Analysis of Soil from the Palouse Prairie Restoration Project: Sample PP-3

Jarod Imel
Eastern Washington University

Spencer Hagel
Eastern Washington University

Keagan Ives
Eastern Washington University

Richard Orndorff , PhD
Eastern Washington University

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By Jarod Imel, Spencer Hagel, Keagan Ives, and Dr. Orndorff

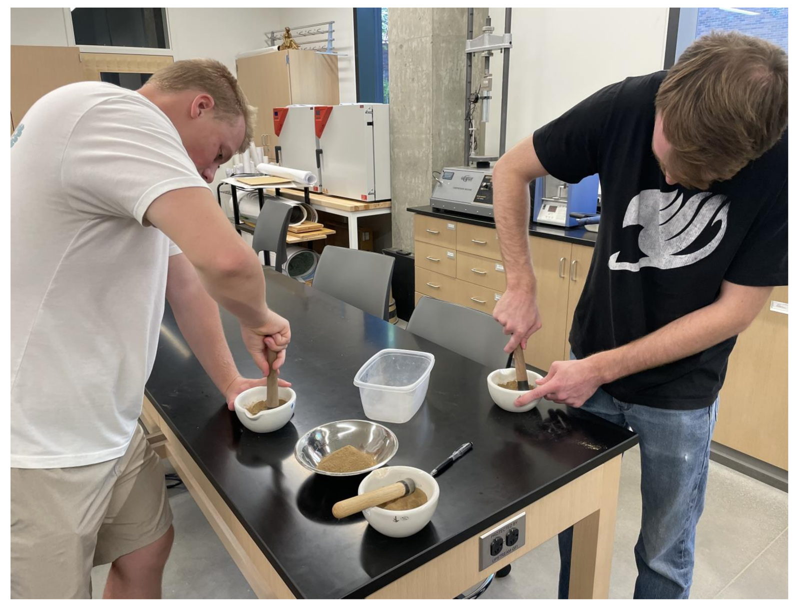
Department of Geosciences
Eastern Washington University

Introduction

The Palouse Prairie Restoration Project is a project in which 120 acres of land to the west of Eastern Washington University is actively being restored to its natural state. Our group was tasked with taking one of four samples from the site and conducting soil analysis to assist in the efforts made in the restoration project. Our analysis included tests which determined the specific gravity, particle size distribution, plastic limit values, optimum water content, and other valuable information concerning the soil. The site in which we collected the soil lies at 47.49391 N , -117.59265 W at an elevation of 2544 feet.

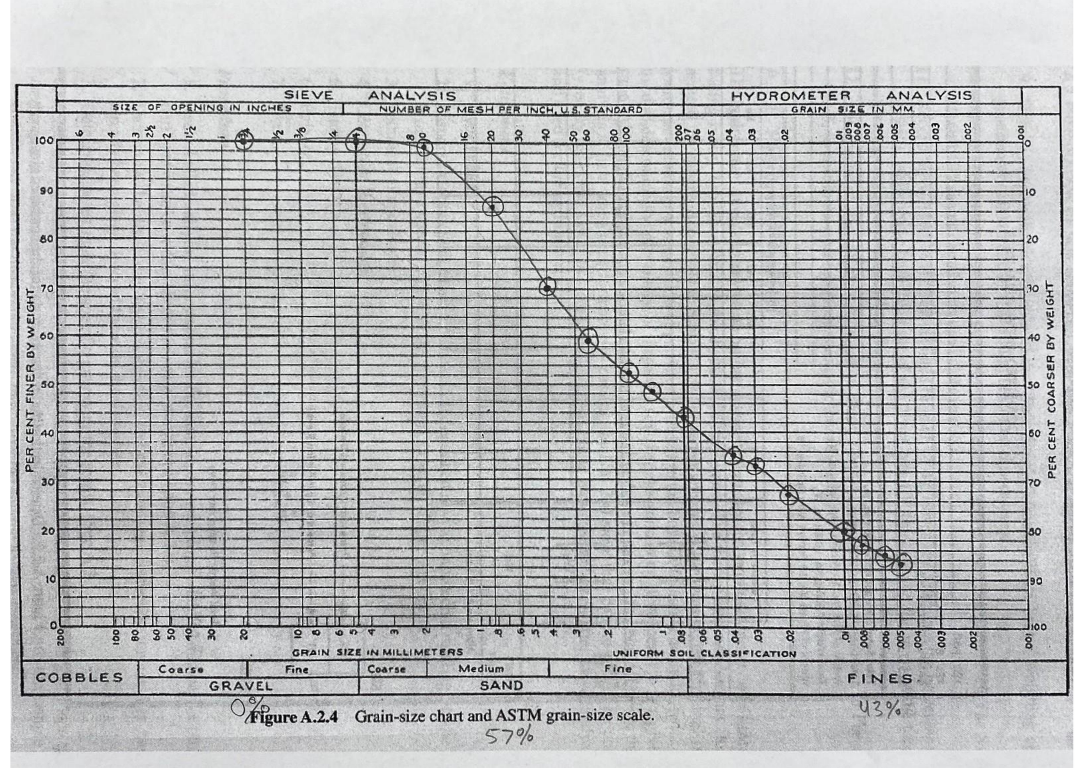
Sieve and Hydrometer Analysis

We determined the percent gravel, sand, and fines, as well as the grains smaller than the 200 sieve, the coefficient of uniformity and curvature of sample PP-3 according to ASTM standard D-422.
Our Sieve analysis determined our soil is 57% sands and 43% fines.
Grains smaller than 0.07mm are considered fines, which consisted of 35.15% (0.04 mm), 33.35% (0.03 mm), 27.10% (0.02 mm), 19.94% (0.01 mm), 16.99% (0.009 mm), 15.20% (0.006 mm), and 13.77% (0.005 mm). The coefficient of uniformity was 62.5 and the coefficient of curvature was 0.625.



Group members Jarod and Keagan disaggregating soil using pestle and mortar for the sieve analysis.

Below is the combination of sieve and hydrometer test results. Each data point represent the percent finer at each stage of the analysis.



Compaction and Unconfined Compressive Strength Tests

Above is a photo of Spencer and Jarod mixing the soil with water to bring the soil to the maximum water content before standard compaction.

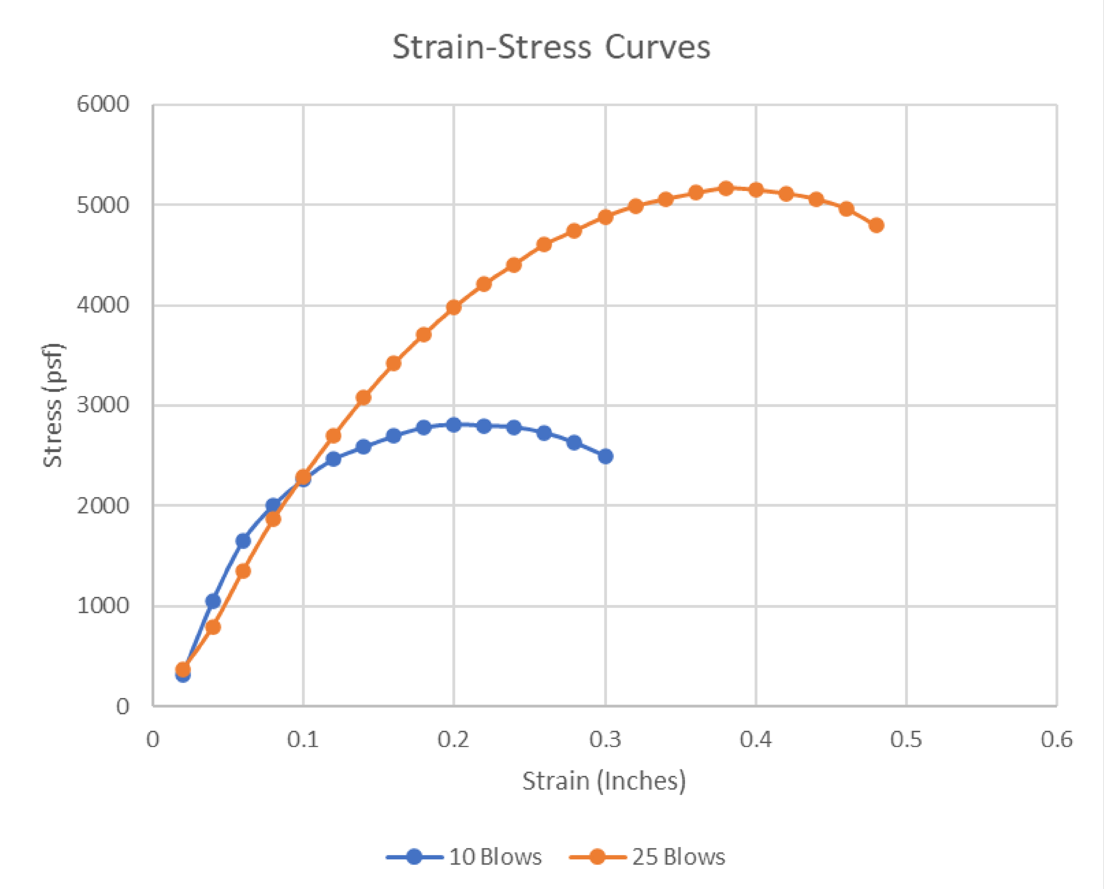
We determined the maximum dry unit weight, optimum water content for compaction, and allowable range of water contents for field compaction of our soil according to ASTM standard D698. The maximum dry unit weight was 109.8pcf, the optimum water content for compaction was 16%, and the allowable range of water contents for field compaction was between 11% and 21%.

First, we pre weighed and recorded 5 drying pans. We then disaggregated roughly seven pounds of soil and recorded the exact weight. We then added water to bring the soil water content to 5%, weighed out the base, collar and mold. We assembled the mold and then added the soil and compacted it in three lifts. Each lift consisted of 25 blows. We then removed the collar and trimmed the surface flat. We then weighed the soil inside the mold and base. We removed the mold from the base and extruded the soil. We took samples from all three lifts, placed them into drying pans, weighed them, then placed them into an oven. We then broke up the soil and added another 5% water. We repeated this until the soil passed its peak compaction.

We determined the unconfined compressive strength of our soil samples according to ASTM standard D-2166-85. During this test we compacted the soil with 10 blows per lift, and then repeated the test with 25 blows. The ultimate strength for the sub-optimal compacted soil was 2811.75psf and the ultimate strength for the optimal compacted soil was 5152.46psf.

We started by disaggregating 7 pounds of soil and pre weighing a drying pan. We brought the soil to the optimal water content (16%) for compaction. We then weighed the mold and base and compacted the soil with 10 blows per lift. We extruded the soil, set the load frame speed to 0.05 inches/minute. During the test we recorded the load for every 0.02 inches of strain. After reaching the ultimate strength, we recorded 3-4 more readings. We lowered the platen and returned the load frame to its lowest position, sampled the soil for water content, and disaggregated the soil again to repeat the test with 25 blows per lift.

After the unconfined compression test, outer layers of the soil cylinder can be peeled away to show this internal hourglass shape that the soil has taken. This shape shows how the soil reacts against the compressive forces acting on it.



This graph shows the difference in unconfined compression stress vs strain between the 10 blows per lift compaction and the 25 blows per lift compaction. 25 blows is the optimal compaction for this test, we conducted the 10 blows to see the difference between the optimal and sub-optimal compaction. As you can see the optimal compaction allows for much higher stress and strain in the soil.

Specific Gravity

We determined the specific gravity of sample PP-3 according to ASTM D854. The specific gravity was 2.458.

The steps taken to test specific gravity are as follows, we labeled and weighed a drying pan and then filled a flask with water to exactly 500 mL and weighed that as well. We then took the temperature of the water. After we weighed out approximately 150 grams of the soil and added 250 mL of water to the empty flask and weighed them together. We boiled the soil and water for 10 minutes to get rid of any extra air and then let it cool. We filled the flask to 500 mL with the soil still in it, then we moved the soil and water into the drying pan. left the soil in an oven until all the water had completely evaporated. We weighed the dry soil and pan, calculated the dry soil weight by subtracting the dry pan weight. Finally, we calculated the specific gravity of the soil.

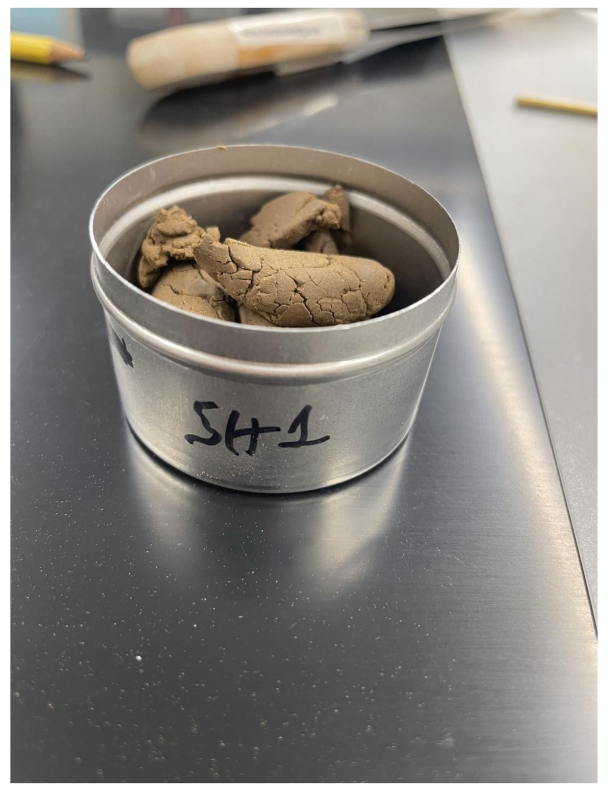
This photo shows what the soil looked like after drying. The mud crack appearance indicates fine clays that are clinging to each other as the soil loses moisture.

Plastic Limit Test

We determined the plastic limit, liquid limit, and plasticity index of sample PP-3 according to ASTM D-4318.

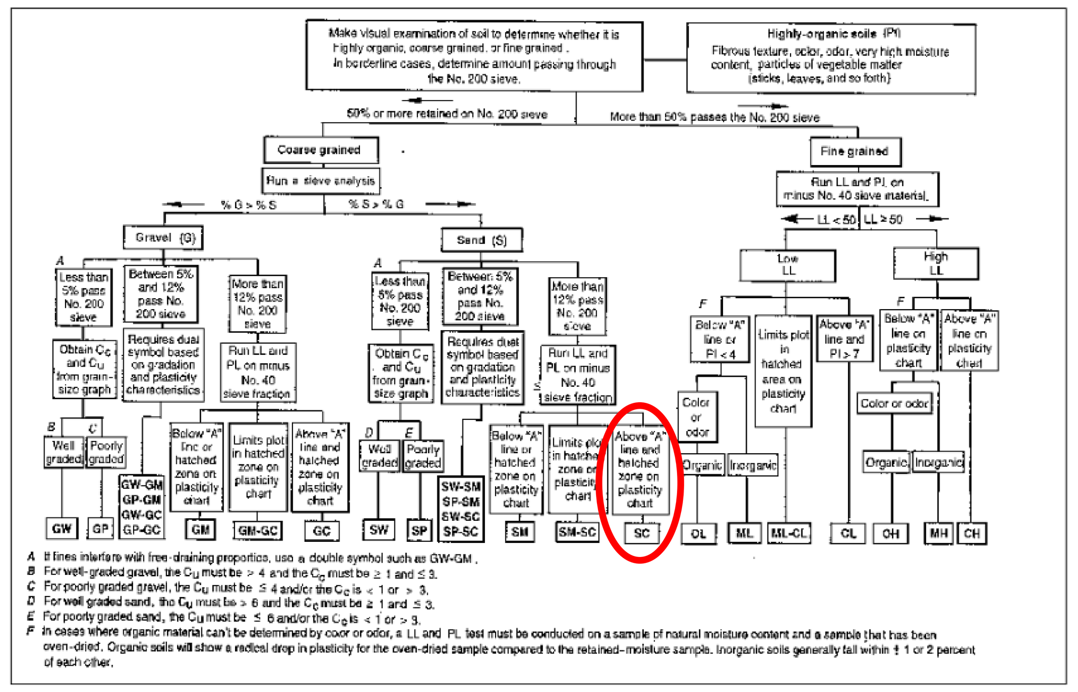
The liquid limit of clay sample B was 37% and the plastic limit was 20%. The plasticity index was found by subtracting the plastic limit from the liquid limit which is 17%. Using the soil plasticity chart, sample PP-3 is considered a fat clay.

Spencer and Keagan rolling the saturated soil to bring it towards its liquid limit.



Once the Soil reached its plastic limit, we collected it a drying pan and placed it in an oven to dry out the soil. Once the soil was dry, we weighed it out and found the % water content that was in the wet soil and can then calculate the soil's plastic limit.

USCS Flowchart Classification



Using the USCS Classification, this soil falls under the SC category, which means it is a Clayey Sand. It falls into this category because it consists of 57% sands, 43% fines, and the soils plasticity falls above the "A" line on the plasticity chart.