



- **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**
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construction, refers to the gradual sinking or shifting of a building's foundation into the ground. This phenomenon can lead to various visible and structural issues within a building, particularly in its floors. Understanding and identifying these signs early can help in taking timely corrective measures, thus preventing more severe damage.

One of the most apparent signs of floor settlement is the development of cracks. These cracks often appear in a pattern that radiates from a central point, resembling a spider web. They are typically more pronounced in areas where the load on the floor is heavier, such as under heavy furniture or in the corners of rooms. The width and depth of these cracks can vary, but any crack that continues to grow over time is a strong indicator of ongoing settlement.

Another sign to look out for is uneven flooring. This can manifest as a noticeable slope in the floor, where one side appears higher than the other. You might notice this when furniture starts to lean or when marbles or other small objects roll across the floor. In severe cases, doors may start to stick or not close properly because the floor has settled unevenly, causing the door frames to shift.

Squeaky floors can also be a subtle hint of settlement. As the floorboards or subfloor shifts due to settlement, the friction between them can cause squeaking sounds when walked upon. While squeaky floors can sometimes be attributed to loose nails or screws, persistent squeaking over a large area might suggest a more significant issue related to settlement.

In addition to visual and auditory cues, changes in the floor's texture or appearance can also signal settlement. For instance, tiles might start to crack or lift, and hardwood floors may show gaps between the boards that weren't there before. These changes are often more pronounced in older buildings where the materials have had more time to settle and shift.

When observing these signs, it's essential to consider the context of the building. Factors such as the soil type, the age of the building, and the local climate can all influence the rate and extent of settlement. For example, buildings constructed on clay soil are more prone to settlement due to the soil's tendency to expand and contract with moisture changes.

If you suspect that your floors are showing signs of settlement, it's advisable to consult with a professional. Structural engineers and experienced contractors can assess the situation and recommend appropriate solutions, which might range from minor repairs to more extensive foundation work.

In conclusion, being vigilant about observing signs of settlement in floors is crucial for the longevity and safety of any building. By recognizing the early indicators such as cracks, unevenness, squeaking, and changes in floor texture, homeowners and building managers can take proactive steps to address these issues before they escalate into more significant problems. Regular inspections and maintenance can go a long way in preserving the structural integrity and aesthetic appeal of a building.



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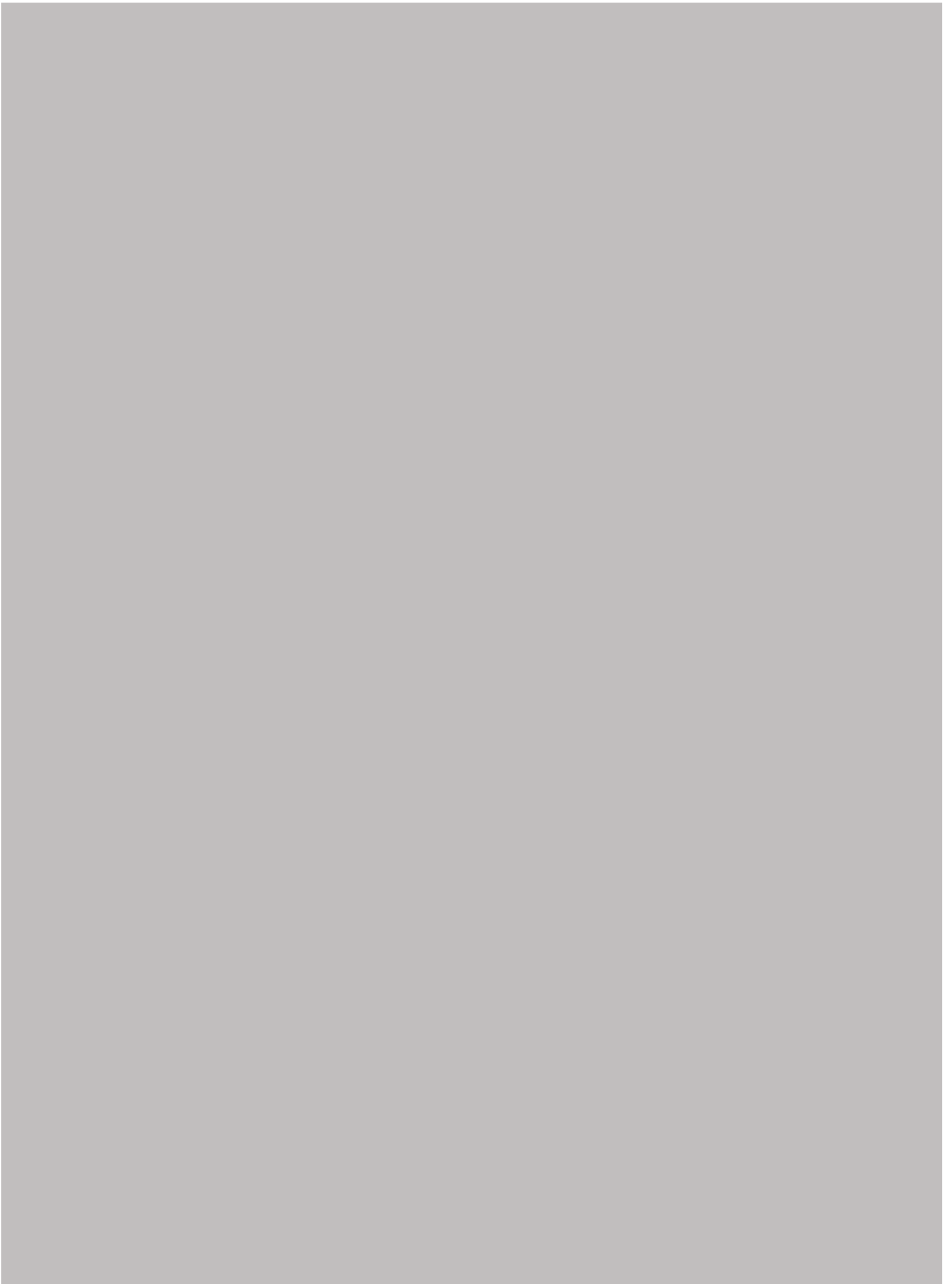


# **Residential Foundation Repair Services**

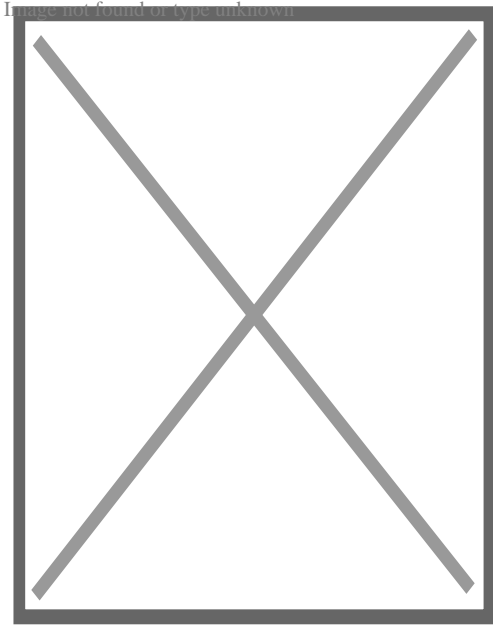


# **Strong Foundations, Strong Homes**

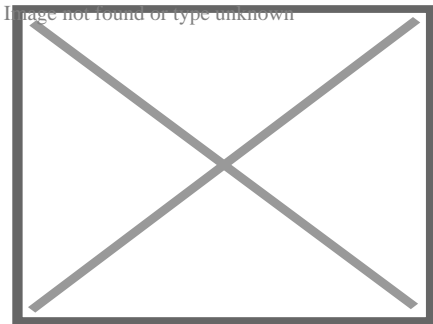




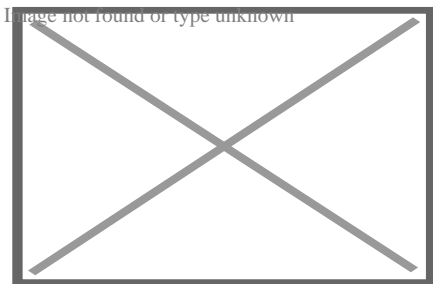
## About geotechnical engineering



Boston's Big Dig presented geotechnical challenges in an urban environment.



Precast concrete retaining wall



A typical cross-section of a slope used in two-dimensional analyzes.

**Geotechnical engineering**, also known as **geotechnics**, is the branch of civil engineering concerned with the engineering behavior of earth materials. It uses the principles of soil

mechanics and rock mechanics to solve its engineering problems. It also relies on knowledge of geology, hydrology, geophysics, and other related sciences.

Geotechnical engineering has applications in military engineering, mining engineering, petroleum engineering, coastal engineering, and offshore construction. The fields of geotechnical engineering and engineering geology have overlapping knowledge areas. However, while geotechnical engineering is a specialty of civil engineering, engineering geology is a specialty of geology.

## History

[edit]

Humans have historically used soil as a material for flood control, irrigation purposes, burial sites, building foundations, and construction materials for buildings. Dykes, dams, and canals dating back to at least 2000 BCE—found in parts of ancient Egypt, ancient Mesopotamia, the Fertile Crescent, and the early settlements of Mohenjo Daro and Harappa in the Indus valley—provide evidence for early activities linked to irrigation and flood control. As cities expanded, structures were erected and supported by formalized foundations. The ancient Greeks notably constructed pad footings and strip-and-raft foundations. Until the 18th century, however, no theoretical basis for soil design had been developed, and the discipline was more of an art than a science, relying on experience.<sup>[1]</sup>

Several foundation-related engineering problems, such as the Leaning Tower of Pisa, prompted scientists to begin taking a more scientific-based approach to examining the subsurface. The earliest advances occurred in the development of earth pressure theories for the construction of retaining walls. Henri Gautier, a French royal engineer, recognized the "natural slope" of different soils in 1717, an idea later known as the soil's angle of repose. Around the same time, a rudimentary soil classification system was also developed based on a material's unit weight, which is no longer considered a good indication of soil type.<sup>[1][2]</sup>

The application of the principles of mechanics to soils was documented as early as 1773 when Charles Coulomb, a physicist and engineer, developed improved methods to determine the earth pressures against military ramparts. Coulomb observed that, at failure, a distinct slip plane would form behind a sliding retaining wall and suggested that the maximum shear stress on the slip plane, for design purposes, was the sum of the soil cohesion,  $c$ , and friction,  $\sigma \tan(\phi)$ , where  $\sigma$  is the normal stress on the slip plane and  $\phi$  is the friction angle of the soil. By combining Coulomb's theory with Christian Otto Mohr's 2D stress state, the theory became known as Mohr-Coulomb theory. Although it is now recognized that precise determination of cohesion is impossible because  $c$  is not a fundamental soil property, the Mohr-Coulomb theory is still used in practice today.<sup>[3]</sup>

In the 19th century, Henry Darcy developed what is now known as Darcy's Law, describing the flow of fluids in a porous media. Joseph Boussinesq, a mathematician and physicist, developed

theories of stress distribution in elastic solids that proved useful for estimating stresses at depth in the ground. William Rankine, an engineer and physicist, developed an alternative to Coulomb's earth pressure theory. Albert Atterberg developed the clay consistency indices that are still used today for soil classification.<sup>[1][2]</sup> In 1885, Osborne Reynolds recognized that shearing causes volumetric dilation of dense materials and contraction of loose granular materials.

Modern geotechnical engineering is said to have begun in 1925 with the publication of *Erdbaumechanik* by Karl von Terzaghi, a mechanical engineer and geologist. Considered by many to be the father of modern soil mechanics and geotechnical engineering, Terzaghi developed the principle of effective stress, and demonstrated that the shear strength of soil is controlled by effective stress.<sup>[4]</sup> Terzaghi also developed the framework for theories of bearing capacity of foundations, and the theory for prediction of the rate of settlement of clay layers due to consolidation.<sup>[1][3][5]</sup> Afterwards, Maurice Biot fully developed the three-dimensional soil consolidation theory, extending the one-dimensional model previously developed by Terzaghi to more general hypotheses and introducing the set of basic equations of Poroelasticity.

In his 1948 book, Donald Taylor recognized that the interlocking and dilation of densely packed particles contributed to the peak strength of the soil. Roscoe, Schofield, and Wroth, with the publication of *On the Yielding of Soils* in 1958, established the interrelationships between the volume change behavior (dilation, contraction, and consolidation) and shearing behavior with the theory of plasticity using critical state soil mechanics. Critical state soil mechanics is the basis for many contemporary advanced constitutive models describing the behavior of soil.<sup>[6]</sup>

In 1960, Alec Skempton carried out an extensive review of the available formulations and experimental data in the literature about the effective stress validity in soil, concrete, and rock in order to reject some of these expressions, as well as clarify what expressions were appropriate according to several working hypotheses, such as stress-strain or strength behavior, saturated or non-saturated media, and rock, concrete or soil behavior.

## **Roles**

[edit]

## **Geotechnical investigation**

[edit]

Main article: Geotechnical investigation

Geotechnical engineers investigate and determine the properties of subsurface conditions and materials. They also design corresponding earthworks and retaining structures, tunnels, and structure foundations, and may supervise and evaluate sites, which may further involve site monitoring as well as the risk assessment and mitigation of natural hazards.<sup>[7][8]</sup>

Geotechnical engineers and engineering geologists perform geotechnical investigations to obtain information on the physical properties of soil and rock underlying and adjacent to a site to design earthworks and foundations for proposed structures and for the repair of distress to earthworks and structures caused by subsurface conditions. Geotechnical investigations involve surface and subsurface exploration of a site, often including subsurface sampling and laboratory testing of retrieved soil samples. Sometimes, geophysical methods are also used to obtain data, which include measurement of seismic waves (pressure, shear, and Rayleigh waves), surface-wave methods and downhole methods, and electromagnetic surveys (magnetometer, resistivity, and ground-penetrating radar). Electrical tomography can be used to survey soil and rock properties and existing underground infrastructure in construction projects.<sup>[9]</sup>

Surface exploration can include on-foot surveys, geologic mapping, geophysical methods, and photogrammetry. Geologic mapping and interpretation of geomorphology are typically completed in consultation with a geologist or engineering geologist. Subsurface exploration usually involves in-situ testing (for example, the standard penetration test and cone penetration test). The digging of test pits and trenching (particularly for locating faults and slide planes) may also be used to learn about soil conditions at depth. Large-diameter borings are rarely used due to safety concerns and expense. Still, they are sometimes used to allow a geologist or engineer to be lowered into the borehole for direct visual and manual examination of the soil and rock stratigraphy.

Various soil samplers exist to meet the needs of different engineering projects. The standard penetration test, which uses a thick-walled split spoon sampler, is the most common way to collect disturbed samples. Piston samplers, employing a thin-walled tube, are most commonly used to collect less disturbed samples. More advanced methods, such as the Sherbrooke block sampler, are superior but expensive. Coring frozen ground provides high-quality undisturbed samples from ground conditions, such as fill, sand, moraine, and rock fracture zones.<sup>[10]</sup>

Geotechnical centrifuge modeling is another method of testing physical-scale models of geotechnical problems. The use of a centrifuge enhances the similarity of the scale model tests involving soil because soil's strength and stiffness are susceptible to the confining pressure. The centrifugal acceleration allows a researcher to obtain large (prototype-scale) stresses in small physical models.

## **Foundation design**

[edit]

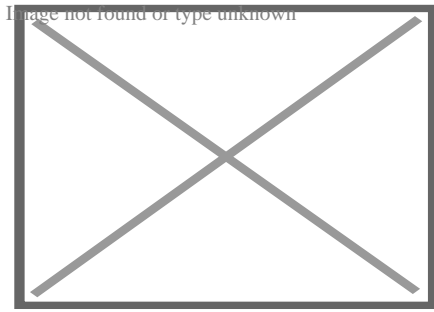
Main article: Foundation (engineering)

The foundation of a structure's infrastructure transmits loads from the structure to the earth. Geotechnical engineers design foundations based on the load characteristics of the structure and the properties of the soils and bedrock at the site. Generally, geotechnical engineers first estimate the magnitude and location of loads to be supported before developing an

investigation plan to explore the subsurface and determine the necessary soil parameters through field and lab testing. Following this, they may begin the design of an engineering foundation. The primary considerations for a geotechnical engineer in foundation design are bearing capacity, settlement, and ground movement beneath the foundations.<sup>[11]</sup>

## Earthworks

[edit]



A compactor/roller operated by U.S. Navy Seabees

See also: Earthworks (engineering)

Geotechnical engineers are also involved in the planning and execution of earthworks, which include ground improvement,<sup>[11]</sup> slope stabilization, and slope stability analysis.

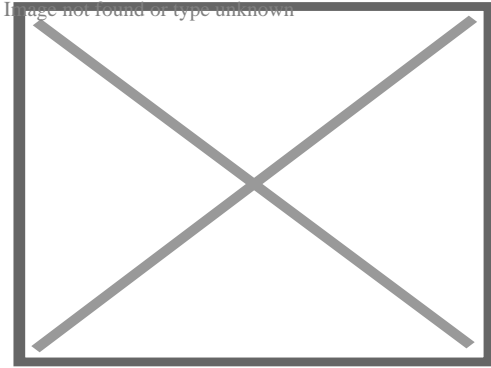
## Ground improvement

[edit]

Various geotechnical engineering methods can be used for ground improvement, including reinforcement geosynthetics such as geocells and geogrids, which disperse loads over a larger area, increasing the soil's load-bearing capacity. Through these methods, geotechnical engineers can reduce direct and long-term costs.<sup>[12]</sup>

## Slope stabilization

[edit]



Simple slope slip section.

Main article: Slope stability

Geotechnical engineers can analyze and improve slope stability using engineering methods. Slope stability is determined by the balance of shear stress and shear strength. A previously stable slope may be initially affected by various factors, making it unstable. Nonetheless, geotechnical engineers can design and implement engineered slopes to increase stability.

## Slope stability analysis

[edit]

Main article: Slope stability analysis

Stability analysis is needed to design engineered slopes and estimate the risk of slope failure in natural or designed slopes by determining the conditions under which the topmost mass of soil will slip relative to the base of soil and lead to slope failure.<sup>[13]</sup> If the interface between the mass and the base of a slope has a complex geometry, slope stability analysis is difficult and numerical solution methods are required. Typically, the interface's exact geometry is unknown, and a simplified interface geometry is assumed. Finite slopes require three-dimensional models to be analyzed, so most slopes are analyzed assuming that they are infinitely wide and can be represented by two-dimensional models.

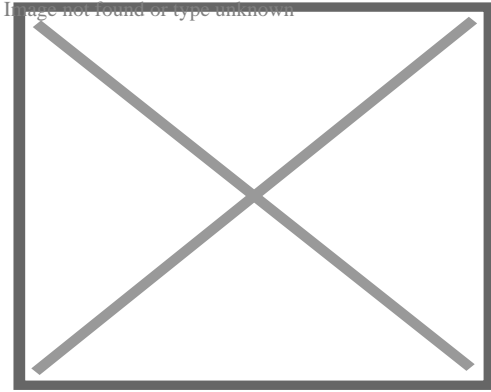
## Sub-disciplines

[edit]

## Geosynthetics

[edit]

Main article: Geosynthetics



A collage of geosynthetic products.

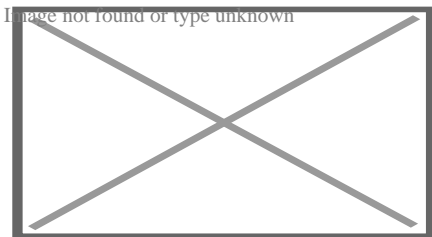
Geosynthetics are a type of plastic polymer products used in geotechnical engineering that improve engineering performance while reducing costs. This includes geotextiles, geogrids, geomembranes, geocells, and geocomposites. The synthetic nature of the products make them suitable for use in the ground where high levels of durability are required. Their main functions include drainage, filtration, reinforcement, separation, and containment.

Geosynthetics are available in a wide range of forms and materials, each to suit a slightly different end-use, although they are frequently used together. Some reinforcement geosynthetics, such as geogrids and more recently, cellular confinement systems, have shown to improve bearing capacity, modulus factors and soil stiffness and strength.<sup>[14]</sup> These products have a wide range of applications and are currently used in many civil and geotechnical engineering applications including roads, airfields, railroads, embankments, piled embankments, retaining structures, reservoirs, canals, dams, landfills, bank protection and coastal engineering.<sup>[15]</sup>

## Offshore

[edit]

Main article: Offshore geotechnical engineering



Platforms offshore Mexico.

*Offshore* (or *marine*) *geotechnical engineering* is concerned with foundation design for human-made structures in the sea, away from the coastline (in opposition to *onshore* or *nearshore* engineering). Oil platforms, artificial islands and submarine pipelines are examples of such structures.<sup>[16]</sup>



There are a number of significant differences between onshore and offshore geotechnical engineering.[<sup>16</sup>][<sup>17</sup>] Notably, site investigation and ground improvement on the seabed are more expensive; the offshore structures are exposed to a wider range of geohazards; and the environmental and financial consequences are higher in case of failure. Offshore structures are exposed to various environmental loads, notably wind, waves and currents. These phenomena may affect the integrity or the serviceability of the structure and its foundation during its operational lifespan and need to be taken into account in offshore design.

In subsea geotechnical engineering, seabed materials are considered a two-phase material composed of rock or mineral particles and water.[<sup>18</sup>][<sup>19</sup>] Structures may be fixed in place in the seabed—as is the case for piers, jetties and fixed-bottom wind turbines—or may comprise a floating structure that remains roughly fixed relative to its geotechnical anchor point. Undersea mooring of human-engineered floating structures include a large number of offshore oil and gas platforms and, since 2008, a few floating wind turbines. Two common types of engineered design for anchoring floating structures include tension-leg and catenary loose mooring systems.[<sup>20</sup>]

## **Observational method**

[edit]

First proposed by Karl Terzaghi and later discussed in a paper by Ralph B. Peck, the observational method is a managed process of construction control, monitoring, and review, which enables modifications to be incorporated during and after construction. The method aims to achieve a greater overall economy without compromising safety by creating designs based on the most probable conditions rather than the most unfavorable.[<sup>21</sup>] Using the observational method, gaps in available information are filled by measurements and investigation, which aid in assessing the behavior of the structure during construction, which in turn can be modified per the findings. The method was described by Peck as "learn-as-you-go".[<sup>22</sup>]

The observational method may be described as follows:[<sup>22</sup>]

1. General exploration sufficient to establish the rough nature, pattern, and properties of deposits.
2. Assessment of the most probable conditions and the most unfavorable conceivable deviations.
3. Creating the design based on a working hypothesis of behavior anticipated under the most probable conditions.
4. Selection of quantities to be observed as construction proceeds and calculating their anticipated values based on the working hypothesis under the most unfavorable conditions.
5. Selection, in advance, of a course of action or design modification for every foreseeable significant deviation of the observational findings from those predicted.
6. Measurement of quantities and evaluation of actual conditions.

## 7. Design modification per actual conditions

The observational method is suitable for construction that has already begun when an unexpected development occurs or when a failure or accident looms or has already happened. It is unsuitable for projects whose design cannot be altered during construction.<sup>[22]</sup>

### See also

[edit]

 Image from the Internet [Engineering portal](#)

- Civil engineering
- Deep Foundations Institute
- Earthquake engineering
- Earth structure
- Effective stress
- Engineering geology
- Geological Engineering
- Geoprofessions
- Hydrogeology
- International Society for Soil Mechanics and Geotechnical Engineering
- Karl von Terzaghi
- Land reclamation
- Landfill
- Mechanically stabilized earth
- Offshore geotechnical engineering
- Rock mass classifications
- Sediment control
- Seismology
- Soil mechanics
- Soil physics
- Soil science

### Notes

[edit]

1. <sup>^</sup> **a b c d** *Das, Braja (2006). Principles of Geotechnical Engineering. Thomson Learning.*
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22. ^ **a b c** Peck, R.B (1969). Advantages and limitations of the observational method in applied soil mechanics, *Geotechnique*, 19, No. 1, pp. 171-187.

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## External links

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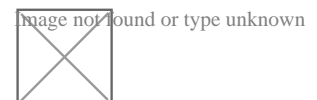
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**Specialties  
and  
interdisciplinarity**



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- Licensed engineer

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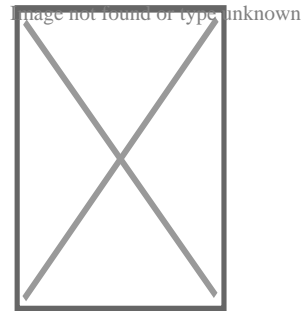
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- Agricultural soil science



## **Soil topics**

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  - 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  
taxonomy**

- Alfisols
- Andisols
- Aridisols
- Entisols
- Gelisols
- Histosols
- Inceptisols

## **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

-  [Wikipedia:WikiProject Soil](#)
-  [Category soil](#)
- [Category soil science](#)
-  [List of soil scientists](#)





















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Geotechnical engineering

Offshore geotechnical engineering

## Investigation and instrumentation

### Field (*in situ*)

-  Core drill
-  Cone penetration test
-  Geo-electrical sounding
-  Permeability test
-  Load test
  - Static
  - Dynamic
  - Statnamic
-  Pore pressure measurement
  - Piezometer
  - Well
-  Ram sounding
-  Rock control drilling
-  Rotary-pressure sounding
-  Rotary weight sounding
-  Sample series
-  Screw plate test
- Deformation monitoring
  -  Inclinometer
  -  Settlement recordings
-  Shear vane test
-  Simple sounding
-  Standard penetration test
-  Total sounding
-  Trial pit
-  Visible bedrock
- Nuclear densometer test
- Exploration geophysics
- Crosshole sonic logging

## Soil

### Types

- Clay
- Silt
- Sand
- Gravel
- Peat
- Loam
- Loess

### Properties

- Hydraulic conductivity
- Water content
- Void ratio
- Bulk density
- Thixotropy
- Reynolds' dilatancy
- Angle of repose
- Friction angle
- Cohesion
- Porosity
- Permeability
- Specific storage
- Shear strength
- Sensitivity

**Structures  
(Interaction)**

Natural features

- Topography
- Vegetation
- Terrain
- Topsoil
- Water table
- Bedrock
- Subgrade
- Subsoil

Earthworks

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

Foundations

- Shallow
- Deep



## Mechanics

### Forces

- Effective stress
- Pore water pressure
- Lateral earth pressure
- Overburden pressure
- Preconsolidation pressure

### Phenomena/ problems

- Permafrost
- Frost heaving
- Consolidation
- Compaction
- Earthquake
  - Response spectrum
  - Seismic hazard
  - Shear wave
- Landslide analysis
  - Stability analysis
  - Mitigation
  - Classification
  - Sliding criterion
  - Slab stabilisation
- Bearing capacity \* Stress distribution in soil

## Numerical analysis software

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

## **Related fields**

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

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## **Construction**

### **Types**

- Home construction
- Offshore construction
- Underground construction
  - Tunnel construction

### **History**

- Architecture
- Construction
- Structural engineering
- Timeline of architecture
- Water supply and sanitation

## **Professions**

- Architect
- Building engineer
- Building estimator
- Building officials
- Chartered Building Surveyor
- Civil engineer
- Civil estimator
- Clerk of works
- Project manager
- Quantity surveyor
- Site manager
- Structural engineer
- Superintendent

## **Trades workers (List)**

- Banksman
- Boilermaker
- Bricklayer
- Carpenter
- Concrete finisher
- Construction foreman
- Construction worker
- Electrician
- Glazier
- Ironworker
- Millwright
- Plasterer
- Plumber
- Roofer
- Steel fixer
- Welder

## **Organizations**

- American Institute of Constructors (AIC)
- American Society of Civil Engineers (ASCE)
- Asbestos Testing and Consultancy Association (ATAC)
- Associated General Contractors of America (AGC)
- Association of Plumbing and Heating Contractors (APHC)
- Build UK
- Construction History Society
- Chartered Institution of Civil Engineering Surveyors (CICES)
- Chartered Institute of Plumbing and Heating Engineering (CIPHE)
- Civil Engineering Contractors Association (CECA)
- The Concrete Society
- Construction Management Association of America (CMAA)
- Construction Specifications Institute (CSI)
- FIDIC
- Home Builders Federation (HBF)
- Lighting Association
- National Association of Home Builders (NAHB)
- National Association of Women in Construction (NAWIC)
- National Fire Protection Association (NFPA)
- National Kitchen & Bath Association (NKBA)
- National Railroad Construction and Maintenance Association (NRC)
- National Tile Contractors Association (NTCA)
- Railway Tie Association (RTA)
- Royal Institution of Chartered Surveyors (RICS)
- Scottish Building Federation (SBF)
- Society of Construction Arbitrators

## **By country**

- India
- Iran
- Japan
- Romania
- Turkey
- United Kingdom
- United States

## **Regulation**

- Building code
- Construction law
- Site safety
- Zoning

## **Architecture**

- Style
  - List
- Industrial architecture
  - British
- Indigenous architecture
- Interior architecture
- Landscape architecture
- Vernacular architecture

## **Engineering**

- Architectural engineering
- Building services engineering
- Civil engineering
  - Coastal engineering
  - Construction engineering
  - Structural engineering
- Earthquake engineering
- Environmental engineering
- Geotechnical engineering

## **Methods**

- List
- Earthbag construction
- Modern methods of construction
- Monocrete construction
- Slip forming

- Building material
  - List of building materials
  - Millwork
- Construction bidding
- Construction delay
- Construction equipment theft
- Construction loan
- Construction management
- Construction waste
- Demolition
- Design–build
- Design–bid–build
- DfMA
- Heavy equipment
- Interior design
- Lists of buildings and structures
  - List of tallest buildings and structures
- Megaproject
- Megastructure
- Plasterwork
  - Damp
    - Proofing
  - Parge coat
  - Roughcast
    - Harling
- Real estate development
- Stonemasonry
- Sustainability in construction
- Unfinished building
- Urban design
- Urban planning

**Other topics**

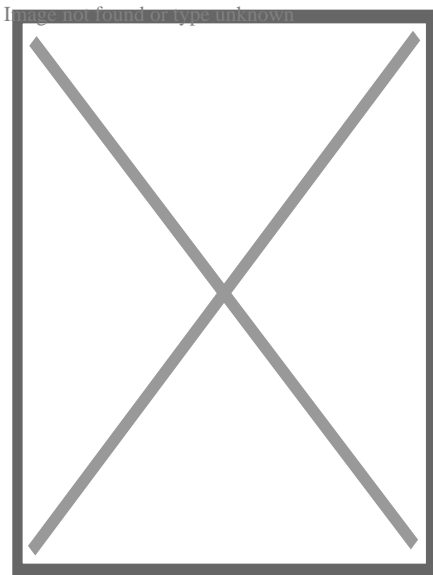
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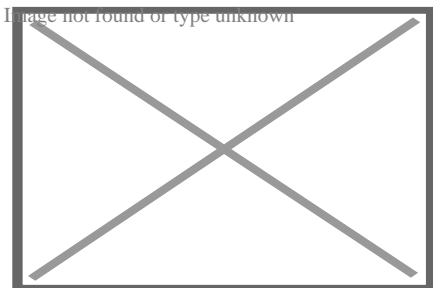
- Germany
- United States
- Czech Republic
- Israel

## About Water damage

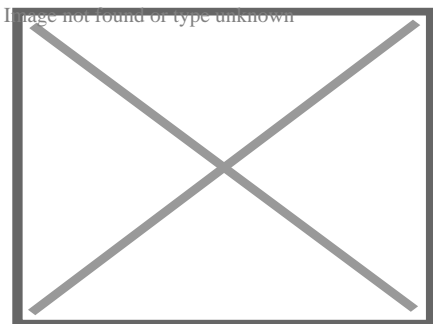
The examples and perspective in this article **may not represent a worldwide view of** **the subject**. You may improve this article, discuss the issue on the talk page, or create **a new article**, as appropriate. *(March 2011) (Learn how and when to remove this message)*



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.<sup>[1]</sup> 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.<sup>[citation needed]</sup>

## 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.<sup>[2]</sup> 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.<sup>[3]</sup> 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<sup>[citation needed]</sup>) costs in the US.<sup>[4]</sup> 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<sup>[5]</sup> 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.<sup>[6]</sup>

## 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.<sup>[7]</sup>

**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.<sup>[8]</sup>

## Standards and regulation

[edit]

While there are currently no government regulations in the United States dictating procedures, two certifying bodies, the Institute of Inspection Cleaning and Restoration Certification (IICRC) and the RIA, do recommend standards of care. The current IICRC standard is ANSI/IICRC S500-2021.<sup>[9]</sup> 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.<sup>[10]</sup> Presently, the California Contractors State License Board has no specific classification for "water and fire damage restoration."

## Procedures

[edit]

Water damage restoration is often prefaced by a loss assessment and evaluation of affected materials. The damaged area is inspected with water sensing equipment such as probes and other infrared tools in order to determine the source of the damage and possible extent of areas affected. Emergency mitigation services are the first order of business. Controlling the

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

## See also

[edit]

- Indoor mold

## References

[edit]

1. ^ *"Individual Disaster Assistance"*. *DisasterAssistance.gov*. Retrieved 2009-09-28.
2. ^ *"How We Use Water"*. 16 January 2017.
3. ^ The University of Maine Corporate Extension – [www.umext.maine.edu](http://www.umext.maine.edu)
4. ^ *Herndon Jr., Everette L.; Yang, Chin S. (August 2000). "Mold & Mildew: A Creeping Catastrophe"*. *Claims Magazine*. Archived from the original on 2000-08-15. Retrieved November 4, 2016.
5. ^ *Moisture Control Guidance for Building Design, Construction and Maintenance*. December 2013.
6. ^ *"Water Damage Restoration Guideline" (PDF)*. Northern Arizona University. Archived from the original (PDF) on 2013-06-26. Retrieved 2 September 2014.
7. ^ *"The Basics Of Water Damage Restoration Training"*. [www.iicrc.org](http://www.iicrc.org). Retrieved 2016-11-03.
8. ^ *"Chapter 6: Psychrometry and the Science of Drying"*. *IICRC Standards Subscription Site*. Institute of Inspection, Cleaning and Restoration Certification. Retrieved 27 September 2020.
9. ^ *"ANSI/IICRC S500 Water Damage Restoration"*. IICRC. 22 December 2020. Retrieved 14 February 2022.
10. ^ *"California Contractors State License Board"*. State of California. Retrieved 2010-08-29.

## 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

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## Palmisano (Henry) Park

4.7 (1262)

## Driving Directions in Cook County

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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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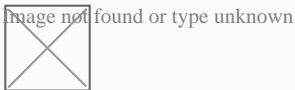
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## Reviews for

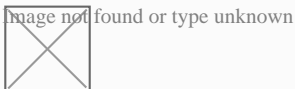
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**Jeffery James**

**(5)**

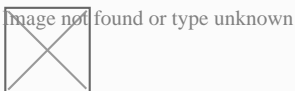
Very happy with my experience. They were prompt and followed through, and very helpful in fixing the crack in my foundation.



**Sarah McNeily**

**(5)**

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

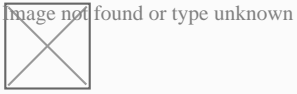


**Jim de Leon**

**(5)**

It was a pleasure to work with Rick and his crew. From the beginning, Rick listened to my concerns and what I wished to accomplish. Out of the 6 contractors that quoted the project, Rick seemed the MOST willing to accommodate my wishes. His pricing was definitely more than fair as well. I had 10 push piers installed to stabilize and lift an addition of my house. The project commenced at the date that Rick had disclosed initially and it was completed within the same time period expected (based on Rick's original assessment). The crew was well informed, courteous, and hard working. They were not loud (even while equipment was being utilized) and were well spoken. My neighbors were very impressed on how polite they were when they entered / exited my property (saying hello or good morning each day when they crossed paths). You can tell they care about the customer concerns. They ensured that the property would be put back as clean as possible by placing MANY sheets of plywood down prior to excavating. They compacted the dirt back in the holes extremely well to avoid large stock piles of soils. All the while, the main office was calling me to

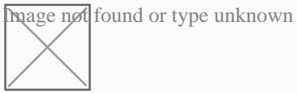
discuss updates and expectations of completion. They provided waivers of lien, certificates of insurance, properly acquired permits, and JULIE locates. From a construction background, I can tell you that I did not see any flaws in the way they operated and this an extremely professional company. The pictures attached show the push piers added to the foundation (pictures 1, 2 & 3), the amount of excavation (picture 4), and the restoration after dirt was placed back in the pits and compacted (pictures 5, 6 & 7). Please notice that they also sealed two large cracks and steel plated these cracks from expanding further (which you can see under my sliding glass door). I, as well as my wife, are extremely happy that we chose United Structural Systems for our contractor. I would happily tell any of my friends and family to use this contractor should the opportunity arise!



**Chris Abplanalp**

**(5)**

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



**Dave Kari**

**(5)**

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

Observing Signs of Settlement in Floors [View GBP](#)

## Frequently Asked Questions

**What are the common signs of floor settlement in a home?**

Common signs include uneven or sloping floors, cracks in the floor, doors and windows that stick, and gaps between walls and floors.

**How can I tell if the floor settlement is due to foundation issues?**

If the settlement is accompanied by cracks in walls, especially around doors and windows, and if the settlement is widespread rather than isolated, its likely related to foundation problems.

**Is floor settlement always a sign of a serious foundation problem?**

Not always. Minor settlement can occur naturally over time, but significant or rapid settlement often indicates a more serious issue requiring professional assessment.

**What should I do if I notice signs of floor settlement?**

Contact a professional foundation repair service to assess the situation. They can determine the cause and recommend appropriate repairs.

**Can floor settlement be fixed, and how?**



Yes, floor settlement can often be fixed. Solutions may include underpinning the foundation, installing piers or helical anchors, or using slab jacking to lift and level the floor. The exact method depends on the cause and severity of the settlement.

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### **Google Business Profile**

Company Website : <https://www.unitedstructuralsystems.com/>

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