Foundation Work

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

Smart sensor technology has revolutionized various industries, and its relevance to foundation monitoring is particularly noteworthny In essence , smart sensors are devices that can detect , record ,and transmit data , providing real - time insights into environmental changes . Obtaining permits is an essential step in any professional foundation repair service **foundation crack repair service near me** property insurance. When it comes Identifying Early Shifts In foundational structures , smart sensor technology plays crucial role . Foundation monitoring traditionally involved manual inspections , which were time-consuming , labor-intensive , and often lacked precision . With the advent of smart sensors , this process has become more efficient and accurate .

Smart sensors can be embedded within foundational structures to continuously monitor parameters such as strain , tilt , humidity , and temperature . These sensors can detect even the slightest shifts or deformations in the structure , which might indicate potential issues like settlement , subsidence, or structural fatigue . The data collected by these sensors is transmitted wirelessly to a central system , where it can be analyzed in real time . This allows engineers and maintenance teams to identify early shifts and address them before they become critical problems .

One of the key advantages of smart sensor technology in foundation monitoring is its ability to provide continuous , real-time data . This is particularly important for structures in areas prone to natural disasters or those undergoing significant environmental changes . For instance , during heavy rainfall or earthquakes , foundations can experience sudden shifts . Smart sensors can immediately detect these changes , alert maintenance teams ,and potentially prevent catastrophic failures . Additionally ,the historical data collected by these sensors can help understand long term trends affecting foundation stability . This information can inform better design practices for future constructions . Overall smart sensor technology significantly enhances foundation monitoring by providing timely , accurate data supporting preventative maintenance strategies thus ensuring structural integrity and safety

Types of smart sensors used in detecting early shifts in residential foundations, such as tilt sensors, moisture sensors etc.. Their working principles explained briefly . . . .

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In the realm of residential foundation monitoring, early detection of shifts can prevent significant structural issues down the line . Thanks to advancements in smart sensor technology , homeowners now have access to innovative solutions that can identify these early shifts efficiently . Several types of smart sensors play crucial roles in this process , each operating on unique working principles . Here , we will explore some key types : tilt sensors , moisture sensors , among others . . . . ,.,.,.,.,.,.,.. __ __ __ __ __ __ __ __ __ __.__ _____.___ _____.___ _____.___ _____.___ _____.___ _____.__ _ _ _ _ _ _ _, _, _, _, _, _, _. ______________________________ _ _ _ _ _ . . . . Tilt sensors are instrumental in detecting angular changes in foundations , which could indicate shifts or settling issues Tilt sensors typically utilize MEMS (Micro - Electro - Mechanical Systems) technology These sensors contain tiny mechanical elements that move in response to changes in orientation As these elements shift , they alter electrical capacitance or resistance , which is then measured by an integrated circuit The resulting data provides real - time information on any tilt or inclination occurring within residential foundations This information can then be wirelessly transmitted via communication protocol such as Zigbee or Bluetooth allowing homeowners continuous monitoring via mobile apps or central hubs Moisture sensors are another critical tool they help detect water intrusion or excessive humidity levels which can lead to foundation issues These sensors operate on principles of electrical conductivity or capacitance Changes in moisture levels alter these properties within the sensor s material The sensor then converts these changes into electrical signals which are processed to indicate moisture presence or its absence Additionally some advanced systems combine both tilt and moisture sensing capabilities along with other environmental parameters such as temperature and pressure This holistic approach offers a comprehensive picture of the foundation s health Other sensors like strain gauges and accelerometers also contribute to early shift detection Strain gauges measure mechanical deformation when foundations shift The resistance change due to deformation is converted into electrical signals Accelerometers on other hand measure vibrations and accelerations using piezoelectric or capacitive sensing methods These signals can indicate sudden movements or impacts affecting the foundation s stability Overall smart sensor technology offers an effective non - invasive method for identifying early shifts in residential foundations By providing real - time data and continuous monitoring these devices empower homeowners to take proactive measures ensuring their properties structural integrity remains intact

How smart sensors can detect minor movements and changes in foundation structures before visible damage occurs.

In the realm of civil engineering and infrastructure management, detecting early shifts and minor movements in foundation structures is crucial for preventing catastrophic failures and ensuring public safety. This is where smart sensor technology steps into the spotlight, offering a proactive approach to structural health monitoring.

Smart sensors are not your average sensors; they are equipped with advanced capabilities that allow them to detect even the slightest changes in a structure's integrity. By embedding these sensors within foundations, we can monitor structures in real-time, picking up on subtle movements, tilts, and stresses that would otherwise go unnoticed until visible damage occurs.

One of the key advantages of smart sensors is their ability to collect and transmit data continuously. This data can be analyzed using sophisticated algorithms to identify patterns and anomalies that indicate potential issues. For instance, a slight shift in a building's foundation due to soil settlement or groundwater changes can be detected early, allowing engineers to intervene before the problem escalates.

These sensors utilize various technologies such as accelerometers, strain gauges, and fiber optic sensors to measure different parameters like displacement, strain, and temperature. Accelerometers can detect minor vibrations and movements, while strain gauges measure deformation in structural components. Fiber optic sensors are particularly useful for monitoring large structures like bridges and tunnels, as they can cover extensive areas and provide highly accurate measurements.

The integration of smart sensor technology with IoT (Internet of Things) platforms further enhances their effectiveness. IoT enables real-time data transmission to cloud servers, where advanced analytics tools can process the information and generate alerts if any irregularities are detected. This seamless flow of data ensures that engineers and maintenance teams are always informed about the structural health of critical infrastructure.

Moreover, smart sensors are designed to be robust and durable, capable of withstanding harsh environmental conditions such as extreme temperatures, humidity, and corrosive elements. This durability ensures reliable performance over extended periods, making them ideal for long-term monitoring of infrastructure like buildings, bridges, dams, and tunnels.

In conclusion, smart sensor technology represents a significant leap forward in identifying early shifts and minor movements in foundation structures. By providing real-time data and early warnings, these sensors enable proactive maintenance and preventive measures, ultimately saving costs associated with repairs and ensuring the safety of people who rely on these structures daily. As we continue to innovate and integrate these technologies into our infrastructure management practices, we move closer to creating smarter cities with safer buildings and more resilient communities.

The benefits of using smart sensor technology for homeowners, including cost savings, enhanced safety, and maintenance prediction..
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In the realm of modern homeownership, embracing smart sensor technology is no longer just a luxury but a strategic move that offers a multitude of benefits. These benefits range from significant cost savings to enhanced safety and even predictive maintenance. When it comes to identifying early shifts with smart sensor technology, the advantages become even more pronounced.

Smart sensors are designed to monitor various aspects of a home, such as temperature, humidity, air quality, water leaks, and even structural integrity. By continuously collecting data, these sensors can detect subtle changes or anomalies that may indicate potential issues long before they become major problems. For instance, a slight increase in humidity levels in a basement could signal an impending mold problem or water leakage. Early detection allows homeowners to address these issues promptly, preventing extensive damage and costly repairs down the line.

One of the most compelling aspects of smart sensor technology is its ability to enhance safety. Sensors can monitor for hazards such as smoke, carbon monoxide, and gas leaks. By providing real-time alerts directly to a homeowner's smartphone or other devices, these sensors ensure that emergencies are dealt with swiftly and effectively. This proactive approach not only safeguards the property but also provides peace of mind for residents, knowing that their home is being monitored constantly for any signs of danger.

Moreover, smart sensors play a crucial role in maintenance prediction. By analyzing historical data and current readings, these systems can forecast when certain components or appliances might need servicing or replacement. For example, a sensor monitoring the performance of an HVAC system can alert homeowners to wear and tear before it leads to breakdowns during extreme weather conditions. This predictive capability helps in scheduling timely maintenance checks and avoiding unexpected disruptions in daily life.

The financial benefits are another key advantage of using smart sensor technology. Early detection of issues means minor fixes rather than major overhauls, leading to substantial cost savings over time. Additionally, many insurance companies offer discounts on premiums for homes equipped with smart sensor systems due to their risk-mitigating capabilities. These combined savings make the initial investment in smart sensors a wise financial decision for any homeowner looking to protect their most significant asset-their home-while also reducing long-term expenses associated with upkeep and repairs.

In conclusion, identifying early shifts with smart sensor technology offers homeowners numerous advantages including cost savings through preventive maintenance and early intervention; enhanced safety through continuous monitoring and real-time alerts; and predictive maintenance that ensures optimal performance of household systems and appliances. As our homes become smarter thanks to technological advancements like these sensors, they not only provide us with comfort but also serve as vigilant guardians ensuring our wellbeing and investment security round the clock

Case studies or real-world examples demonstrating the effectiveness of smart sensors in early shift detection for residential foundations.. . , . , , , , , , ...;............;.............;.............;.............;.............;.............;............;;;;;;;;;;;;;;;;;; . ; ; ; ; ; ; ; ; ; ; ; . .. .

In the realm of residential foundation management, the early detection of shifts and settling issues is paramount to maintaining structural integrity and preventing costly repairs. Traditional methods of monitoring foundation health often rely on periodic visual inspections, which can be inconsistent and may fail to detect subtle, early-stage shifts. However, the advent of smart sensor technology has revolutionized this field, providing a more precise and proactive approach to foundation management.

Smart sensors are small, wireless devices equipped with advanced sensing capabilities. They can be embedded within the foundation or attached to critical structural points to continuously monitor various parameters such as tilt, settlement, pressure, and humidity. These sensors transmit real-time data to a central monitoring system, allowing homeowners and engineers to keep a close eye on any changes in the foundation's condition.

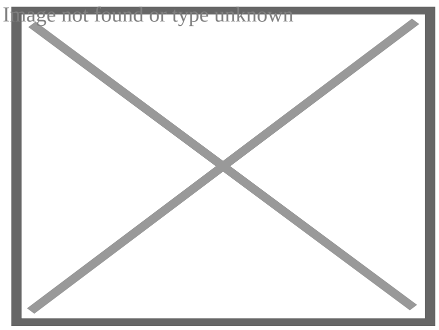
A compelling case study involves a residential property in San Francisco, an area prone to seismic activity and soil instability. The homeowner installed a network of smart sensors throughout the foundation as part of a preventive maintenance strategy. Over a few months, the sensors detected minor but consistent shifts in one section of the foundation. This data was relayed to the homeowner's smartphone app, alerting them to potential issues long before any visible signs of damage appeared. Armed with this early warning, the homeowner was able to consult with structural engineers and implement targeted reinforcements, avoiding what could have been a significant structural failure.

Another example comes from Houston, Texas, where expansive clay soils often lead to foundation problems due to moisture fluctuations. A homeowner who had experienced past issues with foundation settling decided to integrate smart sensors into their residential foundation. The sensors were programmed to monitor both moisture levels and any minute shifts in the foundation slab. During an unusually wet season, the sensors detected increased moisture levels coupled with slight elevation changes in certain areas. This prompt detection allowed the homeowner to address drainage issues around their property proactively, preventing further settling and potential cracks in the walls or floors.

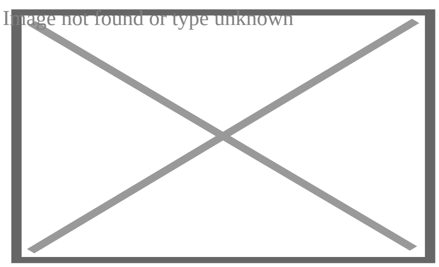
In Phoenix, Arizona, where extreme temperature variations can cause concrete foundations to expand and contract significantly, smart sensors played a crucial role in maintaining structural integrity. A newly constructed home was outfitted with smart sensors during its initial build phase. Over time, the sensors picked up on thermal expansion patterns that indicated uneven heating across different sections of the foundation. This data was analyzed by engineers who recommended adjustments in insulation and shading strategies around the home's perimeter. These proactive measures helped maintain consistent thermal conditions, reducing the risk of future foundation shifts.

These case studies underscore the effectiveness of smart sensors in early shift detection for residential foundations. By providing continuous monitoring and real-time data analysis, smart sensors enable homeowners and engineers to address potential issues before they escalate into costly structural problems. This proactive approach not only enhances safety but also extends the lifespan of residential foundations, making smart sensor technology an invaluable tool in modern foundation management.

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

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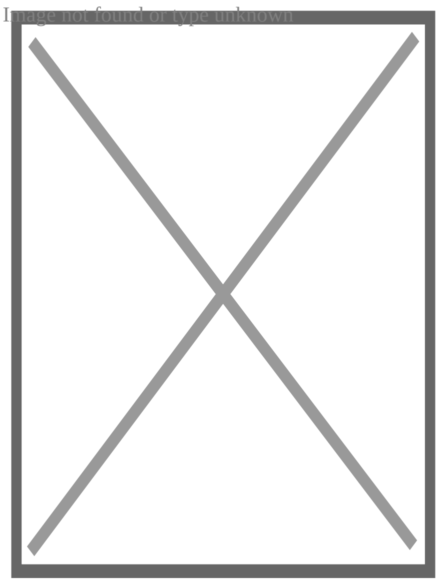
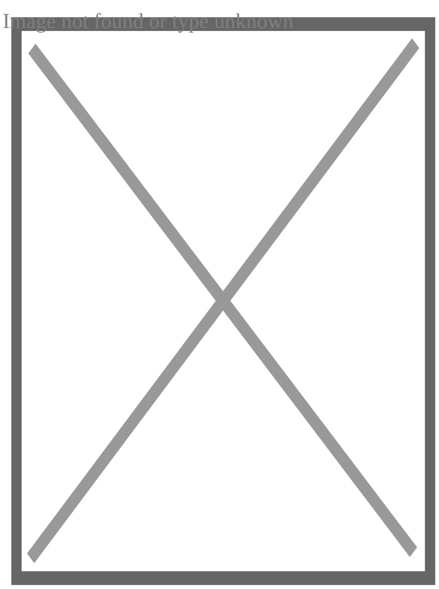
Without insulation, concrete slabs cast directly on the ground can cause a significant amount of extraneous energy transfer by conduction, resulting in either lost heat or unwanted heat. In modern construction, concrete slabs are usually cast above a layer of insulation such as expanded polystyrene, 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

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Further information: Marcus' method

Ground-bearing slabs

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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

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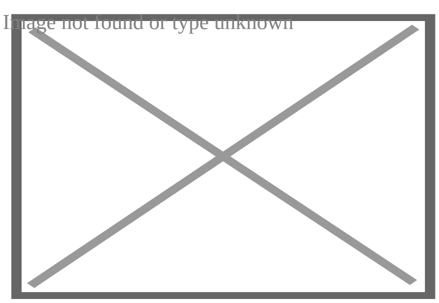
For a suspended slab, there are a number of designs to improve the strength-to-weight ratio. In all cases the top surface remains flat, and the underside is modulated:

- 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

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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

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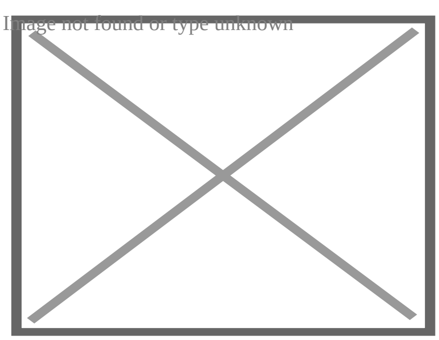
Mud slabs, also known as *rat slabs*, are thinner than the more common suspended or ground-bearing slabs (usually 50 to 150 mm), and usually contain no reinforcement.[21] This makes them economical and easy to install for temporary or low-usage purposes such as subfloors, crawlspaces, pathways, paving, 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

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One-way slabs

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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

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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 $\displaystyle l_x:l_y \le 2$ where $\displaystyle l_x$ is the short dimension and $\displaystyle l_y$ 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

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

Prefabricated

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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

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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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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

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About basement waterproofing

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

Purpose

[edit]

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

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

Methods

[edit]

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

French Drain

- Image not found or type unknown
  French drain
  Interior wall and floor sealers
- Interior water drainage
- Exterior drainage
- Exterior waterproofing coatings
- Box type waterproofing[1]
- Foundation crack injections
- French drains
- Sump pump

Interior sealants

[edit]

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

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

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

Interior water drainage

[edit]

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

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

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

Exterior waterproofing

[edit]

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

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

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

Polymer

[edit]

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

Causes of water seepage and leaks

[edit]

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

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

Warning signs of water damage

[edit]

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

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

Foundation crack injections

[edit]

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

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[edit]

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About Water damage

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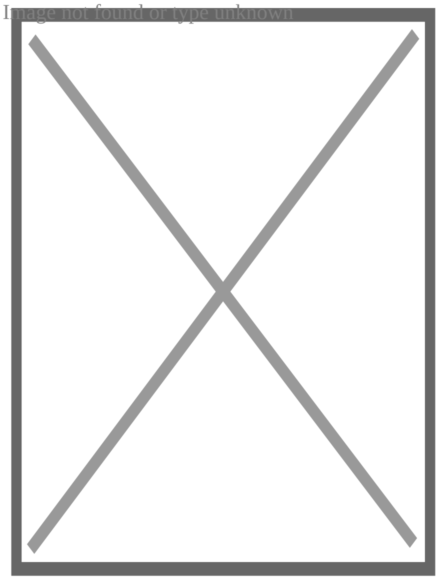
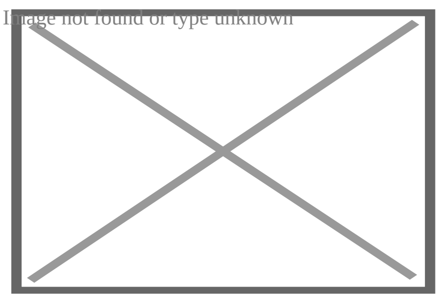
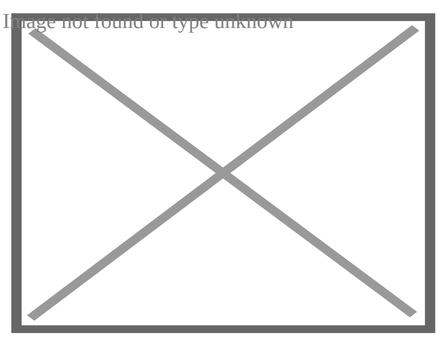


Interior of part of a damaged home in New Orleans after Hurricane Katrina



Family photographs damaged by flooding



A smaller and more minor water spot caused by rainwater leaking through a roof

Water damage describes various possible losses caused by water intruding where it will enable attack of a material or system by destructive processes such as rotting of wood, mold growth, bacteria growth, rusting of steel, swelling of composite woods, de-laminating of materials such as plywood, short-circuiting of electrical devices, etc.

The damage may be imperceptibly slow and minor such as water spots that could eventually mar a surface, or it may be instantaneous and catastrophic such as burst pipes and flooding. However fast it occurs, water damage is a major contributor to loss of property.

An insurance policy may or may not cover the costs associated with water damage and the process of water damage restoration. While a common cause of residential water damage is often the failure of a sump pump, many homeowner's insurance policies do not cover the associated costs without an addendum which adds to the monthly premium of the policy. Often the verbiage of this addendum is similar to "Sewer and Drain Coverage".

In the United States, those individuals who are affected by wide-scale flooding may have the ability to apply for government and FEMA grants through the Individual Assistance program.[1] On a larger level, businesses, cities, and communities can apply to the FEMA Public Assistance program for funds to assist after a large flood. For example, the city of Fond du Lac Wisconsin received $1.2 million FEMA grant after flooding in June 2008. The program allows the city to purchase the water damaged properties, demolish the structures, and turn the former land into public green space.[*citation needed*]

Causes

[edit]

Water damage can originate by different sources such as a broken dishwasher hose, a washing machine overflow, a dishwasher leakage, broken/leaking pipes, flood waters, groundwater seepage, building envelope failures (leaking roof, windows, doors, siding, etc.) and clogged toilets. According to the Environmental Protection Agency, 13.7% of all water used in the home today can be attributed to plumbing leaks.[2] On average that is approximately 10,000 gallons of water per year wasted by leaks for each US home. A tiny, 1/8-inch crack in a pipe can release up to 250 gallons of water a day.[3] According to *Claims Magazine* in August 2000, broken water pipes ranked second to hurricanes in terms of both the number of homes damaged and the amount of claims (on average $50,000 per insurance claim[*citation needed*]) costs in the US.[4] Experts suggest that homeowners inspect and replace worn pipe fittings and hose connections to all household appliances that use water at least once a year. This includes washing machines, dishwashers, kitchen sinks, and bathroom lavatories, refrigerator icemakers, water softeners, and humidifiers. A few US companies offer whole-house leak protection systems utilizing flow-based technologies. A number of insurance companies offer policyholders reduced rates for installing a whole-house leak protection system.

As far as insurance coverage is concerned, damage caused by surface water intrusion to the dwelling is considered flood damage and is normally excluded from coverage under traditional homeowners' insurance. Surface water is water that enters the dwelling from the surface of the ground because of inundation or insufficient drainage and causes loss to the dwelling. Coverage for surface water intrusion[5] to the dwelling would usually require a separate flood insurance policy.

Categories

[edit]

There are three basic categories of water damage, based on the level of contamination.

Category 1 Water - Refers to a source of water that does not pose substantial threat to humans and classified as "**clean water**". Examples are broken water supply lines, tub or sink overflows or appliance malfunctions that involves water supply lines.

Category 2 Water - Refers to a source of water that contains a significant degree of chemical, biological or physical contaminants and causes discomfort or sickness when consumed or even exposed to. Known as "**grey water**". This type carries microorganisms and nutrients of micro-organisms. Examples are toilet bowls with urine (no feces), sump pump failures, seepage due to hydrostatic failure and water discharge from dishwashers or washing machines.

Category 3 Water - Known as "**black water**" and is grossly unsanitary. This water contains unsanitary agents, harmful bacteria and fungi, causing severe discomfort or sickness. Type 3 category are contaminated water sources that affect the indoor environment. This category includes water sources from sewage, seawater, rising water from rivers or streams, storm surge, ground surface water or standing water. Category 2 Water or Grey Water that is not promptly removed from the structure and or have remained stagnant may be re classified as Category 3 Water. Toilet back flows that originates from beyond the toilet trap is considered black water contamination regardless of visible content or color.[6]

Classes

[edit]

Class of water damage is determined by the probable rate of evaporation based on the type of materials affected, or wet, in the room or space that was flooded. Determining the class of water damage is an important first step, and will determine the amount and type of equipment utilized to dry-down the structure.[7]

Class 1 - Slow Rate of Evaporation. Affects only a portion of a room. Materials have a low permeance/porosity. Minimum moisture is absorbed by the materials. **IICRC s500 2016 update adds that class 1 be indicated when <5% of the total square footage of a room (ceiling+walls+floor) are affected **

Class 2 - Fast Rate of Evaporation. Water affects the entire room of carpet and cushion. May have wicked up the walls, but not more than 24 inches. **IICRC s500 2016 update adds that class 2 be indicated when 5% to 40% of the total square footage of a room (ceiling+walls+floor) are affected **

Class 3 - Fastest Rate of Evaporation. Water generally comes from overhead, affecting the entire area; walls, ceilings, insulation, carpet, cushion, etc. **IICRC s500 2016 update adds that class 3 be indicated when >40% of the total square footage of a room (ceiling+walls+floor) are affected **

Class 4 - Specialty Drying Situations. Involves materials with a very low permeance/porosity, such as hardwood floors, concrete, crawlspaces, gypcrete, plaster, etc. Drying generally requires very low specific humidity to accomplish drying.

Restoration

[edit]
See also: Convectant drying

Water damage restoration can be performed by property management teams, building maintenance personnel, or by the homeowners themselves; however, contacting a certified professional water damage restoration specialist is often regarded as the safest way to restore water damaged property. Certified professional water damage restoration specialists utilize psychrometrics to monitor the drying process.[8]

Standards and regulation

[edit]

While there are currently no government regulations in the United States dictating procedures, two certifying bodies, the Institute of Inspection Cleaning and Restoration Certification (IICRC) and the RIA, do recommend standards of care. The current IICRC standard is ANSI/IICRC S500-2021.[9] It is the collaborative work of the IICRC, SCRT, IEI, IAQA, and NADCA.

Fire and Water Restoration companies are regulated by the appropriate state's Department of Consumer Affairs - usually the state contractors license board. In California, all Fire and Water Restoration companies must register with the California Contractors State License Board.[10] Presently, the California Contractors State License Board has no specific classification for "water and fire damage restoration."

Procedures

[edit]

Water damage restoration is often prefaced by a loss assessment and evaluation of affected materials. The damaged area is inspected with water sensing equipment such as probes and other infrared tools in order to determine the source of the damage and possible extent of areas affected. Emergency mitigation services are the first order of business. Controlling the source of water, removal of non-salvageable materials, water extraction and pre-cleaning of impacted materials are all part of the mitigation process. Restoration services would then be rendered to the property in order to dry the structure, stabilize building materials, sanitize any affected or cross-contaminated areas, and deodorize all affected areas and materials. After the labor is completed, water damage equipment including air movers, air scrubbers, dehumidifiers, wood floor drying systems, and sub-floor drying equipment is left in the residence. The goal of the drying process is to stabilize the moisture content of impacted materials below 15%, the generally accepted threshold for microbial amplification. Industry standards state that drying vendors should return at regular time intervals, preferably every twenty-four hours, to monitor the equipment, temperature, humidity, and moisture content of the affected walls and contents.[6] In conclusion, key aspects of water damage restoration include fast action, adequate equipment, moisture measurements, and structural drying. Dehumidification is especially crucial for structural components affected by water damage, such as wooden beams, flooring, and drywall.

See also

[edit]

- Indoor mold

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[edit]

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Things To Do in Cook County

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River Trail Nature Center

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Palmisano (Henry) Park

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Driving Directions in Cook County

Driving Directions From Palmisano (Henry) Park to

Driving Directions From Lake Katherine Nature Center and Botanic Gardens 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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