Long-Term Testing

Condor SS

Soil Sample: Tulsa, OK Midtown Area

Tests Performed: Soil expansion and contraction with moisture changes using an expansion index consolidometer, 2.44-inch diameter soil sample, 60-p.s.f. loading

The following paragraphs show the results of long term testing of Condor SS in a soil sample that had a large amount of clay and that had historically caused seasonal wet/dry movement of a residential foundation. The photo to the left shows the magnitude of cracking of the soil that would typically be expected during a wet/dry cycle. Many of the cracks over this sample were almost ¼ inch. The total aggregate cracking over the 14-inch pan was estimated at almost 0.5 inches. Thus one would expect a wet/dry change in expansion from dry to wet of about 0.5/14= 3.57%. The home at the location where this soil sample was taken had experienced horizontal (lateral) expansion and contraction of at least 0.5 inches over a span of exterior wall approximately 30 feet. The home was constructed on a layer of clay over sandstone. The amount of clay varied over a depth of 3-8 feet below the surface. The soils in this area historically show plastic indices over 20 and over 50% of clay.

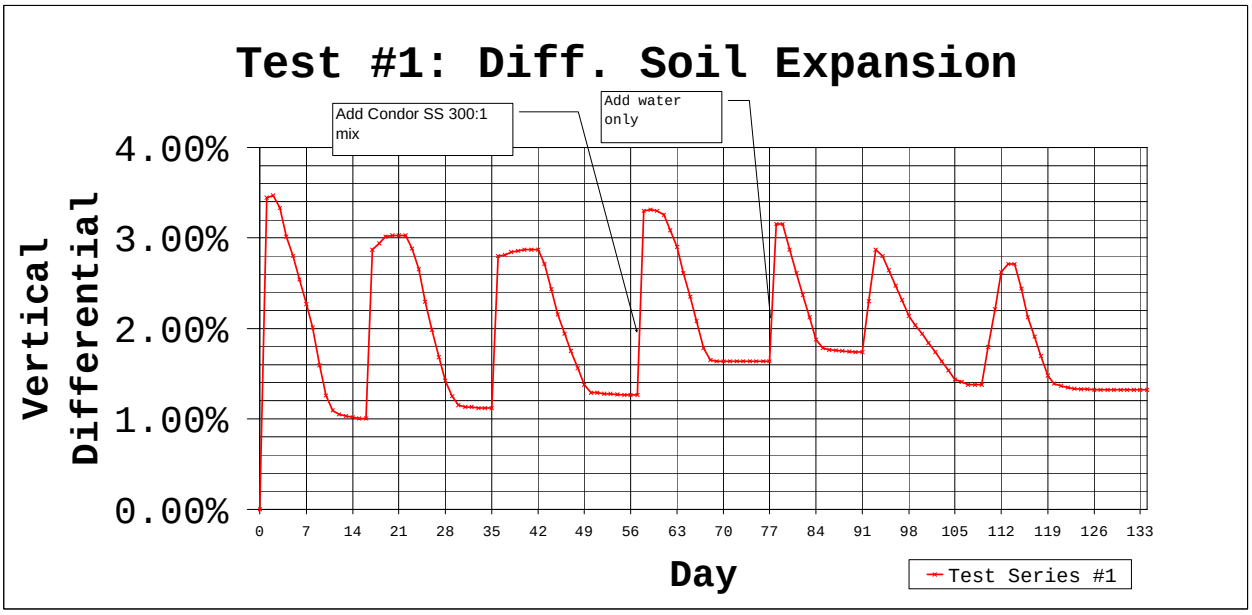
The photo to the right shows the clay soil sample within the consolidometer, dry compacted prior to testing. The test was designed to find the maximum expansion that could be expected from the totally dry state. This deviates from some standard tests methods because many times the standard tests first add water to make sure the clay is in the range of optimal moisture content. Standard testing then can underestimate the amount of expansion of clay soils when the soil is very dry, foundation construction proceeds, and then the soil absorbs moisture during rain cycles. This situation will regularly occur during summer months of residential construction. Many areas will also be severely moisture depleted when there are trees located within 75 feet of a foundation. The tests performed herein were designed to 1) find the maximum expansion characteristics of soil 2) use a single soil sample to see the effects of wet to dry cycles over time 3) see the effects of various concentrations of Condor SS during these extreme wet dry cycles. It is important to note that these tests were performed with no input from the manufacturer for procedures, duration, or expectations other than recommended minimum Condor SS concentrations to use.

The next photo to the left shows the same soil sample with the 60 p.s.f. loading weight and differential gage used to measure the expansion characteristics of the soil. The soil is in a dry state just

prior to adding water.

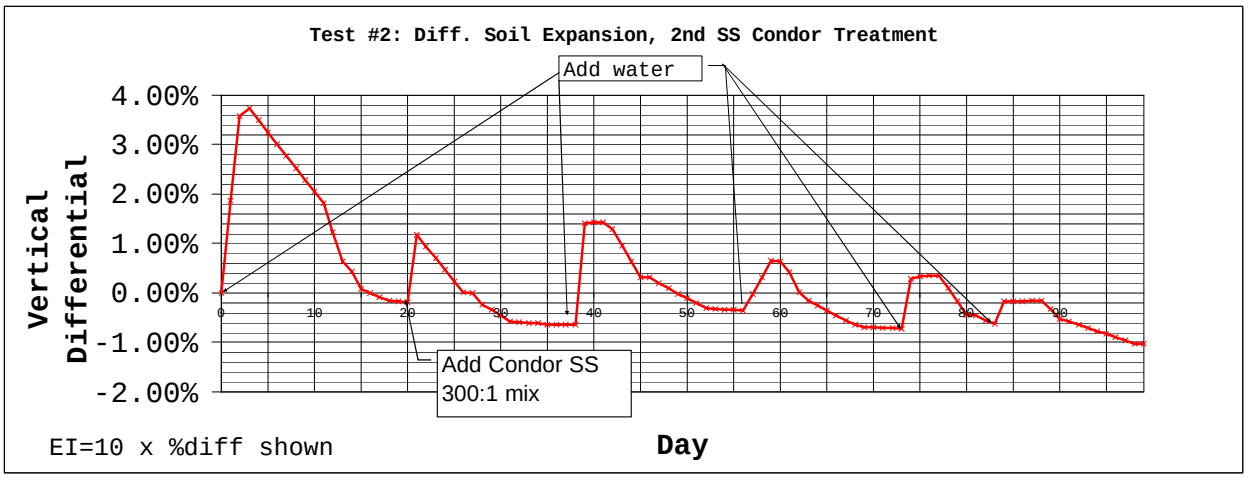
Water was added to the soil sample allowing the water to be absorbed from the bottom up through the porous bottom stone. This simulates the normal absorption characteristics of the clay soil.

After water was added and the initial expansion of the soil was measured, the soil sample was allowed to air dry with out disturbing the test apparatus. Normally it would take approximately one to two weeks for the sample to reach its driest (minimum expansion) state. This procedure was duplicated over several wet/dry cycles. The expansion and contraction during several of these cycles is depicted in the graph below "Test 1".



The first three wet/dry cycles in Test 1 used only standard tap water for wetting the soil. It will be noticed that the first expansion cycle showed a vertical expansion (PVR) of 3.5%. This is very close to the estimate of expansion derived from the visual tub test in the first photo in this paper. Subsequent wet/dry cycles produced between 1.8-2% of vertical expansion.

At day 57, a 300:1 mixture of Condor SS was added in lieu of plain tap water. It will be noted that the first day that it was added the PVR was about 2.2%. There is no ready answer why a PVR of 1.6-1.8% did not result, other than the higher degree of absorptivity of the Condor SS mixture. During the last cycle shown in the above graph, the PVR was dropping to 1.3% but this was not considered dramatic enough of a reduction. It was thought that there was insufficient ionic bonding taking place, so a second treatment was made thus boosting the total Condor SS applied to the equivalent of a 150:1 mixture. The results appear in the next chart.



To re-establish a baseline, only pure water was again added for the first expansion cycle of the above plot. At the point noted, the soil sample was treated again with a 300:1 mixture of Condor SS. At the end of this second 2.5-month test, one will now note that the PVR has dropped to approximately 0.4% during the last cycle. **This is a dramatic improvement!** It will also be noticed from this plot that the last few cycles appear to have gone negative. This should be ignored because the differential gage was reset to zero at the start of the second test.

From these tests, the staff of Soil Stabilization of Oklahoma became convinced that:

1. Condor SS will indeed reduce the vertical and horizontal expansivity of clay soil
2. Standard initial swell test methods used within the industry are ineffective in proving the effectiveness of products such as Condor SS.
3. It appears that it takes 5-6 months before noticeable reduction the expansion of the soil will be noticed.
4. Different clays may require different mixtures of Condor SS to be fully affective.

After this series of lab tests, it was decided to treat the actual home where these soil samples were taken. Only the outside perimeter of the home was treated to a depth of 5-feet, injections 3-feet on centers, with a 300:1 solution of Condor SS. After 6 months, two open sheetrock cracks ¼”-3/8” in width were filled with standard sheetrock compound. See the next series of photos documents the status of the filled cracks almost 5-6 months after filling. **Even after two years of wet/dry cycles the sheetrock compound used to fill the cracks did not show even hairline cracks that would indicate further movement of the sheetrock**.

Photo 1: ¼” crack running diagonally from an interior door up to the ceiling.

Photos 2 and 3: ½” crack that opened and closed. Crack had been filled with compound for over two years and was left unfinished and not smoothed out. Nevertheless, cracks have never appeared within the filled opening.

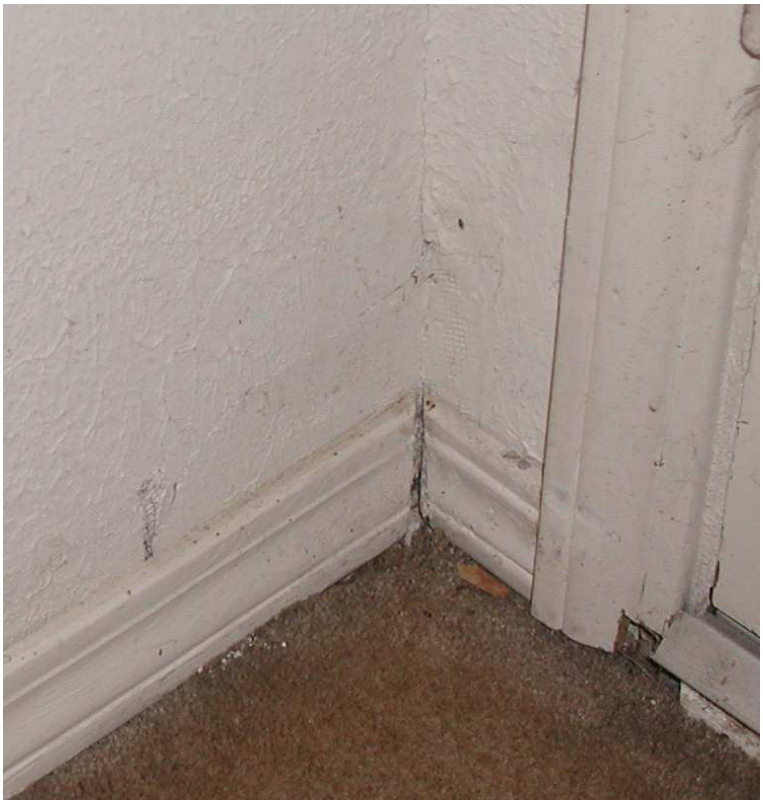


Photo 4: Separation of baseboard molding near an exterior door showing a crack. This crack was never repaired and the photo is depicted only to show the amount of movement along this long interior wall.

(To be continued in later postings to the website.)