LESSONS LEARNED:

CONSTRUCTION MATERIALS

OBSERVATIONS AND LESSONS FROM THE SCHOOL OF EXPERIENCE

EXPANSIVE SOILS

Expansive soils, soils that experience volume changes with changes in moisture content, are most common in the West, but occur throughout the United States. Expansive soils are estimated to cause more economic damage in an average year in the United States than hurricanes, floods, and earthquakes combined. This likely comes as a surprise, unless you have paid for damage caused by expansive soils, since the damage is not generally associated with a dramatic event that is featured on the evening news. Also the cost of repairs is typically not covered by insurance.

What soils are expansive? Expansive soils are clays and silts, but not all clays or silts are expansive. Sands, gravels, and non-plastic silts are not expansive. Clay particles are made up of very small platy minerals. Water can be absorbed between the plates pushing them apart (swell), or lost from between the plates allowing them to move closer together (shrink). To determine if a soil is expansive, tests must be performed on a sample. Tests used to evaluate the expansion potential and potential vertical rise of soils include: volumetric expansion, swell pressure, Atterberg limits, and grain size tests.

What conditions lead to volume change? For a volume change to occur there must be a change in the moisture content. Generally there is a depth below which the moisture content in the soil remains relatively constant. In areas with wetter climates this may only be a few feet, while in arid climates this may be tens of feet. Knowledge of local conditions is essential to understanding risk related to expansive soils. The moisture content below slabs and in crawl spaces can be expected to change with time as sources of moisture or routes of evaporation are changed from preconstruction conditions.

What can be done to control expansive behavior?

Prior to construction: Determine if the soil in question is expansive, by testing which is relatively inexpensive. The presence of expansive soils should routinely be considered during the initial site geotechnical evaluation.

- Replacing expansive soils with non or less expansive soils, taking care not to create a "bathtub" for water to collect
- Reducing the expansion potential of soils by adding lime, Portland cement, or proprietary chemicals
- Moisture conditioning (pre-saturation) to induce swelling prior to construction
- Isolating the expansive soils with a moisture barrier
- Increasing the depth of footings, using drilled shafts with structural slabs, and/or using post tensioned slabs
- Avoidance of expansive soils for fill against basement or retaining walls, or use below footings and slabs

Post construction: Maintaining a constant soil moisture content is the key to controlling potential damage.

- Use gutters with downspouts and tightline drains to carry water away from foundations
- Do not discharge condensate lines near foundations
- Slope the ground away from foundations, and use flatwork around the perimeter of buildings
- Keep surface and subsurface drains in good repair
- Provide adequate irrigation to plants, particularly trees, but avoid over watering
- Maintain vapor barriers in crawl spaces

If damage has occurred, a geotechnical or structural engineer experienced in evaluating damage due to expansive soils should be consulted. Settled foundations can be resupported by underpinning; bowed and tilting below grade walls can be stabilized with tieback anchors or reinforced with soldier beams; and slabs can be pressure grouted or underpinned, but all at significant cost. When dealing with expansive soils an ounce of prevention can truly save a pound of cure.

For more information, please contact ECS or your structural engineer. We hope this "*Lessons Learned*" will be helpful to you in planning your next project.

Respectfully,
ECS Corporate Services, LLC