

Expansive soils have a relatively high percentage of clay minerals and are subject to changes in volume with changing moisture conditions. The minerals for most expansive clay soil damage includes **smectite** and **montmorillonite** (along with *bentonite* and *illite*) which can swell up to **40 times** its own size. Two of the most common expansive soils are the **adobe** soils found predominately in the Southwestern U.S. and **leda** (highly frost-susceptible) soils, found mostly in Eastern Canada. Furthermore, all types of clay soils are found throughout North America and may cause significant damage to a structure. It is estimated that **50%** of the land in North America contains expansive soil.

The soil under a house swells and shrinks with the seasons. This movement is not a problem as long as it is uniform or not great enough to damage the foundation and/or house. Damage to the house may appear and disappear on a regular basis as the seasons change. Significant defects occur when the movement is uneven or localized.

Movement in foundations is caused primarily by:

- ISOLATED MOVEMENT OR UNEVEN SETTLEMENT OF SECTIONS OF THE STRUCTURE
- ADDITIONAL LATERAL PRESSURE APPLIED TO THE FOUNDATION WALLS
- MOVEMENT OF SOILS ON UNSTABLE SLOPES – (SLIDING SURFACE LAYERS)
- EXCESSIVE VIBRATION
- ADDITIONS TO EXISTING STRUCTURE

Moisture can move under the foundation through **suction** (similar to dry sponge absorbing water). Under moist conditions water moves vertically and horizontally through the soils under the foundation – as the clay soils draw water, they grow in volume (swell or heave). The opposite is true as the soils around the foundation dry out – the moist soils lose volume (shrink) as the moisture moves out from under the foundation.

Movement occurs because the soils expand so forcefully, that foundations can actually be displaced. In a structure, cracks are usually caused by this movement at different rates and distances. Changes in the water content of clay soils cause up to 90% of the cracking problems in a house. Uniform changes in soil moisture are less damaging than localized changes. These cracks are evident as:

- CRACKS IN THE EXTERIOR OR INTERIOR WALL COVERING AND CEILINGS
- CRACKS IN GARAGE OR BASEMENT SLAB, DRIVEWAY, PATIO, OR WALKWAY
- SEPARATION OF DRIVEWAY, PATIO, OR WALKWAY FROM FOUNDATION
- BOWING, DISPLACEMENT OR ROTATION OF EXTERIOR WALLS
- SEPARATION OF WOOD TRIM AT CORNERS
- TILTING OF FENCES AND RETAINING WALLS
- BINDING DOORS AND WINDOWS
- UNEVEN FLOORS/SEPARATION OF WALLS FROM FLOOR

A **subsurface watering system** keeps the water content of the soil under your foundation as constant as possible. Other systems consists of **soaker hoses** that are buried in the ground around the perimeter of the foundation (but not against the foundation). When the soil has dried and cracked, the water can travel along the cracks for several feet in all directions. Depending on the region and soil conditions, the amount of water required to keep a foundation stable during dry conditions can be surprisingly large.

**Compaction grouting (mud-jacking)** involves pumping a concrete slurry into the ground under high pressure. The slurry pushes the unstable soil out from under the foundation and fills the void with concrete.

**Underpinning** involves driving steel rods called “**mini-piles**” under the foundation. **Augers** with a ledge to catch the footing may also be used. Another method is to remove the soil under the footing and replacing it with concrete or removing the lower defective part of the wall and replacing it with concrete block.

## EXPANSIVE SOILS MAINTENANCE PLAN

EXCESSIVE WATER	POSSIBLE PROBLEMS	POSSIBLE ACTIONS
<b>Surface Runoff</b>	Non-uniform runoff from roof may result in localized heaving.	Maintain soil sloping away from all sides of the foundation for a distance of at least 5 feet, use gutters with downspouts that discharge at least 3 feet from the foundation.
<b>Roof Drainage</b>	Concentrated sources of water may result in uneven foundation movements.	Extend rain-leaders a minimum of 6 feet from the foundation and use splash blocks to avoid erosion or use perforated discharge tubes.
<b>Poor Landscaping</b>	Puddling or flowing of rainwater next to the foundation may lead to localized heaving.	Slope ground away from all sides of the foundation for a distance of at least 3 feet and use a cap of clay soil or install a concrete walkway around the foundation. Incorporate swales to redirect water away from the foundation.
<b>Shrubs/Flower Beds</b>	Localized source of water may result in uneven foundation movements.	Do not over-water; slope surface away from foundation and do not use edging to trap water.
<b>A/C &amp; Sump Discharge</b>	Concentrated sources of water may result in uneven foundation movements.	Direct discharge line to splash-block or patio block that has been sloped away from the foundation.
<b>Plumbing Line Leaks</b>	Leaks in sewer, water or pool lines may result in localized water sources that may lead to localized foundation settlements.	Determine the location of leaks and have repaired. Verify repairs with pressure tests.
<b>Subsurface Seepage</b>	Concentrated sources of water may result in uneven foundation movements.	Consider subsurface drainage around the perimeter of the foundation. Install a perimeter drain that extends around the base of the foundation or an interceptor (curtain) drain to divert subsurface water when the source is uphill of the area to be protected.

LACK OF WATER	POSSIBLE PROBLEMS	POSSIBLE ACTIONS
<b>Hot/Dry Climates</b>	Moisture loss from around and under the foundation may result in uneven settlement.	Uniformly water flowerbeds and planting next to the foundation. Install automated surface sprinkler systems or a drip irrigation system.
<b>Southwest Exposure</b>	Lack of water on the southwest and excessive moisture on the northeast exposure may result in uneven settlement.	Water dryer landscaping more, use mulch to slow down evaporation, plant shade trees on the southwest side. Provide an impermeable ground cover together with a vertical impermeable barrier or border that is taken down to a depth where the moisture content is constant, about 1 to 3 feet.
<b>Trees</b>	Tree roots may grow under the foundation and dry-out soils resulting in uneven foundation settlement.	Plant trees at a greater distance than their mature height (roots can spread 1½ times the height of the tree). Install a 4 foot root/vertical moisture barrier system near the foundation. Water the tree roots away from the foundation (holes that will fill with water will attract roots to that direction).