UPP GEOTECHNOLOGY
Engineering Geology • Geotechnical Engineering
a division of C2EARTH, INC.

SOIL CREEP – A NON-TECHNICAL DESCRIPTION

By R. Rexford Upp, Ph.D.
Certified Engineering Geologist
Upp Geotechnology, a Division of C2Earth
*Geological Consultant to the Silver Creek Valley Country Club **G**eologic **H**azard **A**batement **D**istrict*

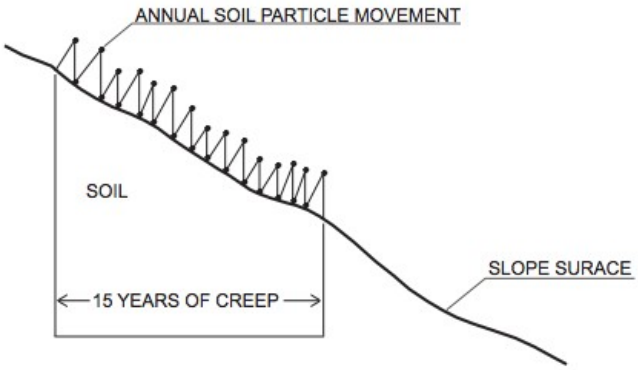
The process by which soil slowly moves down a hillside is called "soil creep." It is one of the many natural events that cause mountains to be reduced to plains. Other, more well known processes include erosion and landslides. You may have noticed fences on hillsides that were built vertical, but now lean downhill. That leaning was probably caused by soil creep. Any other structure that is built on and supported by the creeping soil, such as a house, patio, or sidewalk, will also move slowly down hill. This movement will result in both vertical (downward) and horizontal (outward) movement of the structure. The evidence for this movement includes tilting, cracking of concrete, and both horizontal and vertical separation across the cracks.

What Causes Soil Creep?

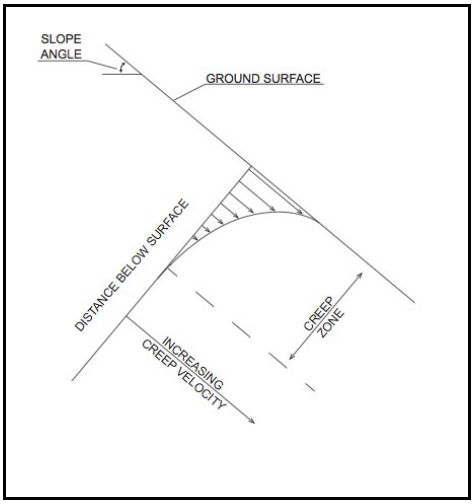
The slow downhill movement of the soil (creep) usually is caused by repeated expansion and contraction of the soil mass. This cyclic volume change can be caused by different things, including freezing-thawing and flooding-draining. In California, the main cause is swelling and shrinking of the expansive clay soil.

Clay consists of individual particles too small to see, even with an optical microscope. When the clay particle gets wet it absorbs the water and swells, sometimes up to several times it original size. When it looses the water, usually by evaporation, it shrinks. In northern California, the clay swells during the wet winter and spring seasons and shrinks during the dry summer and fall. The shrink and swell of the clay soil, composed of billions of individual clay particles, causes the ground surface to expand and contract – and move slowly down hill.

Why does the soil move downhill? When the clay particles on a sloping hillside swell, they expand perpendicular to the slope, as shown in the diagram below. When they shrink, however, the particles move down vertically, under the pull of gravity. As a result, with each cycle the particles move slightly downhill. The amount of movement of each particle is different each year and depends on how wet or dry the season was. In combination, the movement of billions of clay particles, results in the surface soil layer moving slowly down hill.

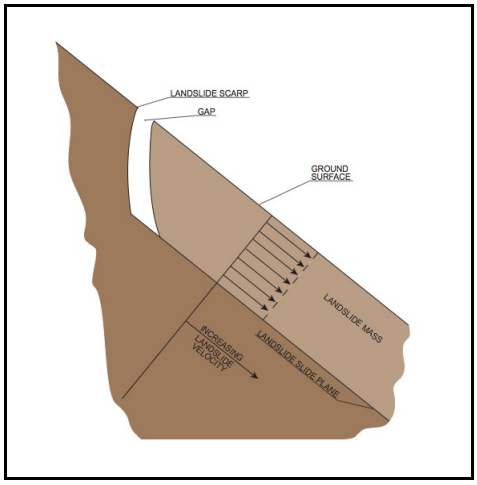


The speed of the surface soil creep is measured in fractions of an inch per year. The steeper the slope, the faster the movement. And, as shown in the diagram below, the speed decreases with depth, eventually reaching a depth where creep movement cannot be measured. This process results in a soil creep zone, but a zone without a well defined lower limit.



Soil Creep vs. Landslides

A landslide is a mass of earth (soil and/or rock) that has separated from the underlying earth and moved downhill. Landslides can move very rapidly, but also can slowly creep downhill, and often move intermittently. A landslide always has a distinct bottom, below which the earth is not moving, as shown in the diagram below. Also, at the top of the landslide, is a gap (called the scarp) where the landslide mass has moved away from the stable earth above. Eventually, more earth from above will move down into the gap.



Mitigation of Soil Creep

There are two principal methods to mitigate the effects soil creep has on structures: (1) stopping the soil creep movement and (2) supporting the structures below the soil creep zone.

1. Soil creep can be stopped with properly placed retaining walls supported by the stable ground below the creep zone.
2. Structures, including houses, pools, patios, and planters, etc., can be supported on deep foundations gaining their support in the stable earth below the creep zone. The soil will continue to creep but the structures will not be damaged by the soil movement.