Name:_____ I.D #_____

FAMU-FSU COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

GEOTECHNICAL DESIGN
CEG 4081
Spring 2024

Exam # 2

Two Hour Exam
From 3:00 - 5:00 pm

By

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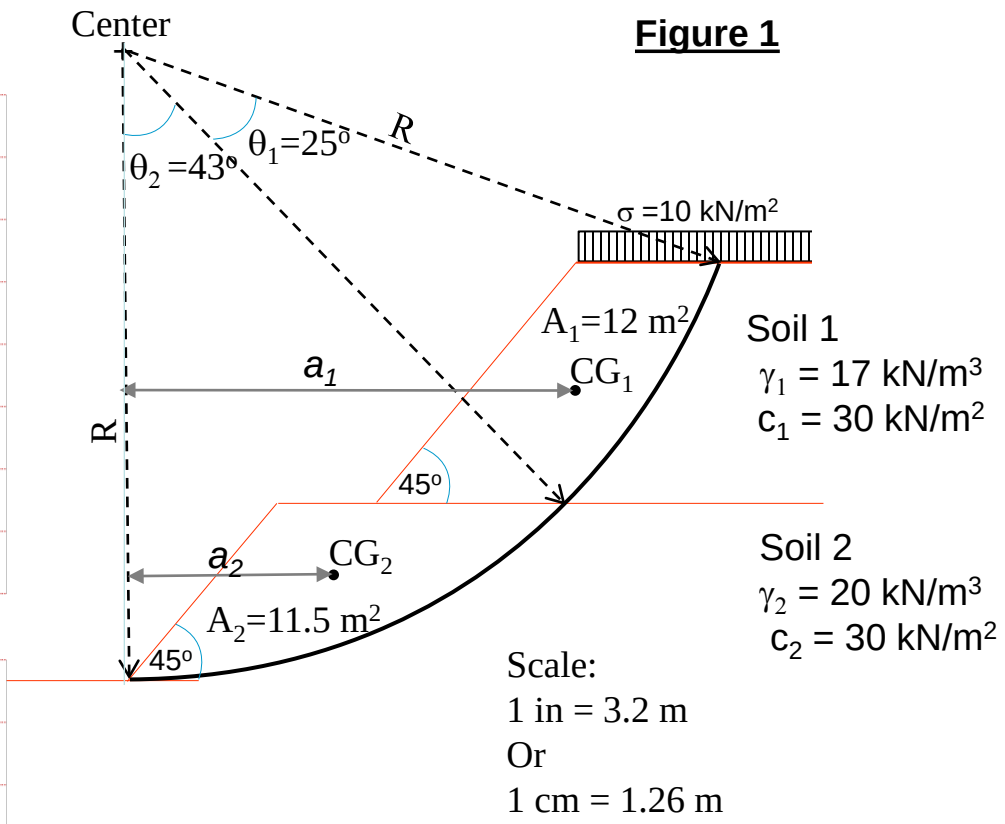
1. For the given failure surface, determine the factor of safety of the slope. The soil properties are given in the figure. (20 points)

The areas and centers of gravity are given in the figure,

Area 1 = 12 m^2

Area 2 = 11.5 m^2

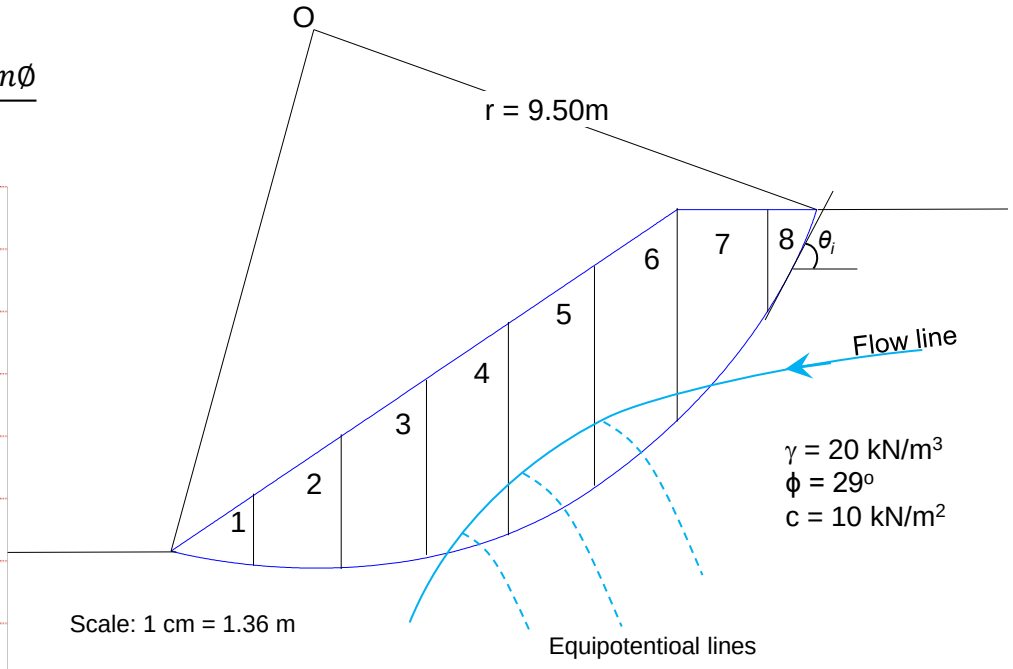
Figure 1



2 - Using the ordinary method of slices, determine the factor of the given slope. (20 points)

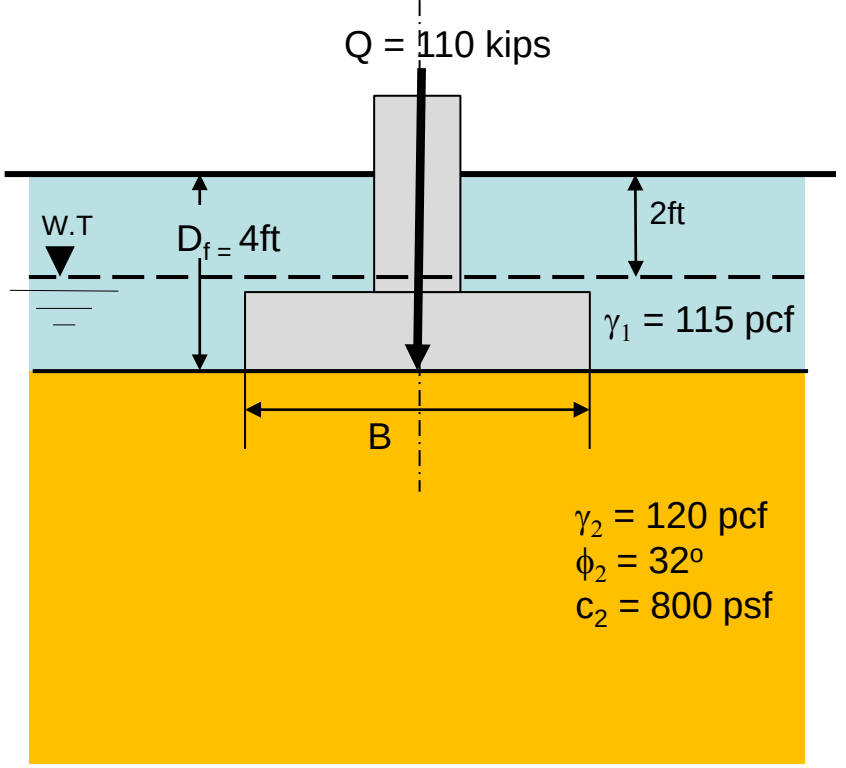
Slice #	α_i	h (m)	d (m)	W (kN)	W cosα_i	W sinα_i	c (kN/m^2)	Δl_i (m)	c Δl_i (kN)	u_i (kN/m^2)	$u_i \Delta l_i$ (kN)
1	-14	0.81	1.35					1.45		0	
2	-3.4	1.89	1.48					1.55		0	
3	9.27	2.835	1.48					1.55		0	
4	16.6	3.51	1.48					1.55		1.57	
5	26.6	3.78	1.48					1.74		6.33	
6	35.7	4.05	1.48					1.94		7.14	
7	49.4	2.97	1.48					2.5		0	
8	63.4	1.215	0.675					1.94		0	

$$F.S. = \frac{\sum Resisting\ Moment}{\sum Driving\ Moment} = \frac{\sum(c\Delta l_i) + \sum(W_i cos\alpha_i - u_i l_i)tan\emptyset}{\sum W_i sin\alpha_i}$$



3 - Given:
Figure 3 shows a square footing.
The inclined load Q = 110 kips. The width of the foundation B = 4'

Determine if the given foundation is adequate to carry the given vertical load. Use F.S. = 3 (25 points)



$q_{ult} = c\,N_c + q\,N_q + 0.5\,\gamma B N_\gamma$

$q_{ult} = 1.3\,c\,N_c + q\,N_q + 0.4\,\gamma B N_\gamma$

$q_{ult} = 1.3\,c\,N_c + q\,N_q + 0.3\,\gamma B N_\gamma$

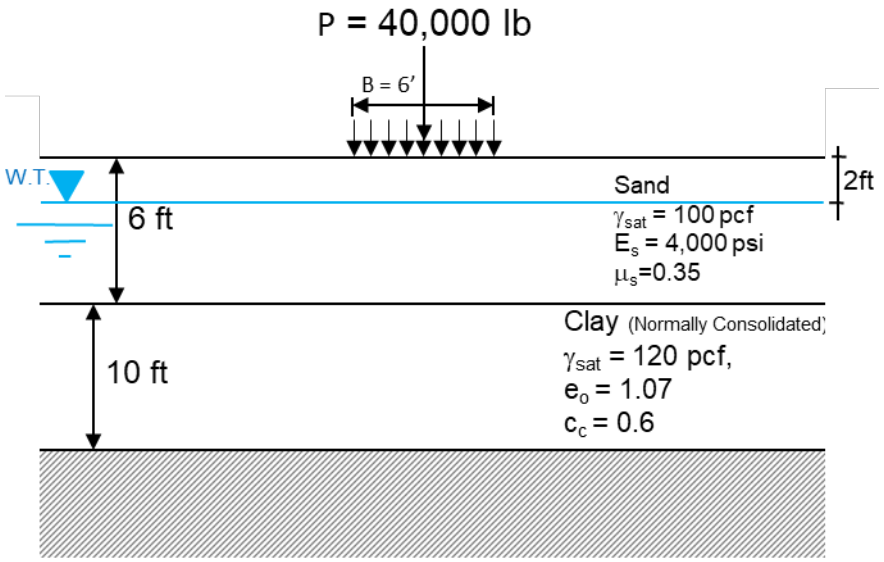
TABLE 2.1 Terzaghi's Bearing Capacity Factors—Eqs. (2.32), (2.33), and (2.34)

ϕ	N_c	N_q	N_γ	ϕ	N_c	N_q	N_γ	ϕ	N_c	N_q	N_γ
0	5.70	1.00	0.00	17	14.60	5.45	2.18	34	52.64	36.50	38.04
1	6.00	1.1	0.01	18	15.12	6.04	2.59	35	57.75	41.44	45.41
2	6.30	1.22	0.04	19	16.57	6.70	3.07	36	63.53	47.16	54.36
3	6.62	1.35	0.06	20	17.69	7.44	3.64	37	70.01	53.80	65.27
4	6.97	1.49	0.10	21	18.92	8.26	4.31	38	77.50	61.55	78.61
5	7.34	1.64	0.14	22	20.27	9.19	5.09	39	85.97	70.61	95.03
6	7.73	1.81	0.20	23	21.75	10.23	6.00	40	95.66	81.27	115.31
7	8.15	2.00	0.27	24	23.36	11.40	7.08	41	106.81	93.85	140.51
8	8.60	2.21	0.35	25	25.13	12.72	8.34	42	119.67	108.75	171.99
9	9.09	2.44	0.44	26	27.09	14.21	9.84	43	134.58	126.50	211.56
10	9.61	2.69	0.56	27	29.24	15.90	11.60	44	151.95	147.74	261.60
11	10.16	2.98	0.69	28	31.61	17.81	13.70	45	172.28	173.28	325.34
12	10.76	3.29	0.85	29	34.24	19.98	16.18	46	196.22	204.19	407.11
13	11.41	3.63	1.04	30	37.16	22.46	19.13	47	224.55	241.80	512.84
14	12.11	4.02	1.26	31	40.41	25.28	22.65	48	258.28	287.85	650.87
15	12.86	4.45	1.52	32	44.04	28.52	26.87	49	298.71	344.63	831.99
16	13.68	4.92	1.82	33	48.09	32.23	31.94	50	347.50	415.14	1072.80

4- Given

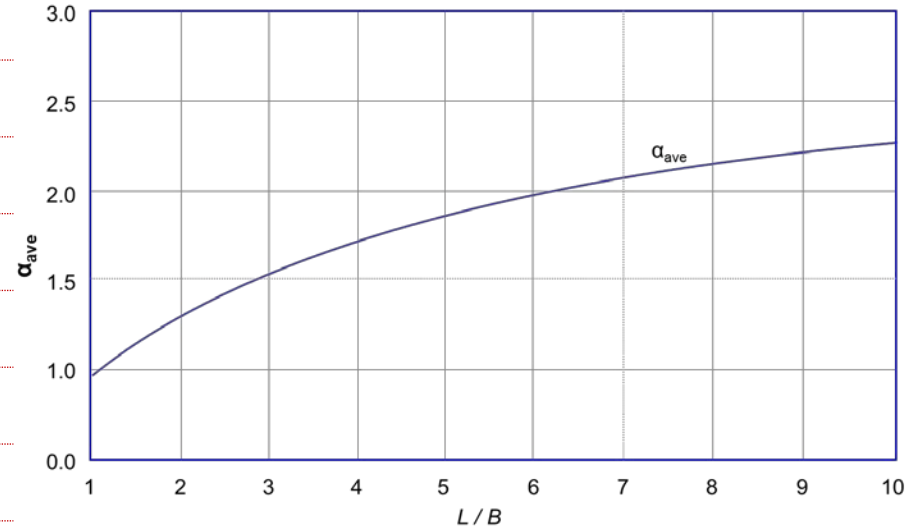
The soil layers and their properties are shown in the figure. The ground water table is at 2ft from the ground surface. For the square footing (6'x6') shown in the figure determine

1. *The elastic settlement of the sandy layer(S_e) (10 points)*
2. *The consolidation settlement (S_c) (15 points)*



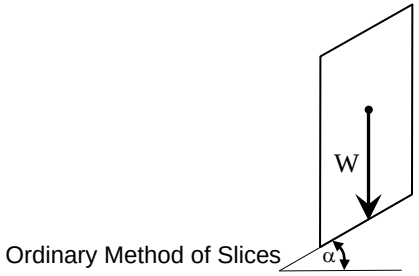
$$S_e = \frac{qB}{E_s}(1-\mu_s^2)\alpha$$

$$S_c = \frac{c_c\, H}{1+e_o}\log\frac{P_o+\Delta P}{P_o}$$



5. Answer the following questions (10 points)

1. What is the main difference between ordinary method of slices and the simplified Bishop method. (2 point)



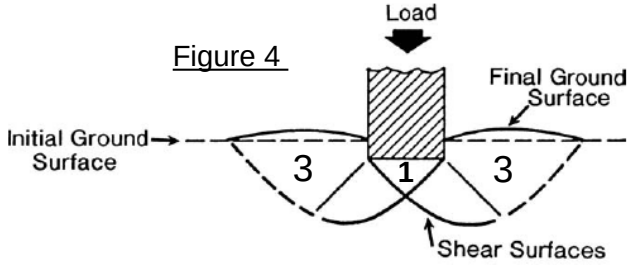
Ordinary Method of Slices

Simplified Bishop Method of Slices

2. The Terzaghi's bearing capacity equation is the only method available to determine bearing capacity of shallow foundations
(2 point)

True_____ False_____

Figure 4



3. Zone 1 in Figure 4 is called the passive zone (2 point)

True_____ False_____

4. The method of slices for slope stability analysis can be used for the following soils (Circle the right answer) (2 point)

i- c -Soil ii- ϕ-Soil iii- All soils

5. The consolidation settlement equation in problem 4 is used to determine the consolidation settlement at time = ∞
(2 point)

True_____ False_____