Engineering Classification of Soils

I. Laboratory Methods

A. Gradation Procedure

1. Weigh out 50.00 g of raw soil
2. Place in container with 500 ml of DI water
3. Add 10 ml of deflocculant
4. Agitate 3 to 4 minutes with blender
5. Empty into a nest of sieves with the following numbers:
    i. #10, #40, #200
6. Using tap water and fingers, gently work soil through sieves, using large dishpan to catch fines that pass the #200 sieve. Be sure to look for 'lingering' sand on the bottoms of the sieves, and wash to the next sieve below using a squirt bottle
7. Remove sand from each sieve into a preweighed beaker (3 total—one for each sieve)
8. Place beakers containing the sand in drying oven for 24 hours
9. After 24 hours remove beakers
10. Weigh beakers with sand; subtract new total from original weight to determine weight of sand
11. Compute the % of each size fraction by:
    a. (Wt. sand in gms for given sieve / 50g) x 100
       AND
    b. the % of the minus 200 fraction by:
       (Wt -200 in gms/ 50g) X 100
12. Replicate the above procedure for the remainder of the soil samples (5 total)

B. Liquid Limit Determination

1. Clean and adjust the liquid limit device to fall exactly one cm
2. Prepare about 150 g of -40 soil
3. Add D.I. water and mix into a uniform paste
4. Place the paste in liquid limit cup to about one cm maximum depth. Paste surface should be approximately level
5. Cut groove in paste with grooving tool, being careful not to cut the brass cup.
6. Turn handle to produce two blows per second until separated halves flow together for a minimum of ½ inch. Count and record the number of blows required to attain this distance of closure.
7. Remove a water content sample from the paste in the cup, and weigh in a preweighed beaker.
8. Repeat these steps for 3 more trials, adding water or soil to your original mix. You must have at least one test of > 25 blows, and one <25 blows, and a total of 4 tests.
9. After 24 hours, remove the water content samples from the oven, weigh, and compute the percent of water as follows:

Weight of water * 100 = _____% water
Weight of dry soil

10. Plot data on the form provided and read the water content percent where your line crosses the 25 blow line. This is your liquid limit.

C. Plastic Limit Determination

1. Mix about 15 g f moist -40 soil
2. Roll the soil on a glass plate with the hand until it is 1/8 inch in diameter
3. Roll sample until it starts to crumble at 1/8 inch, then quickly place in a preweighed tin and cap.
4. Repeat procedure above 2 more times, and dry the three samples for 24 hours (all in one tin).
5. Weigh oven dried samples and compute water content as follows:
   Weight of water * 100 = _____% water
   Weight of dry soil

D. Plasticity Index

1. Plasticity Index = Liquid Limit – Plastic Limit

REPEAT PROCEDURES FOR THE OTHER THREE SAMPLES. YOUR FIFTH SAMPLE IS NON-PLASTIC, AND THEREFORE DOES NOT REQUIRE ATTERBERG LIMITS.

II. Classification

1. Record all of your data on the blackboard in the soils lab as soon as your samples have been properly dried and weighed.
2. Using gradation results and Atterberg Limits, classify your soils according to the AASHTO and Unified Systems, including the Group Index, where appropriate.

Due Dates:
Friday, 18 January: Overview of laboratory procedures by Drs. Eaton/Sherwood.
Monday, 28 January: All lab work should be completed.
Monday, 4 February (start of class time): Students turn in final product.

SOIL MECHANICS LABORATORY **Sheet No.___**
DEPARTMENT OF GEOLOGY & ENVIRONMENTAL SCIENCE
JAMES MADISON UNIVERSITY

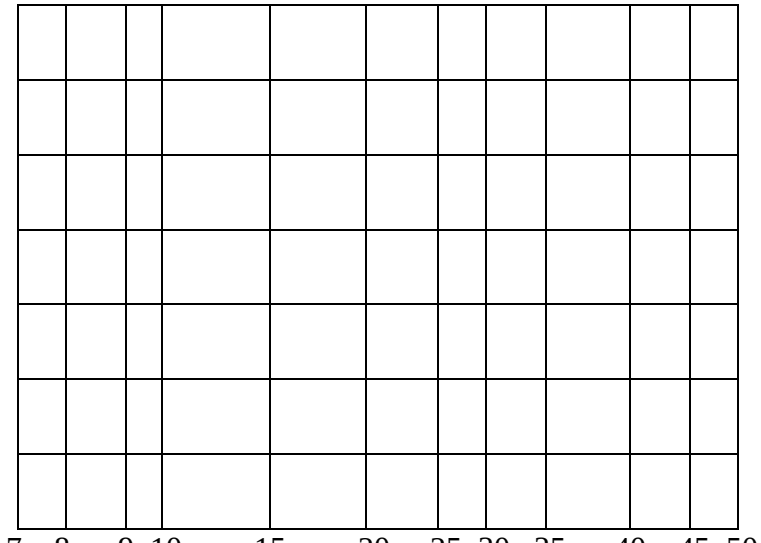
WATER CONTENT AND ATTERBERG LIMITS DATA SHEET

Name:_____ Party No.:_____ Date:_____

Soil Description: _____

Sample No.										
Type of Test										
Container No.										
No. of Blows										
Wt. of Sample & Tare wet (gm)										
Wt of Sample & Tare dry (gm)										
Wt. of Water (gm)										
Tare (gm)										
Wt of dry soil (gm)										
Water Content (%)										

Flow Curve



SHRINKAGE LIMIT DETERMINATION

Wt. of dish & wet soil _____gr.

Wt of dish & dry soil _____gr.

Wt of water _____ gr.

Wt of dish (No.__) _____ gr.

Wt of dry soil W_S _____ gr.

Water content, W% _____

Vol of wet pat (dish), V_____ cc.

Vol of dry soil pat, V_D _____cc.

$$S.L = W\% - \frac{V - V_D}{W_S} \times 100$$

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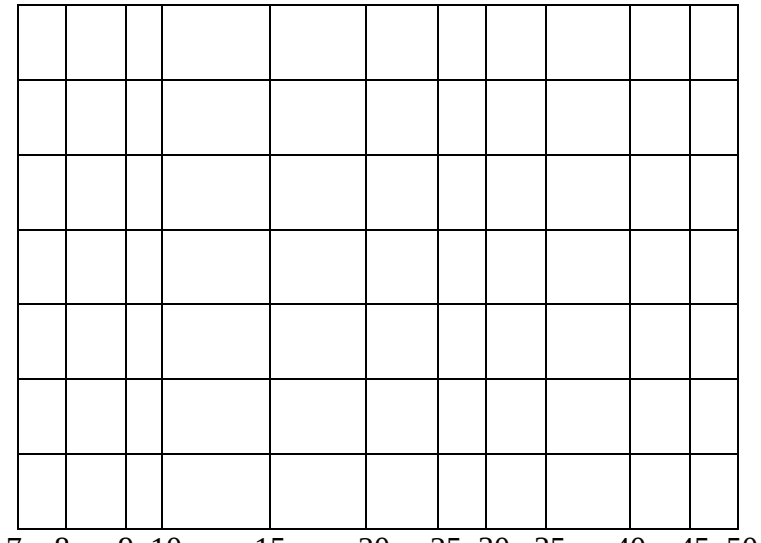

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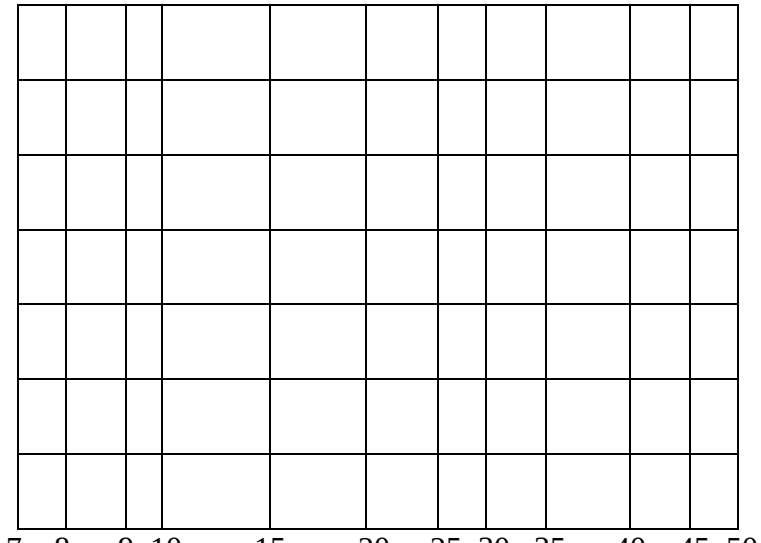

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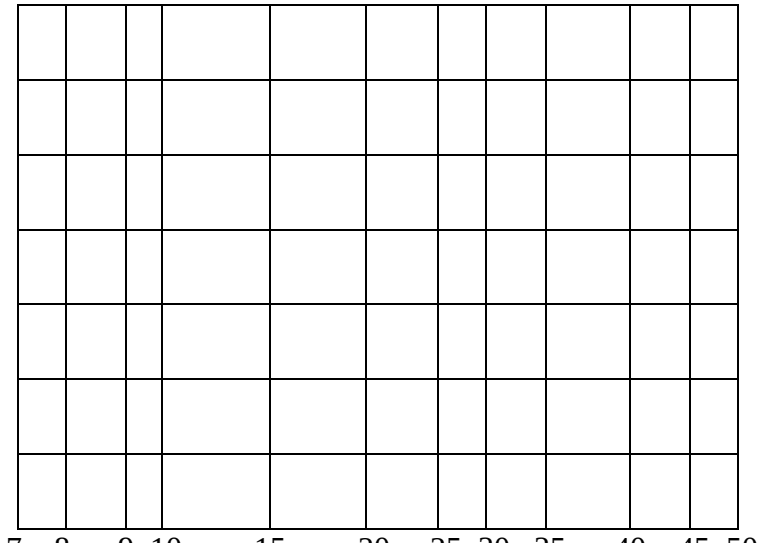

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Laboratory Format

Title

Introduction

Where, when, why, other

Procedures

Step by step for each procedure used, in a manner that you could reproduce your experiments five years from now with your descriptions.

Results:

Table I - Gradation data (weights and percents) for #10, 40, 200, -200 sieves

Table II– Values of liquid limit, plastic limit, plasticity index, group index for each soil

Table III– Soil Classifications (both systems); ALL SOILS MUST BE CLASSIFIED, REGARDLESS OF THEIR VALUES OF PLASTICITY

Figure I– **ORIGINAL** Data sheet for Atterburg Limits for each soil, with the 25^{th} blow plotted on the **ORIGINAL** Data sheet; highlight 25^{th} blow.

Discussion-- include:

- best uses and limitations for each soil
- answer the question, "Do the two systems give similar information?
- rate the two systems on ease of use, etc.
- any other observations pertinent to the laboratory

Conclusions

Number or bullet the conclusions

Include conclusions on:

- Range of engineering properties represented by these soils
- Overall quality of these soils for engineering purposes
- Your rating of the two systems