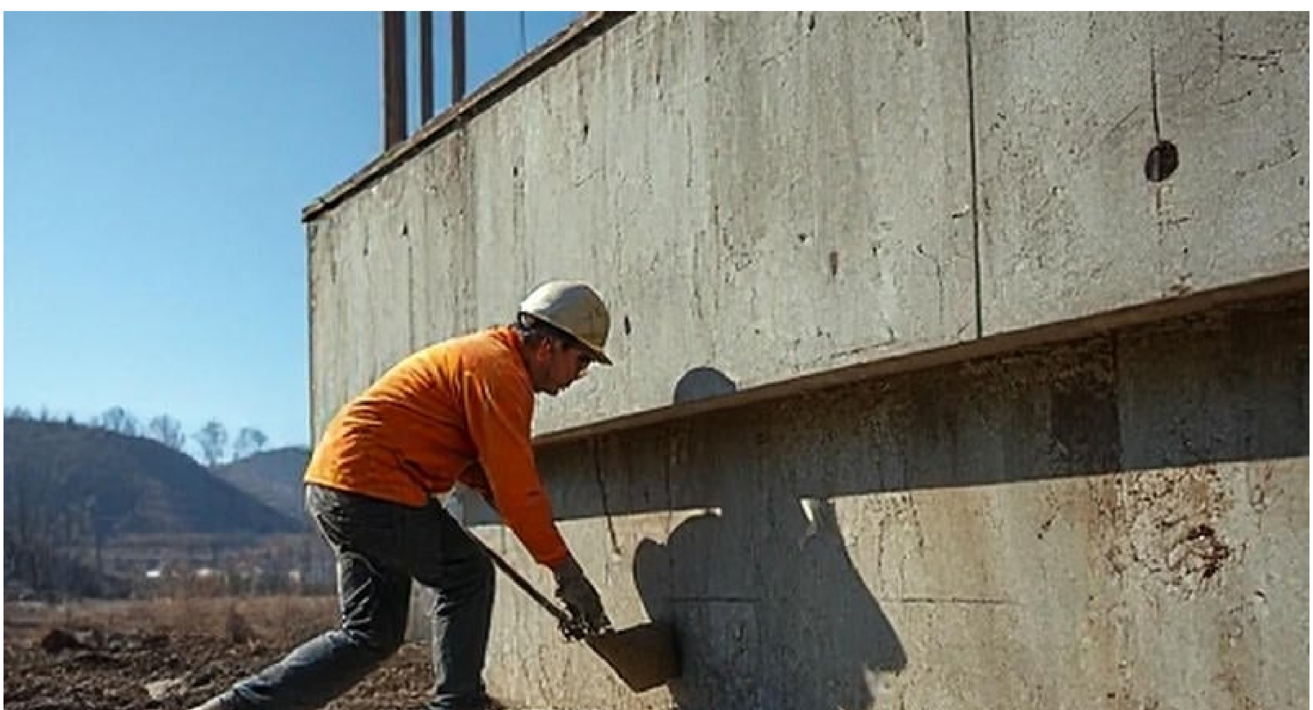
Residential Foundation

- **Recognizing Shifts in the Home Foundation**
  Recognizing Shifts in the Home Foundation Subtle Clues That Indicate Structural Changes Early Indicators of Potential Foundation Damage Observing Signs of Settlement in Floors Identifying Hairline Cracks and Surface Gaps Evaluating Tilted Door Frames and Window Alignment Understanding Bowed Wall Patterns in Basements Detecting Weak Spots Beneath Interior Flooring Uncovering Gradual Shifts in Support Beams Pinpointing Areas Prone to Moisture Intrusion Checking for Stair-Step Cracks Along Walls Preventing Growth of Small Foundation Cracks
- **Exploring Slab on Grade Construction Details**
  Exploring Slab on Grade Construction Details Comparing Pier and Beam Home Foundations Recognizing Basement Foundations in Older Houses Understanding the Basics of Piering Strategies Exploring Techniques for Slab Jacking Projects Grasping the Scope of Epoxy Injection Repairs Assessing Helical Piers for Added Support Considering Carbon Fiber Solutions for Wall Reinforcement Discovering Polyurethane Foam Applications Investigating Steel Piers in Home Restoration Reviewing Concrete Piers for Structural Stability Selecting Appropriate Methods for Specific Soil Types
- **About Us**



foundation repair service near me building insulation.

When it comes to older houses, one of the most intriguing aspects can be the basement foundation. These structural elements not only provide essential support for the entire home but also carry stories of architectural history and evolution. Recognizing basement foundations in older houses requires a keen eye and an understanding of the materials and techniques used in different eras. Let's delve into the fascinating world of these foundational structures.

The first step in recognizing basement foundations in older houses is understanding the age of the property. Houses built before the mid-20th century often feature foundations made from natural stone, brick, or rubble. These materials were abundant and accessible, making them the go-to choices for builders of the time. If you encounter a foundation with irregularly shaped stones held together with mortar, you're likely looking at a home from the 18th or 19th century.

As you examine these older foundations, pay attention to the craftsmanship. Hand-cut stones and carefully laid bricks indicate a level of skill and attention to detail that was common in earlier construction methods. You might also notice that the foundation walls are thicker than those in modern homes, a testament to the builders' focus on durability and longevity.

Moving into the early 20th century, concrete began to replace natural materials as the preferred choice for basement foundations. If you come across a house with a concrete foundation, it's likely from this period or later. Early concrete foundations might appear rough and uneven, as the technology for pouring and finishing concrete was still developing. Over time, as techniques improved, concrete foundations became smoother and more uniform.

Another key factor in recognizing basement foundations in older houses is the presence of a basement itself. Not all older homes have basements, as their construction was influenced by factors like soil type, water table levels, and regional building practices. In areas with high water tables, for example, builders might have opted for crawl spaces or slab-on-grade foundations instead of full basements.

When examining a basement foundation, look for signs of repairs or modifications over time. Older houses often have a history of maintenance and upgrades, and these changes can provide clues about the foundation's age and original construction. Patches of newer concrete or bricks might indicate areas that were repaired or reinforced, while the presence of steel beams or columns could suggest that the foundation was strengthened to support additions or renovations.

It's also important to consider the regional variations in basement foundations. Different parts of the country have their own building traditions and available materials, which can influence the appearance and construction of older foundations. For example, houses in the Northeast might feature fieldstone foundations, while those in the Midwest could have foundations made from locally quarried limestone.

Recognizing basement foundations in older houses is not just about identifying materials and construction techniques; it's also about appreciating the history and character that these structures bring to a home. Each foundation tells a story of the builders who crafted it, the challenges they faced, and the innovations they embraced. By understanding these foundational elements, you gain a deeper appreciation for the homes we live in and the craftsmanship that went into their creation.

In conclusion, recognizing basement foundations in older houses is a rewarding pursuit that combines historical knowledge, architectural appreciation, and a bit of detective work. Whether you're a homeowner, a history buff, or simply curious about the homes around you, taking the time to understand these foundational structures can provide fascinating insights into the past and the evolution of home construction.

About foundation

Image not found or type unknown

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

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

Common uses

[edit]

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

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

Arts, entertainment, and media

[edit]

Film and TV

[edit]

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

Games

[edit]

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

Literature

[edit]

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

- *Foundation* (Lackey novel), a 2008 fantasy novel by Mercedes Lackey

Music

[edit]

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

Albums

[edit]

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

Songs

[edit]

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

Other uses in arts, entertainment, and media

[edit]

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

Education

[edit]

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

Science and technology

[edit]

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

Companies

[edit]

- Foundation Medicine, a genomic profiling company

See also

[edit]

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

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

About radon mitigation

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This article **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.
Find sources: "Radon mitigation" – news · newspapers · books · scholar · JSTOR *(March 2015) (Learn how and when to remove this message)*

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The examples and perspective in this article **deal primarily with North America and do not represent a worldwide view of the subject**. You may improve this article, discuss the issue on the talk page, or create a new article, as appropriate. *(June 2019) (Learn how and when to remove this message)*

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This article **may be too technical for most readers to understand**. Please help improve it to make it understandable to non-experts, without removing the technical details. *(November 2021) (Learn how and when to remove this message)*

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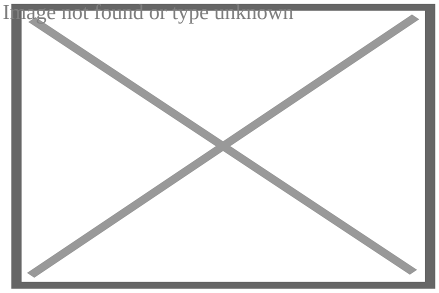
Radon mitigation is any process used to reduce radon gas concentrations in the breathing zones of occupied buildings, or radon from water supplies. Radon is a significant contributor to environmental radioactivity and indoor air pollution. Exposure to radon can cause serious health problems such as lung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

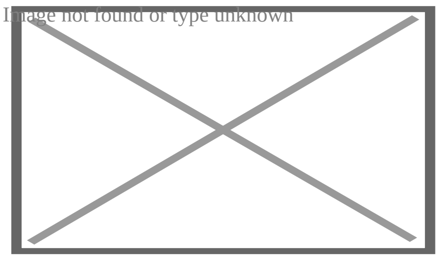
Mitigation of radon in the air by active soil depressurization is most effective. Concrete slabs, sub-floors, and/or crawlspaces are sealed, an air pathway is then created to exhaust radon above the roof-line, and a radon mitigation fan is installed to run permanently. In particularly troublesome dwellings, 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

[edit]



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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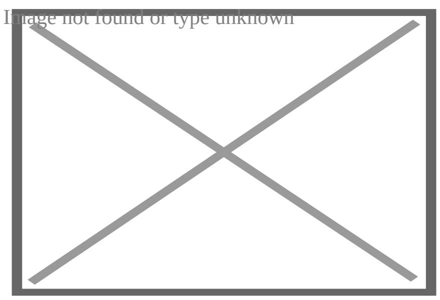

Radon map of the United States

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

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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

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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

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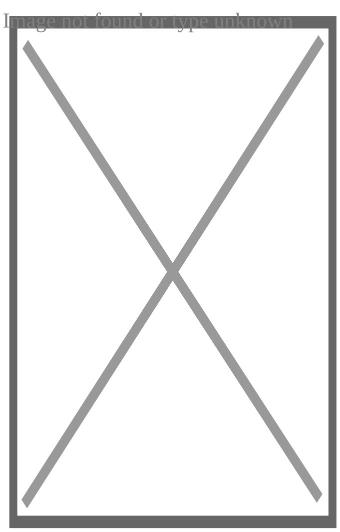
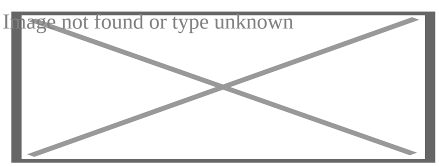


Part of a radon mitigation system including the fan and vent pipe is visible near the gutter downspout.

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

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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.

References

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1. **^** *Nunnally, Diamond (2022-03-30). "Dangerous radon gas dangers and detection tips". WBMA. Retrieved 2022-04-10.*
2. **^** *WHO Handbook on Indoor Radon: A Public Health Perspective. World Health Organization. 2009.*
3. **^** *US EPA, OAR (2013-08-27). "Radon". www.epa.gov. Retrieved 2023-02-04.*
4. **^** *"Recommended Residential Radon Mitigation Standard of Practice". United States Environmental Protection Agency. Archived from the original on 2008-01-16. Retrieved 2008-02-02.*
5. **^** *"ASTM E2121-03 Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings". ASTM International. Retrieved 2008-02-02.*

6. **^** *"Commercially Available Radon Kits". Alpha Energy Labs. Archived from the original on 2012-07-12. Retrieved 2012-04-19.*
7. **^** *"Radon Measurement Method Definitions". The National Environmental Health Association—National Radon Proficiency Program. Archived from the original on 2007-12-24. Retrieved 2008-02-02.*
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11. **^** *"Home radon testing important for health". lethbridgeherald.com. 18 March 2022. Retrieved 2022-04-10.*
12. **^** *"Radon Gas | Vancouver, BC, Canada". Radoncontrol.ca. Retrieved 2015-03-30.*
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15. **^** *"Radon measurements in residential dwellings".*
16. **^** *"Radon boliger 2013" (PDF).*
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18. **^** *"Radon: Myth vs Fact". Radon-Rid/EPA. Retrieved 2009-11-13.*
19. **^** *"Listing of States and Jurisdictions with RRNC Codes". EPA. Retrieved 2009-11-13.*
20. **^** *"A Citizen's Guide to Radon" (PDF). EPA. Retrieved 2024-12-27.*
21. **^** *"Radon Mitigation Methods". Radon Solution. Archived from the original on 2008-12-15. Retrieved 2008-12-02.*
22. ^ ***a b*** *"Consumer's Guide to Radon Reduction: How to Fix Your Home" (PDF). EPA.*
23. **^** *"Radon Mitigation System - EH: Minnesota Department of Health". Health.state.mn.us. 2014-12-10. Retrieved 2019-03-26.*
24. **^** *"Featured Radon Mitigation System Archives". Radonreductioninc.com. Retrieved 2015-03-30.*
25. **^** *""Radon in Drinking Water Health Risk Reduction and Cost Analysis: Notice"" (PDF). Federal Register.* ***64****. February 26, 1999. Retrieved 2015-03-30.*

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

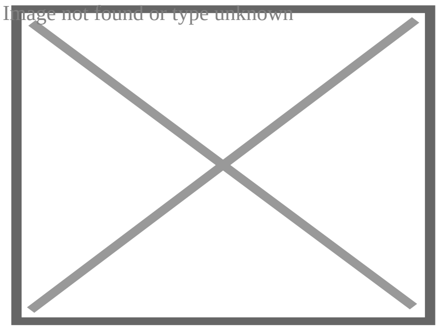
About soil compaction

For soil compaction in agriculture and compaction effects on soil biology, see soil compaction (agriculture), for natural compaction on a geologic scale, see compaction (geology); for consolidation near the surface, see consolidation (soil).

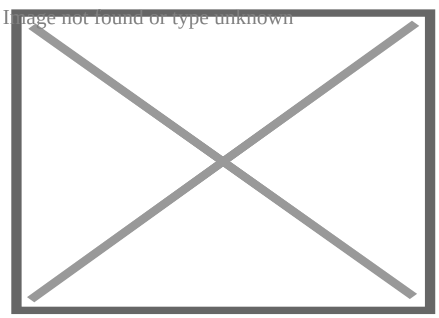
In geotechnical engineering, **soil compaction** is the process in which stress applied to a soil causes densification as air is displaced from the pores between the soil grains. When stress is applied that causes densification due to water (or other liquid) being displaced from between the soil grains, then consolidation, not compaction, has occurred. Normally, compaction is the result of heavy machinery compressing the soil, but it can also occur due to the passage of, for example, animal feet.

In soil science and agronomy, **soil compaction** is usually a combination of both engineering compaction and consolidation, so may occur due to a lack of water in the soil, the applied stress being internal suction due to water evaporation[1] as well as due to passage of animal feet. Affected soils become less able to absorb rainfall, thus increasing runoff and erosion. Plants have difficulty in compacted soil because the mineral grains are pressed together, leaving little space for air and water, which are essential for root growth. Burrowing animals also find it a hostile environment, because the denser soil is more difficult to penetrate. The ability of a soil to recover from this type of compaction depends on climate, mineralogy and fauna. Soils with high shrink–swell capacity, such as vertisols, recover quickly from compaction where moisture conditions are variable (dry spells shrink the soil, causing it to crack). But clays such as kaolinite, which do not crack as they dry, cannot recover from compaction on their own unless they host ground-dwelling animals such as earthworms—the Cecil soil series is an example.

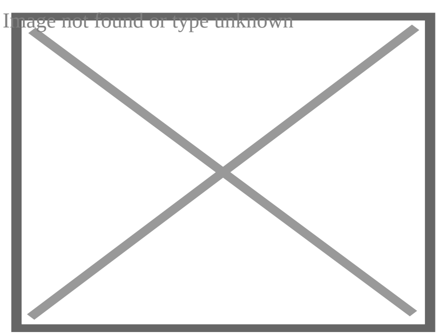
Before soils can be compacted in the field, some laboratory tests are required to determine their engineering properties. Among various properties, the maximum dry density and the optimum moisture content are vital and specify the required density to be compacted in the field.[2]



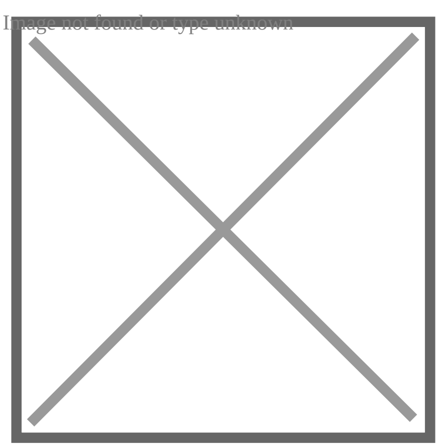
A 10 tonne excavator is here equipped with a narrow sheepsfoot roller to compact the fill over newly placed sewer pipe, forming a stable support for a new road surface.



A compactor/roller fitted with a sheepsfoot drum, operated by U.S. Navy Seabees



Vibrating roller with plain drum as used for compacting asphalt and granular soils



Vibratory rammer in action

In construction

[edit]

Soil compaction is a vital part of the construction process. It is used for support of structural entities such as building foundations, roadways, walkways, and earth retaining structures to name a few. For a given soil type certain properties may deem it more or less desirable to perform adequately for a particular circumstance. In general, the preselected soil should have adequate strength, be relatively incompressible so that future settlement is not significant, be stable against volume change as water content or other factors vary, be durable and safe against deterioration, and possess proper permeability.[3]

When an area is to be filled or backfilled the soil is placed in layers called lifts. The ability of the first fill layers to be properly compacted will depend on the condition of the natural material being covered. If unsuitable material is left in place and backfilled, it may compress over a long period under the weight of the earth fill, causing settlement cracks in the fill or in any structure supported by the fill.[4] In order to determine if the natural soil will support the first fill layers, an area can be proofrolled. Proofrolling consists of utilizing a piece of heavy construction equipment to roll across the fill site and watching for deflections to be revealed. These areas will be indicated by the development of rutting, pumping, or ground weaving.[5]

To ensure adequate soil compaction is achieved, project specifications will indicate the required soil density or degree of compaction that must be achieved. These specifications are generally recommended by a geotechnical engineer in a geotechnical engineering report.

The soil type—that is, grain-size distributions, shape of the soil grains, specific gravity of soil solids, and amount and type of clay minerals, present—has a great influence on the maximum dry unit weight and optimum moisture content.[6] It also has a great influence on how the materials should be compacted in given situations. Compaction is accomplished by use of heavy equipment. In sands and gravels, the equipment usually vibrates, to cause re-orientation of the soil particles into a denser configuration. In silts and clays, a sheepsfoot roller is frequently used, to create small zones of intense shearing, which drives air out of the soil.

Determination of adequate compaction is done by determining the in-situ density of the soil and comparing it to the maximum density determined by a laboratory test. The most commonly used laboratory test is called the Proctor compaction test and there are two different methods in obtaining the maximum density. They are the **standard Proctor** and **modified Proctor** tests; the modified Proctor is more commonly used. For small dams, the standard Proctor may still be the reference.[5]

While soil under structures and pavements needs to be compacted, it is important after construction to decompact areas to be landscaped so that vegetation can grow.

Compaction methods

[edit]

There are several means of achieving compaction of a material. Some are more appropriate for soil compaction than others, while some techniques are only suitable for particular soils or soils in particular conditions. Some are more suited to compaction of non-soil materials such as asphalt. Generally, those that can apply significant amounts of shear as well as compressive stress, are most effective.

The available techniques can be classified as:

1. Static – a large stress is slowly applied to the soil and then released.
2. Impact – the stress is applied by dropping a large mass onto the surface of the soil.
3. Vibrating – a stress is applied repeatedly and rapidly via a mechanically driven plate or hammer. Often combined with rolling compaction (see below).
4. Gyrating – a static stress is applied and maintained in one direction while the soil is a subjected to a gyratory motion about the axis of static loading. Limited to laboratory applications.
5. Rolling – a heavy cylinder is rolled over the surface of the soil. Commonly used on sports pitches. Roller-compactors are often fitted with vibratory devices to enhance their effectiveness.
6. Kneading – shear is applied by alternating movement in adjacent positions. An example, combined with rolling compaction, is the 'sheepsfoot' roller used in waste compaction at landfills.

The construction plant available to achieve compaction is extremely varied and is described elsewhere.

Test methods in laboratory

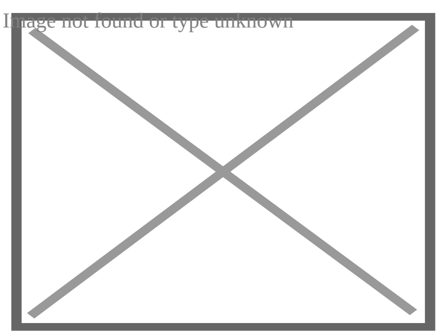
[edit]

Soil compactors are used to perform test methods which cover laboratory compaction methods used to determine the relationship between molding water content and dry unit weight of soils. Soil placed as engineering fill is compacted to a dense state to obtain satisfactory engineering properties such as, shear strength, compressibility, or permeability. In addition, foundation soils are often compacted to improve their engineering properties. Laboratory compaction tests provide the basis for determining the percent compaction and molding water content needed to achieve the required engineering properties, and for controlling construction to assure that the required compaction and water contents are achieved. Test methods such as EN 13286-2, EN 13286-47, ASTM D698, ASTM D1557, AASHTO T99, AASHTO T180, AASHTO T193, BS 1377:4 provide soil compaction testing procedures.[7]

See also

[edit]

- Soil compaction (agriculture)
- Soil degradation
- Compactor
- Earthwork
- Soil structure
- Aeration
- Shear strength (soil)



Multiquip RX1575 Rammax Sheepsfoot Trench Compaction Roller on the jobsite in San Diego, California

References

[edit]

1. **^** Soil compaction due to lack of water in soil
2. **^** *Jia, Xiaoyang; Hu, Wei; Polaczyk, Pawel; Gong, Hongren; Huang, Baoshan (2019). "Comparative Evaluation of Compacting Process for Base Materials using Lab Compaction Methods". Transportation Research Record: Journal of the Transportation Research Board.* ***2673*** *(4): 558–567. doi:10.1177/0361198119837953. ISSN 0361-1981.*
3. **^** *McCarthy, David F. (2007). Essentials of Soil Mechanics and Foundations. Upper Saddle River, NJ: Pearson Prentice Hall. p. 595. ISBN 978-0-13-114560-3.*

4. **^** *McCarthy, David F. (2007). Essentials of Soil Mechanics and Foundations. Upper Saddle River, NJ: Pearson Prentice Hall. pp. 601–602. ISBN 978-0-13-114560-3.*
5. ^ ***a b*** *McCarthy, David F. (2007). Essentials of Soil Mechanics and Foundations. Upper Saddle River, NJ: Pearson Prentice Hall. p. 602. ISBN 978-0-13-114560-3.*
6. **^** *Das, Braja M. (2002). Principles of Geotechnical Engineering. Pacific Grove, CA: Brooks/Cole. p. 105. ISBN 0-534-38742-X.*
7. **^** *"Automatic Soil Compactor". cooper.co.uk. Cooper Research Technology. Archived from the original on 27 August 2014. Retrieved 8 September 2014.*

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Geotechnical engineering

Offshore geotechnical engineering

Investigation and instrumentation

Field (*in situ*)

- Image not found or type unknown Core drill
- Image not found or type unknown Cone penetration test
- Image not found or type unknown Geo-electrical sounding
- Image not found or type unknown Permeability test
- Image not found or type unknown Load test
  - Static
  - Dynamic
  - Statnamic
- Image not found or type unknown Pore pressure measurement
  - Piezometer
  - Well
- Image not found or type unknown Ram sounding
- Image not found or type unknown Rock control drilling
- Image not found or type unknown Rotary-pressure sounding
- Image not found or type unknown Rotary weight sounding
- Image not found or type unknown Sample series
- Image not found or type unknown Screw plate test
- Deformation monitoring
  - Image not found or type unknown Inclinometer
  - Image not found or type unknown Settlement recordings
- Image not found or type unknown Shear vane test
- Image not found or type unknown Simple sounding
- Image not found or type unknown Standard penetration test
- Image not found or type unknown Total sounding
- Image not found or type unknown Trial pit
- Image not found or type unknown Visible bedrock
- Nuclear densometer test
- Exploration geophysics

Soil

- Types
  - Clay
  - Silt
  - Sand
  - Gravel
  - Peat
  - Loam
  - Loess
- Properties
  - Hydraulic conductivity
  - Water content
  - Void ratio
  - Bulk density
  - Thixotropy
  - Reynolds' dilatancy
  - Angle of repose
  - Friction angle
  - Cohesion
  - Porosity
  - Permeability
  - Specific storage
  - Shear strength
  - Sensitivity

	Natural features	○ Topography ○ Vegetation ○ Terrain ○ Topsoil ○ Water table ○ Bedrock ○ Subgrade ○ Subsoil

Structures (Interaction)	Earthworks	○ Shoring structures
		    ○ Retaining walls
		    ○ Gabion
		    ○ Ground freezing
		    ○ Mechanically stabilized earth
		    ○ Pressure grouting
		    ○ Slurry wall
		    ○ Soil nailing
		    ○ Tieback
		○ Land development
		○ Landfill
		○ Excavation
		○ Trench
		○ Embankment
		○ Cut
		○ Causeway
		○ Terracing
		○ Cut-and-cover
		○ Cut and fill
		○ Fill dirt
		○ Grading
		○ Land reclamation
		○ Track bed
		○ Erosion control
		○ Earth structure
		○ Expanded clay aggregate
		○ Crushed stone
		○ Geosynthetics
		    ○ Geotextile
		    ○ Geomembrane
		    ○ Geosynthetic clay liner
		    ○ Cellular confinement
		○ Infiltration

	Foundations	○ Shallow

Mechanics

- Forces
  - Effective stress
  - Pore water pressure
  - Lateral earth pressure
  - Overburden pressure
  - Preconsolidation pressure
- Phenomena/ problems
  - Permafrost
  - Frost heaving
  - Consolidation
  - Compaction
  - Earthquake
    - Response spectrum
    - Seismic hazard
    - Shear wave
  - Landslide analysis
    - Stability analysis
    - Mitigation
    - Classification
    - Sliding criterion
    - Slab stabilisation
  - Bearing capacity * Stress distribution in soil

Numerical analysis software

- SEEP2D
- STABL
- SVFlux
- SVSlope
- UTEXAS
- Plaxis

Related fields

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

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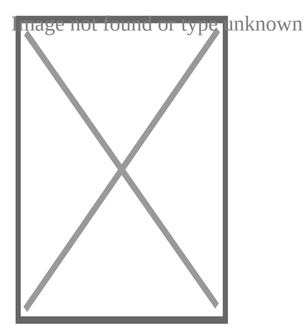
Soil science

- History
- Index

Main fields

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



Soil topics

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

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Soil classification

World Reference Base for Soil Resources (1998–)	○ Acrisols ○ Alisols ○ Andosols ○ Anthrosols ○ Arenosols ○ Calcisols ○ Cambisols ○ Chernozem ○ Cryosols ○ Durisols ○ Ferralsols ○ Fluvisols ○ Gleysols ○ Gypsisols ○ Histosol ○ Kastanozems ○ Leptosols ○ Lixisols ○ Luvisols ○ Nitisols ○ Phaeozems ○ Planosols ○ Plinthosols ○ Podzols ○ Regosols ○ Retisols ○ Solonchaks ○ Solonetz ○ Stagnosol ○ Technosols ○ Umbrisols ○ Vertisols
USDA soil	○ Alfisols ○ Andisols ○ Aridisols ○ Entisols ○ Gelisols ○ Histosols

Applications

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

Related fields

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

Societies, Initiatives

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

Scientific journals

- *Acta Agriculturae Scandinavica B*
- *Journal of Soil and Water Conservation*
- *Plant and Soil*
- *Pochvovedenie*
- *Soil Research*
- *Soil Science Society of America Journal*

See also

- Land use
- Land conversion
- Land management
- Vegetation
- Infiltration (hydrology)
- Groundwater
- Crust (geology)
- Impervious surface/Surface runoff
- Petrichor

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- Category soil science
- Image not found or type unknown List of soil scientists

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About Cook County

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Things To Do in Cook County

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Sand Ridge Nature Center

4.8 (96)

Photo

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River Trail Nature Center

4.6 (235)

Photo

Palmisano (Henry) Park

4.7 (1262)

Driving Directions in Cook County

Driving Directions From Palmisano (Henry) Park to

Driving Directions From Lake Katherine Nature Center and Botanic Gardens to

Driving Directions From Navy Pier to

**https://www.google.com/maps/dir/Navy+Pier/United+Structural+Systems+of+Illinois%2C+
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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.

Recognizing Basement Foundations in Older Houses**View GBP**

Frequently Asked Questions

What are common signs of foundation problems in older houses?

Common signs include cracks in the walls or floors, doors and windows that stick, uneven or sloping floors, and visible water damage or mold in the basement.

How can I identify the type of foundation in my older home?

You can identify the type of foundation by examining the basement walls. Common types in older homes include stone, brick, or concrete block foundations. A professional inspection can confirm the type and condition.

What are the typical causes of foundation issues in older homes?

Typical causes include soil movement due to moisture changes, poor drainage around the house, aging and deterioration of materials, and previous repairs that were not done correctly.

When should I consider hiring a professional for foundation repair?

Consider hiring a professional if you notice significant cracks, major water leakage, or structural issues like bowing walls. Early intervention can prevent more costly repairs later.

How can I prevent further damage to an older homes foundation?

To prevent further damage, ensure proper drainage around your home, maintain consistent moisture levels in the soil, and address any minor issues promptly. Regular inspections by a professional can also help catch problems early.

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City : Hoffman Estates

State : IL

Zip : 60169

Address : 2124 Stonington Ave

Google Business Profile

Company Website : **https://www.unitedstructuralsystems.com/**

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Residential Foundation Repair Services

home foundation repair service

Foundation Repair Service

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