Foundation Repair

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Overview of different types of foundation cracks and their severity levels.

Understanding the various types of foundation cracks and their severity levels is crucial for determining the appropriate repair methods and advanced techniques. Excavation is essential for deep foundation repair in affected areas **professional foundation repair service** brick. Foundation cracks can vary significantly in type, cause, and severity, each requiring different approaches for effective repair.

The most common types of foundation cracks include hairline cracks, diagonal cracks, horizontal cracks, and step cracks. Hairline cracks are the least severe, often occurring due to the natural settling of the foundation. They are typically less than 1/10th of an inch wide and can often be monitored without immediate repair.

Diagonal cracks are more concerning as they usually indicate structural issues. These cracks form at an angle and can be a sign of shifting soil or poor construction practices. Immediate assessment by a professional is recommended to determine the necessary repair methods.

Horizontal cracks are among the most severe types of foundation cracks. They often indicate significant pressure on the foundation walls, such as from soil or water pressure.

Repair Methods and Advanced Techniques of foundation cracks - wood-decay fungus

1. soil compaction
2. pier
3. quality assurance

These cracks require immediate attention and often involve advanced repair techniques like installing steel I-beams or using carbon fiber straps to reinforce the structure.

Step cracks resemble the steps of a staircase and typically occur in masonry walls. They are caused by the foundation settling unevenly. While not as severe as horizontal cracks, step cracks still require professional evaluation and may need repairs such as epoxy injections or wall anchors to stabilize the foundation.

In terms of repair methods, minor cracks can often be addressed with simple solutions like epoxy injections or hydraulic cement. For more severe cracks, advanced techniques such as underpinning, where the foundation is supported by additional materials driven deep into the ground, may be necessary. Helical piers, which are screw-like supports driven into the

soil, offer another effective solution for stabilizing foundations.

In conclusion, the type and severity of foundation cracks dictate the repair methods and advanced techniques required. Regular inspections and timely repairs can prevent minor cracks from becoming major structural issues, ensuring the longevity and safety of the building.

Detailed explanation of traditional repair methods such as epoxy injection, polyurethane foam injection, and concrete patching.

Certainly! When it comes to addressing foundation cracks, there are several traditional repair methods that have proven effective over the years. Among these are epoxy injection, polyurethane foam injection, and concrete patching. Each method has its unique approach and benefits, tailored to specific types of cracks and conditions.

Epoxy injection is a popular method for repairing foundation cracks, especially those that are relatively narrow. This technique involves injecting a low-viscosity epoxy resin into the crack under pressure. The epoxy then hardens, effectively sealing the crack and restoring the structural integrity of the foundation. One of the key advantages of epoxy injection is its ability to penetrate even the smallest of cracks, ensuring a thorough and durable repair. Additionally, the cured epoxy is highly resistant to water, making it an excellent choice for foundations that may be exposed to moisture.

Polyurethane foam injection is another effective method for repairing foundation cracks. This technique involves injecting expanding polyurethane foam into the crack. As the foam expands, it fills the void behind the crack, creating a strong bond with the surrounding concrete. Polyurethane foam is particularly useful for larger cracks or those that extend into the soil beneath the foundation. The expanding nature of the foam allows it to fill irregular voids and provide additional support to the foundation. Moreover, polyurethane foam is moisture-resistant and can help to waterproof the foundation, reducing the risk of future leaks.

Concrete patching is a more straightforward method of repairing foundation cracks, particularly those that are wider or have rough edges. This technique involves removing the damaged concrete around the crack and filling the void with a concrete patch. The patch is then allowed to cure, forming a solid bond with the existing foundation. Concrete patching is often used for larger cracks or those that have caused significant damage to the surrounding concrete. While it may not be as precise as epoxy or polyurethane foam injection, concrete patching is a reliable and cost-effective solution for many foundation repair needs.

In conclusion, epoxy injection, polyurethane foam injection, and concrete patching are all traditional methods for repairing foundation cracks. Each method has its own set of advantages and is suited to different types of cracks and conditions.

Repair Methods and Advanced Techniques of foundation cracks - yard

1. yard
2. building insulation
3. wood-decay fungus

By understanding the unique benefits of each technique, homeowners and contractors can choose the most appropriate method for addressing foundation issues and ensuring the long-term stability of the structure.

Advanced techniques for repairing foundation cracks, including carbon fiber reinforcement and helical piers.

When it comes to repairing foundation cracks, it's essential to use methods that not only address the immediate issue but also provide long-term stability and peace of mind. Traditional repair methods, such as epoxy injections and polyurethane foam, have their place, but advanced techniques offer more robust solutions, especially for severe or persistent cracks. Two such advanced techniques are carbon fiber reinforcement and helical piers.

Carbon fiber reinforcement is a cutting-edge method that involves applying strips of carbon fiber to the inside or outside of a foundation wall. These strips are then saturated with a special resin that bonds them to the wall. Carbon fiber is incredibly strong-much stronger than steel on a weight-for-weight basis-and it's also flexible, which allows it to conform to the contours of the wall. This technique is particularly effective for stabilizing bowing or sagging walls, as it provides significant tensile strength without adding much weight or thickness. Moreover, carbon fiber is resistant to corrosion and environmental factors, ensuring durability over time.

Helical piers, also known as screw piles, are another advanced solution for foundation repair, especially when dealing with settling or shifting foundations. These piers are large screws that are driven deep into the ground until they reach stable soil or bedrock. Once installed, they provide a solid foundation upon which the existing structure can be lifted and stabilized. Helical piers are advantageous because they can be installed with minimal invasiveness compared to traditional underpinning methods. They also offer excellent load-bearing capacity, making them suitable for both residential and commercial structures. Additionally, helical piers can be adjusted after installation to fine-tune the level of the structure, ensuring precise results.

In conclusion, advanced techniques like carbon fiber reinforcement and helical piers represent the forefront of foundation repair technology. They offer not only effective

solutions for immediate issues but also long-term stability and durability. Whether dealing with cracks, bowing walls, or settling foundations, these methods provide homeowners and builders with peace of mind, knowing that their structure is secure for years to come.

Step-by-step guide on how to assess the severity of foundation cracks and choose the appropriate repair method.

When it comes to assessing the severity of foundation cracks and choosing the appropriate repair method, it's crucial to approach the task methodically to ensure both safety and effectiveness. Here's a step-by-step guide to help you navigate through this process.

Firstly, begin with a thorough inspection of the foundation. Look for visible cracks both inside and outside the structure. Pay close attention to the width, length, and pattern of the cracks. Cracks that are wider than a quarter-inch, extend more than a few feet, or exhibit a stair-step pattern are generally more severe and require immediate attention.

Next, assess the location of the cracks. Cracks that occur at corners or along walls are often less concerning than those that run horizontally or diagonally, which may indicate more serious structural issues.

Once you've identified the cracks, it's time to evaluate their severity.

Repair Methods and Advanced Techniques of foundation cracks - building insulation

1. radon mitigation
2. mortar
3. tieback

Use a tape measure to gauge the width of the cracks. Cracks that are less than a quarter-inch wide are typically considered minor and may not require extensive repair. However, wider cracks may indicate significant structural issues and should be addressed promptly by a professional.

In addition to visual inspection, consider any other signs of foundation problems such as uneven floors, sticking doors or windows, or water intrusion in the basement or crawl space. These symptoms can provide valuable insight into the overall condition of the foundation and help determine the appropriate repair method.

After assessing the severity of the cracks and any accompanying symptoms, it's time to choose the appropriate repair method. For minor cracks, simple solutions such as epoxy injection or polyurethane foam may suffice. These materials can effectively seal small

cracks and prevent further water intrusion.

For more severe cracks or extensive foundation issues, more invasive repair methods may be necessary. Techniques such as underpinning, where additional support is added beneath the foundation, or helical piers, which provide additional stability, may be required to ensure the long-term integrity of the structure.

Ultimately, the key to successful foundation repair lies in a thorough assessment of the cracks and a careful selection of the appropriate repair method. By taking a systematic approach and consulting with experienced professionals when necessary, you can ensure that your foundation remains strong and stable for years to come.

Case studies showcasing successful repair projects using various techniques.

Certainly!

In the realm of construction and home maintenance, the repair of foundation cracks is a critical area that demands both skill and innovation. Case studies showcasing successful repair projects using various techniques offer invaluable insights into the most effective methods for addressing these issues.

One notable case involved a historic building suffering from extensive foundation cracks due to soil settlement. The repair team employed a combination of polyurethane injection and carbon fiber reinforcement. Polyurethane injection was used to fill the voids beneath the foundation, effectively stabilizing the soil. Following this, carbon fiber strips were applied to the interior walls to reinforce the structure. The outcome was not only a stabilized foundation but also the preservation of the building's historical integrity.

Another compelling example is the repair of a modern residential home plagued by foundation cracks caused by expansive clay soils. Here, the technique of helical pier installation was utilized. Helical piers were driven deep into the stable soil layers, transferring the home's load and alleviating the pressure on the foundation. This method not only rectified the cracks but also provided a long-term solution to the soil-related issues.

In a different scenario, a commercial building faced foundation cracks due to water infiltration. The repair strategy involved the installation of a French drain system coupled with epoxy injection. The French drain effectively redirected water away from the foundation, while epoxy injection sealed the cracks, preventing further water ingress. This dual approach ensured the building's foundation remained dry and structurally sound.

These case studies underscore the importance of selecting the right repair technique based on the specific causes and conditions of the foundation cracks. Whether it's soil stabilization, load transfer, or water management, each method offers unique benefits that contribute to the overall success of the repair project. By examining these real-world

examples, professionals in the field can gain a deeper understanding of the most effective strategies for repairing foundation cracks, ensuring durability and safety in various structures.

Maintenance tips to prevent future foundation cracks and prolong the lifespan of repairs.

Maintaining a solid foundation is crucial for the longevity and stability of any structure. Here are some practical maintenance tips to prevent future foundation cracks and prolong the lifespan of repairs.

Firstly, managing water around your foundation is key. Ensure that your gutters and downspouts are clean and direct water away from the foundation. Consider installing a French drain system if your property is prone to heavy rainfall. This will help redirect water flow and reduce hydrostatic pressure on your foundation walls.

Secondly, regular inspection of your foundation is essential. Schedule annual checks to identify any early signs of cracks or shifts. Catching issues early can prevent minor problems from becoming major repairs. Use a flashlight and a mirror to inspect hard-to-reach areas, and take note of any changes over time.

Thirdly, maintain consistent moisture levels in the soil surrounding your foundation. Avoid overwatering your garden or lawn near the foundation, as this can lead to soil expansion and contraction, causing cracks. Conversely, during dry periods, ensure the soil doesn't become too dry, which can also lead to shrinkage and cracking.

Fourthly, be mindful of heavy vegetation near your foundation. Large trees with extensive root systems can exert pressure on your foundation walls, leading to cracks. Consider planting smaller shrubs or trees at a safe distance from your home.

Lastly, address any repairs promptly. If you notice cracks, even small ones, don't delay in getting them fixed. Use quality materials and techniques for repairs to ensure they last. Consult with a professional if you're unsure about the best method for your specific situation.

By following these maintenance tips, you can significantly reduce the risk of future foundation cracks and ensure that any repairs made will stand the test of time.

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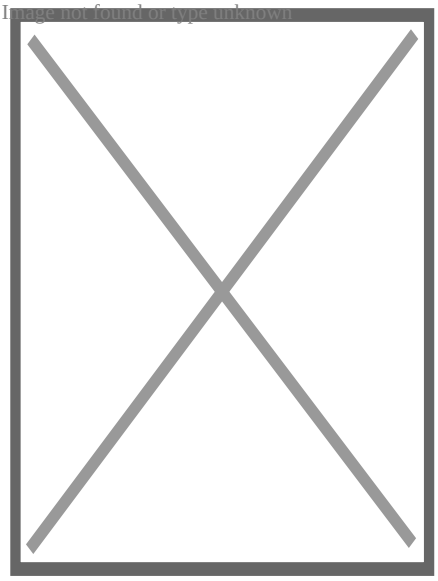
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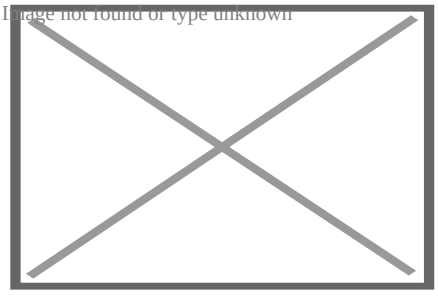
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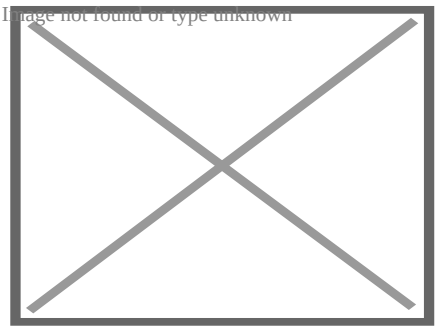
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Interior of part of a damaged home in New Orleans after Hurricane Katrina



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

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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

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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

References

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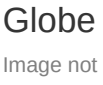
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About radon mitigation



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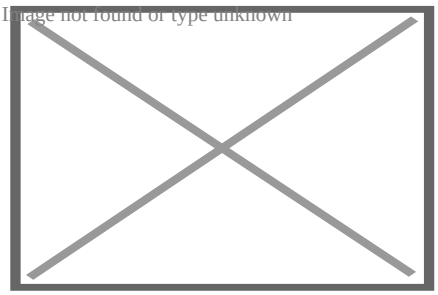
Radon mitigation is any process used to reduce radon gas concentrations in the breathing zones of occupied buildings, or radon from water supplies. Radon is a significant contributor to environmental radioactivity and indoor air pollution. Exposure to radon can cause serious health problems such as lung cancer.[1]

Mitigation of radon in the air by active soil depressurization is most effective. Concrete slabs, sub-floors, and/or crawlspaces are sealed, an air pathway is then created to exhaust radon above the roof-line, and a radon mitigation fan is installed to run permanently. In particularly troublesome dwellings, air exchangers can be used to reduce indoor radon concentrations. Treatment systems using aeration or activated charcoal are available to remove radon from domestic water supplies. There is no proven link between radon in water and gastrointestinal

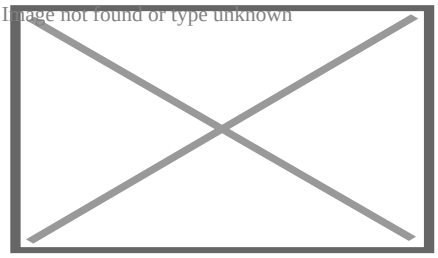
cancers; however, extremely high radon concentrations in water can be aerosolized by faucets and shower heads and contribute to high indoor radon levels in the air.

Testing

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A typical radon test kit



Fluctuation of ambient air radon concentration over one week, measured in a laboratory

The first step in mitigation is testing. No level of radiation is considered completely safe, but as it cannot be eliminated, governments around the world have set various *action levels* to provide guidance on when radon concentrations should be reduced. The World Health Organization's International Radon Project has recommended an action level of 100 Bq/m^3 (2.7 pCi/L) for radon in the air.[2] Radon in the air is considered to be a larger health threat than radon in domestic water. The US Environmental Protection Agency recommendation is to not test for radon in water unless a radon in air test shows concentrations above the action level. However, in some U.S. states such as Maine where radon levels are higher than the national average, it is recommend that all well water should be tested for radon. The U.S. government has not set an action level for radon in water.

Air-radon levels fluctuate naturally on a daily and seasonal basis. A short term test (90 days or less) might not be an accurate assessment of a home's average radon level, but is recommended for initial testing to quickly determine unhealthy conditions. Transient weather such as wind and changes in barometric pressure can affect short-term concentrations as well as ventilation, such as open windows and the operation of exhaust fans.

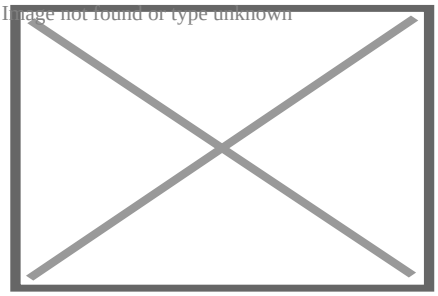
Testing for radon in the air is accomplished using passive or active devices placed in the building. Some devices are promptly sent to a laboratory for analysis, others calculate the

results on-site including digital Radon detectors. Radon-in-water testing requires a water sample being sent to a laboratory.

Retesting is recommended in several situations, for example, before spending money on the installation of a mitigation system. Test results which exceed accuracy tolerances also require re-testing. When a mitigation system installation is warranted, a retest after the system is functional is advised to be sure the system is effectively reducing the radon concentration below the action level, and after any mitigation system repairs such as replacing a fan unit. The US EPA recommends retesting homes with radon problems every two years to ensure proper system function. Due to the vast fluctuation in indoor radon levels, the EPA recommends all homes be tested at least once every five years.[3]

Testing in the United States

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Radon map of the United States

ASTM E-2121 is a US standard for reducing airborne radon in homes as far as practicable below the action level of 4 picocuries per liter (pCi/L) (148 Bq/m^3).[4][5] Some states recommend achieving 2.0 pCi/L or less.

Radon test kits are commercially available[6] and can be used by homeowners and tenants and in limited cases by landlords, except when a property is for sale.

Commercially available test kits include a passive collector that the user places in the lowest livable floor of the house for 2 to 7 days. The user then sends the collector to a laboratory for analysis. Long-term kits, taking collections from 91 days to one year, are also available. Open land test kits can test radon emissions from the land before construction begins, but are not recommended by the EPA because they do not accurately predict the final indoor radon level. The EPA and the National Environmental Health Association have identified 15 types of radon test devices.[7] A Lucas cell is one type of device.

Retesting is specifically recommended in several situations. Measurements between 4 and 10 pCi/L (148 and 370 Bq/m^3) warrant a follow-up short-term or long-term radon test before

mitigation. Measurements over 10 pCi/L (370 Bq/m^3) warrant only another short-term test (not a long-term test) so that abatement measures are not unduly delayed.

Progress has been made regarding radon in the home. A total of 37 states have now[*when?*] passed legislation requiring home-sellers to disclose known radon levels before completing the transaction (although only a handful have introduced criminal penalties for misrepresentation).[8] And over half the legislatures have written radon into their state's building code.[9] Purchasers of real estate may delay or decline a purchase if the seller has not successfully abated radon to less than 4 pCi/L.

The accuracy of the residential radon test depends upon whether closed house conditions are maintained. Thus the occupants will be instructed not to open windows, etc., for ventilation during the pendency of test, usually two days or more. However, the occupants, if the present owners, will be motivated to pass the test and insure the sale, so they might be tempted to open a window to get a lower radon score. Moreover, there may be children or immature teens or young adults in the house who will open a window for ventilation notwithstanding instructions not to do so, particularly in uncomfortably hot weather. Accordingly, whether the potential purchaser should trust the result of such a test is problematic.

Management of radon service provider certification has evolved since being introduced by the EPA in 1986. In the 1990s this service was "privatized" and the National Environmental Health Association (NEHA) helped transition the voluntary National Radon Proficiency Program (NRPP) to be administered by private firms. As of 2012, the NRPP is administered by the American Association of Radon Scientists and Technologists (AARST).[10]

Some states, such as Maine, require landlords to test their rental properties and turn the results in to the state. In limited cases the landlord or tenants may do the testing themselves. The rules in each state vary. In many cases there are private contractors that will inspect hired by the city.

Testing in Canada

[edit]

Health Canada recommends regular annual testing, either by hiring a qualified tester or by using a home-testing kit that should be checked quarterly.[11]

Canadian Government, in conjunction with the territories and provinces, developed the guideline[12] to indicate when remedial action should be taken was originally set at 800 Bq/m^3 (becquerels per cubic meter) and since reduced to 200 Bq/m^3. This new guideline was approved by the Federal Provincial Territorial Radiation Protection Committee in October

2006.[13]

Testing in the UK

[edit]

Radon testing in the UK is managed by UKradon and the UKHSA.[14]

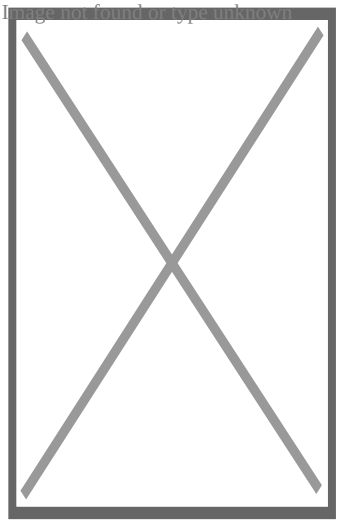
Testing in Norway

[edit]

The Norwegian Radiation and Nuclear Safety Authority (DSA) developed the protocol[15] for radon measurements in residential dwellings[16] with respect to rental accommodation, which is governed by The Radiation Protection Regulations.[17]

Methods of radon gas mitigation

[edit]



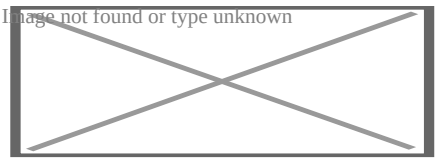
Part of a radon mitigation system including the fan and vent pipe is visible near the gutter downspout.

Because high levels of radon have been found in every state of the United States,[18] testing for radon and installing radon mitigation systems has become a specialized industry since the 1980s. Many states have implemented programs that affect home buying and awareness in

the real estate community; however, radon testing and mitigation systems are not generally mandatory unless specified by the local jurisdiction.[19]

Anticipated high radon levels can be mitigated during building design and construction by a combination of ensuring a perfectly sealed foundation, allowing sufficient passive dispersal of under-slab gas around rather than through the building, and proper building ventilation. In many instances, such approaches may achieve a sufficient reduction of radon levels compared to other buildings where such approaches were not taken. However, quality of implementation is crucial and testing after construction is necessary. For instance, even a small gap in the sealing of the slab may be sufficient for excessive quantities of radon to enter, given pressure differentials.

Where such approaches were not taken during construction or have proven insufficiently effective, remediation is needed. According to the EPA's "A Citizen's Guide to Radon",[20] the method to reduce radon "primarily used is a vent pipe system and fan, which pulls radon from beneath the house and vents it to the outside", which is also called sub-slab depressurization, soil suction, or active soil depressurization (ASD). Generally indoor radon can be mitigated by sub-slab depressurization and exhausting such radon-laden air to the outdoors, away from windows and other building openings.[21] "EPA generally recommends methods which prevent the entry of radon. Soil suction, for example, prevents radon from entering your home by drawing the radon from below the home and venting it through a pipe, or pipes, to the air above the home where it is quickly diluted" and "EPA does not recommend the use of sealing alone to reduce radon because, by itself, sealing has not been shown to lower radon levels significantly or consistently" according to the EPA's "Consumer's Guide to Radon Reduction: How to Fix Your Home".[22] Ventilation systems can utilize a heat exchanger or energy recovery ventilator to recover part of the energy otherwise lost in the process of exchanging air with the outside. For crawlspaces, the EPA states,[22] "An effective method to reduce radon levels in crawlspace homes involves covering the earth floor with a high-density plastic sheet. A vent pipe and fan are used to draw the radon from under the sheet and vent it to the outdoors. This form of soil suction is called submembrane suction, and when properly applied is the most effective way to reduce radon levels in crawlspace homes."



High radon levels in a Minnesota (USA) basement with a passive under slab vent pipe system can be seen in the left half of the graph. After installation of a radon fan (ASD), a permanent reduction in radon levels to approximately 0.6 pCi/L can be seen in the right half of the graph.

- The most common approach is active soil depressurization (ASD). Experience has shown that ASD is applicable to most buildings since radon usually enters from the soil

and rock underneath and mechanical ventilation is used when the indoor radon is emitted from the building materials. A less common approach works efficiently by reducing air pressures within cavities of exterior and demising walls where radon emitting from building materials, most often concrete blocks, collects.

- Above slab air pressure differential barrier technology (ASAPDB) requires that the interior pressure envelope, most often drywall, as well as all ductwork for air conditioning systems, be made as airtight as possible. A small blower, often no more than 15 cubic feet per minute (0.7 L/s) may then extract the radon-laden air from these cavities and exhaust it to the out of doors. With well-sealed HVAC ducts, very small negative pressures, perhaps as little as 0.5 pascal (0.00007 psi), will prevent the entry of highly radon-laden wall cavity air from entering into the breathing zone. Such ASAPDB technology is often the best radon mitigation choice for high-rise condominiums as it does not increase indoor humidity loads in hot humid climates, and it can also work well to prevent mold growth in exterior walls in heating climates.
- In hot, humid climates, heat recovery ventilators (HRV) as well as energy recovery ventilators (ERV) have a record of increasing indoor relative humidity and dehumidification demands on air conditioning systems. Mold problems can occur in homes that have been radon mitigated with HRV and ERV installations in hot, humid climates.[*citation needed*] HRVs and ERVs have an excellent record in cold dry climates.
- A recent technology is based on building science. It includes a variable rate mechanical ventilation system that prevents indoor relative humidity from rising above a preset level such as 50% which is currently suggested by the US Environmental Protection Agency and others as an upper limit for the prevention of mold. It has proven to be especially effective in hot, humid climates. It controls the air delivery rate so that the air conditioner is never overloaded with more moisture than it can effectively remove from the indoor air.
    - It is generally assumed that air conditioner operation will remove excess moisture from the air in the breathing zone, but it is important to note that just because the air conditioner cools does not mean that it is also dehumidfying. If ?*t* is 14 degrees or less, it may not dehumidify at all even though it is cooling.
    - Factors that are likely to aggravate indoor humidity problems from mechanical ventilation–based radon installations are as follows and an expert radon mitigator/building scientist will check for and correct any and all of the following when he or she performs radon mitigation procedures:
        - Air conditioner duct leaks located outside the breathing zone, such as in the attic.
        - Excessive exhaust fan operation
        - Oversize or over-capacity air conditioners
        - AC air handler fans that do not stop running when the air conditioner compressor stops running.
        - Delta *t* (?*t*), which is the amount that the air is cooled as it is passed through the air conditioner's cooling coils. A good ?*t* performance figure for home air

conditioners is about 20 °F (11 °C). In comparison, automobile air conditioners deliver ?*t* performance of 32 to 38 °F (18 to 21 °C). A ?*t* of 14 °F (8 °C) will dehumidify poorly if at all.

In South Florida, most radon mitigation is performed by use of fixed rate mechanical ventilation. Radon mitigation training in Florida does not include problems associated with mechanical ventilation systems, such as high indoor humidity, mold, moldy odors, property damage or health consequences of human occupation in high humidity of moldy environments[*citation needed*]. As a result, most Florida radon mitigators are unaware of and do not incorporate existing building science moisture management technology into mechanical ventilation radon installations. Home inspectors may not necessarily be aware of the mold risks associated with radon mitigation by mechanical ventilation.

The average cost for an ASD radon mitigation system in Minnesota is $1500.[23] These costs are very dependent on the type of home and age of construction.[24]

Methods of radon-in-water mitigation

[edit]

Radon removal from water supplies may be at a treatment plant, point of entry, or point of use. Public water supplies in the United States were required to treat for radionuclides beginning in 2003 but private wells are not regulated by the federal government as of 2014. The radon can be captured by granular activated charcoal (GAR) or released into the air through aeration of the water. Radon will naturally dissipate from water over a period of days, but the quantity of storage needed to treat the water in this manner makes home systems of this type impracticably large.[25]

Activated carbon systems capture radon from the water. The amount of radiation accumulates over time and the filter material may reach the level of requiring disposal as a radioactive waste. However, in the United States there are no regulations concerning radiation levels and disposal of radon treatment waste as of 2014.

Aeration systems move the radon from the water to the air. Radon gas discharged into the air is the release of a pollutant, and may become regulated in the United States.

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[edit]

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External links

[edit]

- Radon at the United States Environmental Protection Agency
- National Radon Program Services hosted by Kansas State University

- Radon and Lung Health from the American Lung Association
- It's Your Health - Health Canada
- Radon's impact on your health – Quebec Lung Association

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Radiation protection

Main articles	○ Background radiation ○ Dosimetry ○ Health physics ○ Ionizing radiation ○ Internal dosimetry ○ Radioactive contamination ○ Radioactive sources ○ Radiobiology
Measurement quantities and units	○ Absorbed dose ○ Becquerel ○ Committed dose ○ Computed tomography dose index ○ Counts per minute ○ Effective dose ○ Equivalent dose ○ Gray ○ Mean glandular dose ○ Monitor unit ○ Rad ○ Roentgen ○ Rem ○ Sievert

Instruments and measurement techniques	○ Airborne radioactive particulate monitoring ○ Dosimeter ○ Geiger counter ○ Ion chamber ○ Scintillation counter ○ Proportional counter ○ Radiation monitoring ○ Semiconductor detector ○ Survey meter ○ Whole-body counting
Protection techniques	○ Lead shielding ○ Glovebox ○ Potassium iodide ○ Radon mitigation ○ Respirators
Organisations	○ Euratom ○ HPS (USA) ○ IAEA ○ ICRU ○ ICRP ○ IRPA ○ SRP (UK) ○ UNSCEAR
Regulation	○ IRR (UK) ○ NRC (USA) ○ ONR (UK) ○ Radiation Protection Convention, 1960
Radiation effects	○ Acute radiation syndrome ○ Radiation-induced cancer

See also the categories Medical physics, Radiation effects, Radioactivity, Radiobiology, and Radiation protection

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Heating, ventilation, and air conditioning

Fundamental concepts	○ Air changes per hour (ACH) ○ Bake-out ○ Building envelope ○ Convection ○ Dilution ○ Domestic energy consumption ○ Enthalpy ○ Fluid dynamics ○ Gas compressor ○ Heat pump and refrigeration cycle ○ Heat transfer ○ Humidity ○ Infiltration ○ Latent heat ○ Noise control ○ Outgassing ○ Particulates ○ Psychrometrics ○ Sensible heat ○ Stack effect ○ Thermal comfort ○ Thermal destratification ○ Thermal mass ○ Thermodynamics ○ Vapour pressure of water

Technology

- Absorption-compression heat pump
- Absorption refrigerator
- Air barrier
- Air conditioning
- Antifreeze
- Automobile air conditioning
- Autonomous building
- Building insulation materials
- Central heating
- Central solar heating
- Chilled beam
- Chilled water
- Constant air volume (CAV)
- Coolant
- Cross ventilation
- Dedicated outdoor air system (DOAS)
- Deep water source cooling
- Demand controlled ventilation (DCV)
- Displacement ventilation
- District cooling
- District heating
- Electric heating
- Energy recovery ventilation (ERV)
- Firestop
- Forced-air
- Forced-air gas
- Free cooling
- Heat recovery ventilation (HRV)
- Hybrid heat
- Hydronics
- Ice storage air conditioning
- Kitchen ventilation
- Mixed-mode ventilation
- Microgeneration
- Passive cooling
- Passive daytime radiative cooling
- Passive house
- Passive ventilation
- Radiant heating and cooling
- Radiant cooling
- Radiant heating
- Radon mitigation
- Refrigeration
- Renewable heat
- Room air distribution
- Solar air heat
- Solar combisystem

- Air conditioner inverter
- Air door
- Air filter
- Air handler
- Air ionizer
- Air-mixing plenum
- Air purifier
- Air source heat pump
- Attic fan
- Automatic balancing valve
- Back boiler
- Barrier pipe
- Blast damper
- Boiler
- Centrifugal fan
- Ceramic heater
- Chiller
- Condensate pump
- Condenser
- Condensing boiler
- Convection heater
- Compressor
- Cooling tower
- Damper
- Dehumidifier
- Duct
- Economizer
- Electrostatic precipitator
- Evaporative cooler
- Evaporator
- Exhaust hood
- Expansion tank
- Fan
- Fan coil unit
- Fan filter unit
- Fan heater
- Fire damper
- Fireplace
- Fireplace insert
- Freeze stat
- Flue
- Freon
- Fume hood
- Furnace
- Gas compressor
- Gas heater
- Gasoline heater

Measurement and control	○ Air flow meter ○ Aquastat ○ BACnet ○ Blower door ○ Building automation ○ Carbon dioxide sensor ○ Clean air delivery rate (CADR) ○ Control valve ○ Gas detector ○ Home energy monitor ○ Humidistat ○ HVAC control system ○ Infrared thermometer ○ Intelligent buildings ○ LonWorks ○ Minimum efficiency reporting value (MERV) ○ Normal temperature and pressure (NTP) ○ OpenTherm ○ Programmable communicating thermostat ○ Programmable thermostat ○ Psychrometrics ○ Room temperature ○ Smart thermostat ○ Standard temperature and pressure (STP) ○ Thermographic camera ○ Thermostat ○ Thermostatic radiator valve

Professions, trades, and services	○ Architectural acoustics ○ Architectural engineering ○ Architectural technologist ○ Building services engineering ○ Building information modeling (BIM) ○ Deep energy retrofit ○ Duct cleaning ○ Duct leakage testing ○ Environmental engineering ○ Hydronic balancing ○ Kitchen exhaust cleaning ○ Mechanical engineering ○ Mechanical, electrical, and plumbing ○ Mold growth, assessment, and remediation ○ Refrigerant reclamation ○ Testing, adjusting, balancing
Industry organizations	○ AHRI ○ AMCA ○ ASHRAE ○ ASTM International ○ BRE ○ BSRIA ○ CIBSE ○ Institute of Refrigeration ○ IIR ○ LEED ○ SMACNA ○ UMC
Health and safety	○ Indoor air quality (IAQ) ○ Passive smoking ○ Sick building syndrome (SBS) ○ Volatile organic compound (VOC)

See also

- ASHRAE Handbook
- Building science
- Fireproofing
- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Fire protection
- Template:Home automation
- Template:Solar energy

About Cook County

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Things To Do in Cook County

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Sand Ridge Nature Center

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River Trail Nature Center

4.6 (235)

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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

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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