

Department of Civil Engineering
CEL 421: Ground Improvement
Major Test

Max. Time: 2 Hours
Credit: 40%

1. At a site where 6 storied commercial building is to be constructed on a 25 m wide raft foundation, the underlying soil comprises medium dense sandy silt from ground surface to elevation -9 m followed by loose fine sand from -9 to -15 m underlain by dense sand. The water table is at a elevation of -6 m. It is anticipated that in the eventuality of an earthquake of magnitude 7.0 or above on the Richter scale, the fine sand stratum will liquefy, causing failure of the foundation. It is proposed to increase the density of the fine sand stratum by means of in-situ ground improvement to change its condition from loose to dense. Which method should be adopted? 10
2. Write a brief note on factors that influence the choice of side-support system to be used for vertical expansion in soil. 7
3. How does tunnelling in rock differ from that tunnelling in soil? 7
4. Site investigations at a site reveal that soil beneath the ground surface comprises of loose sand to a depth of 3.5 m followed by a dense stratum. For ground improvement there are two options under consideration: (i) densification by impact compaction and (ii) densification by excavation and relaying in layers using vibratory rollers for compaction. The cost of the impact compaction is estimated at Rs. 350/- per square metre of the plan area of the site. For excavation, the prevalent unit rate is Rs. 30/- per cubic metre and for relaying soil with compaction, the rate is Rs. 45/- per cubic metre. (a) Which method will be more economical? (b) What other factors should be considered before selecting the method to be used? 10
5. The density of a 10 m deep loose sand deposit is to be increased by compaction piles. Estimate the amount of extra material that will have to be added to the soil per square metre of the plan area if the dry density of the soil is to be increased from 14 kN/m^3 to 16 kN/m^3 . If the material to be added costs Rs. 300/- per cubic metre, and the cost of construction piles is 100% of the cost of the material, what is the cost of the treatment per square metre of the plan area? 10
6. Plot the general trend of the relationships shown below in Figure 1 for loose sand and dense sand at different normal stresses. Show the numbers only where necessary to help illustrate the essential features of the plot. 8
7. Plot the general trend of the relationships shown below in Figure 2 (for UCS test) for clay, clay mixed with 2% (cured for 2 weeks) and clay mixed 4% lime (cured for 4 weeks). 8

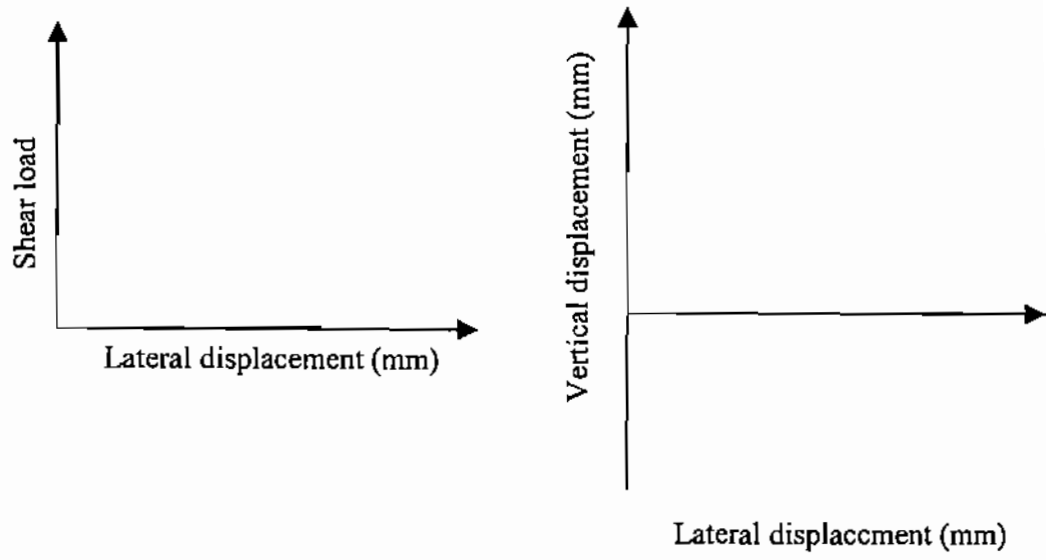


Figure 1

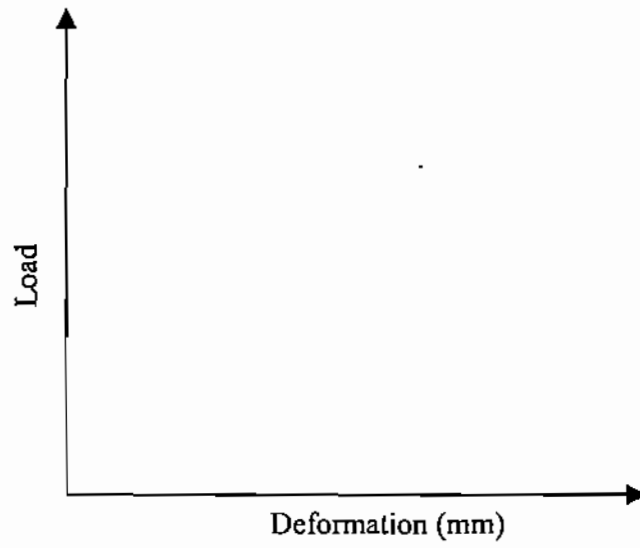


Figure 2