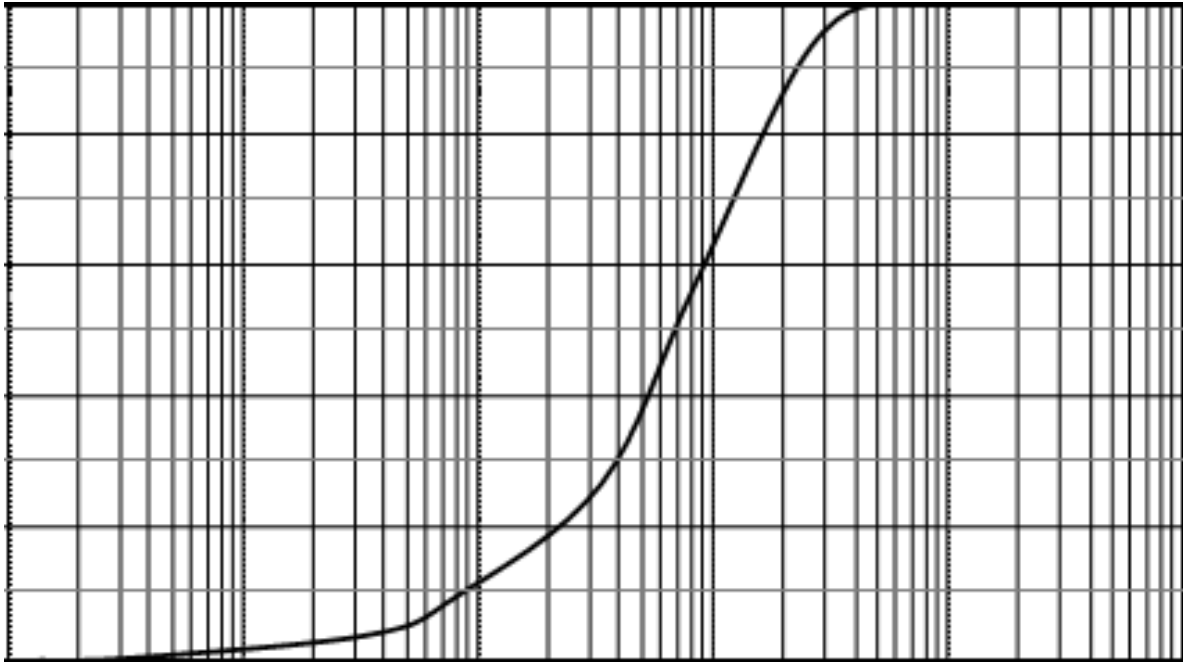


## Soil Mechanics Question Bank

- Q1. Soil is a unique material and complex in nature. List five unique characteristics of soils.
- Q2. What is the difference between the structure and fabric of coarse-grained soil?
- Q3. Why clay soils often swell when wet?
- Q4. How cohesive and cohesionless soils behave under unsaturated conditions? In terms of grain separation.
- Q5. What is the Hand Test? And why civil engineers use it?
- Q6. Particle size analysis was performed on a soil. The results of the analysis are presented in the figure below. Classify the soil according to USCS (Group symbol and name), if the L.L=40% and P.L=20%.



- Q7. An airport runway fill needs 600 000 m<sup>3</sup> of soil compacted to a void ratio of 0.75. There are two borrow pits A and B from where the required soil can be taken and transported to the site. Which of the two borrow pits would be more economical?

Borrow pit	In situ void ratio	Transportation cost
A	0.80	5 USD
B	1.70	2.5 USD

Q8. The in-situ moisture content of a soil is 18% and its moist unit weight is  $16.5 \text{ kN/m}^3$ . The specific gravity of the soil solids is 2.75. This soil is to be excavated and transported to a construction site, and then compacted to a minimum dry weight of  $16.26 \text{ kN/m}^3$  at a moisture content of 20%.

a) How many cubic meters of excavated soil is needed for  $8361 \text{ m}^3$  of compacted fill?

b) How many truckloads are needed to transport the excavated soil, if each truck can carry 20 tons?

Q9. Why is it difficult to predict precisely the behaviour of soils?

Q10. Soil is a unique material and complex in nature. To handle this unique nature, the discipline utilizes many different areas of mechanics. What are they and why?

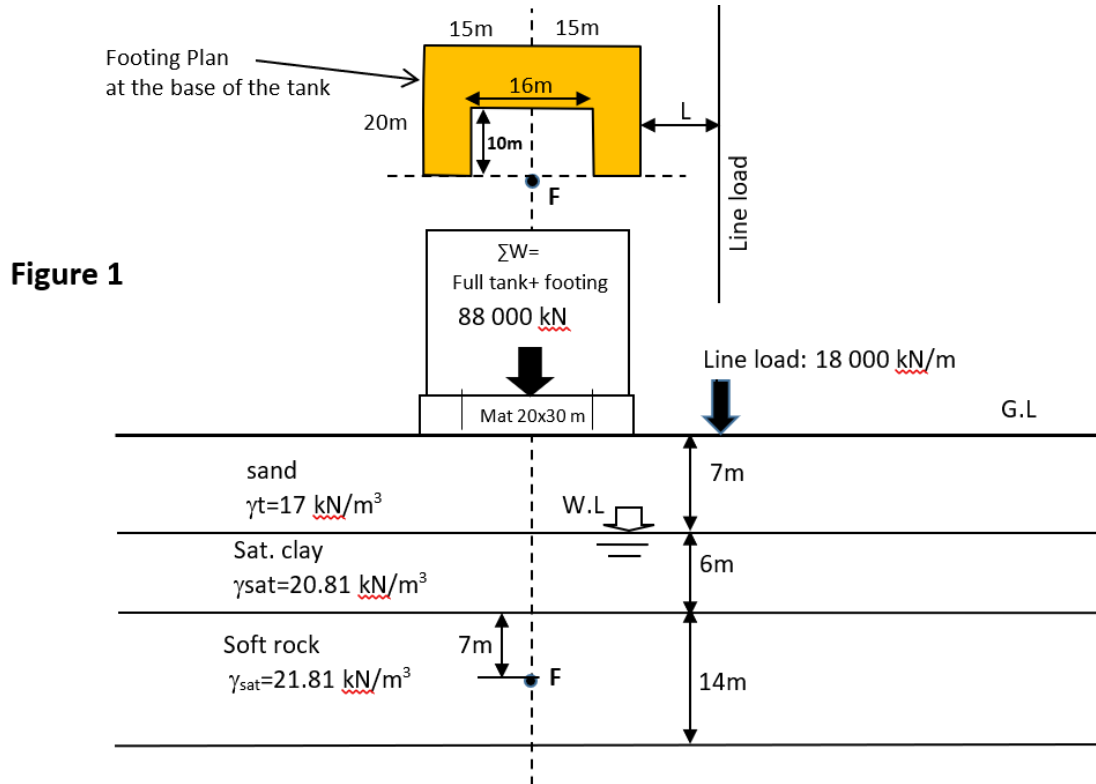
Q11. Why we classify the soils? Moreover, what is the benefit of it?

Q12. If a soil has 12% gravel, 22% sand, 26% silt and 40% clay in the textural classification system, how do you find the percentages of sand, silt, and clay to use them in the system?

Q13. A mass of 67.5g and a volume of  $39.2 \text{ cm}^3$  were measured of a soil sample. After oven drying of the soil sample, no change of the mass happened. If the  $G_s = 2.7$ , then:

1. determine the volume of voids,
2. calculate the volume of water to change the  $S_r$  to 100%,
3. determine the dry and saturated densities.

Q14. Figure 1 shows the locations of point F in a profile and a plan. If the effective stress at point F due to self-weight of soil, oil tank and line load is  $410 \text{ kN/m}^2$ , find the distance of line load to the edge of the oil tank footing (  $L$  ) to verify this stress ? use Fadum method for  $\Delta\sigma_z$ .



Q15. A standard proctor compaction test carried out on a soil which provided the following results:

Mass (g)	2010	2092	2114	2100	2055
Water content (%)	12.8	14.5	15.6	16.8	19.2

Based on the results:

- plot the dry density against water content to obtain MDD and OMC, if the value of  $G_s=2.67$ ,
- Plot also the curves for  $S_r$  equals to 90% and 100%,
- calculate air content (A) at the maximum dry density if  $A=n(1-S_r)$ .

Q16. Figure 2 shows the flow net under a sheet pile wall. Considering 1 meter length of the wall:

- calculate the rate of flow (in  $\text{m}^3/\text{year}$ ),

- 2- calculate the value of pore water pressure at point A,
- 3- Determine the value of z at point B.

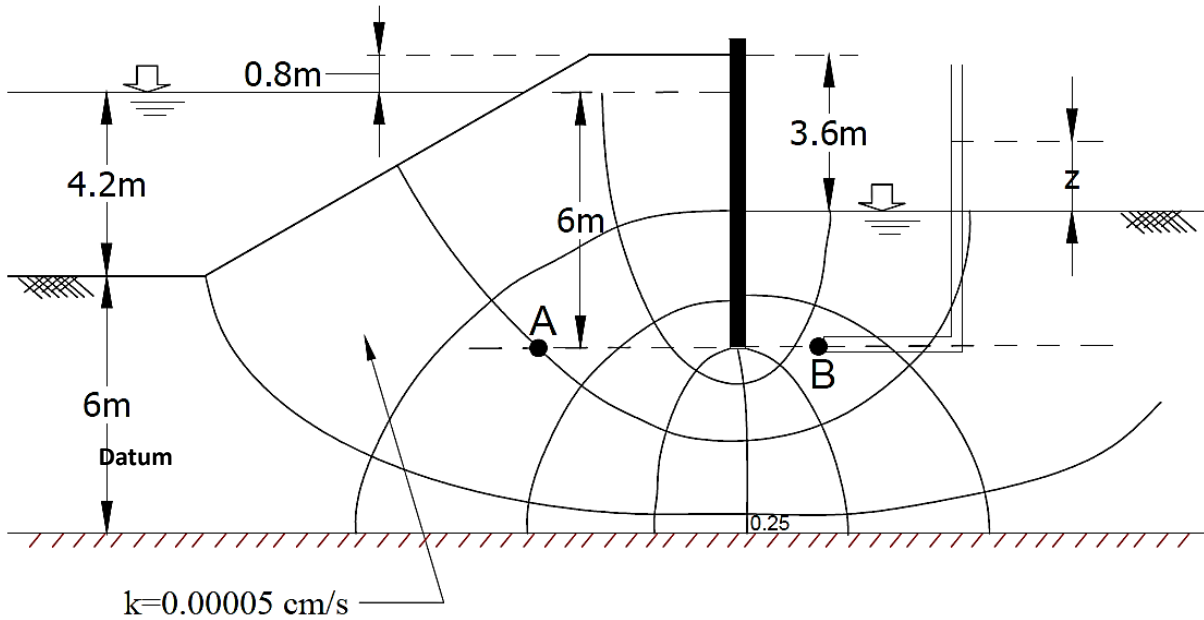


Figure 2

Q17. A 45% of soil sample retained on sieve No.4 and 89% retained (cumulative) on sieve No.200. The soil has a liquid limit (LL) =28% and plastic limit (PL) =18% ,  $C_u=4.2$ ,  $C_c=1.4$ . Classify the soil using the unified soil classification system including group symbol and group name. (Note: Write all important steps of the classification)

Q18. An oven dry soil sample of volume 250cc weights 430g. If the specific gravity of soils is 2.70, what is the water content when the soil becomes fully saturated without any change in its volume?

What will be the water content which will fully saturate the sample and also cause an increase in volume equal to 10% of the original dry volume?

Q19. A large excavation was made in a stratum of saturated stiff clay as shown in Figure 1. When the depth of excavation reached 8 m, the excavation failed. To what height would the water have risen above the stratum of sand into a drill hole before the excavation was started?

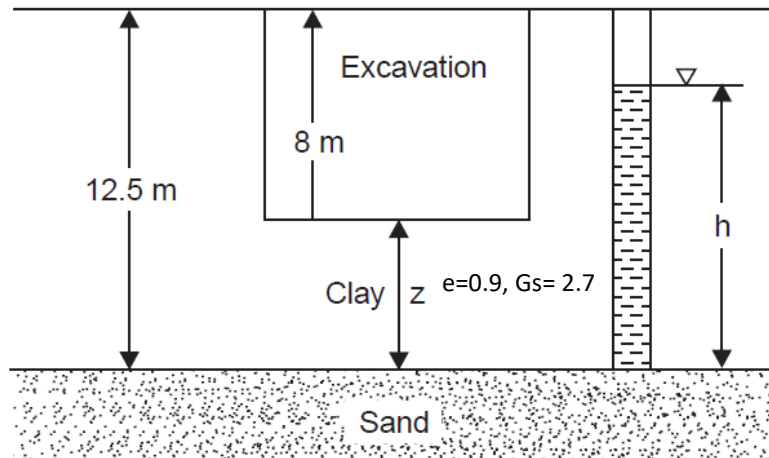


Figure 1

Q20. Figure 2 shows a sheet pile retaining clean sand and fine silty sand layers to install a sewer drian pipe 24ft below the ground surface. The flow net of the system is drawn in Figure 2. Determine; 1) flow rate per one meter of the sheet pile; 2) effective stress at Point A 3) effective stress at point B.

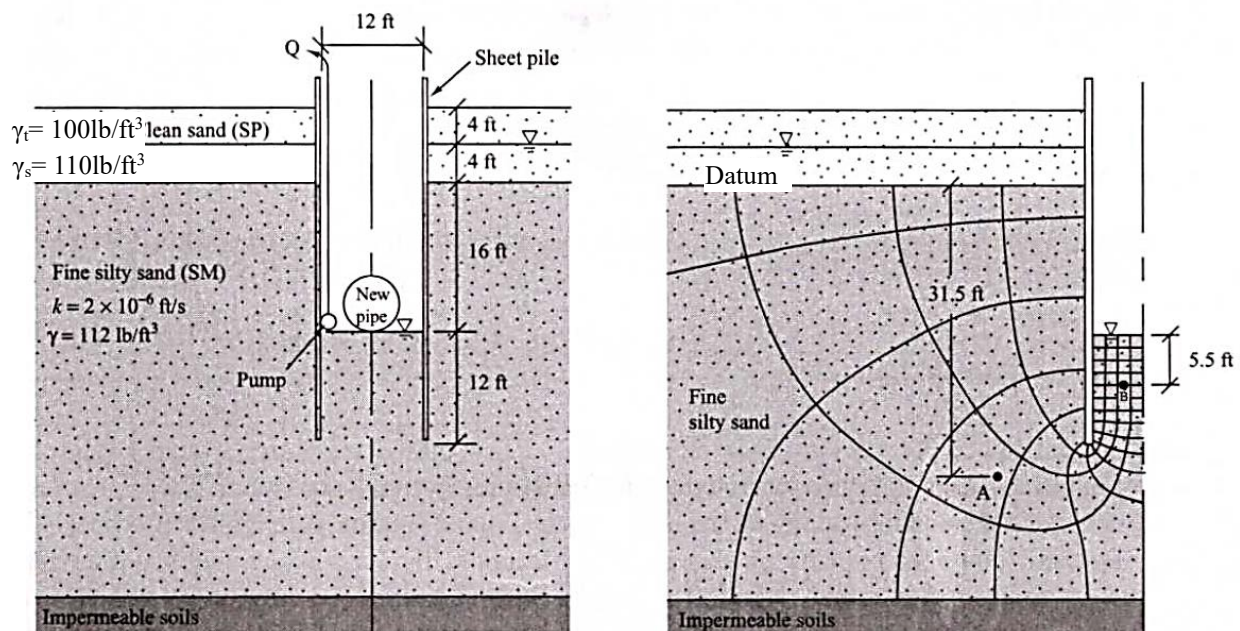


Figure 2

Q21. A silo is supported on a ring foundation, as shown in Figure 3. The total vertical load is 4MN. Determine the vertical stress increase at 3.5m under the center of the ring (point O, see Figure 3) using Newmark's influence chart.  
 $\Delta\sigma_z = q \cdot IV \cdot N$

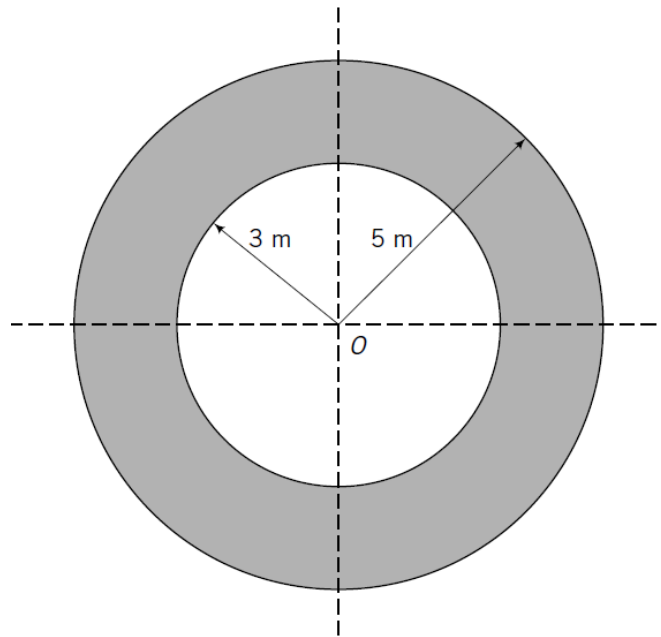


Figure 3