Dr Manendra Singh 8/5/2023

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NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR
B..TECH. (2nd YEAR, IV SEM.), Session: 2022-2023 (Even Semester)
End Sem Theory Examination May 2023

CE- 223 Soil Mechanics **Course Coordinator- Dr. Manendra Singh**

Time: 3 hours **Marks: 50**

Instructions: Read the instructions carefully.

- Write to the point only. Do not write anything which is not related to the question.
- Do all parts of a question in sequence order otherwise other parts may not be evaluated.
- There is no step marking therefore whatever you attempt try to do correctly.
- Assume missing data if any.

Q. 1 What is compaction curve and explain the shape of compaction curve using Lambe (1986) theory. 5 marks

Q. 2 Answer the following questions. 2*5=10 marks

a) What is soil cohesion and is it the same as the undrained shear strength? Explain your answer.

b) Does the increase in vertical stress at a certain soil depth from an applied surface load a total stress increase or an effective stress increase? Explain your answer.

c) What would happen to the maximum dry unit weight and optimum water content determined from a standard Proctor test if a higher level of compactive energy is used to compact the soil? Justify your answer.

d) The dry unit weights of a sand and a clay are the same. Would you expect them to have the same hydraulic conductivity? Explain your answer

e) A container contains a dry powdered clay. A similar container contains sand filled to the same volume. If water is added to saturate both the clay and the sand, which is likely to have a higher water content and why?

Q. 3 a) Derive the following expression: $S.e = w.G$

b) Derive the expression of average coefficient of permeability in stratified soil when flow is normal (perpendicular) to the layers. (5+5=10 marks)

Q. 4 a) A thin layer of silt exists at a depth of 18 m below the surface of the ground. The soil above this level has an average dry density of 1.53 g/cc and an average water content of 36%. The water table is almost at the surface. Tests on undisturbed samples of the silt indicate the following values:

$$c_u = 45 \text{ kN/m}^2;\ \varphi_u = 18°;\ c' = 35 \text{ kN/m}^2;\ \varphi' = 27°$$

Estimate the shearing resistance of the silt on a horizontal plane, (a) when the shear stress builds up rapidly and (b) when the shear stress builds up very slowly.

b) An embankment is being built of a soil whose effective stress shear strength parameters are: $c' = 100$ kN/m² and $\varphi' = 20°$; unit weight is equal to 17 kN/m². The pore pressure parameters A and B as determined by the triaxial shear tests are 0.6 and 0.8 respectively. The height of the embankment has just been raised from 5 m to 8 m. Determine the shear strength of the soil at the base of the embankment. It can be assumed that the dissipation of pore-pressure during this stage of the construction is negligible and the lateral pressure at any point is one-half of the vertical pressure. (5+5=10 marks)

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Q. 5 The soil profile (Fig. 1) at a building site consists of dense sand up to 2 m depth, normally loaded soft clay from 2 m to 6 m depth, and stiff impervious rock below 6 m depth. The ground-water table is at 0.40 m depth below ground level. The sand has a density of 18.5 kN/m^3 above water table and 19 kN/m^3 below it. For the clay, natural water content is 50%, liquid limit is 65% and grain specific gravity is 2.65. Calculate the probable ultimate settlement resulting from a uniformly distributed surface load of 40 kN/m^2 applied over an extensive area of the site. 10 marks

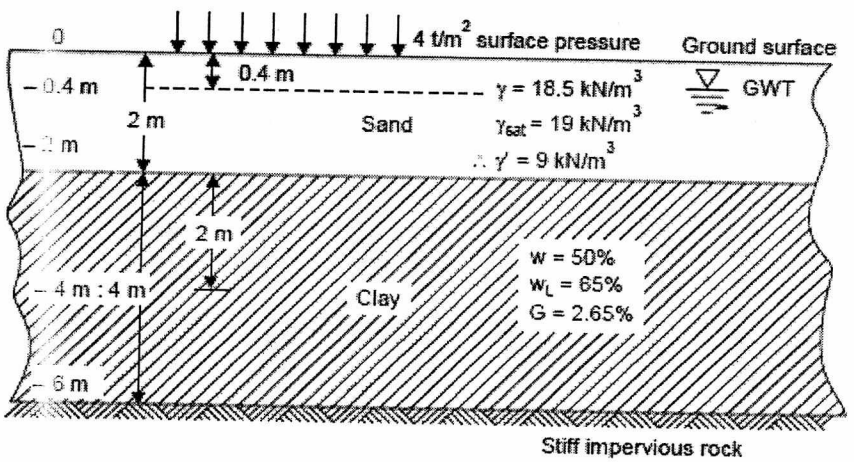

Fig. 1

Q. 6 A Rectangular foundation 3m x 1.5m carries a uniform load of 40 kPa. Determine the vertical stress at point P which is 3 m below the ground surface (Fig. 2). Use equivalent point load method. 5 marks

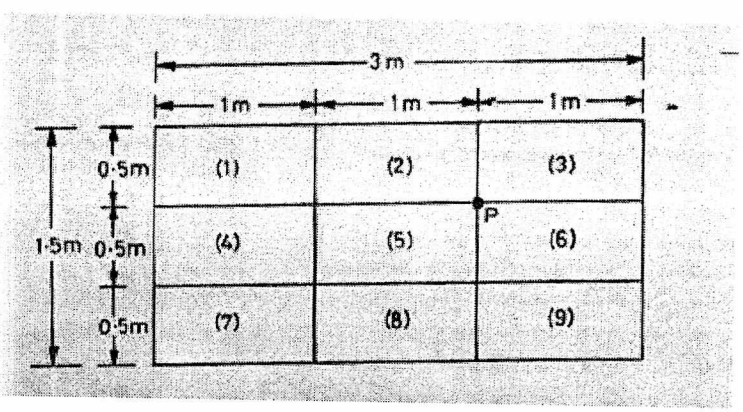

Fig. 2