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Expansive Soil and Expansive Clay

The hidden force behind basement and foundation problems

What is an "Expansive Soil"?

Expansive soils contain minerals such as smectite clays that are capable of absorbing water. When they absorb water they increase in volume. The more water they absorb the more their volume increases. Expansions of ten percent or more are not uncommon. This change in volume can exert enough force on a building or other structure to cause damage.

Cracked foundations, floors and basement walls are typical types of damage done by swelling soils. Damage to the upper floors of the building can occur when motion in the structure is significant.

Expansive soils will also shrink when they dry out. This shrinkage can remove support from buildings or other structures and result in damaging subsidence. Fissures in the soil can also develop. These fissures can facilitate the deep penetration of water when moist conditions or runoff occurs. This produces a cycle of shrinkage and swelling that places repetitive stress on structures.

How Many Buildings are at Risk?

Expansive soils are present throughout the world and are known in every US state. Every year they cause billions of dollars in damage. The American Society of Civil Engineers estimates that 1/4 of all homes in the United States have some damage caused by expansive soils. In a typical year in the United States they cause a greater financial loss to property owners than earthquakes, floods, hurricanes and tornadoes combined.

Even though expansive soils cause enormous amounts of damage most people have never heard of them. This is because their damage is done slowly and can not be attributed to a specific event. The damage done by expansive soils is then attributed to poor construction practices or a misconception that all buildings experience this type of damage as they age.

Expandable, Shrink-Swell, Heavable Soils?

Expandable soils are referred to by many names. "Expandable soils", "expansive clays", "shrink-swell soils" and "heavable soils" are some of the many names used for these materials.

Expansive Soils Map

The map below shows the geographic distribution of soils which are known to have expandable clay minerals which can cause damage to foundations and structures. It also includes soils that have a clay mineral composition which can potentially cause damage.

How to Interpret the Map

The map above is meant to show general trends in the geographic distribution of expansive soils. It is not meant to be used as a property evaluation tool. It is useful for learning areas where expansive soils underlie a significant portion of the land and where expansive soils might be a localized problem.

All construction projects should include a soil analysis to identify the types of soil present and determine their expansive properties. Local occurrences of expansive soils can be found in all of the soil categories shown on this map.

Why Do These Soils Expand?

Soils are composed of a variety of materials, most of which do not expand in the presence of moisture. However, a number of clay minerals are expansive. These include: smectite, bentonite, montmorillonite, beidellite, vermiculite, attapulgite, nontronite, illite and chlorite. There are also some sulfate salts that will expand with changes in temperature. When a soil contains a large amount of



Building damage: note displaced bricks and inward deflection of foundation. U.S. Army Corps of Engineers Photo [Click Image to Enlarge](#)

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Desiccation cracks in soil caused by drying. U.S. Army Corps of Engineers Photo [Click Image to Enlarge](#)

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expansive minerals it has the potential of significant expansion. When the soil contains very little expansive minerals it has little expansive potential.

Changes in Moisture Content Trigger Damage

When expansive soils are present they will generally not cause a problem if their water content remains constant. The situation where greatest damage occurs is when there are significant or repeated moisture content changes.

The Bottom Line

It is possible to build successfully and safely on expansive soils if stable moisture content can be maintained or if the building can be insulated from any soil volume change that occurs. The procedure for success is as follows:

- Testing to identify any problems
- Design to minimize moisture content changes and insulate from soil volume changes
- Build in a way that will not change the conditions of the soil
- Maintain a constant moisture environment after construction

Expert assistance is needed to do these things successfully.

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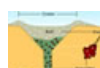
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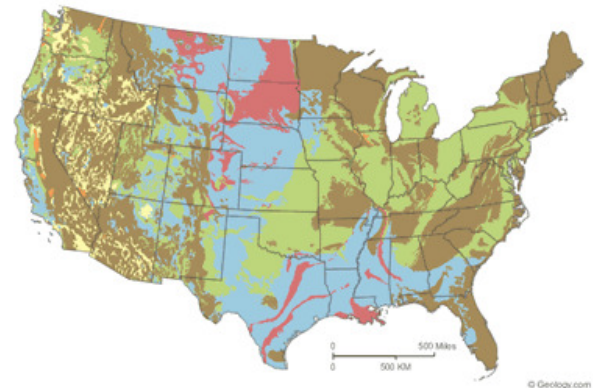
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Inward deflection of a basement wall and pilasters. The plumb-bob reveals 9 inches of inward displacement. U.S. Army Corps of Engineers Photo [Click Image to Enlarge](#)



- Over 50 percent of these areas are underlain by soils with abundant clays of high swelling potential.
- Less than 50 percent of these areas are underlain by soils with clays of high swelling potential.
- Over 50 percent of these areas are underlain by soils with abundant clays of slight to moderate swelling potential.
- Less than 50 percent of these areas are underlain by soils with abundant clays of slight to moderate swelling potential.
- These areas are underlain by soils with little to no clays with swelling potential.
- Data insufficient to indicate the clay content or the swelling potential of soils.

The map above is based upon "Swelling Clays Map of the Conterminous United States" by W. Olive, A. Chleborad, C. Frahme, J. Shlocker, R. Schneider and R. Schuster. It was published in 1989 as Map I-1940 in the USGS Miscellaneous Investigations Series. This map was generalized for display on the web by Bradley Cole of Geology.com using a base map licensed from MapResources. [Click Image to Enlarge](#)

Land areas were assigned to map soil categories based upon the type of bedrock that exists beneath them as shown on a geologic map. In most areas, where soils are produced "in situ", this method of assignment was reasonable. However, some areas are underlain by soils which have been transported by wind, water or ice. The map soil categories would not apply for these locations.

Expansive Soils Information on the Web

[Does Homeowner's Insurance Cover Expansive Soil Damage?](#) - Geology.com

[Expansive Soil And Foundation Cracks Video](#) - Ask The Builder

[So Your Home Is Built on Expansive Soils](#) - American Society of Civil Engineers

[Town of Amherst \(NY\) Soils and Residential Foundation Study](#) - Army Corps of Engineers

[Expansive Soils - Hazard Information](#) - JCP Geologists

[Swelling Soil](#) - Colorado Geological Survey

[Understanding Soil Risks and Hazards](#) - United States Department of Agriculture

