Foundation Repair

- **Repair Methods and Advanced Techniques of foundation cracks**
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Detailed explanation of the underpinning process, including the various methods employed such as mass concrete underpinning, mini-piled underpinning, and screw pile underpinning.

Underpinning is a crucial technique used in construction to stabilize and strengthen existing structures that have suffered from settlement issues or require additional load-bearing capacity. Expert contractors use specialized techniques to stabilize shifting foundations **foundation crack repair service** masonry. This process involves extending the depth or breadth of existing foundations to improve their stability. Let's delve into the detailed explanation of the underpinning process, including the various methods employed such as mass concrete underpinning, mini-piled underpinning, and screw pile underpinning.

Mass concrete underpinning is one of the oldest and most traditional methods of underpinning. It involves excavating beneath the existing foundation in small sections and pouring mass concrete to create a new, deeper foundation. This method is effective for structures with shallow foundations and is particularly useful when the soil conditions are stable. The process is relatively straightforward but requires careful planning to ensure that the structure remains stable during the excavation and pouring stages.

Mini-piled underpinning is a more modern approach that involves drilling small-diameter piles into the ground beneath the existing foundation. These piles are typically between 100mm and 300mm in diameter and are reinforced with steel bars. Once the piles reach the desired depth, they are filled with concrete, creating a strong and stable support system. Mini-piled underpinning is particularly useful in urban areas where space is limited, as the small size of the piles means that they can be installed with minimal disruption to the surrounding area.

Screw pile underpinning is another contemporary method that has gained popularity due to its efficiency and minimal invasiveness. This technique involves screwing helical piles into the ground beneath the existing foundation. These piles are made from steel and have large helical plates that grip the soil as they are installed. Once the piles are in place, they are connected to the existing foundation using brackets and additional concrete. Screw pile underpinning is advantageous in situations where the soil conditions are challenging, as the helical plates can penetrate through various soil types with ease.

Each of these underpinning methods has its own set of advantages and is chosen based on the specific requirements of the project, including the type of structure, soil conditions, and access constraints. Regardless of the method used, the goal of underpinning remains the same: to provide a stable and secure foundation that can support the existing structure for years to come. By understanding the various methods of underpinning, construction professionals can make informed decisions that ensure the safety and longevity of the structures they work on.

Examination of the common causes of foundation instability in residential buildings, such as soil erosion, poor construction practices, and natural disasters, and how underpinning addresses these issues.

Certainly!

When it comes to the stability of residential buildings, the foundation plays a crucial role. Unfortunately, several common causes can lead to foundation instability, posing serious risks to the structure and safety of homes. Among these causes are soil erosion, poor construction practices, and natural disasters. Each of these factors can compromise the integrity of a building's foundation, leading to cracks, settlement, and even collapse in severe cases.

Soil erosion is a gradual process where the topsoil is washed away by natural elements like water or wind. Over time, this can lead to a loss of support under the foundation, causing it to become unstable. Poor construction practices, on the other hand, can manifest in various ways, such as inadequate compaction of soil, improper drainage around the foundation, or using substandard materials. These mistakes can weaken the foundation from the get-go, making the building susceptible to instability.

Natural disasters like earthquakes, floods, and hurricanes can also wreak havoc on foundations. The force exerted by these events can displace soil, cause significant structural damage, or lead to sudden shifts in the ground beneath the building. In the aftermath of such disasters, many buildings are left with compromised foundations that require immediate attention.

This is where underpinning comes into play as a stabilization approach. Underpinning is a construction process used to increase the depth or width of existing foundation soil, lower the foundation to a new depth, increase the bearing capacity of soil under the foundation, or correct construction faults of the original foundation.

By reinforcing the foundation, underpinning effectively addresses the issues caused by soil erosion, poor construction, and natural disasters. It provides additional support and stability, ensuring that the building remains safe and secure. Whether it's through mass concrete underpinning, mini-piled underpinning, or beam and base underpinning, the goal remains the same: to restore and enhance the stability of the foundation.

In conclusion, while soil erosion, poor construction practices, and natural disasters pose significant threats to the stability of residential buildings, underpinning offers a reliable solution. By addressing the root causes of foundation instability, underpinning not only repairs but also strengthens the foundation, ensuring the longevity and safety of the building.

Case studies showcasing successful underpinning projects in residential settings, illustrating the effectiveness and benefits of this approach in restoring structural integrity.

Exploring underpinning as a stabilization approach in residential settings reveals a wealth of case studies showcasing its effectiveness and benefits. One notable example is a Victorian townhouse in London that had been suffering from significant subsidence due to nearby construction work. The property, with its intricate architecture and historical significance, required a delicate yet robust solution to restore its structural integrity.

Underpinning was chosen as the method to stabilize the foundation. Engineers employed a technique known as mass concrete underpinning, where a series of concrete piles were driven deep into the ground beneath the existing foundation. These piles provided additional support, effectively counteracting the subsidence. The process involved careful excavation, placement of the piles, and then pouring concrete to form a new, stable foundation.

The results were remarkable. Not only did the subsidence cease, but the structural stability of the townhouse was significantly enhanced. The owners reported no further issues with cracks in the walls or uneven floors. Moreover, the value of the property increased, as potential buyers were reassured by the thorough stabilization work.

Another compelling case is a modern apartment building in New York City that experienced foundation settlement due to the weight of additional floors added over the years. Traditional underpinning methods were insufficient for this complex scenario. Instead, engineers opted for a more innovative approach: helical piers. These screw-like structures were driven deep into the soil, providing substantial support without the need for extensive excavation.

The helical piers were installed with precision, ensuring minimal disruption to the residents. Once in place, they effectively transferred the building's load to more stable soil layers, halting the settlement and restoring the building's stability. The success of this project not only preserved the structural integrity of the apartment building but also set a precedent for future stabilization projects in urban environments.

These case studies underscore the versatility and effectiveness of underpinning as a stabilization approach. Whether dealing with historical buildings or modern structures, underpinning offers a reliable solution to restore and maintain structural integrity, ensuring safety and longevity for residential properties.

Discussion on the cost-effectiveness of underpinning compared to other foundation repair methods, including long-term savings and increased property value.

When considering the cost-effectiveness of underpinning as a foundation repair method, it's crucial to weigh both immediate expenses and long-term benefits, including potential increases in property value. Underpinning, the process of strengthening and stabilizing an existing foundation, is often seen as a more expensive option upfront compared to other repair methods like crack injection or helical piers. However, its long-term advantages can make it a more cost-effective choice in the end.

One of the primary benefits of underpinning is its ability to provide a permanent solution to foundation issues. Unlike temporary fixes that may need frequent repairs, underpinning addresses the root cause of foundation problems, ensuring structural stability for years to come. This durability can lead to significant savings over time, as homeowners avoid the costs associated with repeated repairs.

Moreover, underpinning can enhance a property's value. A stable foundation is a key factor in a home's appraisal, and underpinning can reassure potential buyers of the home's structural integrity. This can lead to a higher selling price, offsetting the initial cost of the repair.

In comparing underpinning to other methods, it's important to consider the specific needs of the foundation. For minor cracks, simpler and cheaper methods might suffice. However, for more severe issues like significant settling or shifting, underpinning offers a comprehensive solution that other methods may not provide. The investment in underpinning can thus be seen as an investment in the home's future, offering peace of mind and financial security.

In conclusion, while underpinning may require a larger initial investment, its long-term cost-effectiveness, durability, and potential to increase property value make it a compelling option for foundation repair. Homeowners should carefully evaluate their specific situation and consider the long-term benefits when choosing a foundation repair method.

Overview of the environmental impact of underpinning, focusing on sustainable practices and materials used in the process to minimize ecological footprint.

Underpinning is a crucial technique in civil engineering, primarily used to stabilize existing structures by increasing the depth or breadth of their foundations. While its importance in structural integrity is undeniable, the environmental impact of underpinning deserves careful consideration, especially in the context of sustainable practices and the use of eco-friendly materials.

Traditionally, underpinning involves significant excavation and the use of materials like concrete, which has a high carbon footprint due to its production process. However, advancements in technology and a growing awareness of environmental issues have led to the adoption of more sustainable practices in underpinning.

One of the key sustainable practices in underpinning is the use of materials with a lower environmental impact. For instance, recycled aggregates can be used in concrete mixes, reducing the demand for virgin materials and lowering the carbon footprint. Additionally, the use of geopolymer concrete, which is made from industrial by-products like fly ash or slag, offers a more environmentally friendly alternative to traditional Portland cement.

Another sustainable approach is the implementation of minimal invasive techniques. Methods like micro-piling and jet grouting require less excavation compared to traditional underpinning, thereby reducing disturbance to the surrounding environment. These techniques also allow for more precise underpinning, minimizing waste and the need for excessive material use.

Energy efficiency is another critical aspect. Using renewable energy sources to power equipment during the underpinning process can significantly reduce the carbon emissions associated with this activity. Furthermore, adopting practices that reduce water usage and manage waste effectively are essential components of sustainable underpinning.

In conclusion, while underpinning is vital for the stabilization of structures, its environmental impact can be mitigated through the adoption of sustainable practices and materials. By choosing eco-friendly materials, employing less invasive techniques, and focusing on energy efficiency, the construction industry can significantly reduce the ecological footprint of underpinning projects. This approach not only preserves the integrity of existing structures but also contributes to the broader goal of environmental sustainability in construction.

Insights into the regulatory and safety standards governing underpinning in residential construction, ensuring compliance and safety in repair works.

Exploring underpinning as a stabilization approach in residential construction is crucial for ensuring the structural integrity and longevity of buildings. This method is particularly vital when dealing with foundation issues that threaten the stability of homes. However, the process of underpinning is not without its complexities, especially when considering the regulatory and safety standards that govern these practices.

Firstly, it's important to understand what underpinning entails. Essentially, underpinning is a construction process where the foundation of a building is deepened or reinforced to provide additional support. This might be necessary due to various reasons such as soil movement, changes in water levels, or the need to extend the building upwards. The goal is to stabilize the structure and prevent further deterioration or collapse.

When it comes to regulatory and safety standards, there are several key aspects to consider. In many countries, underpinning work is subject to strict building codes and regulations. These codes are designed to ensure that the underpinning process is carried out in a manner that is safe for both the workers and the occupants of the building. They also aim to ensure that the work done will be effective in stabilizing the structure for the long term.

One of the primary regulatory considerations is obtaining the necessary permits. This typically involves submitting detailed plans and specifications to local authorities for approval. These plans must demonstrate compliance with current building codes and safety standards. This step is crucial not only for legal reasons but also for ensuring that the work is conducted in a manner that will be effective and safe.

Safety standards during the underpinning process are equally important. Workers must adhere to strict safety protocols to protect themselves from potential hazards such as collapsing structures, heavy machinery, and hazardous materials. This includes wearing appropriate personal protective equipment, following safe work practices, and ensuring that the work area is secure and free from unnecessary risks.

Moreover, the materials used in underpinning must meet specific standards to ensure durability and effectiveness. This might include using high-quality concrete, steel reinforcements, and other materials that are tested and approved for construction purposes. The installation of these materials must also be done according to precise specifications to ensure that the underpinning is effective.

In addition to these considerations, ongoing monitoring and maintenance are often required to ensure that the underpinning remains effective over time. This might involve periodic inspections by qualified professionals to check for signs of deterioration or movement in the foundation. Any issues identified during these inspections must be addressed promptly to maintain the stability of the building.

In conclusion, exploring underpinning as a stabilization approach in residential construction requires a thorough understanding of the regulatory and safety standards that govern this practice. By ensuring compliance with these standards, builders and homeowners can achieve a stable and secure foundation that will support the structure for years to come. This not only protects the investment in the property but also ensures the safety and well-being of those who live and work within it.

Future trends and innovations in underpinning technology, exploring how advancements in materials and techniques are enhancing the efficiency and reliability of this stabilization approach.

In recent years, the field of construction and civil engineering has seen remarkable advancements in underpinning technology. This stabilization approach, which involves strengthening the foundation of an existing building or other structure, has evolved significantly due to innovations in materials and techniques. These advancements are not only enhancing the efficiency of underpinning projects but are also improving their reliability and overall effectiveness.

One of the most notable trends in underpinning is the use of advanced composite materials. These materials, which include carbon fiber-reinforced polymers (CFRP) and glass fiber-reinforced polymers (GFRP), offer superior strength-to-weight ratios compared to traditional materials like steel and concrete. Their application in underpinning allows for lighter yet stronger solutions, reducing the overall load on the structure and speeding up the installation process. Moreover, these materials are resistant to corrosion, which significantly extends the lifespan of the underpinning work.

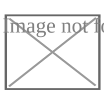
Another exciting development is the integration of smart materials and sensors in underpinning projects. Smart materials can adapt to environmental changes, providing real-time data on the condition of the foundation. For instance, self-healing concrete is being explored for its potential to repair cracks automatically, thereby maintaining the integrity of the underpinning over time. Additionally, the use of sensors and IoT (Internet of Things) technology enables continuous monitoring of the structure, allowing engineers to detect issues early and take proactive measures to prevent failure.

Techniques in underpinning have also seen significant improvements. Traditional methods like mass concrete underpinning, which involve digging pits under the existing foundation and pouring concrete, are being supplemented with more innovative approaches. One such method is the use of helical piers, which are screw-like piles that are driven into the ground to provide support. This technique is less invasive than traditional methods, causing minimal disruption to the surrounding area and reducing the risk of further destabilizing the structure during installation.

Furthermore, the adoption of 3D printing technology in construction is beginning to influence underpinning practices. 3D printing allows for the precise fabrication of complex geometries that can be tailored to the specific needs of a project. This customization can lead to more efficient and effective underpinning solutions, as well as reduced material waste.

In conclusion, the future of underpinning as a stabilization approach looks promising, thanks to these advancements in materials and techniques. As technology continues to evolve, we can expect even more innovative solutions that will further enhance the efficiency, reliability, and sustainability of underpinning projects. These developments not only benefit the construction industry but also contribute to safer and more resilient built environments.

About basement waterproofing



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

Purpose

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

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

Methods

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

French Drain

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  French drain
  Interior wall and floor sealers
- Interior water drainage
- Exterior drainage
- Exterior waterproofing coatings
- Box type waterproofing[1]
- Foundation crack injections
- French drains
- Sump pump

Interior sealants

[edit]

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

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

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

Interior water drainage

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

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

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

Exterior waterproofing

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

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

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

Polymer

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

Causes of water seepage and leaks

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

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

Warning signs of water damage

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

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

Foundation crack injections

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

References

[edit]

1. **^** *Waheed, M. A. (11 July 2014). "Top tips to optimally use conventional waterproofing techniques". Business Standard India. Archived from the original on 5 July 2022. Retrieved 28 May 2021.*
2. **^** *"FloodSmart | How to Prepare for a Flood and Minimize Losses". Archived from the original on 9 May 2020. Retrieved 20 March 2020.*
3. **^** *Carter, Tim. "How to redirect water around a damp garage". The Washington Post. Archived from the original on 15 August 2016. Retrieved 2 November 2015.*
4. **^** *Chodorov, Jill. "Basement flooding may put a damper on your home sale". The Washington Post. Archived from the original on 18 May 2018. Retrieved 2 November 2015.*

About foundation

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

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

Common uses

[edit]

- Foundation (cosmetics), a skin-coloured makeup cream applied to the face

- Foundation (engineering), the element of a structure which connects it to the ground, and transfers loads from the structure to the ground
- Foundation (evidence), a legal term
- Foundation (nonprofit), a type of charitable organization
    - Foundation (United States law), a type of charitable organization in the U.S.
    - Private foundation, a charitable organization that might not qualify as a public charity by government standards

Arts, entertainment, and media

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Film and TV

[edit]

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

Games

[edit]

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

Literature

[edit]

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

Music

[edit]

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

Albums

[edit]

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

Songs

[edit]

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

Other uses in arts, entertainment, and media

[edit]

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

Education

[edit]

- Foundation degree, a British academic qualification
- Foundation school, a type of school in England and Wales
- Foundation Stage, a stage of education for children aged 3 to 5 in England
- University Foundation Programme, a British university entrance course

Science and technology

[edit]

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

Companies

[edit]

- Foundation Medicine, a genomic profiling company

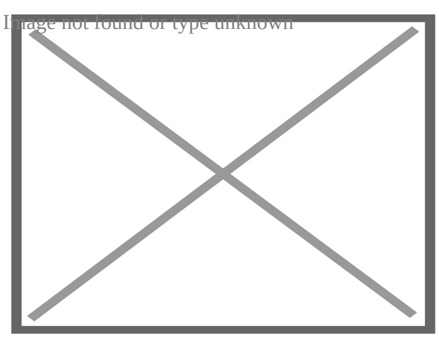
See also

[edit]

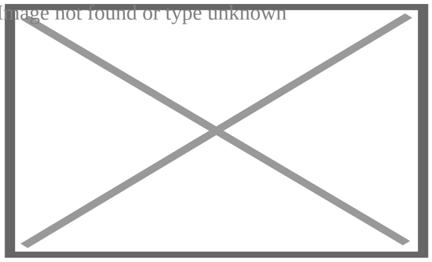
- All pages with titles beginning with *Foundation*
- All pages with titles beginning with *The Foundation*
- Foundations of mathematics, theory of mathematics

Disambiguation icon
Image not found or type unknown
This disambiguation page lists articles associated with the title **Foundation**.
If an internal link led you here, you may wish to change the link to point directly to the intended article.

About 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

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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

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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 W m$^{?1}$ 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 W m$^{?1}$ K$^{?1}$. One way of mitigating the effects of thermal conduction is to introduce insulation (

see § Insulation).

Thermal mass

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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]

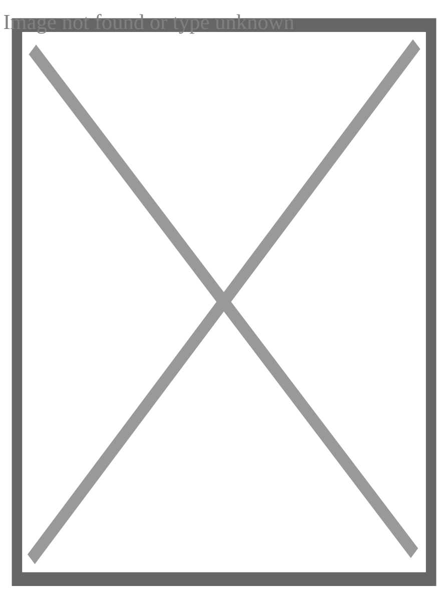
Insulation

[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.

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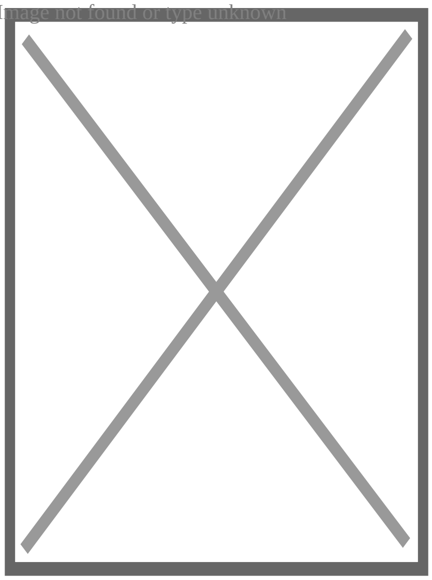


Concrete poured into formwork. This slab is ground-bearing and reinforced with steel rebar.

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 (

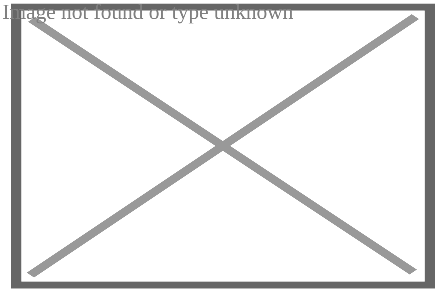
see below).

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]

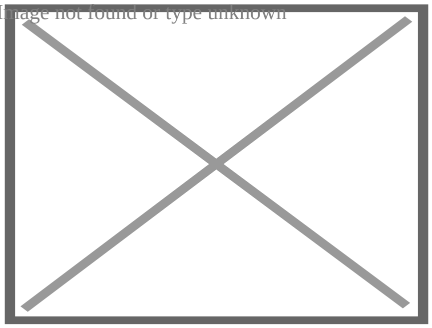
Unreinforced or "plain"[18] slabs are becoming rare and have limited practical applications, with one exception being the mud slab (

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 L_x where L_x is the short dimension and L_y 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

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[edit]

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External links

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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

○ Image not found or type unknown Category:Concrete

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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

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Jeffery James

(5)

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

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Sarah McNeily

(5)

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

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Jim de Leon

(5)

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

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Chris Abplanalp

(5)

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

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Dave Kari

(5)

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

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United Structural Systems of Illinois, Inc

Phone : +18473822882

City : Hoffman Estates

State : IL

Zip : 60169

Address : 2124 Stonington Ave

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