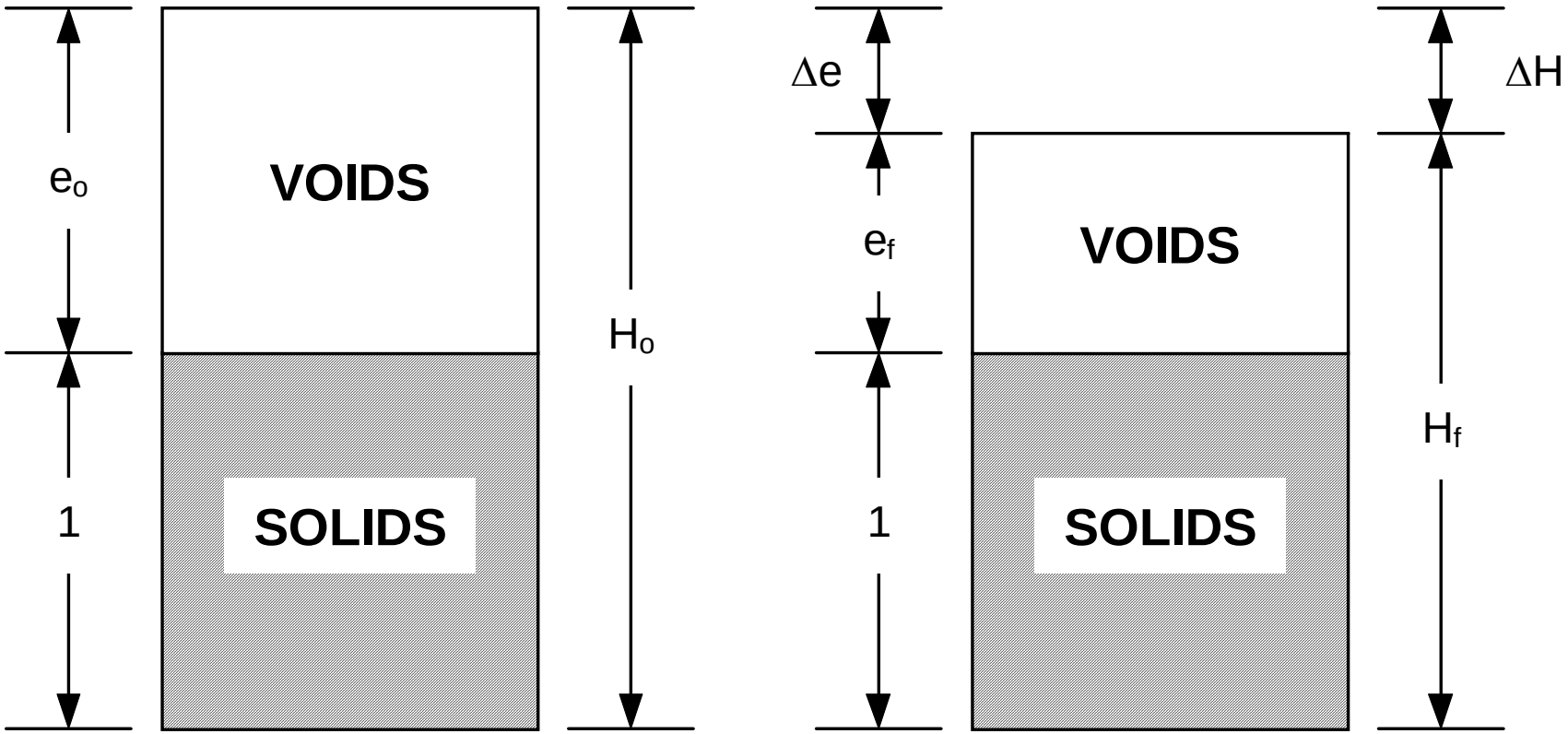
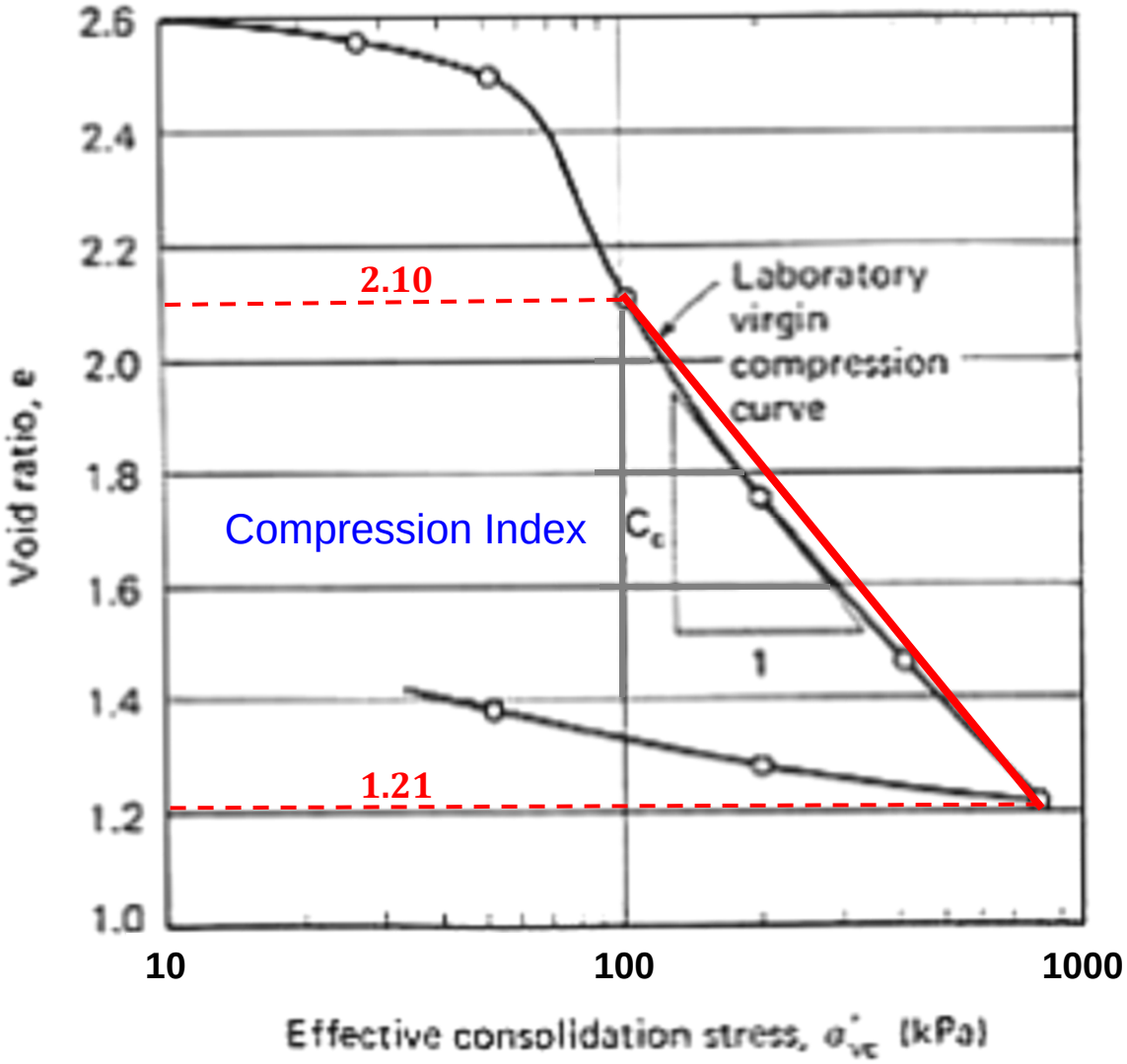
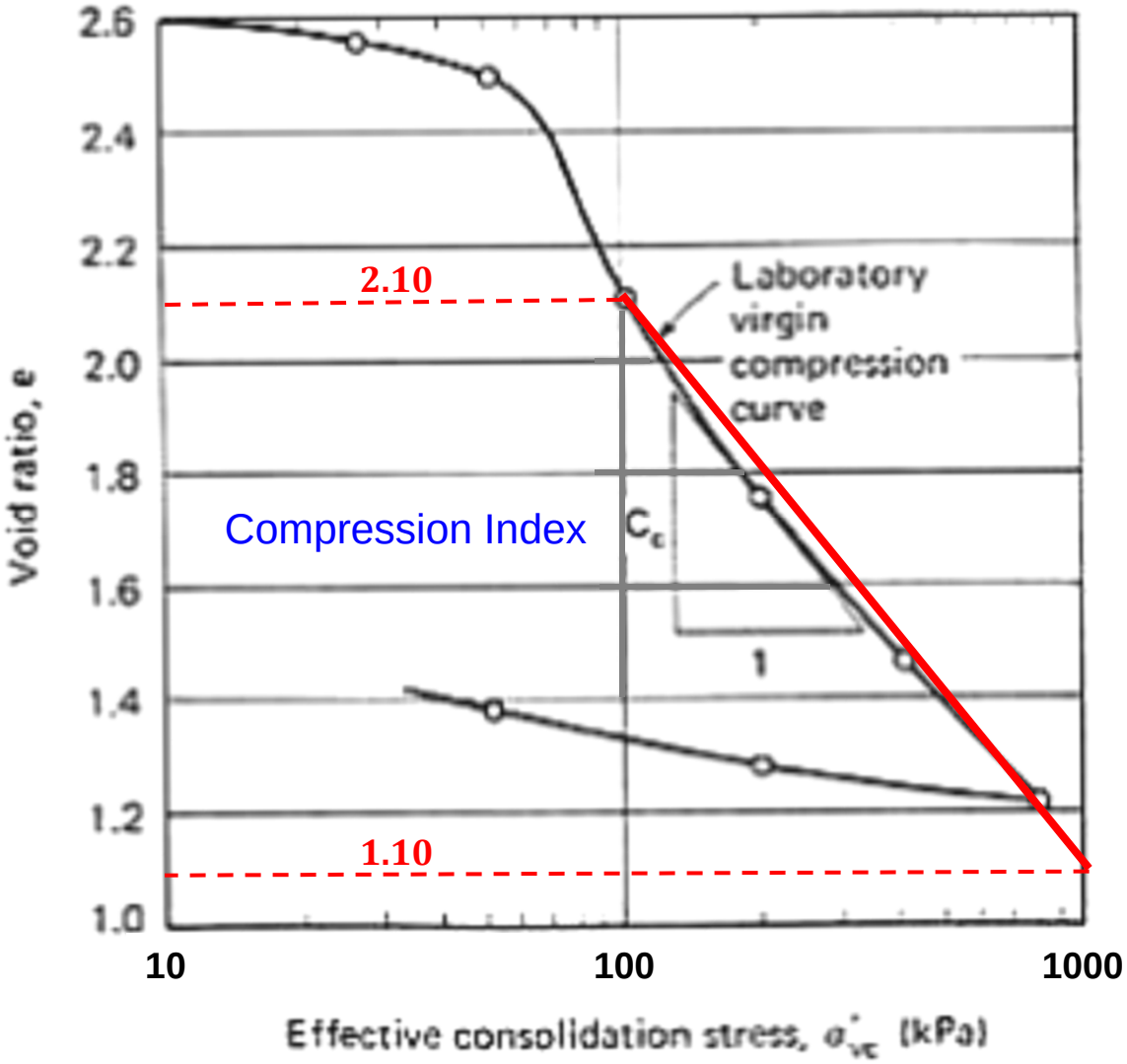
Consolidation Settlement


e_o
VOIDS
1
SOLIDS
H_o
Δe
e_f
VOIDS
1
SOLIDS
ΔH
H_f

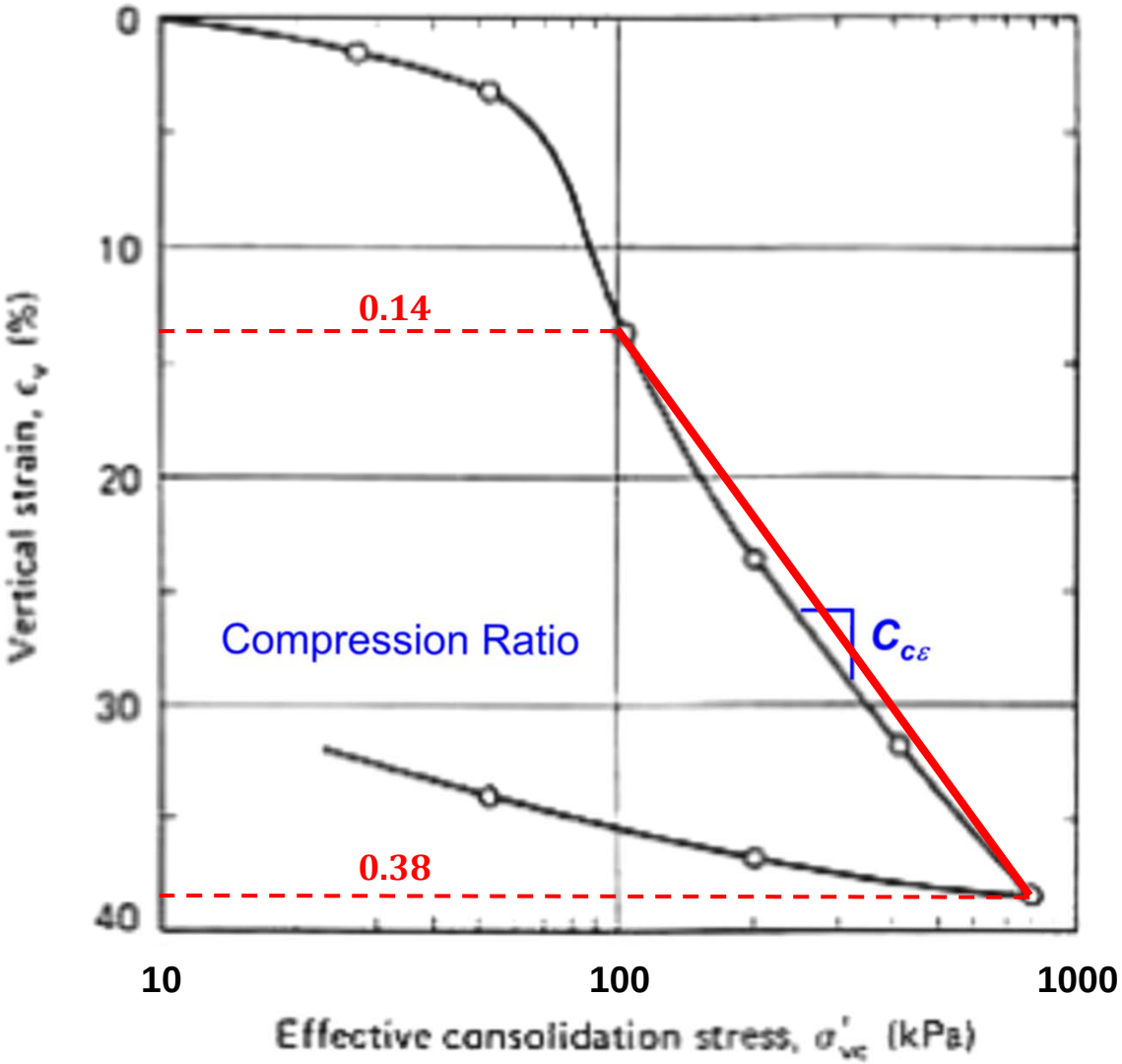
$$C_c = \frac{2.10 - 1.21}{\log(800/100)} = \frac{0.89}{\log 8} = 0.99$$



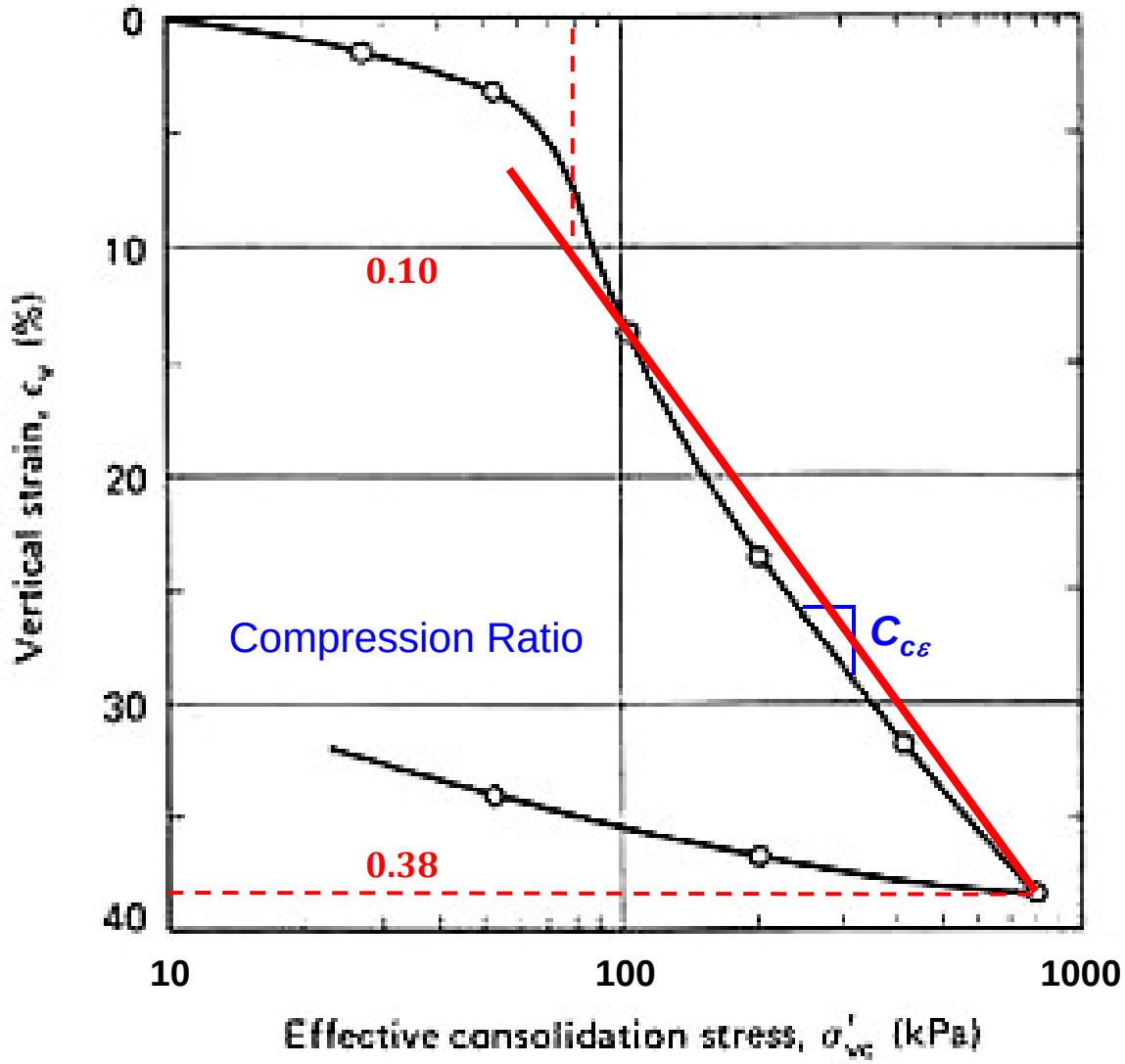
$$C_c = \frac{2.10 - 1.10}{\log(1000/100)} = \frac{1.00}{\log 10} = \frac{1.00}{1} = 1.00$$

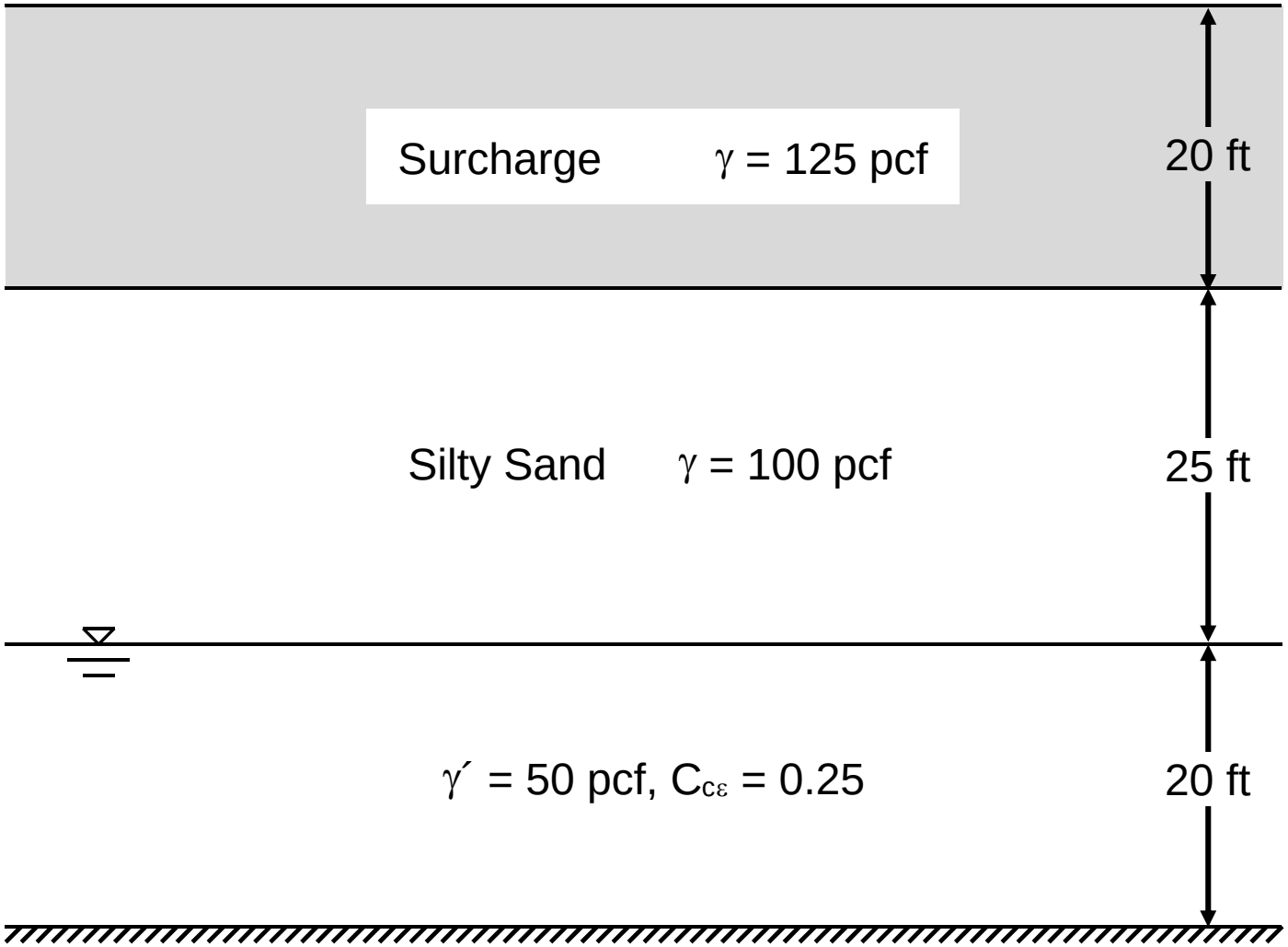


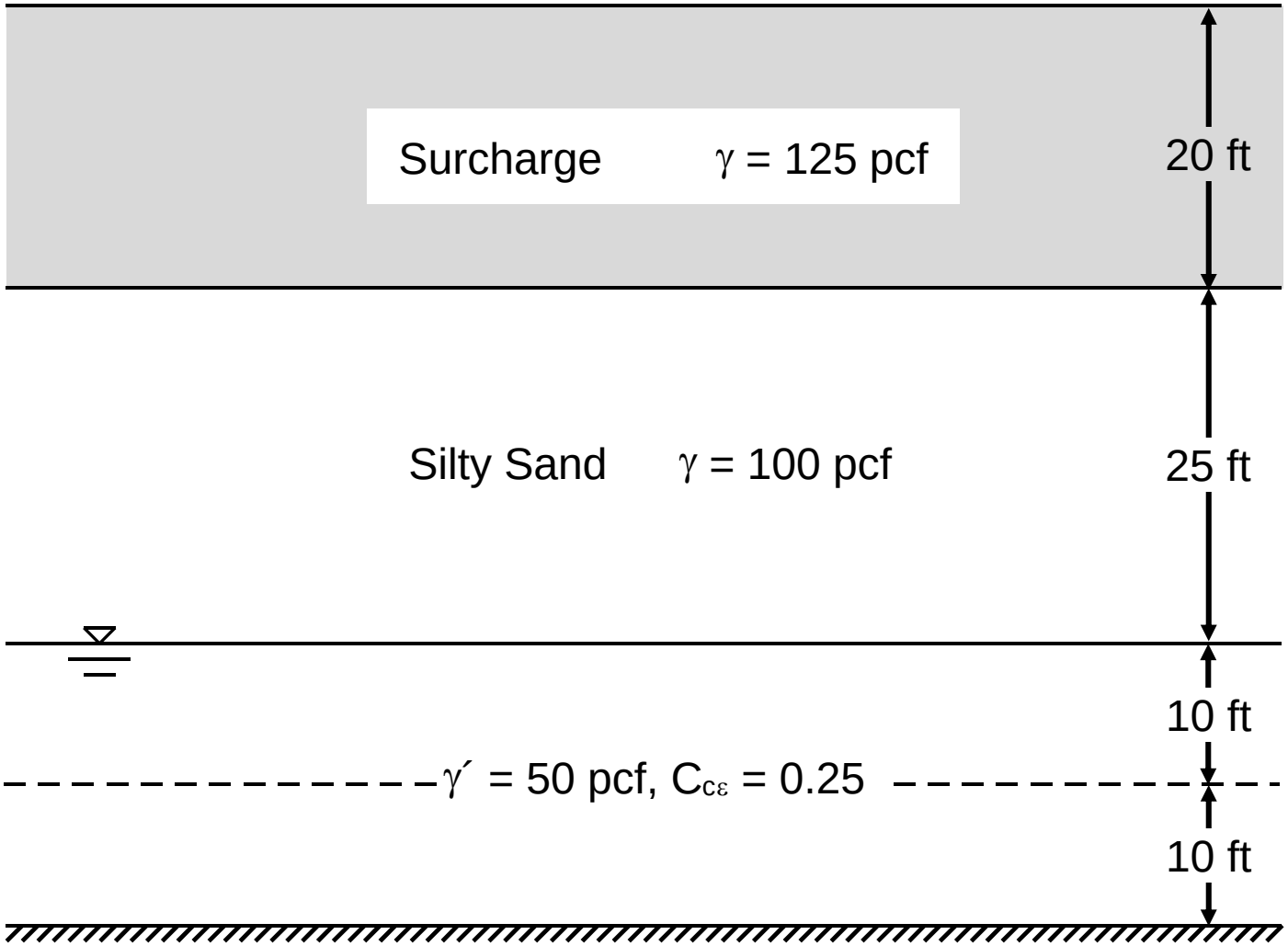
$$C_{c\varepsilon} = \frac{0.38 - 0.14}{\log(800/100)} = \frac{0.24}{\log 8} = 0.27$$

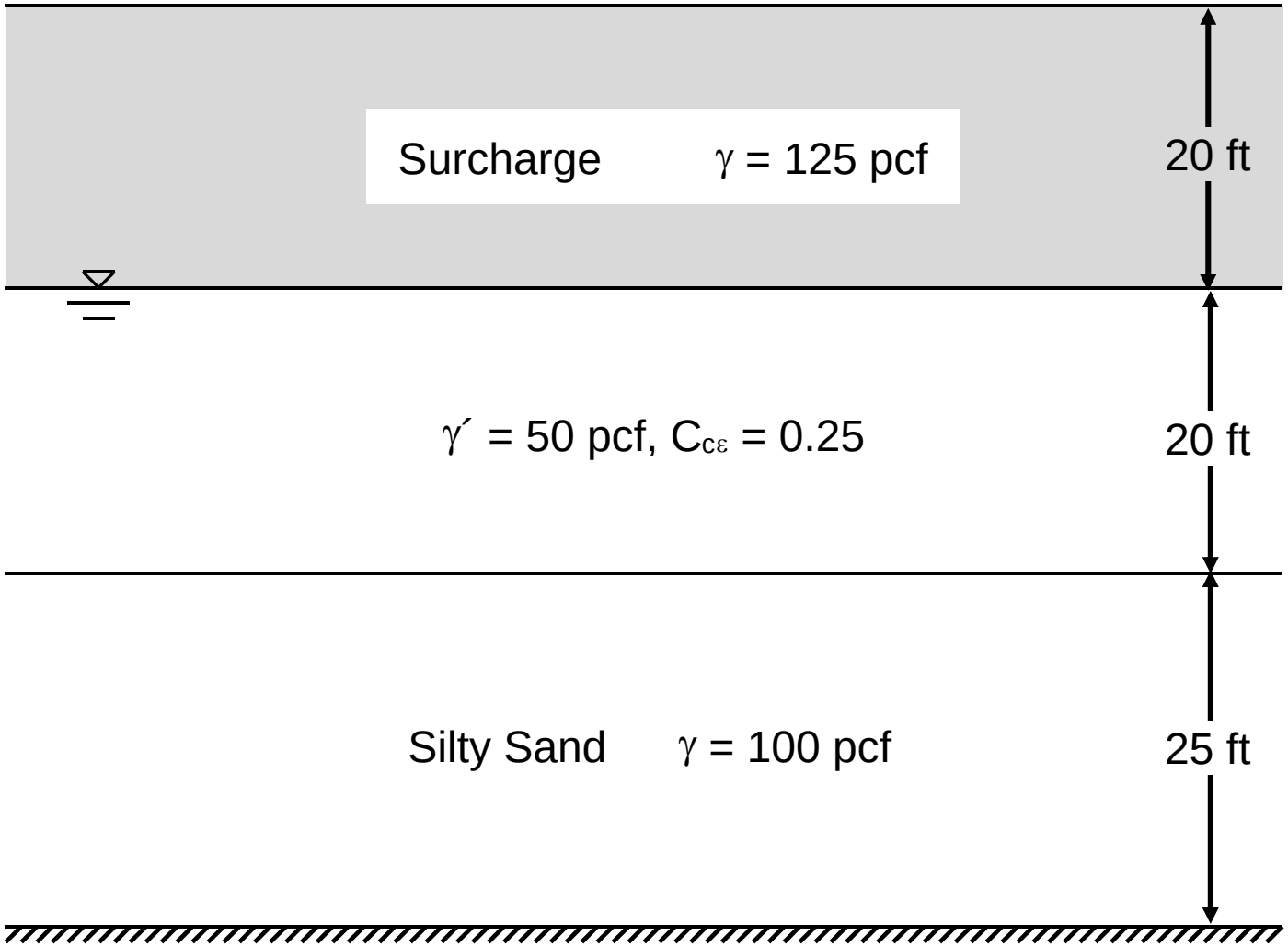


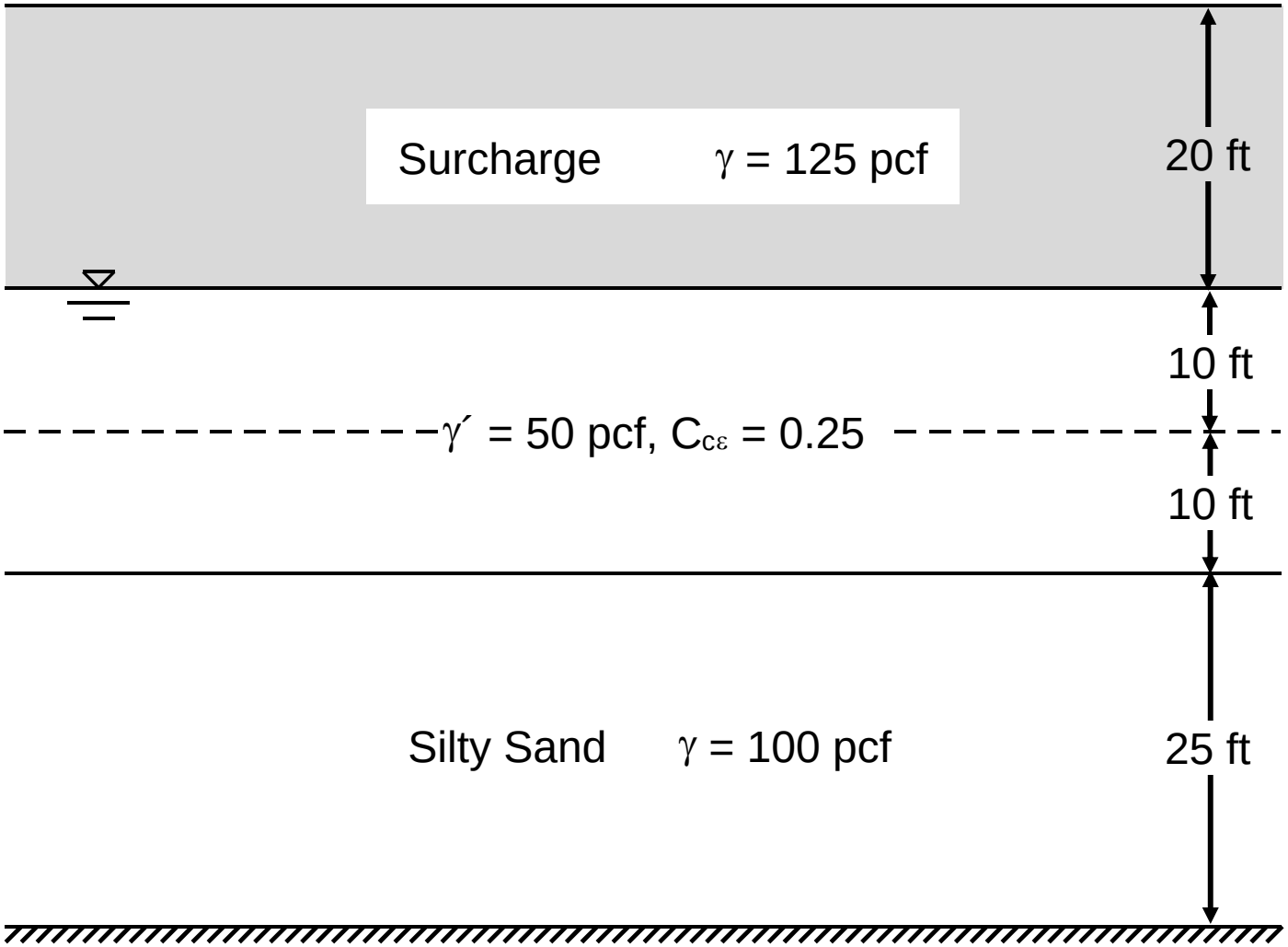
$$C_{c\varepsilon} = \frac{0.38 - 0.10}{\log(800/80)} = \frac{0.28}{1} = 0.28$$




Surcharge γ = 125 pcf
20 ft
Silty Sand γ = 100 pcf
25 ft
γ´ = 50 pcf, Ccε = 0.25
20 ft


Surcharge γ = 125 pcf
20 ft
Silty Sand γ = 100 pcf
25 ft
10 ft
γ´ = 50 pcf, Ccε = 0.25
10 ft

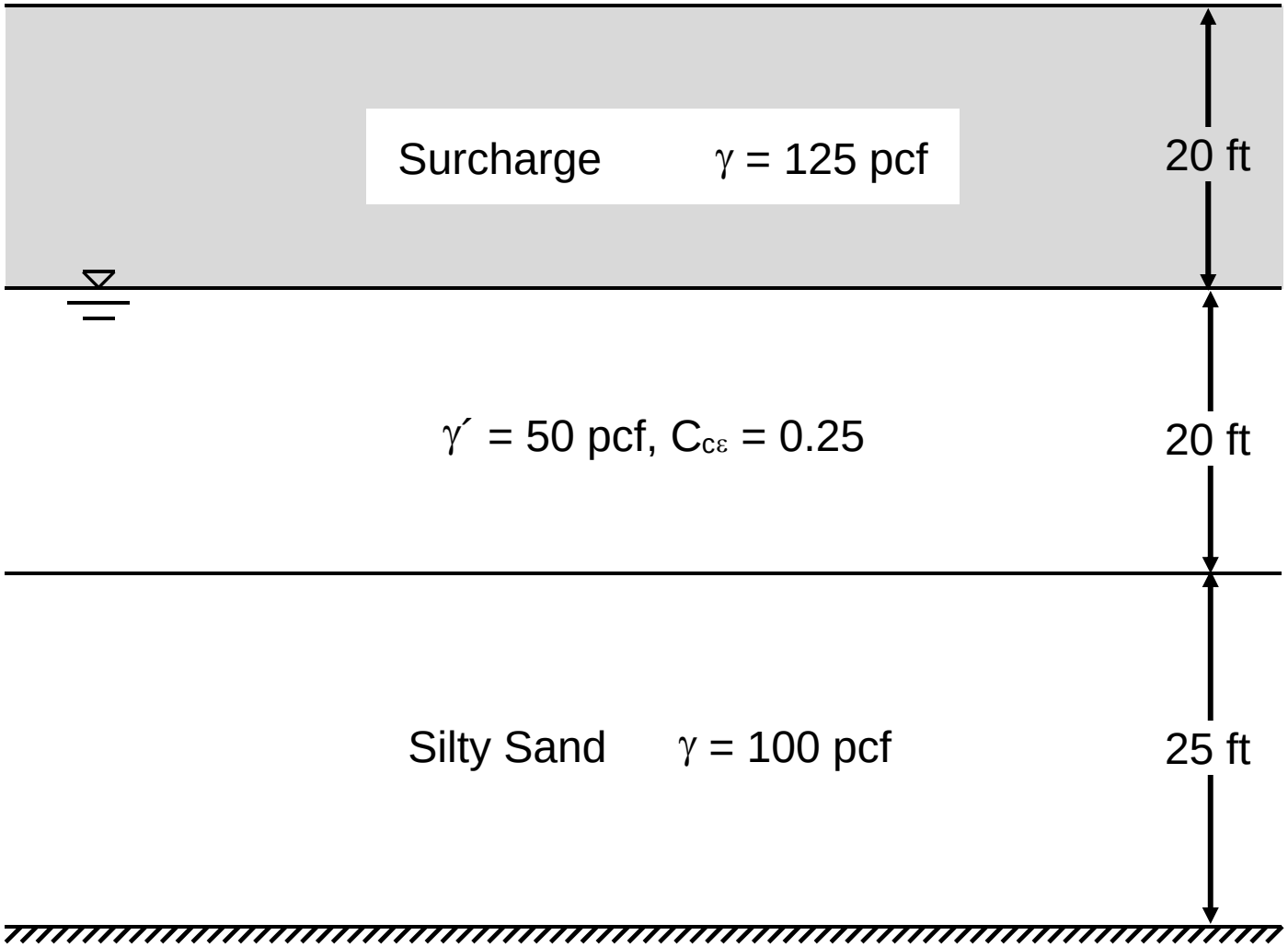

Surcharge γ = 125 pcf
20 ft
γ′ = 50 pcf, Ccε = 0.25
20 ft
Silty Sand γ = 100 pcf
25 ft

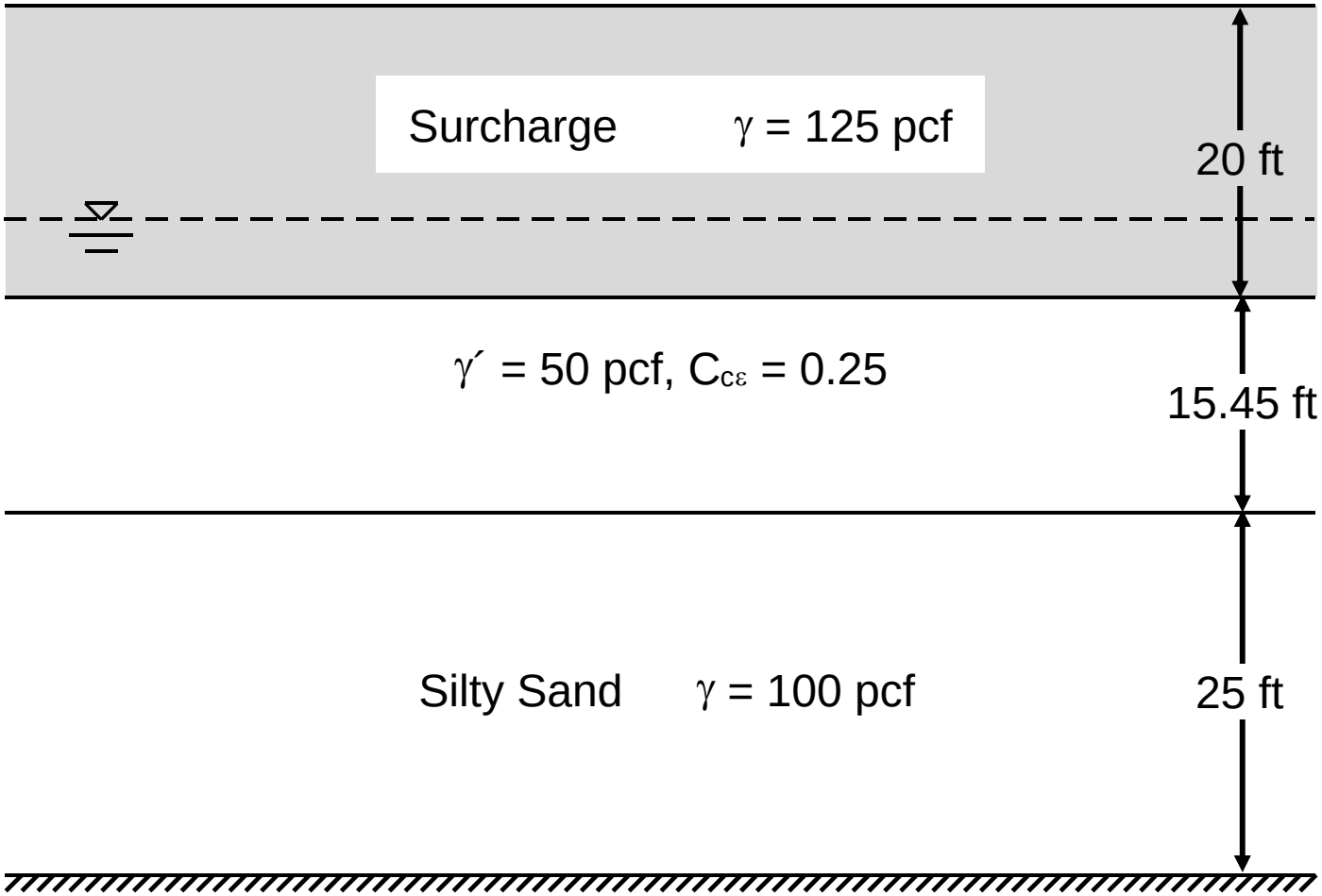

Surcharge
γ = 125 pcf
20 ft
10 ft
γ´ = 50 pcf, Ccε = 0.25
10 ft
Silty Sand
γ = 100 pcf
25 ft

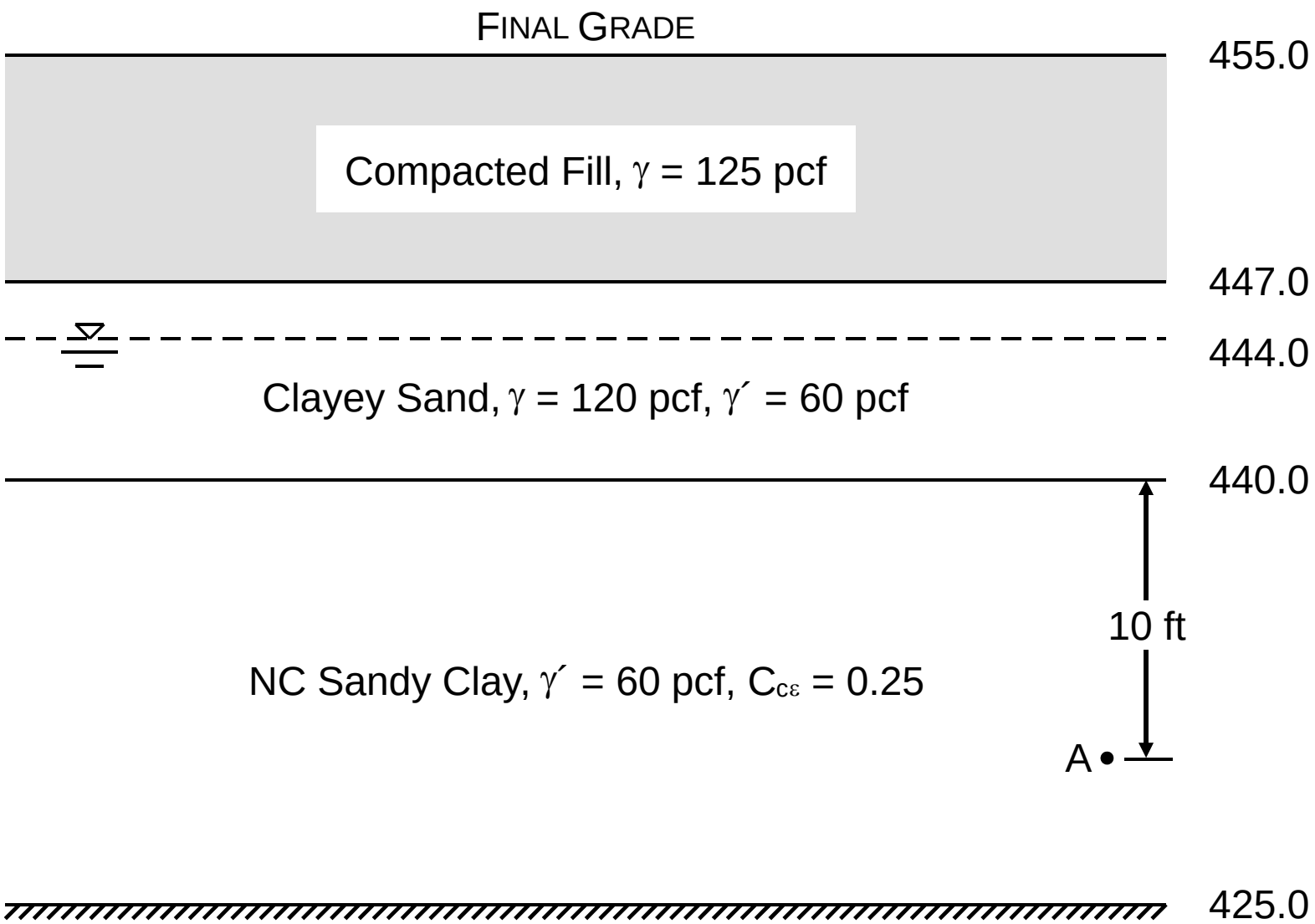
Normally-Consolidated Soils

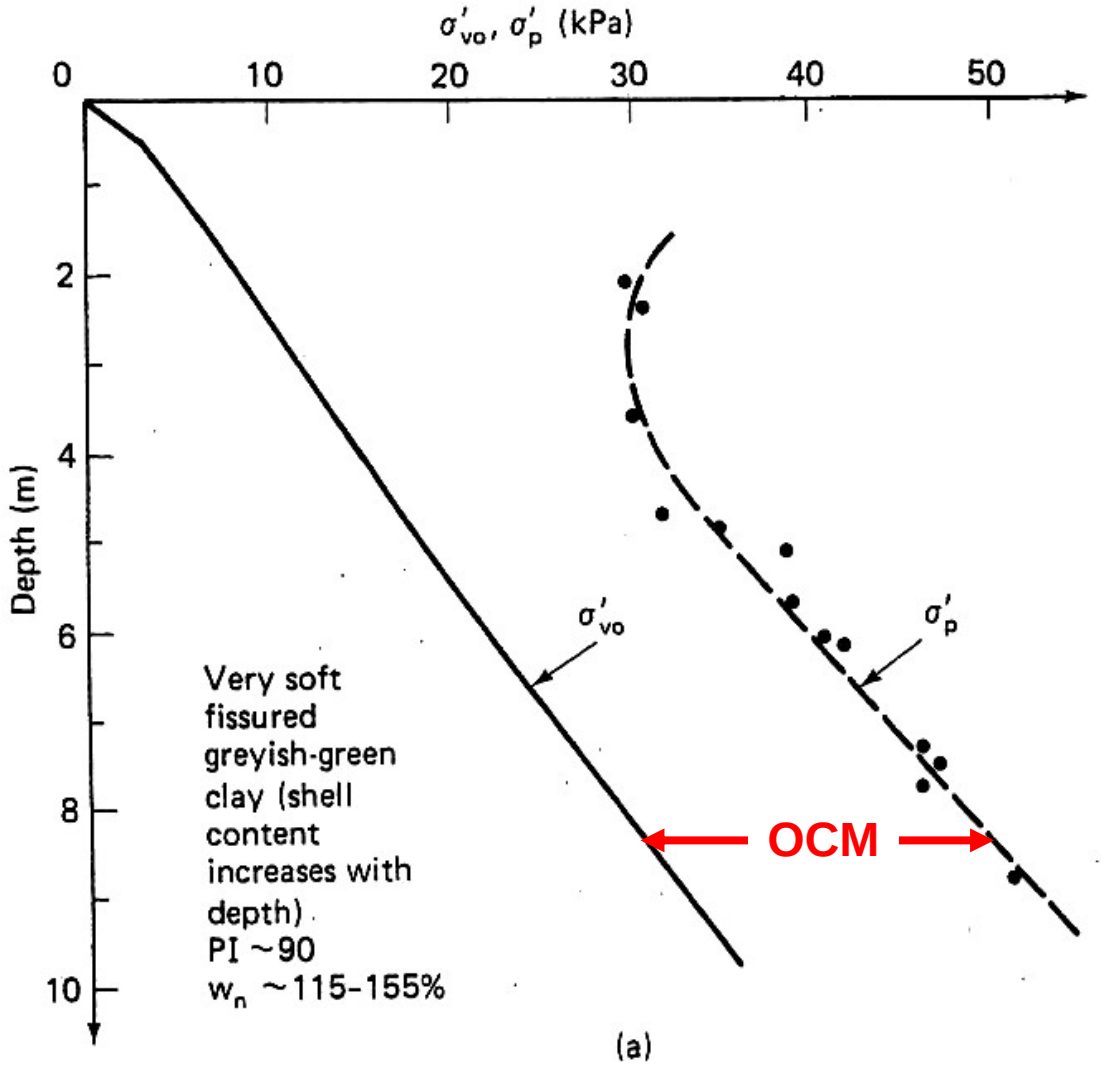
$$\Delta H = \frac{C_{c\varepsilon}}{\gamma'}\left(\sigma'_{vo}{}^{top}\log\sigma'_{vo}{}^{top} - \sigma'_{vo}{}^{bot}\log\sigma'_{vo}{}^{bot}\right)$$

$$-\frac{C_{c\varepsilon}}{\gamma'}\left(\sigma'_{vf}{}^{top}\log\sigma'_{vf}{}^{top} - \sigma'_{vf}{}^{bot}\log\sigma'_{vf}{}^{bot}\right)$$

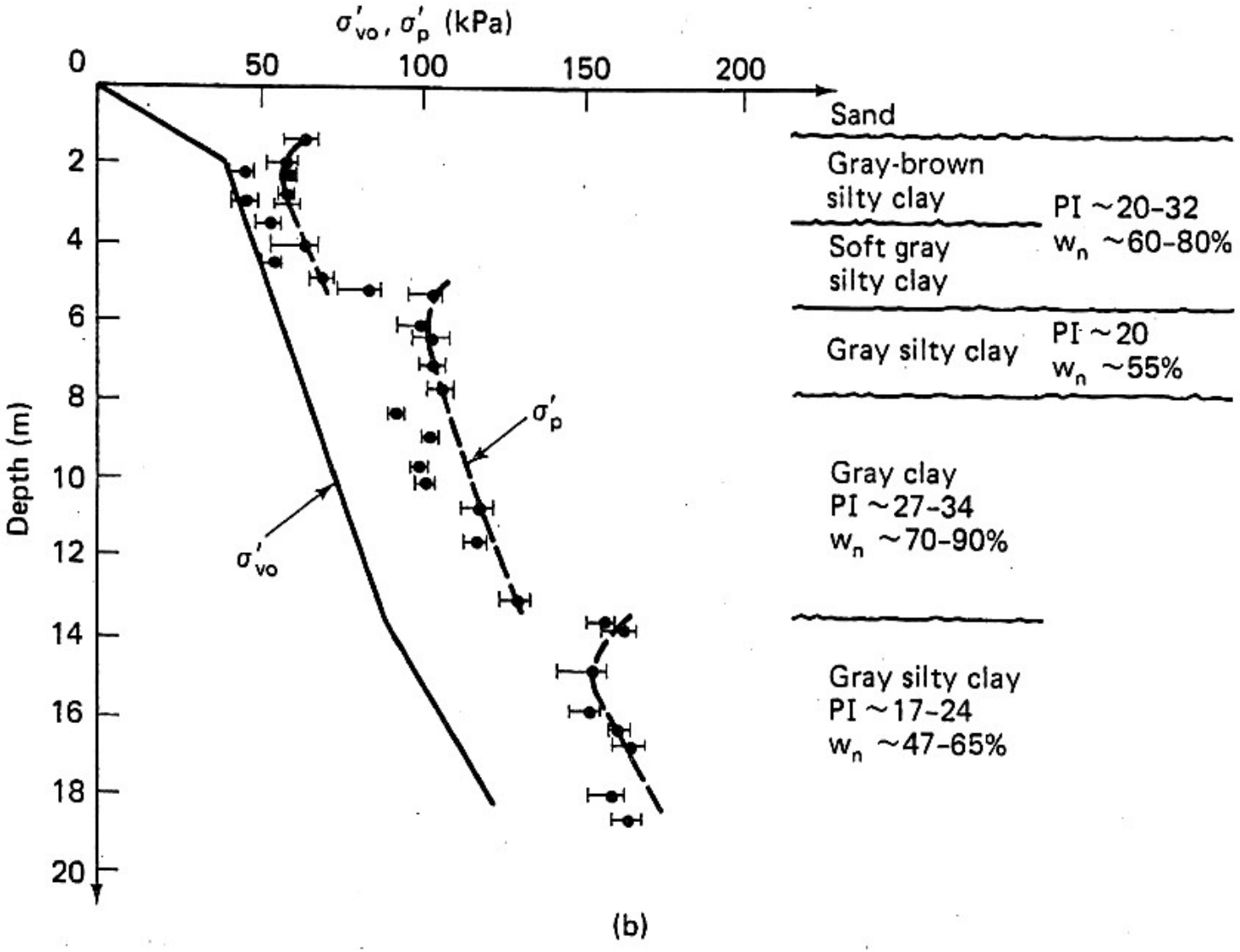

Surcharge γ = 125 pcf
20 ft
γ′ = 50 pcf, Ccε = 0.25
20 ft
Silty Sand γ = 100 pcf
25 ft


Surcharge γ = 125 pcf
20 ft
γ´ = 50 pcf, Ccε = 0.25
15.45 ft
Silty Sand γ = 100 pcf
25 ft

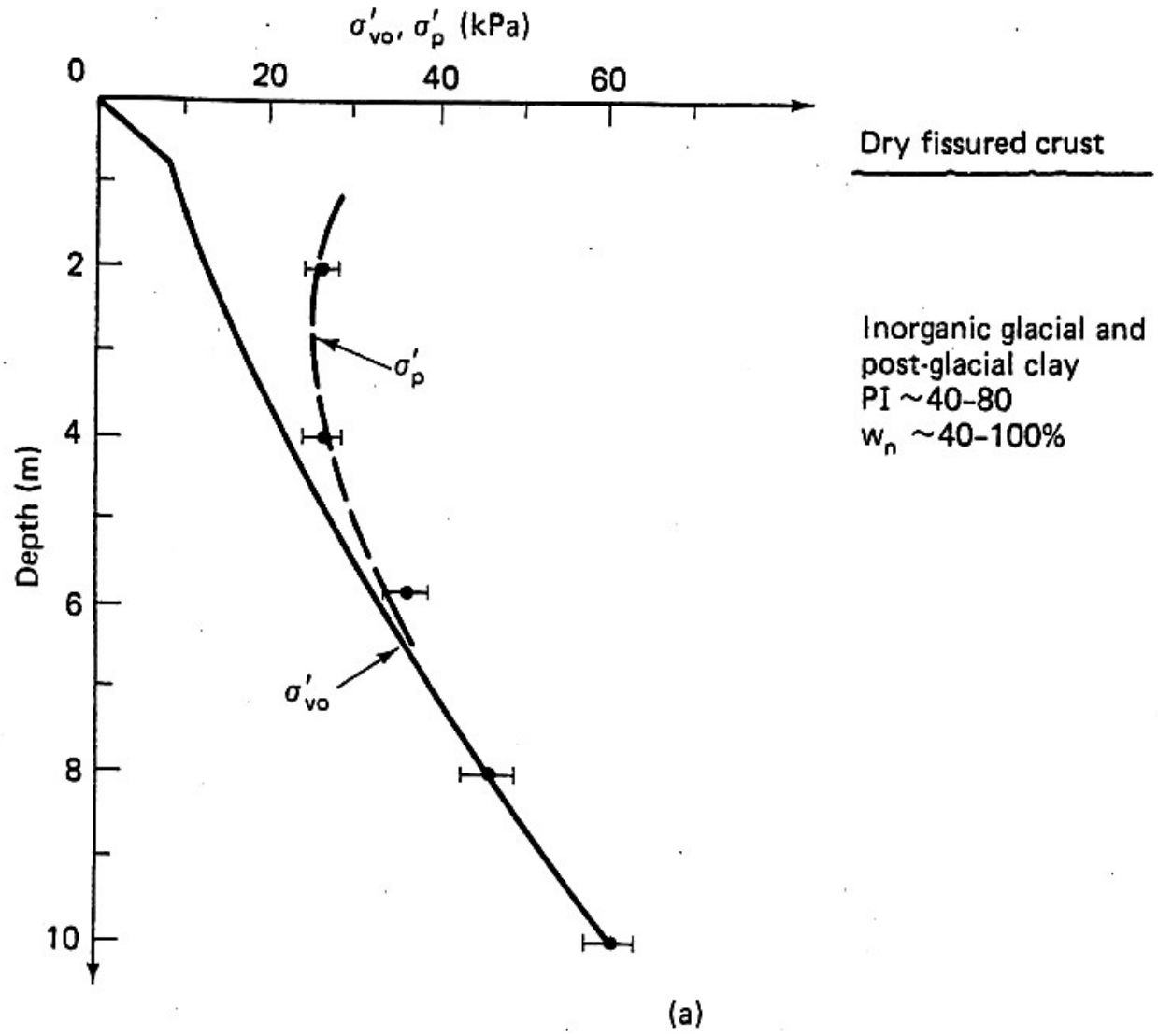

FINAL GRADE
455.0
Compacted Fill, γ = 125 pcf
447.0
444.0
Clayey Sand, γ = 120 pcf, γ´ = 60 pcf
440.0
10 ft
NC Sandy Clay, γ´ = 60 pcf, Ccε = 0.25
A
425.0



(Holtz & Kovacs, *An Introduction to Geotechnical Engineering*, 1981)



(Holtz & Kovacs, *An Introduction to Geotechnical Engineering*, 1981)



(Holtz & Kovacs, *An Introduction to Geotechnical Engineering*, 1981)

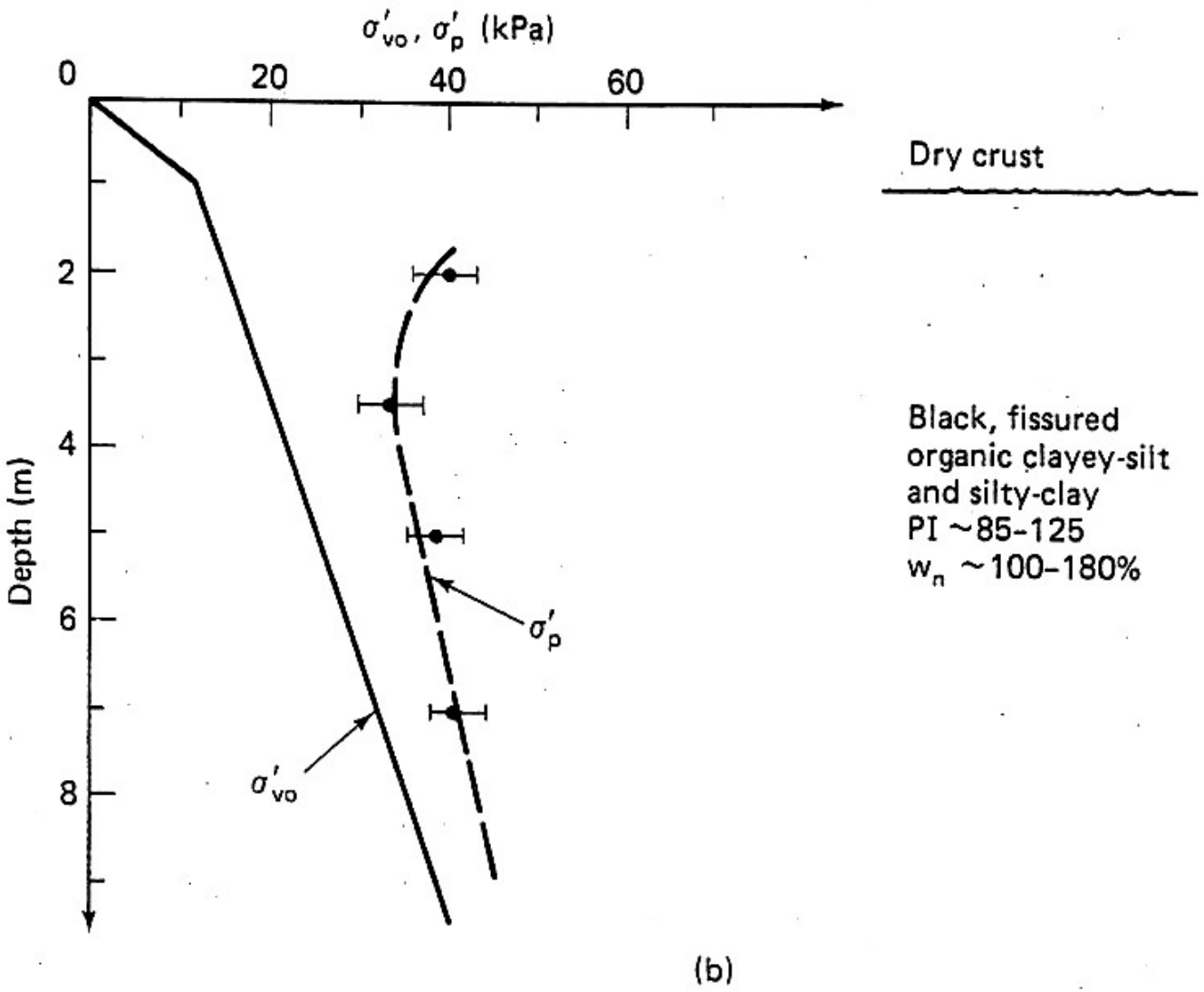
Over-Consolidated Soils

$$\Delta H = \frac{C_{r\varepsilon} - C_{c\varepsilon}}{\gamma'}\left(\sigma_p'^{\,bot}\log\sigma_p'^{\,bot} - \sigma_p'^{\,top}\log\sigma_p'^{\,top}\right)$$

$$-\frac{C_{r\varepsilon}}{\gamma'}\left(\sigma_{vo}'^{\,bot}\log\sigma_{vo}'^{\,bot} - \sigma_{vo}'^{\,top}\log\sigma_{vo}'^{\,top}\right)$$

$$+\frac{C_{c\varepsilon}}{\gamma'}\left(\sigma_{vf}'^{\,bot}\log\sigma_{vf}'^{\,bot} - \sigma_{vf}'^{\,top}\log\sigma_{vf}'^{\,top}\right)$$

For cases where the OCM is constant with depth



(Holtz & Kovacs, *An Introduction to Geotechnical Engineering*, 1981)

Over-Consolidated Soils

$$\Delta H = \frac{C_{r\varepsilon} - C_{c\varepsilon}}{s_p}\left(\sigma_p'^{\,bot}\log\sigma_p'^{\,bot} - \sigma_p'^{\,bot} - \sigma_p'^{\,top}\log\sigma_p'^{\,top} + \sigma_p'^{\,top}\right)$$

$$-\frac{C_{r\varepsilon}}{s_o}\left(\sigma_{vo}'^{\,bot}\log\sigma_{vo}'^{\,bot} - \sigma_{vo}'^{\,bot} - \sigma_{vo}'^{\,top}\log\sigma_{vo}'^{\,top} + \sigma_{vo}'^{\,top}\right)$$

$$+\frac{C_{c\varepsilon}}{s_f}\left(\sigma_{vf}'^{\,bot}\log\sigma_{vf}'^{\,bot} - \sigma_{vf}'^{\,bot} - \sigma_{vf}'^{\,top}\log\sigma_{vf}'^{\,top} + \sigma_{vf}'^{\,top}\right)$$

For cases where the OCM is not constant with depth

$s_p = d\sigma_p'/dz \quad s_o = d\sigma_{vo}'/dz \quad s_f = d\sigma_{vf}'/dz$