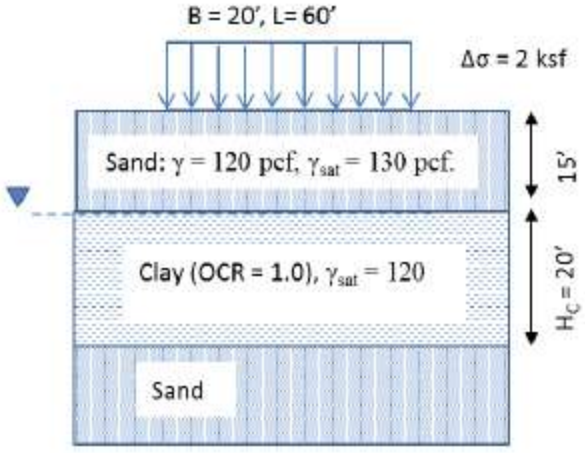
GIVEN



Clay consolidation test data: $e_0 = 0.9$, $C_c = .35$, $C_v = .003$ ft²/min, $C_\alpha = .01$

$B := 20$ ft $\quad L := 60$ ft

$qo := 2 \cdot 10^3$ psf

$Hs := 15$ ft $\quad Hc := 20$ ft

$\gamma 1 := 120$ $\quad \gamma sat2 := 120$

$\gamma sat1 := 130$ $\quad OCR := 1$

$Cc := .35$ $\quad eo := 0.9$

$Cv := .003 \ \frac{ft^2}{min}$ $\quad C\alpha := 0.01$

$Df := 0$ $\quad \gamma w := 62.4$ pcf

FIND

1. Total Settlement at the center of the surcharge after primary consolidation
2. Time to reach end of primary consolidation U=99% in days.
3. Additional settlement (in.) at the center due to secondary consolidation t=25 years later

METHOD

1.1 Determine the effective stress in the middle of clay layer
1.2 Use Griffiths EQ 5.19 Determine the average vertical stress increase in the given layer
1.3 In order to determine Primary Consolidation Use EQ 1.61 (since normally consolidated clay)
1.4 Determine Elastic Settlement Using Janbu
1.5 Total Settlement = 1.1 + 1.4 = Se+Sc

2.

SOLUTION

Height	Stress	Pore Pressure	Effective Stress
$Hs = 15$	$\sigma 1 := Hs \cdot \gamma 1 = 1.8 \times 10^3$	$u1 := 0$	$\sigma 1' := \sigma 1 - u1 = 1.8 \times 10^3$ psf
$H := \frac{Hc}{2} = 10$	$\sigma 2 := H \cdot \gamma sat2 + \sigma 1 = 3 \times 10^3$	$u2 := \gamma w \cdot H = 624$	$\sigma 2' := \sigma 2 - u2 = 2.376 \times 10^3$ psf

$$\sigma o' := \sigma 2' = 2.376 \times 10^3 \quad psf$$

1.2 Since EQN 5.19 determines the average vertical stress within a corner of a rectangular area, we'll divide the surcharge area into 4 pieces (Thus B/2 and L/2). We also have that:

$H2 := Hs + Hc = 35$ $\quad H1 := Hs = 15$ ft

To determine Ia(h2) and Ia(h1): (Determine factors below and use Figure 5.7 for Ia`s)

$m2 := \frac{\frac{B}{2}}{H2} = 0.286$ $\quad n2 := \frac{\frac{L}{2}}{H2} = 0.857$ $\quad Ia2 := .155$ $\quad m1 := \frac{\frac{B}{2}}{H1} = 0.667$ $\quad n1 := \frac{\frac{L}{2}}{H1} = 2$ $\quad Ia1 := 0.22$

$\Delta\sigma 1 := qo \cdot \frac{(H2 \cdot Ia2 - H1 \cdot Ia1)}{(H2 - H1)} = 212.5$

The total stress is equal to 4 times the value obtained (since 4 areas): $\Delta\sigma avg := 4 \cdot \Delta\sigma 1 = 850$

Primary Consolidation: $Sp := \left(\frac{Cc \cdot Hc}{1 + eo}\right) \cdot \log\left(\frac{\sigma o' + \Delta\sigma avg}{\sigma o'}\right) = 0.489$ ft $\quad Sp' := Sp \cdot 12 = 5.872$ in

PART 2: TIME TO REACH END OF PRIMARY CONSOLIDATION:

For U=99% $Tv := 1.781$ Since both sand layers are freely draining $H := \frac{Hc}{2} = 10$ $t := Tv \cdot \frac{H^2}{Cv} = 5.937 \times 10^4$ min

$t' := \frac{t}{60 \cdot 24} = 41.227$ days

PART 3 - SETTLEMENT DUE TO SECONDARY CONSOLIDATION $t2' := 25$ years $\quad t2 := t2' \cdot 365 = 9.125 \times 10^3$ days

$t1 := t' = 41.227$ days From EQ 5.91 $\Delta e := ep - eo$ $ep := C\alpha \cdot \log\left(\frac{t2}{t1}\right) + eo = 0.923$

$C\alpha' := \frac{C\alpha}{(1 + ep)} = 5.199 \times 10^{-3}$ $Ss := C\alpha' \cdot Hc \cdot \log\left(\frac{t2}{t1}\right) = 0.244$ ft $\quad Ss' := Ss \cdot 12 = 2.926$ in