[This question paper contains 10 printed pages.]

Your Roll No. .....

3165 **J**

MEC

Paper—CE.604

FOUNDATION ENGINEERING

Time : 3 *Hours* *Maximum Marks* : 100

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. **1** *is compulsory.*

Answer any ***four*** *questions out of the remaining.*

You can use design charts and graphs provided alongwith the question paper.

Any other data, if missing, can be assumed suitably.

1. (a) Explain some laboratary and field methods to determine deformation modulus of soils. 5½

   (b) How the bearing capacity of a pile-group in cohesive soils can be calculated. Explain. 5½

   (c) Explain Brom's method to calculate ultimate lateral load capacity of long piles. 5½

   (d) What is pressure-bulb concept in the vibrating soil-foundation system. Explain its use. 5½

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(e) What are various elastic coefficients and spring constants for various modes of vibrations of soil-foundation systems? How they are determined? 5½

(f) What is damping and damping factor? How are these determined experimentaly? 5½

(g) Write various commonly used dynamic pile formulae to calculate pile capacities. What are their limitations? 5½

(h) Explain Pauw's analogy of foundation-soil system for vertical vibrations. How natural frequency and amplitude of motion will be calculated by using this analogy. 5½

2. A square footing is 1.5 m × 1.5 m with a 0.3 m × 0.3 m square column. It is loaded with an axial load of 1500 kH and moment about x-axis of 400 kHm and about y-axis of 300 kHm. Undrained soil properties are ϕ = 40° and c = 15 kPa. The footing is placed at a depth of 1.5 m. The unit weight of soil is 19 kH/m^3. The water table is at a depth of 6 m from the ground surface. Calculate the ultimate soil pressure by using Hansen bearing capacity equation. 14

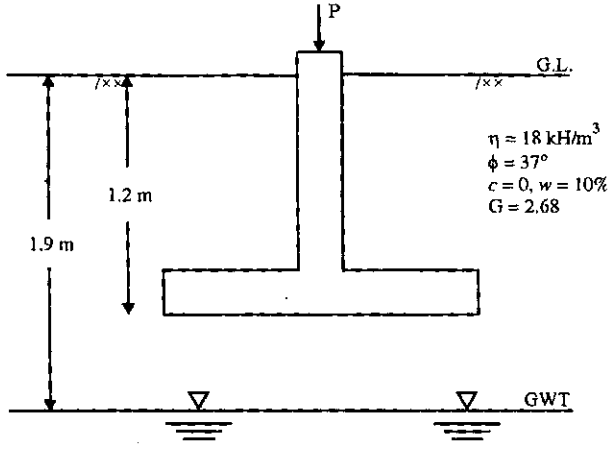
3. A vertical bored-cast-in-situ pile 900 mm in diameter carrying a centrally applied load of 1200 kH is installed to a depth of 6 m in a stiff over consolidated clay having undrained cohesion of 140 kH/m^2 and drained shear

strength parameters of $c' = 10$ kH/m^2 and $\phi' = 30°$. A sustained horizontal load on pile is applied at a point 4 m above the ground level. Find :

(i) The magnitude of ultimate horizontal load from consideration of short-term and long-term stability.

(ii) The allowable horizontal load which limits the lateral deflection at ground level to 25 mm. 14

4. A square footing is shown in the figure given below :



Compute the allowable bearing capacity using Vesic equation and factor of safety of 2.0. Would you recommend such an allowable bearing capacity, comment ? 14

5. Design a suitable foundation for a double-acting steam hammer for the following data :

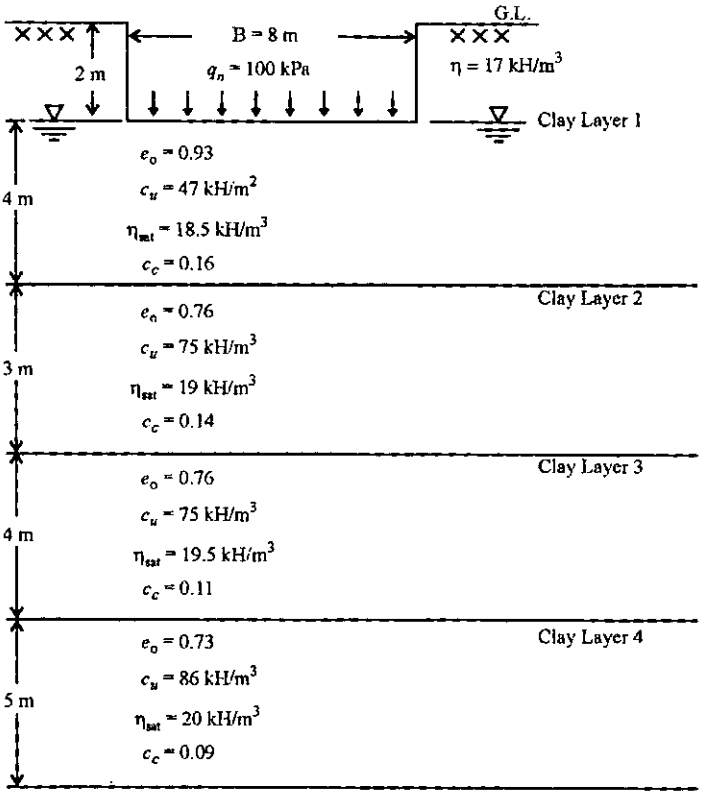
Weight of tup	= 40 kH
Height of fall	= 1000 mm
Area of piston	= 0.2 m^2
Steam pressure on piston	= 800 kH/m^2
Safe bearing capacity of soil under static loading conditions	= 200 kH/m^2
Coefficient of elastic uniform compression of soil	= 5×10^4 kH/m^3
Base area of anvil (and also that of elastic pad)	= 5.0 m^2
Thickness of elastic pad	= 0.60 m
Modulus of elasticity of the material of the pad	= 5×10^5 kH/m^2
Coefficient of restitution	= 0.5
Unit weitght of soil	= 17 kH/m^3 14

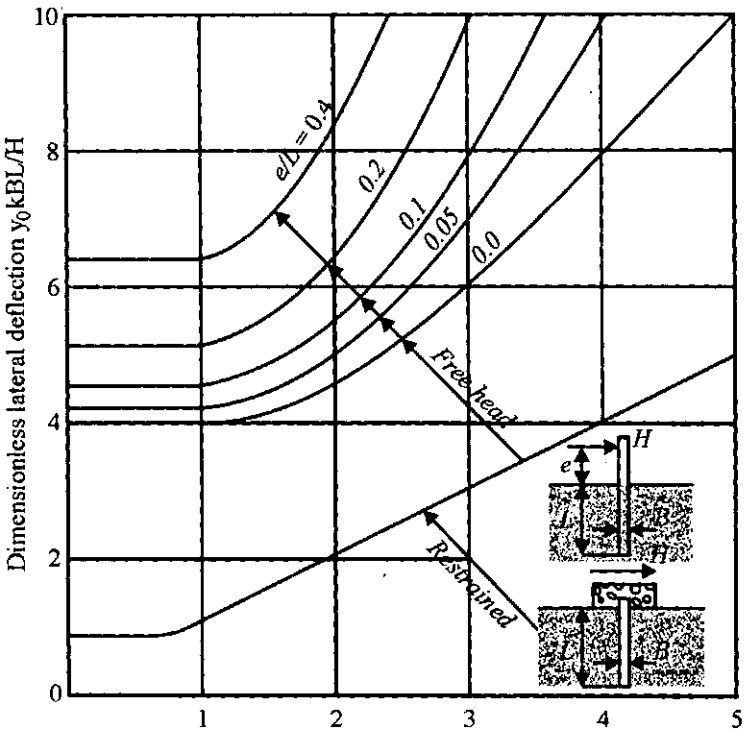
6. It is proposed to construct an over head tank at a site on a raft foundation of size 8 m × 12 m, with the footing at a depth of 2 m below ground level. The soil exploration conducted at the site indicate that the soil upto a depth of 18 m is normally consolidated in sensitive clay with the water table at 2m below ground level; the foundation

along with soil properties is shown in the figure given below. Calculate for the raft foundation :

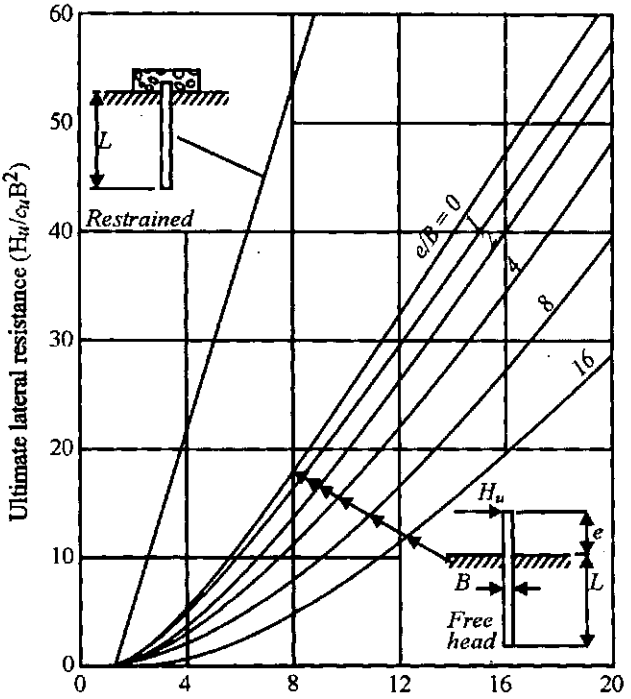
(i) Immediate settlement

(ii) Consolidation settlement 14



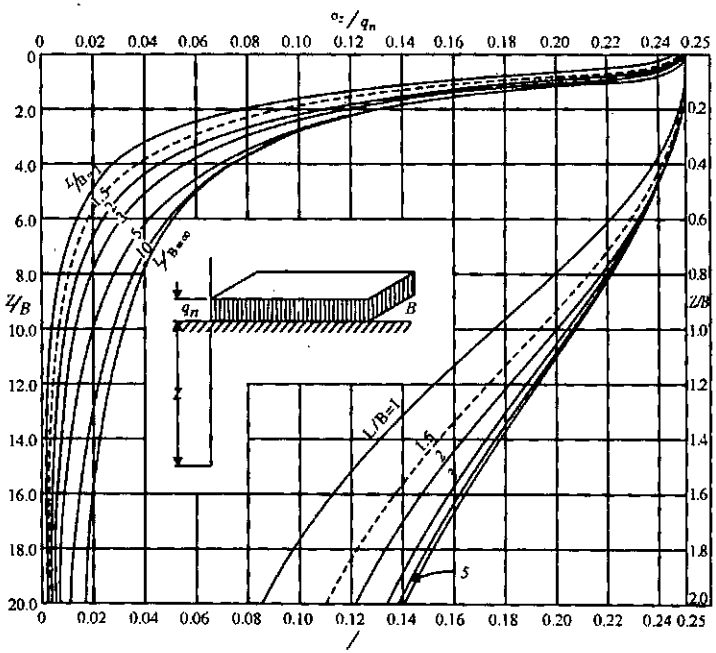


Charts for calculating lateral deflection at ground surface of horizontally loaded pile in cohesive soil (after Broms[6.7])

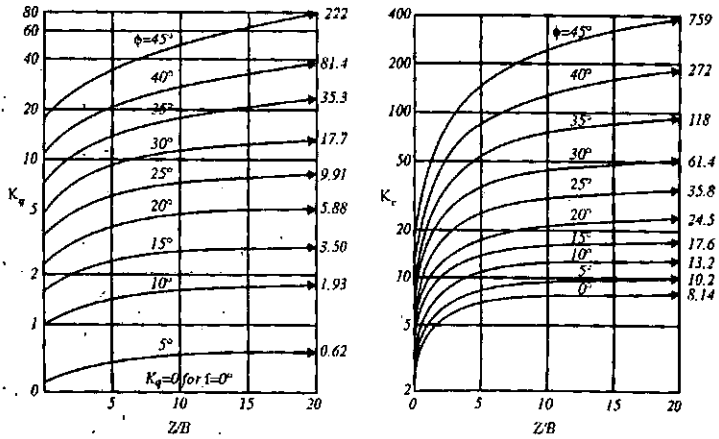


Embedment length L/B

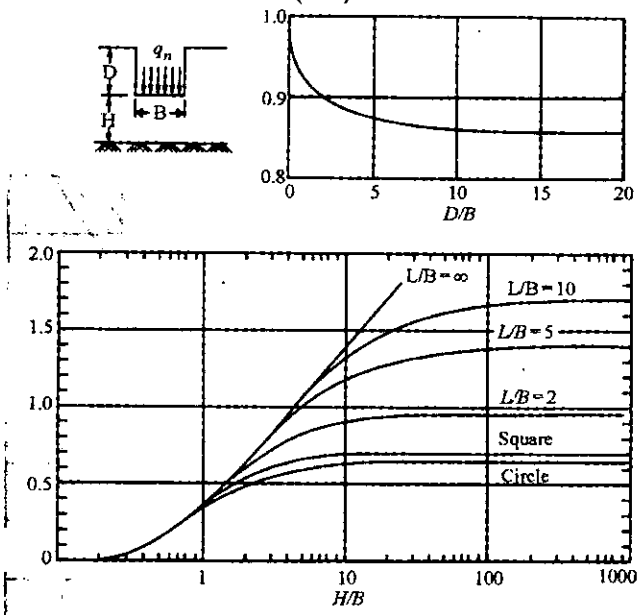
Ultimate lateral resistance of short pile in cohesive soil related to embedded length (after Broms[6.7])



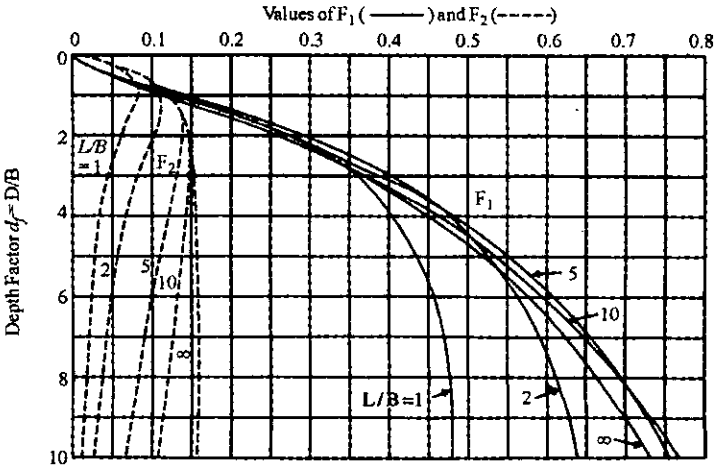
Stress distribution beneath flexible rectangular foundation



Brinch Hansen's coefficients K_q and K_c



Factors for calculating settlement (after Janbu, Bjerrum & Kjaernsli; Modified by Christian and Carrier, 1978)



Factors for estimating settlement (Steinbrenner, 1934)

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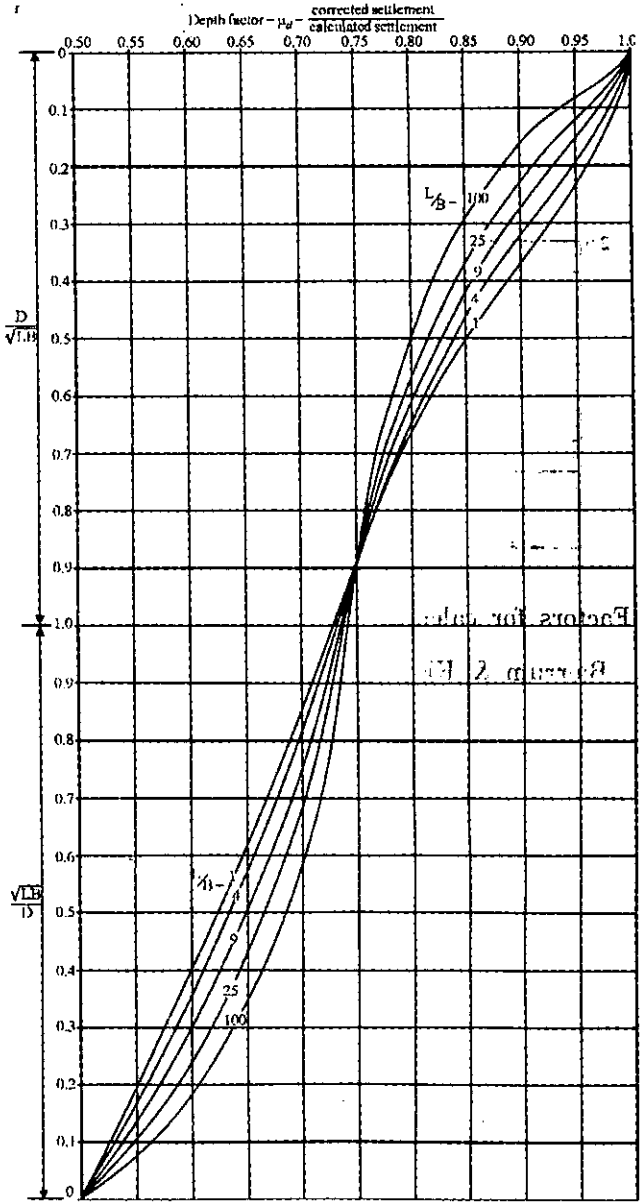

Depth factor μ_d for calculating oedometer settlements (after Fox[5.3])