國立成功大學
111學年度碩士班招生考試試題

編　號：98

系　所：土木工程學系

科　目：基礎工程

日　期：0219

節　次：第 1 節

備　註：可使用計算機

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※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. For the gravity retaining wall (γ_{concrete} = 24 kN/m^3) as shown in Fig 1, give the following data.

   Wall dimensions:

   H = 7 m, D = 1 m, $x_1 = x_2 = x_3 = x_4 = x_5 = x_6$ = 1 m

   Soil properties:

   γ_1 = 17 kN/m^3, ϕ_1'= 30°, c_1'= 0;

   γ_2 = 18 kN/m^3, ϕ_2'= 25°, c_2' = 20 kN/m^2.

   Answer the following questions (45%).

   (1) Calculate the Rankine active force per unit length of the wall (with the simplified assumption for design). (10%)

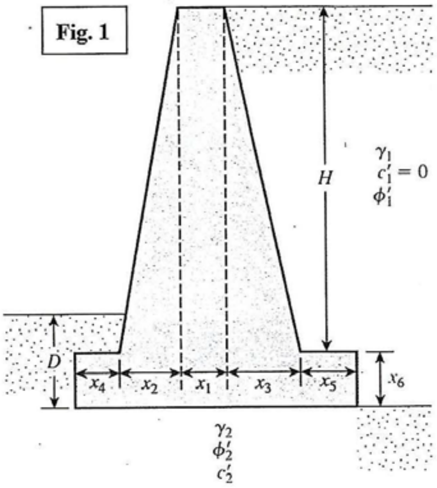
   (2) Following (1), Calculate the corresponding overturning moment about the toe. (5%)

   (3) Following (2), Calculate the factor of safety against overturning (neglect the passive force in front of the wall$_p$). (10%)

   (4) Following (1), calculate the factor of safety against sliding (neglect the passive force in front of the wall). (10%)
   [friction angle between the soil and the base $\delta' = (1/2)\phi'$
   adhesion between the soil and the base $c_a' = (1/2)c'$]

   (5) Is the wall safe (considering both overturning and sliding)? (4%)
   If not, give two suggestions for improvement. (6%).

Fig. 1



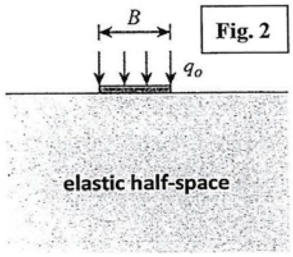
2. For a flexible foundation lying on a homogeneous elastic half-space, as shown in Fig. 2, the elastic settlement under the center on the foundation, $S_{e(flexible,@center)}$, may be expressed as:

$$S_{e(flexible,@center)} = \frac{q_0 B}{E_s}(1 - \mu_s{}^2)I_{center}$$

where q_0 is the net applied pressure on the foundation, μ_s and E_s are Poisson's ratio and the elastic modulus of the soil under the foundation, respectively, B is the width of the foundation, and I_{center} is the influence factor that depends on the shape of the foundation.

In addition, the elastic settlement of a rigid foundation, $S_{e(rigid)}$, can be approximated as $S_{e(rigid)} \approx 0.93 \cdot S_{e(flexible,@center)}$

Fig. 2



Determine the coefficient of subgrade reaction of a rigid foundation based on the given equations (10%).

Hint: In the approximate flexible method of design, the soil is assumed to be equivalent to an infinite number of elastic springs. The elastic constant of these assumed springs is referred to as the coefficient of subgrade reaction, which can be regarded as the spring stiffness per area (unit usually in kN/m^3 or lb/in^3).

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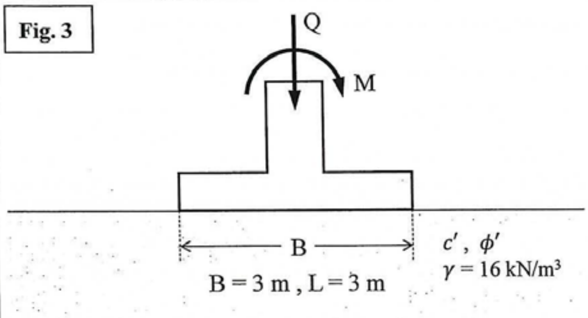
3. Fig. 3 shows a surface foundation of dimensions = 3 m × 3 m. Answer the following questions (45%).
   (1) Suggest the minimum depth of boring for site investigation for this foundation. (10%)
   Hint: The depth where the stress increase caused by the foundation below its center is equal to 10% of the net applied pressure on the foundation can be regarded as the minimum required depth of boring. Assuming this foundation as a uniformly loaded flexible rectangular area, then the stress increase can be approximately estimated using the 2:1 method.
   (2) Considering Q = 1000 kN, M = 0, $c' = 50$ kN/m², $\phi' = 0$, use general bearing capacity equation to determine the ultimate load that the foundation can carry (10%).
   (3) Following (2), check if the bearing capacity of this foundation meets the required factor of safety for long-term loading (5%).
   (4) Considering Q = 500 kN, M = 200 kN-m, $c' = 0$, $\phi' = 30°$, check if the load eccentricity causes a separation between the foundation and the soil (the reason MUST be given) (10%).
   (5) Following (4), use general bearing capacity equation and effective area method (Meyerhoff, 1953) to determine the ultimate load that the foundation can carry (10%).

Fig. 3



Bearing capacity factors

ϕ'	N_c	N_q	N_γ
26	22.25	11.85	12.54
27	23.94	13.20	14.47
28	25.80	14.72	16.72
29	27.86	16.44	19.34
30	30.14	18.40	22.40
31	32.67	20.63	25.99
32	35.49	23.18	30.22
33	38.64	26.09	35.19
34	42.16	29.44	41.06
35	46.12	33.30	48.03

Shape factors

$F_{cs} = 1 + \left(\frac{B}{L}\right)\left(\frac{N_q}{N_c}\right)$　　$F_{qs} = 1 + \left(\frac{B}{L}\right)\tan\phi'$　　$F_{\gamma s} = 1 - 0.4\left(\frac{B}{L}\right)$