



BASICS

Landscaping on Expansive Soils

no. 7.236

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Quick Facts...

Expansive soils are found throughout Colorado.

Growing plants near buildings on expansive soils can cause structural damage.

Plant flowers and shrubs at least 5 feet from the foundation. Plant trees at least 15 feet away.

Any landscaping near foundations should be xeriscape-type ground covers and mulches.

Sprinklers should spray no closer to the foundation than 5 feet.

Maintain good drainage away from the structure.

What Are Expansive Soils?

Expansive soils shrink when dry and swell when wet. This movement can exert enough pressure to crack sidewalks, driveways, basement floors, pipelines and even foundations. Pressures can be as great as 15,000 pounds per square foot.

Expansive soils are found throughout Colorado. Parts of the major population centers along the Front Range and on the West Slope are located on expansive soils.

Soil surveys provide general information about soils in an area. They are available from the Natural Resources Conservation Service, U.S. Department of Agriculture. However, maps provide only generalized locations. Before construction, test the soil on a specific site.

Not all expansive soils have the same swell potential. Tests can determine the swell potential of a particular soil and the probability for structural damage.

Expansive soils are also known as shrink-swell or swelling soils. In Colorado, expansive soils contain montmorillonite, a special kind of clay. These soils are sometimes called bentonite. However, true bentonite soils are found in Wyoming and Nevada.

Construction Impacts on Landscaping

Soil engineers and engineering geologists test soils for swell potential when designing a building's foundation. Simple observation often can reveal the presence of expansive soils. Soils with a high percentage of swelling clay usually have cracks or a puffy appearance when dry and are sticky when wet. Amended or introduced topsoil may mask the presence of swelling clay underneath.

It is critical that the homeowner understand how the contractor dealt with the problem of expansive soils and how to maintain the contractor's soil treatment. Under Colorado law, builders must let homeowners know if expansive soils are present and provide information about them. At resale, homeowners also must disclose expansive soil conditions. Home buyers should use this information to further check the site's soil. This may include soil swell potential, observations, soil treatment recommendations, engineering information, building recommendations and construction methods.

The goals for soil treatment are to reduce the amount of water that enters the ground near the foundation and to reduce the swell potential of the soil.

Contractors may install vertical or horizontal moisture barriers to protect the foundation. In this case, the homeowner should know where the barriers are and should not irrigate inside them. Normal gardening can occur outside the barriers.

Two soil treatment methods can reduce the soil's swell potential: engineered fills and chemical treatments. Both have landscape implications.



Putting Knowledge to Work

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Reviewed 5/06.
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Engineered fills include replacing existing soil with an impermeable soil or compacting the soil. Contractors may replace the top 3 to 4 feet of soil with a nonexpansive, impermeable soil. In this case, the main landscaping problem is dealing with a soil that does not take in water. The normal treatment for impermeable soil is to increase permeability with soil amendments. However, this leaves the foundation vulnerable to damage. Contractors also may compact the soil to reduce permeability and minimize the shrink-swell action. In this case, do not try to increase permeability.

On expansive soils, the main landscaping goal is to minimize fluctuations in soil water content.

Chemical soil treatments are not common in residential construction. They are mostly used on commercial building sites and roads. To stabilize the soil, contractors may apply lime, cement or salts. Under certain conditions, contractors may apply lime at rates of 2 to 10 percent. This is effective on many Colorado soils. The lime is usually mixed into the soil to depths of 12 to 18 inches. Liming further increases soil pH and buffers the soil at a pH of 8.2 or greater.

Sometimes homeowners try to lower soil pH in order to grow certain plants or to reduce nutrient deficiencies. If you are gardening on an expansive soil that has been stabilized with lime, then:

- Do not use sulfur, ammonium and other acid-forming fertilizers, pine needles or coffee grounds.
- Do not apply gypsum or iron sulfate fertilizer.
- Do not apply organic materials in the treated area around foundation walls. They will reduce the impact of the lime.
- Do not improve drainage. That will cause lime to leach out and destabilize the foundation.

Other less common construction treatments include mixing cement with the soil or adding salts like sodium chloride or calcium chloride. These treatments are not recommended. They create severe challenges for gardeners by either cementing soils or causing them to become sodic or saline. Do not use normal remedies for leaching salts out of these soils, because the soils will become more expansive.

The principles discussed in this fact sheet also apply to renovating mature landscapes on expansive soils.

Landscaping Implications

The potential for structural damage often can be minimized or avoided altogether by following certain landscaping practices. On expansive soils, the main landscaping goal is to minimize fluctuations in soil water content. Proper surface drainage, plant choices, sprinkling practices and long-term maintenance are all important.

To ensure adequate drainage before a landscape is installed, contractors grade the site away from the building. Maintain the grade established by the builder. The recommended slope within 10 feet of a foundation is 10 percent, or 12 inches of vertical fall in 10 feet. Slopes greater than 20 percent can be problematic because of soil erosion. Grade to 15 to 20 percent only if the slope is short (less than 20 feet) and/or if adequate vegetative cover is established and maintained.

Do not remove downspout extensions and splash blocks to harvest water that runs off of the roof. Release downspout water at least 5 feet away from foundation walls.

Plant Selection

The conventional (but not necessarily recommended) practice of planting near foundations definitely is not recommended for swelling soils. Do not plant flowers or shrubs closer than 5 feet from foundations built on expansive soils. If the swell characteristics of soil are minimal, if the risk of planting is deemed acceptable, and if soil treatments during construction allow for planting,

References

Nelson, John D., and Debora J. Miller. 1992. Expansive soils: problems and practice in foundation and pavement engineering. *John Wiley & Sons, Inc.; New York, N. Y.*

Noe, David C., Jochim, Candace L., and Rogers, William P. 1997. A Guide to Swelling Soils for Colorado Homebuyers and Homeowners, *Special Publication 43. Colorado Geological Survey, Department of Natural Resources, Denver, Colo.*

Table 1: Low-water ground covers.

For sunny exposures
Creeping juniper <i>Juniperus horizontalis</i>
Creeping penstemon <i>Penstemon caespitosus</i>
Hardy yellow iceplant <i>Delosperma nubigenum</i>
Lavender cotton <i>Santolina chamaecyparissus</i>
Pink pussytoes <i>Antennaria rosea</i>
Snow-in-summer <i>Cerastium tomentosum</i>
Stonecrop <i>Sedum spurium</i>
Woolly speedwell <i>Veronica pectinata</i>
For shady exposures
Creeping grape holly <i>Mahonia repens</i>
Dead nettle <i>Lamium maculatum</i>
Periwinkle <i>Vinca minor</i>
Sweet woodruff <i>Galium odoratum</i>

then choose plants with very low water requirements. For greater moisture control, water by hand. Limit watering to the minimum needed to maintain the landscaping.

Ground cover plants may be acceptable, and sometimes more desirable than bare soil. Ground covers reduce moisture fluctuations and minimize soil movement from the shrink-swell cycle. Ground covers with low water requirements are the best plants for areas near foundations on expansive soils.

Plant trees at least 15 feet away from foundations on expansive soils. The rule of thumb is that a tree should be at least 1 ½ times its mature height away from the foundation. Tree roots draw moisture from soils, causing shrinking and swelling. The amount of moisture drawn out of the soil depends on the tree species, size and location. If trees are planted well away from foundations in irrigated areas, the chances of foundation damage are minimal. See fact sheet 7.229, *Xeriscaping: Trees and Shrubs*, for a list of trees that are considered xeric or low water using.

Another alternative is to mulch the backfill around the foundation with rock. The rock must be placed in a durable liner. Landscape edging must be perforated to drain the water collected by the liner. Also consider a xeriscape border next to traditional landscape areas. This may protect walks and other concrete flatwork from damage. A totally xeriscape landscape will further lower the risk of structural damage. New developments in xeric lawn grasses, such as new varieties of buffalograss, offer more choices to minimize soil moisture fluctuations across a site.

Water Management

Sprinkler systems should spray no closer than 5 feet from the foundation. Maintain sprinkler heads and lines to avoid breaks that could allow water to pool next to the foundation. If a drip irrigation system is well maintained, it may be an acceptable alternative to hand watering plants near foundation walls.

Expansive soils do not swell and shrink if the moisture content remains constant. To maintain consistent moisture, apply water selectively near foundation walls.

Site Maintenance

The long-term maintenance of slope, drainage and the landscape is crucial to avoid problems. Settling of minimally graded slopes near buildings can create reverse drainage next to foundations. Resculpt soil to restore drainage away from buildings. Reinstall landscaping if necessary.

The importance of maintaining drainage systems cannot be overemphasized. This includes gutters, downspouts, downspout extensions and splash blocks. Tree leaves can clog gutters and downspouts. This, in turn, can cause rainwater to overflow near foundations, a serious concern on expansive soils.

Periodically look for leaks in all sprinkler system lines, backflow devices and other connections from the building to the landscape. Immediately repair malfunctioning or broken sprinkler heads that throw water back towards a building. Be extra vigilant if a drip irrigation system was installed to water ground cover plantings near buildings.

Pay attention to watering practices near buildings. Both overwatering and underwatering can affect the integrity of a building and associated structures.

These principles also apply to renovating mature landscapes on expansive soils.

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