INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR

M.E. (Civil) 2nd Semester Examination, 2014

Sub: Advanced Soil Mechanics – II (CE – 1009)

Full Marks: 70 Times: 3 Hours

Answer any **Four** questions

Assume reasonable data not supplied

Q.1.(a) Write short notes on: ( i ) Method of construction of sand drain; ( iii ) Normally consolidated clay and Over consolidated clay; ( iii ) Creep and Relaxation, (iv) High strain dynamic testing of deep foundation.

(b) Explain the three basic rheological models with neat sketches.

$\left[3\times4+5\frac{1}{2}=17\frac{1}{2}\right]$

Q.2. Enumerate the assumptions for one dimensional consolidation and then deduce the basic differential equation for one dimensional consolidation. Also write equations for 3 – D consolidations.

$\left[17\frac{1}{2}\right]$

Q.3 (a) Explain with neat sketches the several possible types of variation for $u_i$ ( pore water pressure ) with depth of clay layer undergo consolidation and also write down the relationship for $u_i$ and boundary conditions.

(b) The results of oedometer test on normally consolidated clay are given below (Two way drainage):

| $\sigma$, lb/ft$^2$ | e |
|---|---|
| 1000 | 1.01 |
| 2000 | 0.90 |

The time for 50 % consolidation for the load increment from 1000 to 2000 lb/ft$^2$ was 12 min, and the average thickness of sample was 0.95 in. Determine the coefficient of permeability and the compression index.

(c) Undisturbed samples were collected from a 3 m thick clay stratum, which lies between two sand strata. A laboratory consolidation test performed on a 2.5 cm thick sample of the clay. During the test, water was allowed to drain out only through the top of the sample. The time required for 50 % consolidation was found to be 35 minutes. Determine the time required for 60 % and 90 % consolidation in the field.

$\left[10+2\frac{1}{2}+5=17\frac{1}{2}\right]$

Q.4 (a) Explain with neat sketches the block vibration test. How do you determine the coefficient of elastic uniform compression and damping coefficient of the test?

( b ) The following data refers to a vertical resonance test carried out on a 1.5 × 0.75 × 0.70 m high concrete block for estimating dynamic elastic constants for the design of a forge hammer foundation:

| f ( cps) | 20 | 25 | 30 | 35 | 40 | 24 | 26 | 45 |
|---|---|---|---|---|---|---|---|---|
| Amp. (mm) | 0.018 | 0.030 | 0.068 | 0.120 | 0.138 | 0.22 | 0.18 | 0.130 |

The test was carried out at a depth of 6 m below the ground surface. The soil ta the site was clay of low to intermediate compressibility. The weight of oscillator motor is 2.1 kN. Draw the amplitude-frequency plot and determine the value of $C_u$ , $C_\tau$ , $C_\phi$ for 10 m$^2$ base area. If the weight of the block and oscillator assembly is 22 kN and maximum dynamic force of oscillator (eccentricity $\phi$ = 140$^0$ ) at 50 Hz frequency is 5.0 kN. Determine the damping factor.

$\left[10+7\frac{1}{2}=17\frac{1}{2}\right]$

Q.5(a).The water table in a lake has been lowered by 20 m. Will this cause consolidation settlement of the lake- bed sediments? Explain.

(b) The dial readings recorded during the consolidation test at a certain load increment are given below.

| Time (min) | 0 | 0.10 | 0.25 | 0.50 | 1 | 2 | 4 | 8 | 15 | 30 | 60 | 120 | 240 | 1200 | 1620 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dial Reading ($cm \times 10^{-4}$) | 240 | 318 | 340 | 360 | 385 | 415 | 464 | 530 | 622 | 738 | 842 | 930 | 975 | 1070 | 1090 |

Determine $C_v$ by the all available methods and compare the values of $C_v$.

$\left[1\frac{1}{2}+16=17\frac{1}{2}\right]$

Q.6. Undrained triaxial test on bluish clay was conducted. Sample size was 38 mm diameter and 76 mm height. L.C. of strain dial : 0.025 mm / div. and L.C. of proving ring dial constant : 2.83 N /div.

| Strain dial reading | $\sigma_3$=70 kPa | $\sigma_3$=140 kPa | $\sigma_3$=210 kPa |
|---|---|---|---|
| | Proving ring dial reading | Proving ring dial reading | Proving ring dial reading |
| 0 | 0 | 0 | 0 |
| 10 | 5.0 | 6 | 7 |
| 20 | 9.2 | 11.5 | 15 |
| 40 | 11.5 | 15.0 | 20.8 |
| 60 | 12.5 | 17.4 | 23.7 |
| 80 | 13.5 | 18.5 | 25.5 |
| 100 | 14.2 | 19.7 | 26.5 |
| 140 | 15.6 | 21.2 | 28.2 |
| 180 | 17.4 | 22.4 | 30.4 |
| 200 | 18.5 | 23.1 | 31.6 |
| 250 | 16.0 | 25.4 | 32.4 |
| 300 | - | 27.4 | 33.9 |
| 350 | - | 28.0 | 35.2 |
| 400 | - | 27.0 | 36.0 |
| 450 | - | - | 36.5 |
| 500 | - | - | 38.5 |
| 550 | - | - | 38.0 |

(i) Plot the stress strain curve in normal condition and also transform stress strain curve.
( ii ) Determine the initial tangent modulus ( Ei ) and $(\sigma_1 - \sigma_3)_{ult}$ from both the plot.
( iii) Determine the secant modulus at 2 % and 5 % strain.
(iv ) Determine the tangent modulus at S = 0.8.

$\left[17\frac{1}{2}\right]$

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