U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January 2024 Semester End Main Examinations

Programme: B.E. **Semester: VII**
Branch: Civil Engineering **Duration: 3 hrs.**
Course Code: 21CV7PEAFD **Max Marks: 100**
Course: Advanced Foundation Design

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of IS 6403, IS 8009, IS 2911 and IRC 78 allowed

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	***CO***	***PO***	**Marks**
1	a)	With neat illustrations list and explain briefly the different types of shallow foundations indicating the situation under which each one is provided.		*CO1*	*PO3 & 2*	**10**
	b)	A square footing is required to carry a load of 800kN. The footing is located at a depth of 1.5m below the ground surface. The properties of the soil are G=2.7, e=0.4, c=20kN/m^2, ϕ=25^o. Assume ground water table is at the ground surface. Design the plan dimensions of the footing FS=2. Adopt Terzaghi's analysis $N_c=(N_q-1)\cot\phi$ $N_q=e^{\pi\tan\phi}\tan^2(45+\phi/2)$ $N_\gamma=(N_q-1)\tan(1.4\phi)$		*CO1*	*PO3 & 2*	**10**
		OR				
2	a)	List and briefly explain the basic requirements for a satisfactory shallow foundation		*CO1*	*PO3 & 2*	**06**
	b)	A rectangular footing, with a plan area of 1.4m x 2m is to be placed at a depth of 2m below the ground surface. The footing would be subjected to a load inclined at 10^0 to the vertical. The subsoil is clayey, sandy silt with saturated unit weight of 18kN/m^3 and c=10kN/m^2 and ϕ=30. Assuming the rate of loading is such that drained condition prevails, compute the magnitude of load the footing can carry if the water table is at the base of the footing. Use IS 6403 recommendations and take FS=3 Additionally, What will be the safe load if undrained condition prevails? Take Cu=30kN/m^2, ϕ=0, Nc=5.14, Nq=1 and N_γ=0.		*CO1*	*PO3 & 2*	**14**
		UNIT - II				
3	a)	Proportion a rectangular combined footing for uniform pressure under deadload plus reduced live load, the following data:		*CO1*	*PO3 & 2*	**10**

			Allowable soil pressures: 150 kN/m^2 for *DL* + reduced *LL* 225 kN/m^2 for *DL* + *LL* Column loads / Column A (kN) / Column B (kN) DL / 540 / 690 LL / 400 / 810 Distance c/c of columns = 5.4 m Projection of footing beyond Column *A* = 0.5 m			
		b)	A footing 2m square rests on soft clay soil with its base at a depth of 1.5m from ground surface. The clay stratum is 3.5m thick and is underlain by a firm sand stratum. The clay soil has the following properties. w_L=30%, w_n=40%, G=2.7, ϕ_u=0, c_u=0.5kg/cm^2. It is known that the clay stratum is normally consolidated. Using Skempton's equation, determine the net safe bearing capacity of the footing. Compute the settlement that would result if this load intensity were allowed to act on the footing. Natural water table is quite close to the ground surface	*CO1*	*PO3 & 2*	**10**
			UNIT - III			
	4	a)	A group of 9 piles arranged in a square pattern with diameter and length of each pile as 25cm and 10m respectively, is used as a foundation in soft clay deposit. Taking the unconfined compressive strength of clay as 120kN/m^2 and the pile spacing as 100cm centre to centre, find the load carrying capacity of the group by considering both individual and group action . Assume the bearing capacity factor N_c=9 and adhesion factor = 0.75. A factor of safety of 2.5 may be taken.	*CO2*	*PO1&2*	**12**
		b)	Explain pile integrity test	*CO2*	*PO1&2*	**08**
			OR			
	5	a)	Find the uplift capacity of the pile embedded in a sandy strata Given: Dia = 0.4m, Length = 20m, Depth of GWT = 2m from surface, γ_{sat} = 19.5kN/m^3, γ_b= 18kN/m^3, γ_w=10kN/m^3, γ_{conc} = 24kN/m^3, $\phi=\delta=38^o$, D_c = 14.5B, K=2.3	*CO2*	*PO1&2*	**10**
		b)	Enumerate the term negative skin friction and methods of reducing the same.	*CO2*	*PO1&2*	**06**
		c)	List any four circumstances when a pile foundation is provided.	*CO2*	*PO1&2*	**04**
			UNIT - IV			
	6	a)	A concrete pile 0.3m x 0.3m and 5m long is subjected to a horizontal load of 5kN and moment of 4 kN-m at the ground level. Taking k'= 2 x 10^4 kN/m^3, calculate the maximum BM and deflection if a) the head of the pile is considered to be free b) b) when the head is fixed with no external moment.	*CO2*	*PO1&2*	**20**

			The value of E = 3 x 10^7 kN/m^2. Use Reese and Matlock method. Refer the table for non dimensional coefficients for laterally loaded pile			
			UNIT - V			
	7	a)	Define swelling pressure and enumerate its influence on soils. Describe briefly the method of determining the same in the laboratory.	*CO3*	*PO1,2*	**06**
		b)	Briefly enumerate the methods adopted to minimize the potential damage caused by an expansive soil on a structure	*CO3*	*PO1,2*	**08**
		c)	Explain the concept of a CNS layer	*CO3*	*PO1,2*	**06**

Table 1 (**For Q 6b**) Non dimensional coefficients for laterally loaded pile (Reese and Matlock)

Z	A_y	A_s	A_m	A_v	A_p
0.0	2.435	– 1.623	0.000	1.000	0.000
0.1	2.273	– 1.618	0.100	0.989	– 0.227
0.2	2.112	– 1.603	0.198	0.956	– 0.422
0.3	1.952	– 1.578	0.291	0.906	– 0.586
0.4	1.796	– 1.545	0.379	0.840	– 0.718
0.5	1.644	– 1.503	0.459	0.764	– 0.822
0.6	1.496	– 1.454	0.532	0.677	– 0.897
0.7	1.353	– 1.397	0.595	0.585	– 0.947
0.8	1.216	– 1.335	0.649	0.489	– 0.973
0.9	1.086	– 1.268	0.693	0.392	– 0.977
1.0	0.962	– 1.197	0.727	0.295	– 0.962
1.2	0.738	– 1.047	0.767	0.109	– 0.885
1.4	0.544	– 0.893	0.772	– 0.056	– 0.761
1.6	0.381	– 0.741	0.746	– 0.193	– 0.609
1.8	0.247	– 0.596	0.696	– 0.298	– 0.445
2.0	0.142	– 0.464	0.628	– 0.371	– 0.283
3.0	– 0.075	– 0.040	0.225	– 0.349	0.226
4.0	– 0.050	0.052	0.000	– 0.106	0.201
5.0	– 0.009	0.025	– 0.033	0.013	0.046

Z	B_y	B_s	B_m	B_v	B_p
0.0	1.623	– 1.750	1.000	0.000	0.000
0.1	1.453	– 1.650	1.000	– 0.007	– 0.145
0.2	1.293	– 1.550	0.999	– 0.028	– 0.259
0.3	1.143	– 1.450	0.994	– 0.058	– 0.343
0.4	1.003	– 1.351	0.987	– 0.095	– 0.401
0.5	0.873	– 1.253	0.976	– 0.137	– 0.436
0.6	0.752	– 1.156	0.960	– 0.181	– 0.451
0.7	0.642	– 1.061	0.939	– 0.226	– 0.449
0.8	0.540	– 0.968	0.914	– 0.270	– 0.432
0.9	0.448	– 0.878	0.885	– 0.312	– 0.403
1.0	0.364	– 0.792	0.852	– 0.350	– 0.364
1.2	0.223	– 0.629	0.775	– 0.414	– 0.268
1.4	0.112	– 0.482	0.688	– 0.456	– 0.157
1.6	0.029	– 0.354	0.594	– 0.477	– 0.047
1.8	–0.030	– 0.245	0.498	– 0.476	– 0.054
2.0	–0.070	– 0.155	0.404	– 0.456	– 0.140
3.0	–0.089	0.057	0.059	– 0.213	0.268
4.0	–0.028	0.049	–0.042	0.017	0.112
5.0	–0.000	0.011	–0.026	0.029	– 0.002

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