the form-work, so that when the concrete sets it completely envelops the reinforcement. This concept is known as concrete cover. For a ground-bearing slab, the formwork may consist only of side walls pushed into the ground. For a suspended slab, the formwork is shaped like a tray, often supported by a temporary scaffold until the concrete sets.

The formwork is commonly built from wooden planks and boards, plastic, or steel. On commercial building sites, plastic and steel are gaining popularity as they save labour.^[27] On low-budget or small-scale jobs, for instance when laying a concrete garden path, wooden planks are very common. After the concrete has set the wood may be removed.

Formwork can also be permanent, and remain in situ post concrete pour. For large slabs or paths that are poured in sections, this permanent formwork can then also act as isolation joints within concrete slabs to reduce the potential for cracking due to concrete expansion or movement.

In some cases formwork is not necessary. For instance, a ground slab surrounded by dense soil, brick or block foundation walls, where the walls act as the sides of the tray and hardcore (rubble) acts as the base.

See also

[edit]

- Shallow foundation (Commonly used for ground-bearing slabs)
- Hollow-core slab (Voided slab, one-way spanning)
- Beam and block (voided slab, one way spanning)
- Voided biaxial slab (Voided slab, two-way spanning)
- Formwork
- Precast concrete
- Reinforced concrete
- Rebar
- Concrete cover

References


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1. ^ Garber, G. Design and Construction of Concrete Floors. 2nd ed. Amsterdam: Butterworth-Heinemann, 2006. 47. Print.
2. ^ Duncan, Chester I. Soils and Foundations for Architects and Engineers. New York: Van Nostrand Reinhold, 1992. 299. Print.
3. ^ "Ground slabs - Introduction". *www.dlsweb.rmit.edu.au*. Archived from the original on 2019-11-18. Retrieved 2017-12-07.
4. ^ "What is a rib and block slab?". *www.royalconcreteslabs.co.za*. Royal concrete slabs.
5. ^ **a b c d e** Cavanaugh, Kevin; et al. (2002). *Guide to Thermal Properties of Concrete and Masonry Systems: Reported by ACI Committee 122*. American Concrete Institute.
6. ^ **a b** Campbell-Allen, D.; Thorne, C.P. (March 1963). "The thermal conductivity of concrete". *Magazine of Concrete Research*. **15** (43): 39–48. doi:10.1680/mac.1963.15.43.39. UDC 691.32.001:536.21:691.322.

7. ^ Valore, R.C. Jr. (February 1980). "Calculation of U-values of Hollow Concrete Masonry". *Concrete International*. **2**: 40–63.
8. ^ Young, Hugh D. (1992). "Table 15.5". *University Physics* (7th ed.). Addison Wesley. ISBN 0201529815.
9. ^ Sabnis, Gajanan M.; Juhl, William (2016). "Chapter 4: Sustainability through Thermal Mass of Concrete". *Green Building with Concrete: Sustainable Design and Construction* (2nd ed.). Taylor & Francis Group. ISBN 978-1-4987-0411-3.
10. ^ **a b c d e** Garber, George (2006). *Design and Construction of Concrete Floors* (2nd ed.). Amsterdam: Butterworth-Heinemann. ISBN 978-0-7506-6656-5.
11. ^ "What is a polystyrene concrete slab?". www.royalconcreteslabs.co.za. Royal concrete slabs.
12. ^ **a b** McKinney, Arthur W.; et al. (2006). *Design of Slabs-on-Ground: Reported by ACI Committee 360* (PDF). American Concrete Institute. Archived from the original (PDF) on 2021-05-08. Retrieved 2019-04-04.
13. ^ **a b c** Staines, Allan (2014). *The Australian House Building Manual*. Pinedale Press. pp. 40–41. ISBN 978-1-875217-07-6.
14. ^ "Concrete in Practice 11 - Curing In-Place Concrete" (PDF). Engineering.com. National Ready Mixed Concrete Association. Archived from the original (PDF) on 4 April 2019. Retrieved 4 April 2019.
15. ^ "Ribbed Slabs Datasheet" (PDF). Kaset Kalip. Archived from the original (PDF) on 29 March 2018. Retrieved 4 April 2019.
16. ^ "Ribbed and waffle slabs". www.concretecentre.com. Retrieved 2019-04-04.
17. ^ *Concrete Framed Buildings: A Guide to Design and Construction*. MPA The Concrete Centre. 2016. ISBN 978-1-904818-40-3.
18. ^ Garrison, Tim (19 February 2014). "Clearing the confusion on 'plain concrete'". *Civil & Structural Engineer*. Archived from the original on 8 May 2019. Retrieved 8 May 2019.
19. ^ Walker, Wayne. "Reinforcement for slabs on ground". *Concrete Construction*. Retrieved 8 May 2019.
20. ^ "Rupture depth of an unreinforced concrete slab on grade" (PDF). Aluminium Association of Florida, Inc. Archived from the original (PDF) on 2020-09-26. Retrieved 2019-05-08.
21. ^ Arcoma, Peter. "What is a mud slab?". *Builder-Questions.com*. Retrieved 8 May 2019.
22. ^ Postma, Mark; et al. "Floor Slabs". *Whole Building Design Guide*. National Institute of Building Sciences. Retrieved 8 May 2019.
23. ^ Gilbert, R. I. (1980). UNICIV Report 211 (PDF). University of New South Wales.
24. ^ Prieto-Portar, L. A. (2008). EGN-5439 The Design of Tall Buildings; Lecture #14: The Design of Reinforced Concrete Slabs (PDF). Archived from the original (PDF) on 2017-08-29. Retrieved 2019-04-04.
25. ^ "What is the difference between one way and two way slab?". *Basic Civil Engineering*. 16 June 2019. Retrieved 8 July 2019.
26. ^ *Concrete Basics: A Guide to Concrete Practice* (6th ed.). Cement Concrete & Aggregates Australia. 2004. p. 53.
27. ^ Nemati, Kamran M. (2005). "Temporary Structures: Formwork for Concrete" (PDF). Tokyo Institute of Technology. Archived from the original (PDF) on 12 July 2018. Retrieved 4 April 2019.

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- *Concrete Basics: A Guide to Concrete Practice*
- *Super Insulated Slab Foundations*
- *Design of Slabs on Ground* Archived 2021-05-08 at the Wayback Machine

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Concrete

History

- Ancient Roman architecture
- Roman architectural revolution
- Roman concrete
- Roman engineering
- Roman technology

Composition

- Cement
 - Calcium aluminate
 - Energetically modified
 - Portland
 - Rosendale
- Water
- Water–cement ratio
- Aggregate
- Reinforcement
- Fly ash
- Ground granulated blast-furnace slag
- Silica fume
- Metakaolin

Production

- Plant
- Concrete mixer
- Volumetric mixer
- Reversing drum mixer
- Slump test
- Flow table test
- Curing
- Concrete cover
- Cover meter
- Rebar

Construction

- Precast
- Cast-in-place
- Formwork
- Climbing formwork
- Slip forming
- Screed
- Power screed
- Finisher
- Grinder
- Power trowel
- Pump
- Float
- Sealer
- Tremie

Science

- Properties
- Durability
- Degradation
- Environmental impact
- Recycling
- Segregation
- Alkali–silica reaction

Types

- AstroCrete
- Fiber-reinforced
- Filigree
- Foam
- Lunarcrete
- Mass
- Nanoconcrete
- Pervious
- Polished
- Polymer
- Prestressed
- Ready-mix
- Reinforced
- Roller-compacting
- Self-consolidating
- Self-leveling
- Sulfur
- Tabby
- Translucent
- Waste light
- Aerated
 - AAC
 - RAAC

Applications

- Slab
 - waffle
 - hollow-core
 - voided biaxial
 - slab on grade
- Concrete block
- Step barrier
- Roads
- Columns
- Structures

Organizations

- American Concrete Institute
- Concrete Society
- Institution of Structural Engineers
- Indian Concrete Institute
- Nanocem
- Portland Cement Association
- International Federation for Structural Concrete

Standards

- Eurocode 2
- EN 197-1
- EN 206-1
- EN 10080

See also

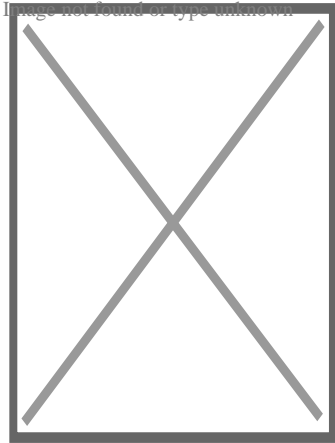
- Hempcrete

-  **Category:Concrete**

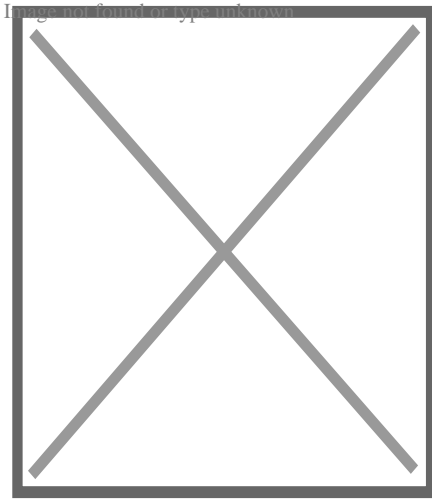
About bedrock

For other uses, see [Bedrock \(disambiguation\)](#).

"Subsurface" redirects here. For other uses, see [Subsurface \(disambiguation\)](#).



Soil with broken rock fragments overlying bedrock, Sandside Bay, Caithness, Scotland



Soil profile with bedrock labeled R

In geology, **bedrock** is solid rock that lies under loose material (regolith) within the crust of Earth or another terrestrial planet.

Definition

[edit]

Bedrock is the solid rock that underlies looser surface material.^[1] An exposed portion of bedrock is often called an outcrop.^[2] The various kinds of broken and weathered rock material, such as soil and subsoil, that may overlie the bedrock are known as regolith.^[3]^[4]

Engineering geology

[edit]

The surface of the bedrock beneath the soil cover (regolith) is also known as *rockhead* in engineering geology,^[5]^[6] and its identification by digging, drilling or geophysical methods is an important task in most civil engineering projects. Superficial deposits can be very thick, such that the bedrock lies hundreds of meters below the surface.^[7]

Weathering of bedrock

[edit]

Exposed bedrock experiences weathering, which may be physical or chemical, and which alters the structure of the rock to leave it susceptible to erosion. Bedrock may also experience subsurface weathering at its upper boundary, forming saprolite.^[8]









Geologic map

[edit]

A geologic map of an area will usually show the distribution of differing bedrock types, rock that would be exposed at the surface if all soil or other superficial deposits were removed. Where superficial deposits are so thick that the underlying bedrock cannot be reliably mapped, the superficial deposits will be mapped instead (for example, as alluvium).^[9]

See also

[edit]

-   [Geology portal](#)
-   [Geography portal](#)
-   [Maps portal](#)
-   [Minerals portal](#)

References

[edit]

- ↑ *Jackson, Julia A., ed. (1997). "Bedrock". *Glossary of geology* (4th ed.). Alexandria, Virginia: American Geological Institute. ISBN 0922152349.*
- ↑ Jackson 1997, "Outcrop".
- ↑ Jackson 1997, "Regolith".
- ↑ *Allaby, Michael (2013). "Regolith". *A dictionary of geology and earth sciences* (4th ed.). Oxford: Oxford University Press. ISBN 9780199653065.*
- ↑ *Price, David George (2009). "The Basis of Engineering Geology". In de Freitas, Michael H. (ed.). *Engineering Geology: Principles and Practice*. Springer. p. 16. ISBN 978-3540292494.*
- ↑ *McLean, A.C.; Gribble, C.D. (9 September 1985). *Geology for Civil Engineers* (Second ed.). CRC Press. p. 113. ISBN 978-0419160007.*
- ↑ *Swinford, E. Mac (2004). "What the glaciers left behind – the drift-thickness map of Ohio" (PDF). *Ohio Geology*. No. 1. Ohio Department of Natural Resources, Division of Geological Survey. pp. 1, 3–5. Archived (PDF) from the original on 2 October 2012. Retrieved 12 September 2012.*
- ↑ *Lidmar-Bergström, Karna; Olsson, Siv; Olvmo, Mats (January 1997). "Palaeosurfaces and associated saprolites in southern Sweden". *Geological Society, London, Special Publications*. **120** (1): 95–124. Bibcode:1997GSLSP.120...95L. doi:10.1144/GSL.SP.1997.120.01.07. S2CID 129229906. Retrieved 21 April 2010.*
- ↑ *"Digital Geology – Bedrock geology theme". *British Geological Survey*. Archived from the original on 13 December 2009. Retrieved 12 November 2009.*

Further reading

[edit]

- *Rafferty, John P. "Bedrock". Encyclopædia Britannica. Archived from the original on 29 July 2019. Retrieved 1 April 2019.*
- *Harris, Clay (2013). "Bedrock". In Lerner, K. Lee; Lerner, Brenda Wilmoth (eds.). The Gale Encyclopedia of Science. Vol. 1 (5th ed.). Farmington Hills, MI: Cengage Gale. pp. 515–516.*

External links

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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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About Cook County

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Things To Do in Cook County

Photo

Sand Ridge Nature Center

4.8 (96)

Photo

Image not found or type unknown

River Trail Nature Center

4.6 (235)

Photo

Image not found or type unknown

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-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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<https://www.google.com/maps/dir/Palmisano+%28Henry%29+Park/United+Structural+Systems+of+Illinois%2C-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.



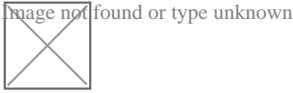
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Sarah McNeily

(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

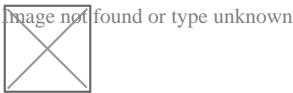
an area of the yard. We've had other services from different companies and our yard was really a mess after. They kept the job site meticulously clean. The crew was on time and friendly. I'd recommend them any day! Thanks to Jessie and crew.



Jim de Leon

(5)

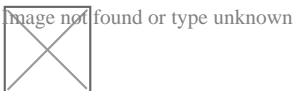
It was a pleasure to work with Rick and his crew. From the beginning, Rick listened to my concerns and what I wished to accomplish. Out of the 6 contractors that quoted the project, Rick seemed the MOST willing to accommodate my wishes. His pricing was definitely more than fair as well. I had 10 push 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 Expansive Clay and Its Impact on Foundations [View GBP](#)

Check our other pages :

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