Cive 353 Geotech 1

Assignment #1 - Answer Key

1) The general definition of a soil is a mineral particle assemblage that is unconsolidated, or poorly consolidated. A rock is a particle assemblage where the particles are highly consolidated (bonded together). The dividing line between soils and rocks is fuzzy but for geotechnical purposes the dividing line is whether or not the sample can be sampled with a split spoon sampler (soil can, rock cannot).

2) It is important for cost estimation. If you call it a soil and it turns out to be rock then the budgets of the contractors who bid on the project will be low and they will try to recuperate damages from the soils engineer.

3) The main methods of soil formation are chemical and physical weathering. However, we are also looking for the actual soil types created by the various transportation methods (you need this to answer question #4).

   i. Colluvium (gravity soil deposits)
   ii. Alluvial Soils (water transported – flood plain and delta)
   iii. Lacustrine Soils (water transported – lakes)
   iv. Marine Soils (water transported – salt water)
   v. Aeolian Soils (air transported)
   vi. Glacial Soils
   vii. Organic Soils

4) Table 1: Properties of Soil Types

Soil Type	Particle Shape	Grain Size Distribution	Compressibility	Strength	Permeability
Colluvium	Angular	Mixed	High	Med-low	Med-high
Alluvial Soils	Rounded to sub-rounded	Dependent on energy of system. Increased energy = increased particle size	Low-high depending on GSD	Low-med	Low-med
Lacustrine Soils	Plate-like and rounded	Fine	High	Low	Low
Marine Soils	Rounded to sub-rounded	Varying	Med-high	Low-med	Med-high
Aeolian Soils	Well rounded	Silts and sands	Low-med	High when dry, low when wet	High
Glacial Soils	Angular fragments	Mixed	Low	High	Low
Organic Soils	Angular	Mixed	High	Low	High

5) Aeolian sand has a high dry strength but a low wet strength. It is also composed of one particle size and a large void ratio due to honeycomb structure. When Aeolian sand gets wet it structure can collapse. Thus, it is not a good foundation material (High compressibility, low strength). Alluvial sand will have a mixture of grain sizes deposited depending on the velocity of the water in the depositional environment. The alluvial sand will also have a low void ratio due to the mixed grain sized distribution and a stable structure. Hence alluvial sand will provide better support for a building (low compressibility, high strength).

6) Soil is considered to be cohesive if the particles adhere after wetting and subsequent drying and if significant force is then required to crumble the soil (this does not include soils whose particles adhere when wet due to surface tension). It is the electrostatic and electromagnetic forces between the small clay particles which cause these soils to adhere. Thus soils with high clay content are considered to be cohesive.

A soil that does not possess these characteristics is said to be cohesionless. Sand, gravel and silt with low clay content are cohesionless soils. These soil will not support vertical sides when dry.

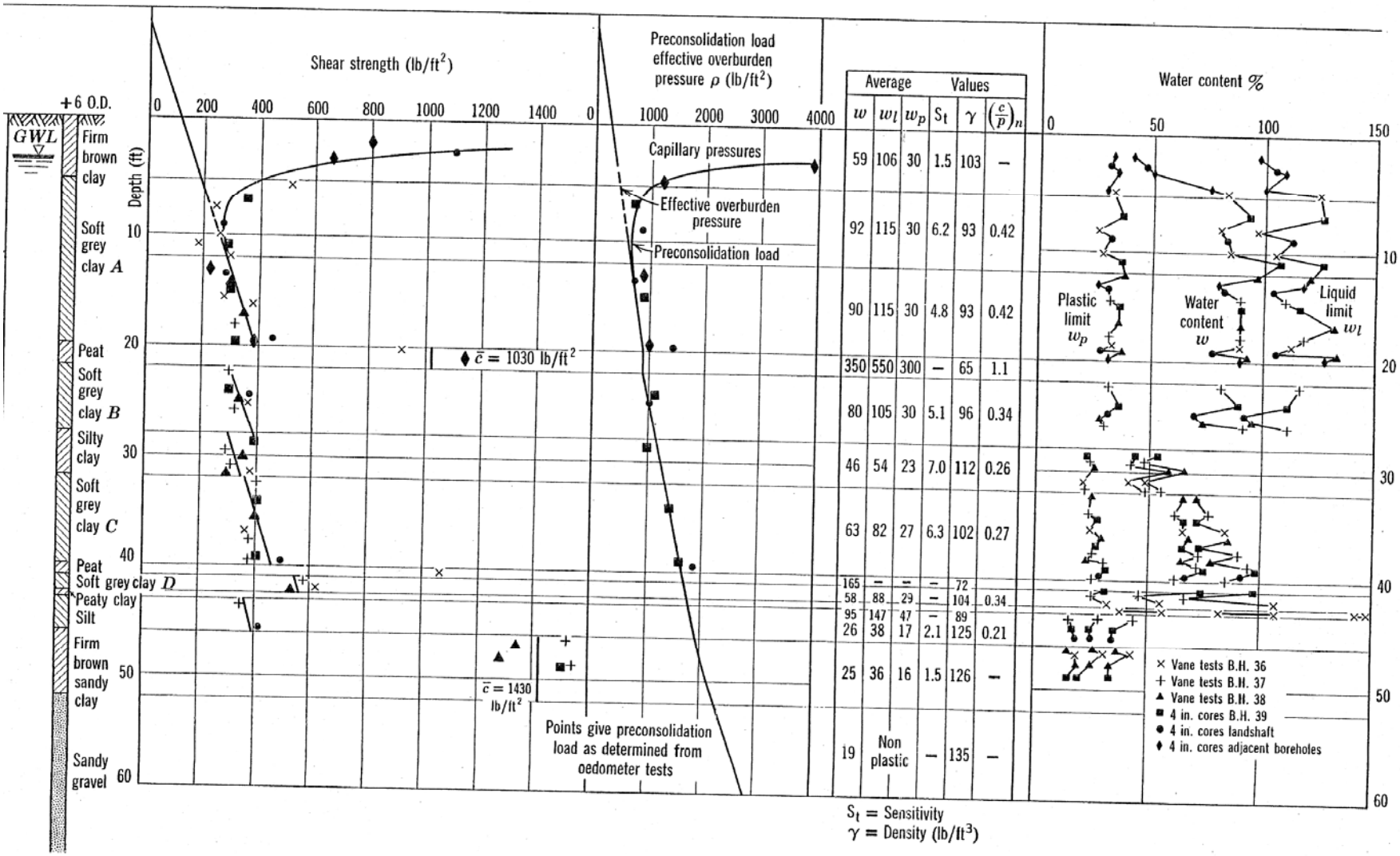
+6 O.D.
GWL
Firm brown clay
Soft grey clay A
Peat
Soft grey clay B
Silty clay
Soft grey clay C
Peat
Soft grey clay D
Peaty clay Silt
Firm brown sandy clay
Sandy gravel
Depth (ft)
Shear strength (lb/ft²)
0 200 400 600 800 1000 1200 1400
c̄ = 1030 lb/ft²
c̄ = 1430 lb/ft²
Points give preconsolidation load as determined from oedometer tests
Preconsolidation load effective overburden pressure ρ (lb/ft²)
0 1000 2000 3000 4000
Capillary pressures
Effective overburden pressure
Preconsolidation load
Average Values
w | w_l | w_p | S_t | γ | (c/p)_n
59 106 30 1.5 103 –
92 115 30 6.2 93 0.42
90 115 30 4.8 93 0.42
350 550 300 – 65 1.1
80 105 30 5.1 96 0.34
46 54 23 7.0 112 0.26
63 82 27 6.3 102 0.27
165 – – – 72
58 88 29 – 104 0.34
95 147 47 – 89
26 38 17 2.1 125 0.21
25 36 16 1.5 126 –
19 Non plastic – 135 –
S_t = Sensitivity
γ = Density (lb/ft³)
Water content %
0 50 100 150
Plastic limit w_p
Water content w
Liquid limit w_l
× Vane tests B.H. 36
+ Vane tests B.H. 37
▲ Vane tests B.H. 38
■ 4 in. cores B.H. 39
● 4 in. cores landshaft
♦ 4 in. cores adjacent boreholes

Table 2: Environmental conditions which formed the soil stratigraphy.

Soil Unit 4	Frim Brown Clay	Weathered clay	Over Consolidated	Post Glacial	
	Soft Grey Clay	Marine or Laustrine (very low energy)			
Soil Unit 3	Peat	Marsh Deposits	Normally Consolidated		Cycle of water level changes (Low energy environment)
	Soft Grey Clay	Marine or Laustrine (very low energy)			
	Silty Clay	Marine or Laustrine (very low to low energy)			
	Soft Grey Clay	Marine or Laustrine (very low energy)			
Soil Unit 2	Peat	Marsh Deposits			Cycle of water level changes
	Soft Grey Clay	Marine or Laustrine (very low energy)			
Soil Unit 1	Peaty Clay	Marsh Deposits			Note: fining upward sequence likely due to melting glacier
	Silt	Flood Plain (low Energy)			
	Firm Brown Sandy Clay	Outwash Deposit (Medium to low energy)			
	Sandy Gravel	Outwash Deposit (High energy)			