

Living With Shrink/Swell Soils

A HOMEOWNERS' GUIDE TO MAINTENANCE OF SHALLOW FOUNDATIONS

© ASCE

DEVELOPED BY
SHALLOW FOUNDATIONS COMMITTEE
GEO INSTITUTE
AMERICAN SOCIETY OF CIVIL ENGINEERS

LIVING WITH SHRINK/SWELL SOILS

Shrink/swell soils can create damaging up-and-down movements to foundations and structures. These movements are caused by changes in soil moisture. *Providing uniform soil moisture next to and under your foundation is the single best thing you can do to reduce the effect that shrink/swell soil movements have on your structure.*

INDICATORS OF SHRINK/SWELL SOIL MOVEMENTS

The following items are typical signs of shrink/swell soil-related movement. The probability that your foundation has experienced some movement increases with the number of indicators observed, their frequency, and location in the structure.

Possible Exterior Indicators:

- § Diagonal (stair-stepping) cracks in brick or masonry walls. Cracks may go through brick or masonry or through the mortar and vary in width
- § Sagging masonry lines when sighting along a wall
- § Gaps between window frames and walls

- § Separation of constructed wall expansion joints
- § Bowed or non-vertical walls
- § Separation of siding and trim joints at corners
- § Vertical or horizontal separation of concrete driveway, patio, porch, or sidewalks from foundation
- § Tilting of landscaping/retaining walls

Possible Interior Indicators:

- § Cracks or separations in walls or ceilings
- § Bowed or non-vertical walls
- § Bottom of wall separating from the floor
- § Cracks at wall corners
- § Cracks above doors or windows
- § Sticking doors (warped door frames)
- § Sticking windows
- § Sloping floor surface
- § Cracks in ceramic or vinyl tile flooring
- § Cracks in concrete floor 1/16 inch across or wider

SOIL MOISTURE CHANGES

Observing soil moisture changes around your foundation is possible, but what about under it? Moisture can move from outside the foundation to under it through a soil property known as *suction*. Soil suction is similar to placing a corner of a dry, compressed sponge in contact with a puddle of water. In a short time, the sponge has drawn water into itself and grown in volume. As long as a water source is present, the sponge will continue to absorb water until it is saturated. If the water source is cutoff, then water already in the sponge will distribute itself evenly, but the sponge will not reach saturation.

Water can move horizontally and vertically through the soils under your foundation in a similar, but much slower manner. As clayey soils draw water to themselves, they too can grow in volume (swell or heave), potentially causing your foundation to move.

Drying outside your foundation reverses the process. Moist soils will lose volume (shrink) as soil moisture moves out from under your foundation, causing the foundation to settle. Shrinking and swelling soil motions can damage your foundation and structure. Uniform changes in soil moisture are less damaging to your structure than localized changes.

Several sources of soil moisture changes are listed in the following table. You should review the list and possible actions to control or reduce the various sources. Begin practicing the suggested actions as soon as possible to improve your foundation and structure performance. Many of these actions can become a routine part of your ongoing conscientious owner maintenance activities. Annually inspect the area within 5 feet of all sides of your foundation to determine if proper drainage is maintained away from your structure. Monitor existing cracks for progressive or seasonal movements. Some of the possible actions suggested in the accompanying table will require expert assistance.

Additional information on all of these items can be found in the reference, *So Your Home is Built On Expansive Soils*. This 54-page booklet can be purchased by visiting www.pubs.asce.org.

Disclaimer

These materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or other legal documents. ASCE makes no representation or warranty of any kind, express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefor. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. ASCE will not be responsible for any loss sustained by anyone relying on this publication, and anyone utilizing this information assumes all liability arising from such use.

Living With Shrink/Swell Soils Action Plan

TYPICAL SOURCES OF SOIL MOISTURE CHANGES	POSSIBLE PROBLEMS	POSSIBLE ACTIONS
Rainfall	Non-uniform runoff from roof may concentrate water sources or create ponding adjacent to the foundation and result in localized heave.	Maintain soil sloping away from all sides of the foundation with at least 3 inches fall in 5 feet and use gutters and downspouts that discharge at least 3 feet from the foundation into well-drained areas.
Gutter Down Spout	Concentrated sources of water could result in erosion and ponding and may also lead to non-uniform foundation movements.	Extend discharge well past abutting planting beds and a minimum of 3 feet from the foundation into well-drained areas. Use splash blocks to avoid erosion.
Poor Drainage	Localized source of water from rain or landscape irrigation may flow or pond near the foundation and could lead to localized heave of the foundation.	Slope ground away from all sides of the foundation with at least 3 inches fall in 5 feet; direct water into longitudinal drainage swales with 6 inches fall in 25 feet; keep dirt line several inches below the top of foundation; and use clay soil fill to create positive slope away from the foundation. Do not use SANDY SOILS for fill next to the foundation, use CLAYS. Compact the fill to shed water, not to absorb it.
Planter Beds	Localized source of water that is not on all sides of the foundation may result in non-uniform foundation movements.	Do not saturate or pond irrigation water in beds; slope ground surface away from the foundation as described above; do not trap water near the foundation with edging; and use less water. Use mulch to slow evaporation.
Landscape Sprinkler Systems	Valves and joints may leak and spray heads may become loose or misdirected with time, resulting in localized water sources which may cause non-uniform foundation movements.	Locate lines, valves, and heads at least 5 feet from foundation. Inspect valves and heads frequently and look for soggy areas of overwatering or leaking lines. Direct water spray towards house, but not so it lands on the walls. Manually activate watering and adjust timer settings throughout the growing season to avoid overwatering.
Overwatering	Provides excess source of soil water for suction to draw moisture under foundation, which may cause a stable area to begin heaving and damaging your structure.	Water just enough to keep landscape plantings alive and growing, not thriving and lush through saturating the ground.
Drought	Extended periods of lower-than-normal precipitation can result in non-uniform drying or shrinkage settlement of the foundation.	Know and obey your municipality's landscape watering bans during droughts. During high restrictions, consider using soaker hoses 18 inches away from the foundation, applying more water on south & west sides.
Hot and Dry Climate	Loss of soil moisture from under foundation edges may cause foundation settlement.	Water landscape planting and areas next to all sides of the foundation, applying more water on drier sides. Consider automatic sprinkler systems or adding concrete flatwork adjacent to the foundation to reduce evaporation losses.
Excess Drying on the South & West Sides / Non-Uniform Moisture Loss	Non-uniform drying on some sides of the foundation from the sun or failure to provide watering on all sides of the foundation may cause non-uniform foundation movements.	Apply more landscape water on drier sides of the foundation, use mulch to slow evaporative drying, and plant quality shade trees along with the installation of a tree root/vertical moisture barrier.
Trees	Roots from trees that grow next to and/or under the foundation can dry out soils causing non-uniform foundation settlements.	Plant trees a distance greater than their mature height from the foundation. If existing trees are closer and foundation movements correlate with seasonal tree growth or droughts, install a deep tree root/vertical moisture barrier between such trees and the foundation. Tree roots could also be pruned to temporarily decrease soil drying. Water tree roots away from the foundation.
Landscape Planting	Drying from roots, transpiration, and soil suction may cause non-uniform foundation settlement.	Plant bushes and shrubs away from the foundation, prune to keep their heights low, and uniformly water them taking care not to flood or pond water next to the foundation.
Retaining Walls or Steep Sloping Ground Near a Foundation Edge	Non-uniform drying on all sides of the foundation caused by retaining walls or steep slopes may result in non-uniform foundation settlements.	Apply less landscape water on sloping ground, or sides with adjacent retaining walls, but apply it more frequently than on other sides of the foundation, so it will soak in deeper rather than running off. Use mulch to slow evaporation.
Plumbing Line Leaks	Leaks in sewer or water lines provide localized source of water that may lead to localized foundation movements.	Monitor water bills and foundation performance, get leak detection plumber to isolate and repair leaks, and verify repairs with pressure tests.
Shallow Subsurface Seepage Moving Down Slope	Concentrated source of water to foundation soils may result in non-uniform heave of foundation.	Install trench drain up slope to a sufficient depth to intercept shallow water. Line bottom of trench with a tough water barrier membrane and divert seepage water around foundation soils to discharge down slope or to a sump.
Moisture Vapor Rising from Wetter Soil Beneath Foundation	Gradual and uniform rise in soil moisture under the foundation may lead to gradual heave of the structure.	Since this is a normal occurrence, foundation stiffness should be designed and constructed for this long-term condition.