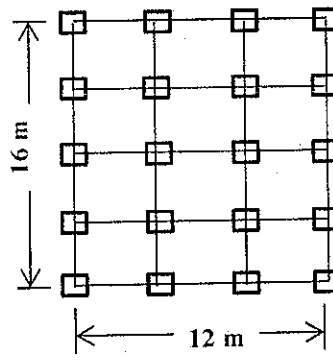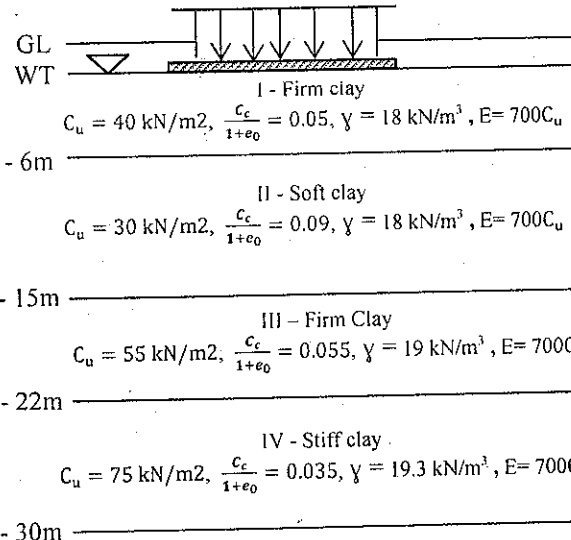# BACHELOR OF ENGINEERING (CIVIL ENGINEERING)
FOURTH YEAR SECOND SEMESTER EXAM - 2019
DESIGN OF FOUNDATION

Time: Three Hours

Full Marks 100

Q. No.	(Answer Any Four Questions.) [Students are allowed to carry IS 2911, IS 6403 and IS 8009 (Part-I)] [Assume any data reasonably if necessary]	Marks
1. (a)	Write a short note on 'plate load test'.	[6]
(b)	The following data was obtained from a plate load test carried out on a 60cm square test plate at a depth of 2m below ground surface on a sandy soil which extends up to a large depth. Plot load-settlement curve and determine the settlement of a foundation 3.0m x 3.0m carrying a load of 110t and located at a depth of 3m below ground surface.	[9]

Load test data:

Load Intensity (kg/cm^2)	0	0.5	1	1.5	2	2.5	3	3.5	4
Settlement (mm)	0	2	4	7	11	16	23	32	45

[Water table is located at a large depth from the ground surface]

(c)	Write short notes on: (i) Buisman's method for settlement calculation and (ii) Differential settlement	[5 +5]
2.	Design a raft foundation for the building shown in Figure below:	

16 m

12 m

[Inner Columns = 750 kN each]
Outer Columns = 600 kN each]

GL
WT

I - Firm clay
$C_u = 40$ kN/m2, $\frac{C_c}{1+e_0} = 0.05$, $\gamma = 18$ kN/m^3, E= 700C_u

- 6m

II - Soft clay
$C_u = 30$ kN/m2, $\frac{C_c}{1+e_0} = 0.09$, $\gamma = 18$ kN/m^3, E= 700C_u

- 15m

III – Firm Clay
$C_u = 55$ kN/m2, $\frac{C_c}{1+e_0} = 0.055$, $\gamma = 19$ kN/m^3, E= 700C_u

- 22m

IV - Stiff clay
$C_u = 75$ kN/m2, $\frac{C_c}{1+e_0} = 0.035$, $\gamma = 19.3$ kN/m^3, E= 700C_u

- 30m

[25]

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3.	A multistoreyed building is to be constructed at a site whose subsoil profile and properties are shown in the following figure. Pile foundation will be provided with a cut-off level at 1.5m below G.L. Compute the safe compressive and uplift load carrying capacity of 20m long bored piles of 500mm, 600mm and 700mm diameter. [Assume water table at ground level.]	[25]

```
0 m  ┌─────────────────────────────────────────────┐
     │        Filled up soil    Υ = 1.45 t/m³       │
1.3m ├─────────────────────────────────────────────┤
     │ Medium stiff, light yellowish/Brownish Grey   │
     │ silty clay  Υ = 1.7 t/m³,  Cu = 3.1 t/m²      │
6.0m ├─────────────────────────────────────────────┤
     │                                               │
     │ Loose, whitish grey silty fine sand           │
     │          Υ = 1.75 t/m³,  φ = 26°              │
14.5m├─────────────────────────────────────────────┤
     │                                               │
     │ Dense to very dense, whitish grey silty fine  │
     │ sand    Υ = 1.75 t/m³,  φ = 32°               │
25m  └─────────────────────────────────────────────┘
```

4. (a)	Discuss how you will determine the settlement of pile group in clay.	[6]
(b)	Determine the settlement of pile group for the soil profile given below: [Take: Length of Pile = 10m, Pile Dia = 600mm and Load acting on pile group = 600kN]	[10]

```
 1.5m   1.5m
├────┼────┤
 ⊕   ⊕   ⊕  ↑
            │ 1.5m
 ⊕   ⊕   ⊕  ×
            │ 1.5m
 ⊕   ⊕   ⊕  ↓
```

```
0m  ┌─────────────────────────────────┐
    │░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░│
    │            NC Clay               │
    │                                  │
    │      Υ_sat = 19 kN/m3            │
    │        C_c                       │
    │      ────── = 0.05               │
    │       1 + e_0                     │
    │                                  │
13m ├─────────────────────────────────┤
    │          Hard Stratum            │
    └─────────────────────────────────┘
```

$\gamma_{sat} = 19 \ kN/m3$

$\dfrac{C_c}{1 + e_0} = 0.05$
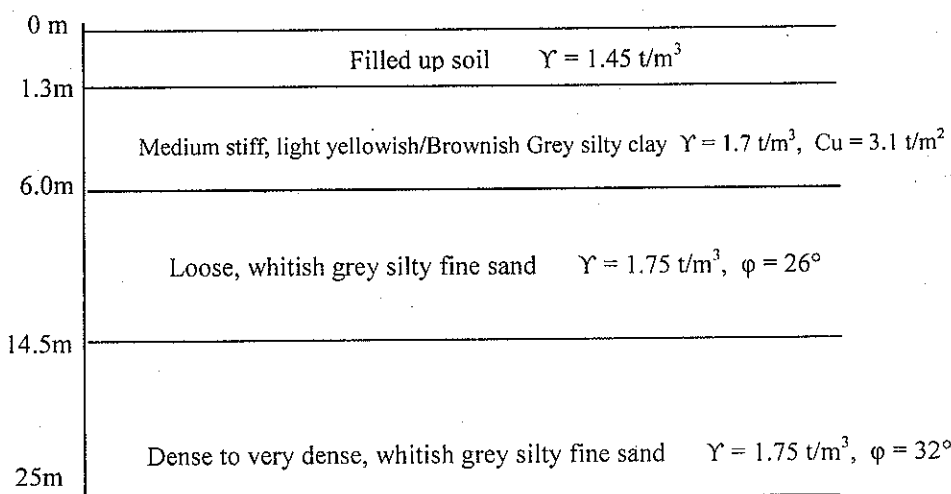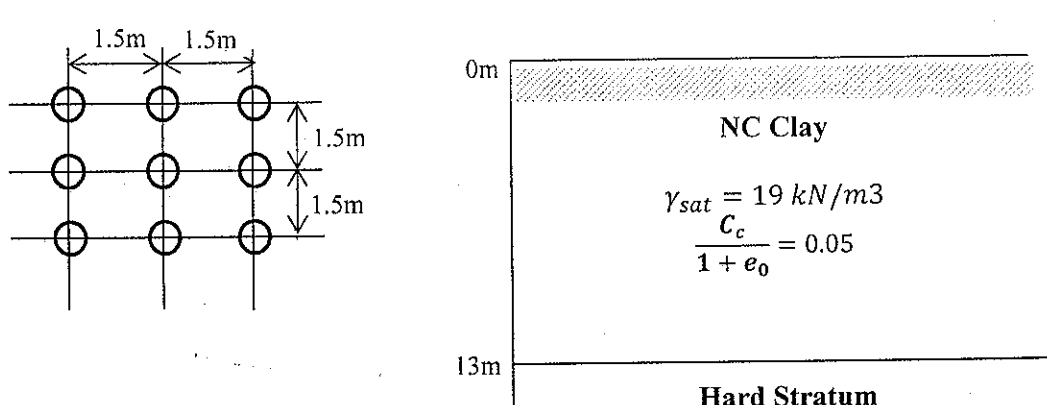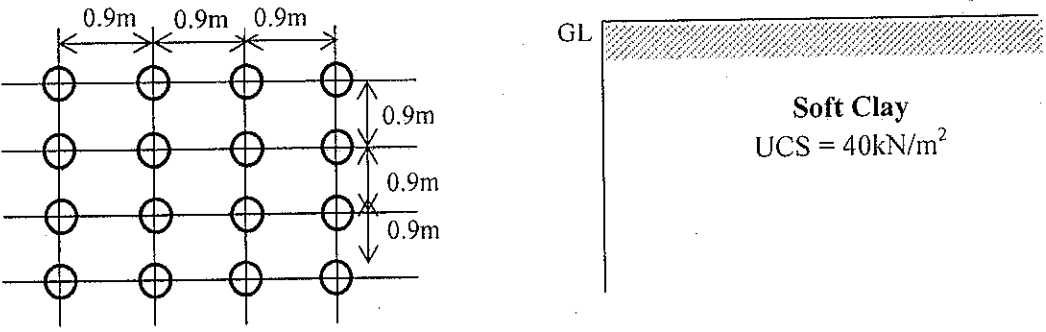
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Q. No.	(Answer Any Four Questions.) [Students are allowed to carry IS 2911, IS 6403 and IS 8009 (Part-I)] [Assume any data reasonably if necessary]	Marks
(c)	What do you understand by Initial and Routing load tests of pile?	[4]
(d)	Write different criteria for calculating allowable load on single pile and pile group from a pile load test as per IS: 2911(Part IV)	[5]
5.(a)	A symmetrical 16 pile group in soft clay, with unconfined compressive strength of 40 kN/m^2, is to be used as foundation for a column. The piles are 300mm in dia and 10m long and arranged at a square pattern as follows. Determine the maximum load the group can carry with the piles failing (i) Individually and (ii) as a block. 	[12]
(b)	Write down the principle of dynamic pile formulae in estimating pile capacity. Discuss ENR formula in details in this regard.	[3+10]