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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

I SEMESTER M.TECH. (STRUCTURAL ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL/MAY 2024-25

SUBJECT: ADVANCED FOUNDATION ENGINEERING **[CIE – 5419]**

(/ 05 /2024)

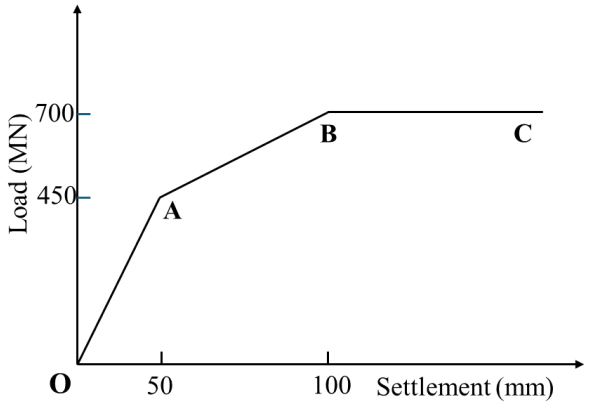
Time: 3 Hours MAX. MARKS: 50

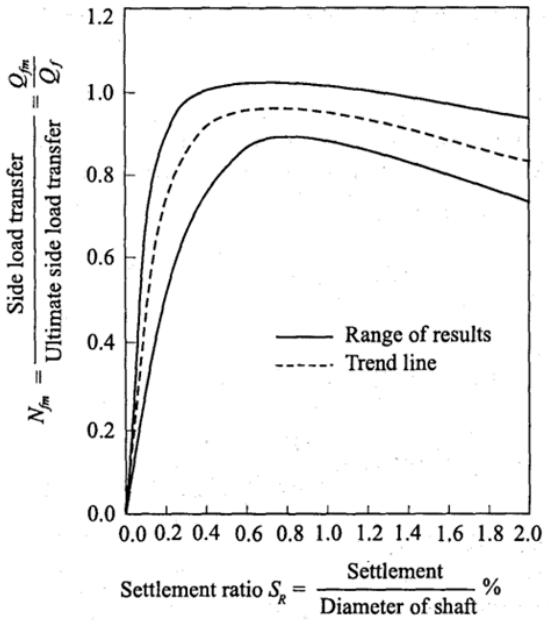
Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data, if any, may be suitably assumed.

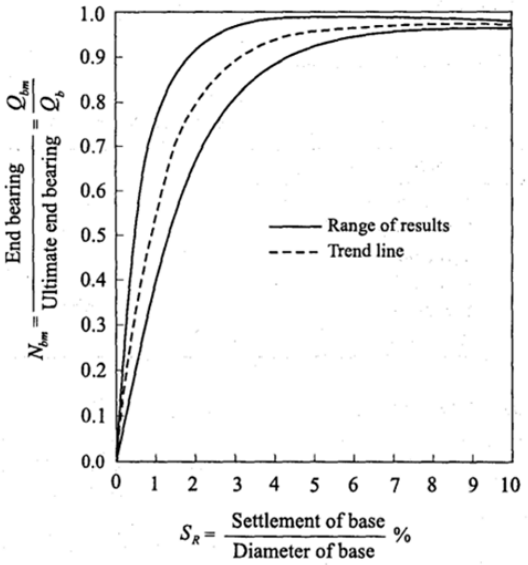
Q No		Marks	CO	BT
1A	Estimate the settlement of a flexible circular foundation of diameter 2m, and the vertical displacement of a point located below the center of the foundation at a depth of 5m. The soil has properties υ =0.45 and E=10.5MPa. The axial load is 1200 kN.	03	CO1	5
1B	Explain the methods used to determine the settlement of shallow foundations using Cone Penetration Test (CPT) data in cohesionless soil.	02	CO1	4
1C	Estimate the skin friction resistance, end bearing resistance, ultimate load, and allowable bearing capacity for a pile driven into a sand layer (ϕ=36°) using critical length parameter. The pile has a diameter of 300mm and a length of 12m. The unit weight of soil is 18 kN/m^3, N_q is 51, and FOS 2.5.	05	CO2	,5
2A	A Caisson foundation, having an outer diameter of 5m and a stening thickness of 0.75m, is positioned at a depth of 12m in uniform sand. The sand exhibits an angle of shearing resistance of 30° and a submerged unit weight of 1.0 t/m^3. The well encounters a resultant horizontal force of 50 tons and a total moment of 500 ton-m at the scour level. Assuming the well is light, Evaluate the permissible total equivalent resisting force due to earth pressure, with a factor of safety (FOS) of 2 for soil. Take K_a=0.33, K_p=3.	03	CO3	5
2B	Illustrate any one of the Block vibration tests with neat sketch	02	CO4	4
2C	Illustrate the equation for critical damping in forced vibration using a single degree of freedom system.	05		4
3A	A vertical test was conducted on a concrete block measuring 1.5m x 0.75m x 0.70m (height) to estimate the dynamic elastic constant for designing a machine foundation. The test was performed at a depth of 5m below the ground surface in clay soil with low to intermediate compressibility. The weight of the oscillator motor used in the test was 2.6 kN. Determine the values of $\mathbf{C_u}$, $\mathbf{C_\tau}$, and $\mathbf{C_\phi}$ for a base area of 10 m^2. If the weight of block and oscillator assembly is 25 kN and maximum dynamic force of oscillator at 50 Hz is 6 kN , evaluate the damping factor.	05	CO4	4,5

P.T.O.

	Note: The amplitude of vibration block is 0.15mm at natural frequency of 45 cps and density of concrete 24 kN/m^3.			
3B	A straight shaft drilled pier is built in homogenous loose to medium dense sand. The pile and soil characteristics are as follows pile length-24m, diameter-1.45m, friction angle-35°, N_q -30, and soil unit weight-18.5 kN/m^3. Estimate, the ultimate load capacity and the allowable load with a factor of safety of 2.5. Take, the average SPT value N_{cor} =30 for friction angle of 35°. Use (i) Meyerhof's method (SPT value for bored piles) (ii) O'Neill and Reese Method	**05**	**CO5**	**5**
4A	An apartment building is to be constructed in stiff to very stiff clay. The soil is homogenous to a great depth. The average value of undrained shear strength is 180 kN/m^2 and α=0.55. It is proposed to use a drilled pier of length 30m and 1.8m diameter. Evaluate (a) ultimate load capacity of the pier, and (b) the allowable load on the pier with FOS 2.5. (c) the allowable load for a settlement of 10 mm.	**05**	**CO5**	**5**
4B	The simplified trilinear load-settlement plot of a piled raft is shown in the Figure. The piles are designed to be utilized to their full capacity. (a) What are the values of K_{pr} and K_r used in this simplified model? (b) What is the settlement when the piles reach their full capacity? (c) Evaluate the pile raft interaction factor. (d) Evaluate the load shared by the raft and piles by using Clancy and Randolph method. K_p=800 MN/m, P_t= 15 MN 	**05**	**CO5**	**5**
5A	Estimate the relative proportion of the load carried by the pile raft X and the stiffness of the piled raft K_{pr}. Using, K_p= 2500 MN/m, K_r= 800 MN/m, and α_{rp}, = 0.75.	**03**	**CO5**	**5**
5B	Illustrate the Poulos-Davis Randolph Simplified design method.	**02**		**4**
5C	Illustrate the step-by-step design procedure for determining the stress resultant under normal soil pressure for a *hyperbolic paraboloidal* type shell foundation according to IS code specifications.	**05**	**CO5**	**4**



Normalized side load transfer for drilled shaft in cohesive soil (O'Neill and Reese, 1999)



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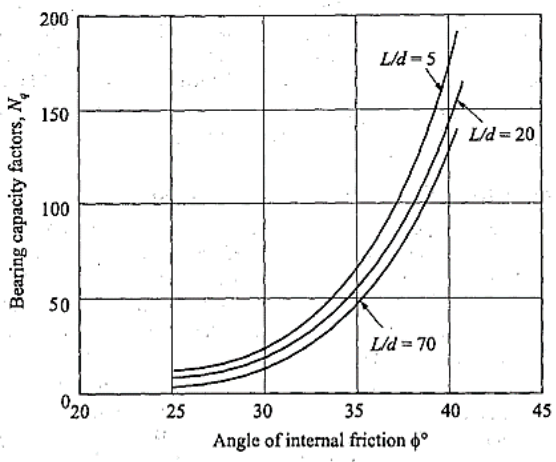

Berezantsev's bearing capacity factor, N_q (after Tomlinson, 1986)