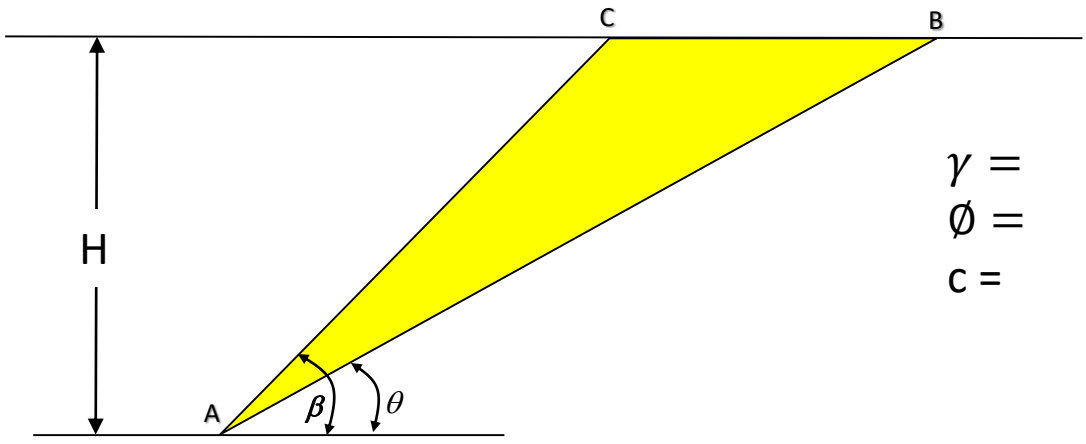
Slope Stability Analysis
Homework #5
Fall 2022

Problem 1

The following figure shows a 15-ft cut through two soil strata. The lower is a highly impermeable cohesive soil. Shearing strength data between the two strata are as follows:

Cohesion=400 psf
Angle of internal friction= 25^o
Unit weight of the upper layer= 105 pcf
Height of the slope, H= 10 ft
$\beta = 45^o$
$\theta = 30^o$

Find if the slope is safe or not



Problem 2

A 45° slope is excavated to a depth of 8 m in a deep layer of saturated clay of unit weight 19 kN/m^3: the relevant shear strength parameters are c_u = 65 kN/m^2 and ϕ_u = 0. Determine the factor of safety for the trial failure surface specified in Fig. 9.3.

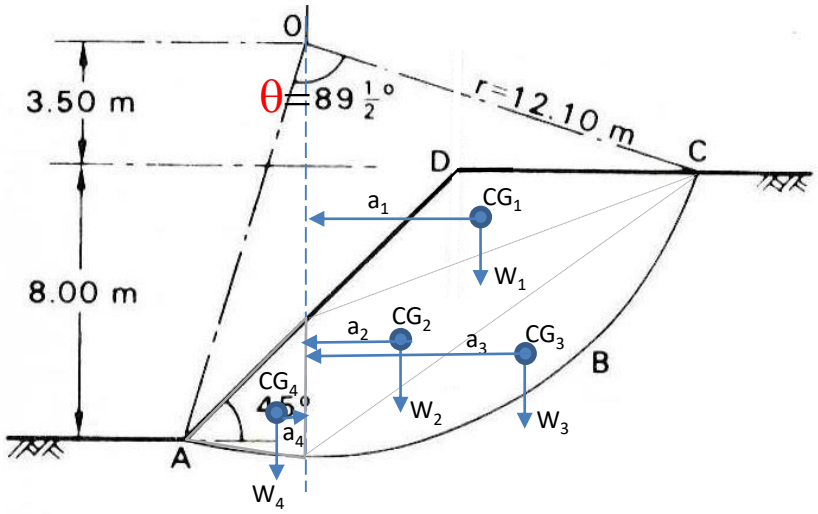
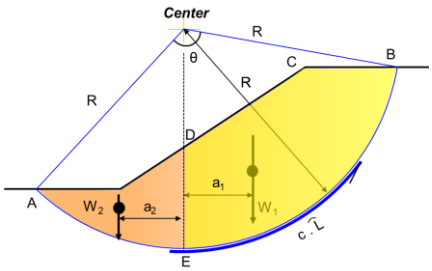


Figure 9.3 Example 9.1.

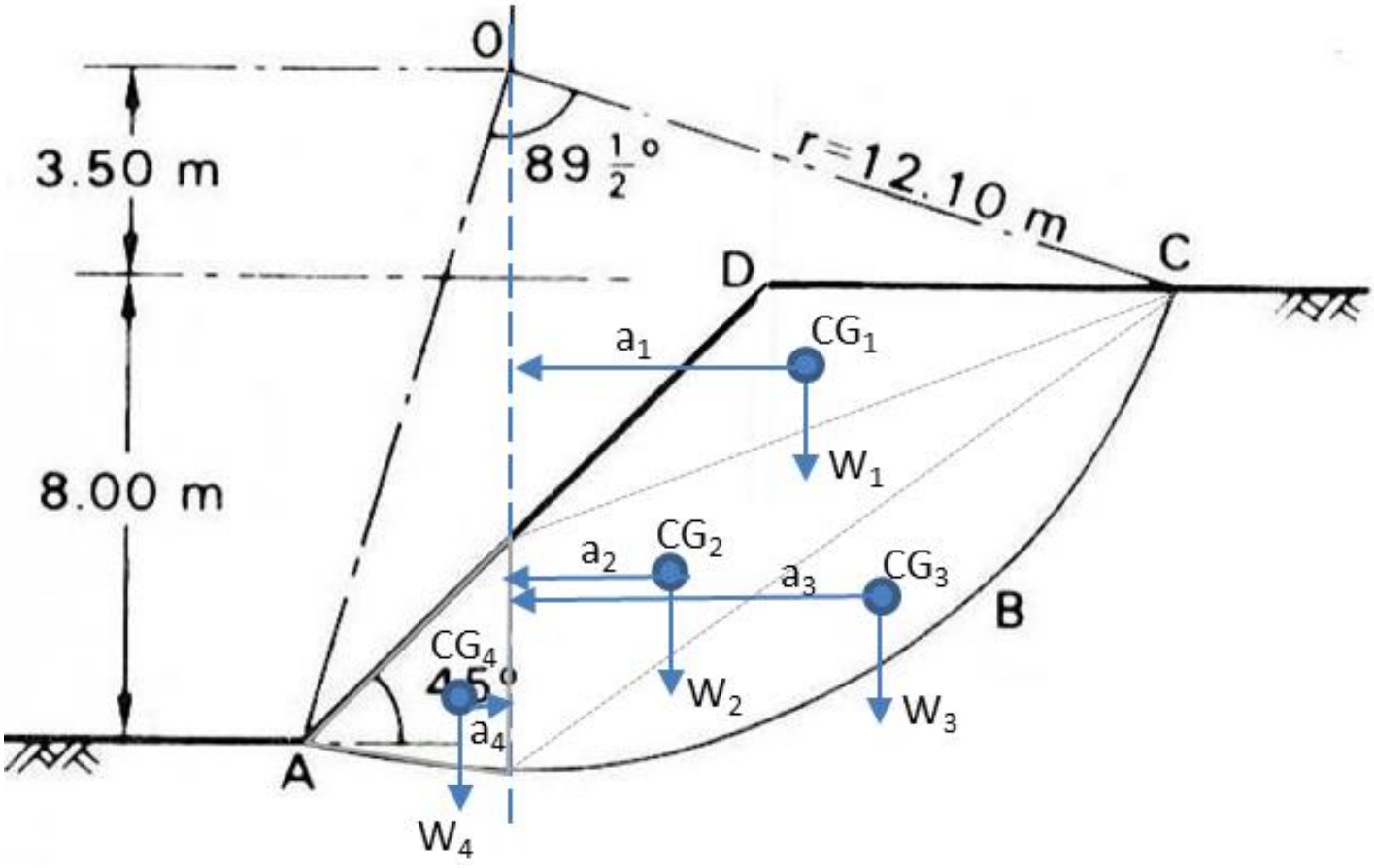


Resisting Moment (M_R) = W_2 x a_2 + C x R

Driving Moment (M_D) = W_1 x a_1

1. Draw the problem to scale
2. Divide the shapes to smaller areas (1, 2, 3, and 4)
3. Find the weight of each area (For example $A_1 x \gamma_{soil} = W_1$)
4. Find where is the center of gravity for each area (CG_1, CG_2, …)
5. Using the scale, measure the arms (a1, a2, a3, ..)
6. For A_4 you can approximate the area to triangle.
7. Now determine the driving moments ($W_1 x a_1 + W_2 x a_2 + W_3 x a_3$)
8. Determine the resisting moments ($W_4 x a_4 + c \times L_{curve}$)

9. $L_{curve} = \theta \times r$ … θ in radians


O
3.50 m
8.00 m
89 1/2°
r = 12.10 m
C
D
B
A
a1
CG1
W1
a2
CG2
a3
CG3
W2
W3
CG4
45°
a4
W4

Problem 3

Refer to Figure 4, Given: $\beta = 20^o$, $\gamma = 18$ kN/m^3, $\phi = 25^o$, and c' = 14 kN/m^2. Find the height, H, that will have a factor of safety, F_s of 2.5 against sliding along the soil-rock interface.

$$FS = \frac{c}{\gamma_{soil} H \cos\beta \sin\beta} + \left(1 - \frac{u}{\gamma_{soil} H \cos^2\beta}\right) \frac{\tan\phi}{\tan\beta}$$

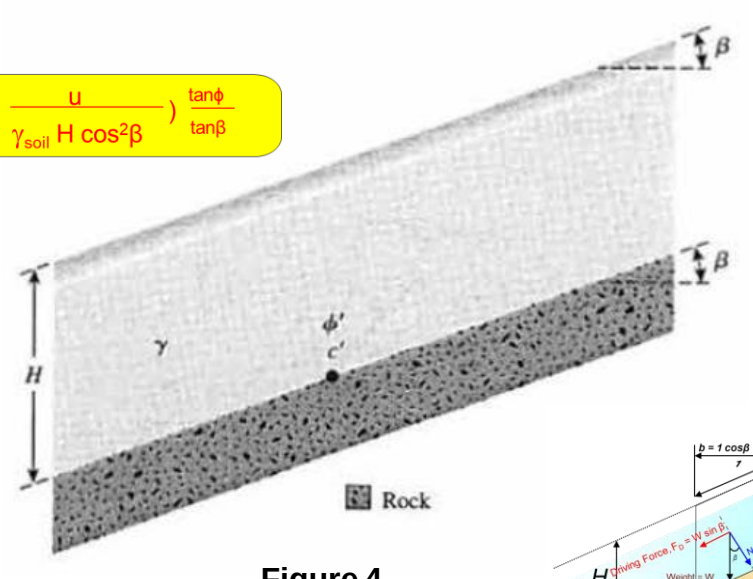
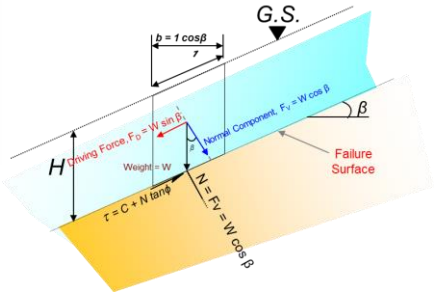


Figure 4



Problem 4

For the infinite slope shown in Figure 5, find the factor of safely against sliding along the plane *AB,* given that H = 20 ft. $\gamma = 110$ pcf, $\phi = 20^o$, and c' = 500 psf. Note that there is seepage through the soil and that the groundwater table coincides with the ground surface.

$$FS = \frac{c}{\gamma_{soil} H \cos\beta \sin\beta} + \left(1 - \frac{u}{\gamma_{soil} H \cos^2\beta}\right) \frac{\tan\phi}{\tan\beta}$$

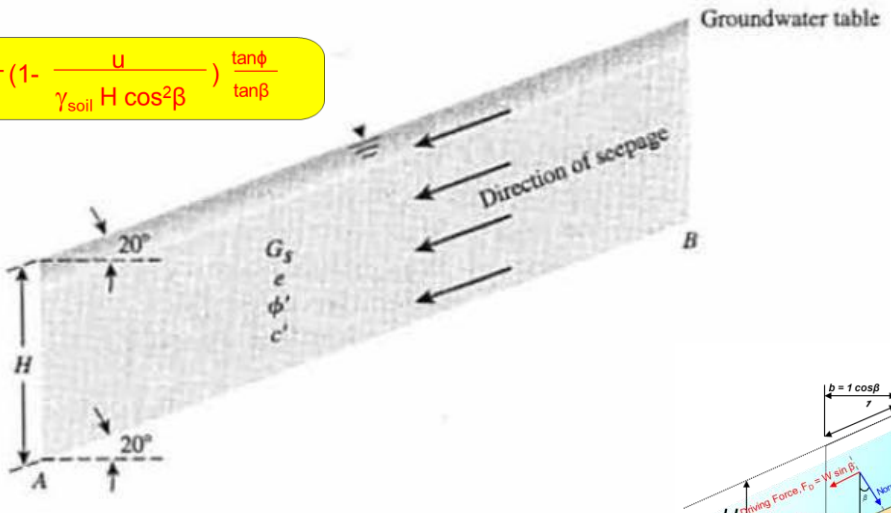
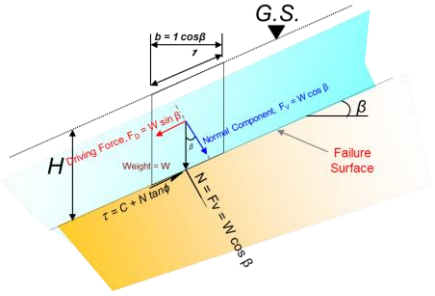


Figure 5



Problem 5

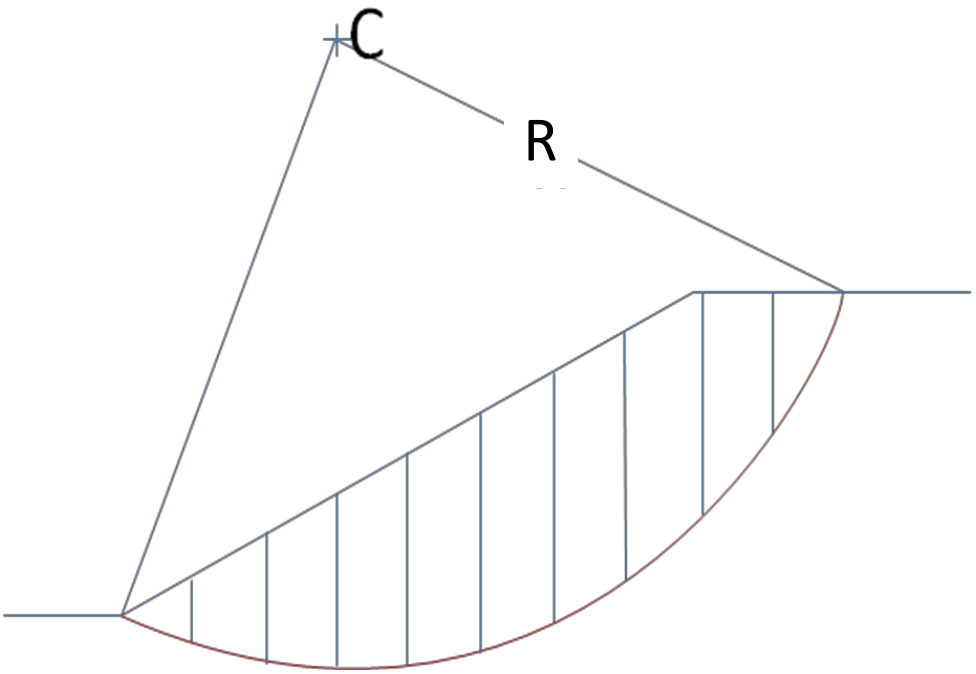
Find the factor of safety for a 20 meter high 2H - l V slope shown in the following figure using ordinary method of slices. Each slice has a width of 5 meters.

γ = 16 kN/m^3

c =20 kPa

ϕ = $20O$

R =38.1 m



Slice	Width Δx (ft)	Ave Height (ft)	Weight (Kips)	θ_i	$W_i \sin\theta_i$	$W_i \cos\theta_i$	u_i	Δl_i	$U_i = u_i \Delta l_i$	$N_i = W_i \cos\theta_i - U_i$
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

$$\text{F.S.} = \frac{cL + \tan\varphi \sum_{i=1}^{i=n}(W_i cos\theta_i - u_i \Delta l_i)}{\sum_{i=1}^{i=n} W_i sin\theta_i}$$