11.1 Fig. Prob. 11.1 shows a rigid retaining wall prevented from lateral movements. Determine for this wall the lateral thrust for the at-rest condition and the point of application of the resultant force.

11.2 For Prob 11.1, determine the active earth pressure distribution for the following cases:
(a) when the water table is below the base and $\gamma = 17$ kN/m^3.
(b) when the water table is at 3m below ground level
(c) when the water table is at ground level

11.3 Fig. Prob. 11.3 gives a cantilever retaining wall with a sand backfill. The properties of the sand are:

$e = 0.56$, $\phi = 38°$, and $G_s = 2.65$.

Using Rankine theory, determine the pressure distribution with respect to depth, the magnitude and the point of application of the resultant active pressure with the surcharge load being considered.

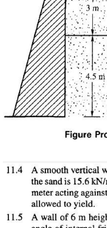

Figure Prob. 11.1

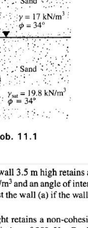

Figure Prob. 11.3

11.4 A smooth vertical wall 3.5 m high retains a mass of dry loose sand. The dry unit weight of the sand is 15.6 kN/m^3 and an angle of internal friction ϕ is 32°. Estimate the total thrust per meter acting against the wall (a) if the wall is prevented from yielding, and (b) if the wall is allowed to yield.

11.5 A wall of 6 m height retains a non-cohesive backfill of dry unit weight 18 kN/m^3 and an angle of internal friction of 30°. Use Rankine's theory and find the total active thrust per meter length of the wall. Estimate the change in the total pressure in the following circumstances:
(i) The top of the backfill carrying a uniformly distributed load of 6 kN/m^2
(ii) The backfill under a submerged condition with the water table at an elevation of 2 m below the top of the wall. Assume $G_s = 2.65$, and the soil above the water table being saturated.

11.6 For the cantilever retaining wall given in Fig. Prob 11.3 with a sand backfill, determine pressure distribution with respect to depth and the resultant thrust. Given:

$H_1 = 3$m, $H_2 = 6$m, $\gamma_{sat} = 19.5$ kN/m^3

q =25 kN/m^2, and $\phi = 36°$

Assume the soil above the GWT is saturated

11.7 A retaining wall of 6 m height having a smooth back retains a backfill made up of two strata shown in Fig. Prob. 11.7. Construct the active earth pressure diagram and find the magnitude and point of application of the resultant thrust. Assume the backfill above WT remains dry.

11.8 (a) Calculate the total active thrust on a vertical wall 5 m high retaining sand of unit weight 17 kN/m^3 for which $\phi = 35°$. The surface is horizontal and the water table is below the bottom of the wall. (b) Determine the thrust on the wall if the water table rises to a level 2 m below the surface of the sand. The saturated unit weight of the sand is 20 kN/m^3.

11.9 Figure Problem 11.9 shows a retaining wall with a sloping backfill. Determine the active earth pressure distribution, the magnitude and the point of application of the resultant by the analytical method.

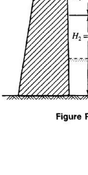

Figure Prob. 11.7

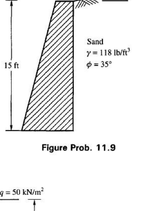

Figure Prob. 11.9

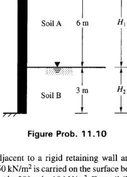

Figure Prob. 11.10

11.10 The soil conditions adjacent to a rigid retaining wall are shown in Fig. Prob. 11.10, A surcharge pressure of 50 kN/m^2 is carried on the surface behind the wall. For soil (A) above the water table, $c' = 0$, $\phi' = 38°$, $\gamma' = 18$ kN/m^3. For soil (B) below the WT, $c' = 10$ kN/m^2, $\phi' = 28°$, and $\gamma_{sat} = 20$ kN/m^3. Calculate the maximum unit active pressure behind the wall, and the resultant thrust per unit length of the wall.

11.11 For the retaining wall given in Fig. Prob. 11.10, assume the following data:
(a) surcharge load = 1000 lb/ft^2, and (b) $H_1 = 10$ ft, $H_2 = 20$ ft,
(c) Soil A: $c' = 500$ lb/ft^2, $\phi' = 30°$, $\gamma = 110$ lb/ft^3
(d) Soil B: $c' = 0$, $\phi' = 35°$, $\gamma_{sat} = 120$ lb/ft^3
Required:
(a) The maximum active pressure at the base of the wall.
(b) The resultant thrust per unit length of wall.

11.12 The depths of soil behind and in front of a rigid retaining wall are 25 ft and 10 ft respectively, both the soil surfaces being horizontal (Fig. Prob 11.12). The appropriate

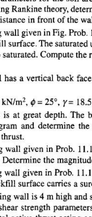

Figure Prob. 11.12

shear strength parameters for the soil are $c = 600$ lb/ft^2, and $\phi = 22°$, and the unit weight is 110 lb/ft^3. Using Rankine theory, determine the total active thrust behind the wall and the total passive resistance in front of the wall. Assume the water table is at a great depth.

11.13 For the retaining wall given in Fig. Prob. 11.12, assume the water table is at a depth of 10 ft below the backfill surface. The saturated unit weight of the soil is 120 lb/ft^3. The soil above the GWT is also saturated. Compute the resultant active and passive thrusts per unit length of the wall.

11.14 A retaining wall has a vertical back face and is 8 m high. The backfill has the following properties:
cohesion $c = 15$ kN/m^2, $\phi = 25°$, $\gamma = 18.5$ kN/m^3
The water table is at great depth. The backfill surface is horizontal. Draw the pressure distribution diagram and determine the magnitude and the point of application of the resultant active thrust.

11.15 For the retaining wall given in Prob. 11.14, the water table is at a depth of 3 m below the backfill surface. Determine the magnitude of the resultant active thrust.

11.16 For the retaining wall given in Prob. 11.15, compute the magnitude of the resultant active thrust, if the backfill surface carries a surcharge load of 30 kN/m^2.

11.17 A smooth retaining wall is 4 m high and supports a cohesive backfill with a unit weight of 17 kN/m^3. The shear strength parameters of the soil are cohesion = 10 kPa and $\phi = 10°$. Calculate the total active thrust acting against the wall and the depth to the point of zero lateral pressure.

11.18 A rigid retaining wall is subjected to passive earth pressure. Determine the passive earth pressure distribution and the magnitude and point of application of the resultant thrust by Rankine theory.
Given: Height of wall = 10 m; depth of water table from ground surface = 3 m; $c = 20$ kN/m^2, $\phi = 20°$ and $\gamma_{sat} = 19.5$ kN/m^3. The backfill carries a uniform surcharge of 20 kN/m^2.
Assume the soil above the water table is saturated.

11.19 Fig. Prob. 11.19 gives a retaining wall with a vertical back face and a sloping backfill. All the other data are given in the figure. Determine the magnitude and point of application of resultant active thrust by the Culmann method.

Figure Prob. 11.19

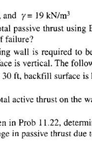

Figure Prob. 11.20

11.20 Fig. Prob. 11.20 gives a rigid retaining wall with a horizontal backfill. The backfill carries a strip load of 1200 lb/ft^2 as shown in the figure. Determine the following:
(a) The unit pressure on the wall at point A at a depth of 5 ft below the surface due to the surcharge load.
(b) The total thrust on the wall due to surcharge load.

11.21 A gravity retaining wall with a vertical back face is 10 m high. The following data are given:
$\phi = 25°$, $\delta = 15°$, and $\gamma = 19$ kN/m^3
Determine the total passive thrust using Eq (11.76). What is the total passive thrust for a curved surface of failure?

11.22 A gravity retaining wall is required to be designed for seismic conditions for the active state. The back face is vertical. The following data are given:
Height of wall = 30 ft, backfill surface is horizontal; $\phi = 40°$, $\delta = 20°$, $k_v = 0$, $k_h = 0.3$, $\gamma = 120$ lb/ft^3.
Determine the total active thrust on the wall. What is the additional lateral pressure due to the earthquake?

11.23 For the wall given in Prob 11.22, determine the total passive thrust during the earthquake What is the change in passive thrust due to the earthquake? Assume $\phi = 30°$ and $\delta = 15°$.