

Living With Shrink/Swell Soils

A HOMEOWNERS' GUIDE TO
MAINTENANCE OF SHALLOW FOUNDATIONS
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Version 2 (2022)

DEVELOPED BY

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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 and their frequency.

Possible Exterior Indicators:

- Diagonal or stair-stepping cracks in masonry walls. Cracks may go through masonry or through the mortar joint and vary in width
- Sagging masonry lines when sighting along a wall

- Gaps between doors, 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
- Separations along the top and bottom of walls
- Cracks at wall corners
- Cracks above doors or windows
- Sticking doors (warped door frames)
- Sticking windows
- Sloping floor surface
- Cracks or gaps in floor coverings
- 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 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 move downward. 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 evaluate the area within 10 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, such as an experienced arborist, plumber, licensed irrigator or professional engineer.

Additional information on all of these items can be obtained in the excellent reference, *So Your Home is Built On Expansive Soils, Second Edition, A Discussion of How Expansive Soils Affect Buildings*, edited by Warren K. Wray, Ph.D., P.E., Marshall B. Addison, Ph. D., P.E. and Kenneth M. Strzyk, P.E., published in 2019 by the American Society of Civil Engineers. This fully illustrated booklet can be purchased by visiting www.ascelibrary.org.

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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 preferably 6 inches in 10 feet. Use gutter and downspouts as discussed next. |
| 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 5 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 6 inches fall in 10 feet; direct water into longitudinal drainage swales with a minimum of 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. Evaluate 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, but not saturating the ground. |
| Drought | Extended periods of lower-than-normal precipitation can result in non-uniform drying resulting in downward foundation movements. | Know and obey your municipality's 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 downward movement of the foundation. | Water plants and areas next to the foundation, applying more water on drier sides. Consider automatic sprinkler systems, adding horizontal or vertical moisture barriers adjacent to the foundation to reduce moisture 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 water on drier sides of the foundation, use mulch to slow evaporative drying. |
| Trees | Roots from trees that grow next to and/or under the foundation can dry out soils causing non-uniform downward foundation movements. | 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 canopies and roots could also be pruned to temporarily decrease tree moisture demand. Water tree roots away from the foundation to encourage root growth away from the building. |
| Landscape Planting | Drying from roots, transpiration, and soil suction may cause non-uniform downward movement of the foundation. | Plant bushes and shrubs away from the foundation, prune to reduce water demand. Uniformly water vegetation 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 downward foundation movements. | 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 a leak detection plumber quickly 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. |