Birzeit University
Faculty of Engineering
Department of Civil and Environmental Engineering

ENCE 331, Soil Mechanics

Homework assignment #5
Due on Thursday Oct 29th, 2020 @ 11:59 PM.

QUIZ on this HW Material on the same day

Problem 1:

A standard Proctor test was conducted on a silty clay soil collected from a proposed construction site. The results are shown in the following table. (G_s = 2.7)

Trial no.	Mass of moist soil in the mold (g)	Moisture content (%)
1	1689	12.7
2	1752	15.0
3	1800	17.8
4	1845	20.6
5	1844	23.8

- Using the compaction test data determine the optimum moisture content and the maximum dry unit weight.
- Plot the zero-air-void curve and check whether it intersects the compaction curve.
- Plot the void ratio and the degree of saturation against the moisture content.
- What are the void ratio and degree of saturation at the optimum moisture content?
- If the specification calls for 95% DOC, What the is least acceptable field dry density?

Problem 2:

Refer to the silty clay soil at the construction site in Problem 1. As part of a quality control program, the field inspection engineer conducted a sand cone test to determine the field density. The following data were recorded using the sand cone method.

- Calibrated density of the used sand is 1667 kg/m^3
- Mass of sand needed to fill the cone (only the cone) is 0.117 kg
- Mass of jar + cone + sand before use is 6.1 kg
- Mass of jar + cone + sand after use is 2.83 kg
- Mass of moist soil from the hole is 3.35 kg
- Moisture content of moist soil 16.1%

Determine:

A. The dry unit weight of compaction in the field?
B. The relative compaction (DOC) in the field?
C. Was the compaction specification stated in Problem 1 met?
D. Field void ratio and degree of saturation?

Problem 3:

A proposed embankment fill requires 7500 m^3 of compacted soil. The void ratio of the compacted fill is specified as 0.7. Soil can be transported from one of the four borrow pits, as described in the following table. The void ratio, specific gravity of soil solids, and the cost per cubic meter for moving the soil to the proposed construction site are provided in the table.

a. Determine the volume of each borrow pit soil required to meet the specification of the embankment site.
b. Make the necessary calculations to select the borrow pit which would be most cost-effective.

Borrow pit	Void ratio	G_s	Cost ($/m^3)
I	0.85	2.66	11
II	0.92	2.69	8
III	1.21	2.71	9
IV	0.89	2.73	10

Problem 4:

For a given soil (G_s = 2.72), following are the results of compaction tests conducted in the laboratory.

Moisture content (%)	Dry unit weight γ_d (kN/m^3)
12	16.34
14	16.93
16	17.24
18	17.20
20	16.75
22	16.23

After compaction of the soil in the field, sand cone tests (control tests) were conducted at five separate locations. Following are the results:

Location	Moisture content (%)	Moist density, ρ (kg/m^3)
1	15.2	2055
2	16.4	2060
3	17.2	1971
4	18.8	1980
5	21.1	2104

The specifications require that

a. γ_d must be at least 0.95 $\gamma_{d(max)}$.
b. Moisture content w should be within 1-2% of w_{opt}.

Make necessary calculations to see which the control tests meet the specifications and determine whether any of the control tests should be rejected.

Problem 5:

The maximum and minimum dry unit weights of a sand were determined in the laboratory to be 16.9 kN/m^3 and 14.2 kN/m^3, respectively. If the field relative density is 82%?

Determine

- The degree of compaction in the field.
- Field dry unit weight.
- Field bulk unit weight if the field moisture content is 15%.