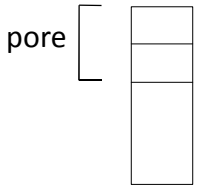
POROZNOST I KOEFICIJENT POROZNOSTI
tri faze u tlu



s-čvrste čestice

w-voda

v- vazduh

poroznost $n = \frac{V_v + V_w}{V} * 100(\%)$

koeficijent poroznosti $e = \frac{V_v + V_w}{V_s}$

povezanost e i n $e = \frac{n}{1-n}$ $n = \frac{e}{1+e}$

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ZAPREMINSKE TEŽINE TLA

-zapreminska težina tla u prirodnom stanju

$\gamma = \frac{W}{V}$ (kN/m^3)

W=Ws+Ww+Wv - ukupna težina

V=Vs+Vw+Vv - ukupna zapremina

-zapreminska težina tla u suvom stanju

$\gamma_d = \frac{Ws + Wv}{V}$ (kN/m^3)

Wv – težina vazduha $\cong 0$

sve pore ispunjene vazduhom (tlo potpuno suvo)

-zapreminska težina tla u zasićenom stanju

$\gamma_z = \frac{Ws + Ww}{V}$ (kN/m^3)

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-zapreminska težina tla u potopljenom stanju

$\gamma' = \gamma_z - \gamma_w$ (kN/m^3)

Arhimedov zakon

-zapreminska težina čvrstih čestica

$\gamma_s = \frac{Ws}{Vs}$ (kN/m^3)

VLAŽNOST TLA

$w = \frac{Ww}{Ws} \cdot 100(\%)$ odnos težine vode u tlu prema težini čvrstih čestica izražen u procentima

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Stepen zasićenja tla

$S_r = \frac{w}{w_z}$ $w_z = \frac{(V - Vs) \cdot \gamma_w}{Ws} \cdot 100(\%)$ w_z-vlažnost pri zasićenju

Specifična težina tla

$G_s = \frac{\gamma_s}{\gamma_w}$ γ_w=9.807 kN/m^3 - zapreminska težina vode

Uticaj vlažnosti na zapreminsku težinu

$\gamma = \gamma_d(1 + w)$

$\gamma_z = \gamma_d(1 + w_z)$

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Zadaci

1. Dato je γ_s i γ_d odrediti e=? n=?

$$\gamma_s = \frac{Ws}{Vs} \rightarrow Vs = \frac{Ws}{\gamma_s}$$

$$\gamma_d = \frac{Ws}{V} \rightarrow V = \frac{Ws}{\gamma_d}$$

$$e = \frac{V - Vs}{Vs} = \frac{V}{Vs} - 1 = \frac{\frac{Ws}{\gamma_d}}{\frac{Ws}{\gamma_s}} - 1 = \frac{\gamma_s}{\gamma_d} - 1 = \frac{\gamma_s - \gamma_d}{\gamma_d}$$

$$e = \frac{\gamma_s - \gamma_d}{\gamma_d} \qquad e = \frac{\gamma_s}{\gamma_d} - 1$$

$$\frac{\gamma_s}{\gamma_d} = e + 1 \rightarrow \qquad \gamma_d = \frac{\gamma_s}{e+1} \qquad \gamma_s = \gamma_d(e+1)$$

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$$n = \frac{V - Vs}{V} = 1 - \frac{Vs}{V} = 1 - \frac{\frac{Ws}{\gamma_s}}{\frac{Ws}{\gamma_d}} = 1 - \frac{\gamma_d}{\gamma_s} = \frac{\gamma_s - \gamma_d}{\gamma_s}$$

$$n = 1 - \frac{\gamma_d}{\gamma_s} \qquad n = \frac{\gamma_s - \gamma_d}{\gamma_s}$$

$$\frac{\gamma_d}{\gamma_s} = 1 - n \rightarrow \qquad \gamma_d = \gamma_s(1-n) \qquad \gamma_s = \frac{\gamma_d}{1-n}$$

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2. Dato je γ_s i γ_d odrediti w_z =?

$$w_z = \frac{(V - Vs)\cdot \gamma_w}{Ws} = \left(\frac{V}{Ws} - \frac{Vs}{Ws}\right)\cdot \gamma_w$$

$$\gamma_d = \frac{Ws}{V} \rightarrow \frac{1}{\gamma_d} = \frac{V}{Ws} \qquad \gamma_s = \frac{Ws}{Vs} \rightarrow \frac{1}{\gamma_s} = \frac{Vs}{Ws}$$

$$w_z = \left(\frac{1}{\gamma_d} - \frac{1}{\gamma_s}\right)\cdot \gamma_w$$

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3. Uzorak uzet iz sondažne bušotine ima sledeće karakteristike:
e=0.45 ; w_z=17% ; γ_d=18 kN/m³
Odrediti: n , γz , G_s

Rešenje:

$$n = \frac{e}{1+e} = \frac{0.45}{1+0.45} = 0.31*100 = 31\%$$

$$\gamma_z = \gamma_d(1+w_z) = 18(1+17/100) = 21{,}06 kN/m^3$$

$$\gamma_s = \gamma_d(e+1) = 18(1+0.45) = 26{,}10 kN/m^3$$

$$G_s = \frac{\gamma_s}{\gamma_w} = \frac{26{,}10}{9{,}807} = 2{,}66$$

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4. Neporemećen uzorak cilindričnog oblika uzet iz sondažne bušotine ima dimenzije: prečnik 8 cm, visina 25 cm
Masa tla u prirodnom stanju je M_W=2371 g,
a u osušenom M_d=1948g

G_s=2.72
Odrediti: w , γ , γ_d, γz , γ' , e , n , S_r

Rešenje:

vlažnost tla

$$w = \frac{M_w - M_d}{M_d} = \frac{2371 - 1948}{1948} \cdot 100 = 21{,}70\%$$

zapremina uzorka

$$V = \frac{d^2\pi}{4} \cdot h = \frac{8^2\pi}{4} \cdot 25 = 1256{,}64\,cm^3$$

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zapreminske težine

-vlažno stanje

$$\gamma = \frac{M_w \cdot g}{V} = \frac{2371 \cdot 9{,}807}{1256{,}64} = 18{,}5 kN/m^3$$

sređivanje jedinica

$$\frac{g}{cm^3} \cdot \frac{m}{s^2} = \frac{10^{-3} kg \cdot m}{cm^3 \cdot s^2} = \frac{10^{-3} N}{cm^3} = \frac{10^{-6} kN}{10^{-6} m^3} = \frac{kN}{m^3}$$

-suvo stanje

$$\gamma_d = \frac{M_d \cdot g}{V} = \frac{1948 \cdot 9{,}807}{1256{,}64} = 15{,}2 kN/m^3$$

-zasićeno stanje

$$\gamma_z = \gamma_d(1 + w_z)$$ **nepoznato w_z**

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$$w_z = \left(\frac{1}{\gamma_d} - \frac{1}{\gamma_s}\right)\cdot\gamma_w$$ **nepoznato γ_s**

$$G_s = \frac{\gamma_s}{\gamma_w} \rightarrow \gamma_s = G_s\cdot\gamma_w = 2{,}72\cdot 9{,}807 = 26{,}68\,kN/m^3$$

$$w_z = \left(\frac{1}{15{,}2} - \frac{1}{26{,}68}\right)\cdot 9{,}807 * 100 = 27{,}8\%$$

$$\gamma_z = 15{,}2(1+0{,}278) = 19{,}43\,kN/m^3$$

-potopljeno stanje

$$\gamma' = \gamma_z - \gamma_w = 19{,}43 - 9{,}807 = 9{,}62\,kN/m^3$$

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-koeficijent poroznosti

$$e = \frac{\gamma_s - \gamma_d}{\gamma_d} = \frac{26{,}7 - 15{,}2}{15{,}2} = 0.757$$

-poroznost

$$n = \frac{e}{1+e}\cdot 100 = \frac{0{,}757}{1+0{,}757}\cdot 100 = 43{,}10\%$$

-Stepen zasićenja

$$S_r = \frac{w}{w_z}\cdot 100 = \frac{21{,}7}{27{,}8}\cdot 100 = 78{,}10\%$$

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5. Kocka vlažnog tla sa dužinom ivice 20 cm ima masu M_w=14,5 kg. Vlažnost tla je w=17,8%, specifična težina je G_s=2,75. Odrediti: e , n , S_r

Rešenje:

$$w = \frac{M_w - M_d}{M_d} \qquad \frac{17,8}{100} = \frac{14500 - M_d}{M_d}$$

$$1,178 M_d = 14500 \rightarrow M_d = 12309\,g$$

$$\gamma_d = \frac{M_d \cdot g}{V} = \frac{12309 \cdot 9,807}{8000} = 15,10 kN/m^3$$

$$G_s = \frac{\gamma_s}{\gamma_w} \rightarrow \gamma_s = G_s \cdot \gamma_w = 2,75 \cdot 9,807 = 26,97 kN/m^3$$

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$$w_z = \left(\frac{1}{15,1} - \frac{1}{26,97} \right) \cdot 9,807 * 100 = 28,58\%$$

-koeficijent poroznosti

$$e = \frac{\gamma_s - \gamma_d}{\gamma_d} = \frac{26,97 - 15,1}{15,1} = 0.78$$

-poroznost

$$n = \frac{e}{1+e} \cdot 100 = \frac{0,78}{1+0,78} \cdot 100 = 44\%$$

-Stepen zasićenja

$$S_r = \frac{w}{w_z} \cdot 100 = \frac{17,8}{28,58} \cdot 100 = 62,27\%$$

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6. Dato je:

γ= 19,3 kN/m^3

γ_d= 16,2 kN/m^3

γ' = 10,0 kN/m^3

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Odrediti:

w = ?

w_z = ?

n = ?

γ_s = ?

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$$\gamma = \gamma_d(1+w) \rightarrow (1+w) = \frac{\gamma}{\gamma_d} \rightarrow w = \frac{\gamma - \gamma_d}{\gamma_d} = \frac{19,3 - 16,2}{16,2} * 100$$

$$w = 19,13\%$$

$$\gamma_z = \gamma' + \gamma_w = 10,0 + 9,807 = 19,807 kN/m^3$$

$$\gamma_z = \gamma_d(1+w_z) \rightarrow w_z = \frac{\gamma_z - \gamma_d}{\gamma_d} = \frac{19,807 - 16,2}{16,2} * 100$$

$$w_z = 22,26\%$$

$$w_z = \left(\frac{1}{\gamma_d} - \frac{1}{\gamma_s}\right) \cdot \gamma_w \qquad \frac{22,26}{100} = \left(\frac{1}{16,2} - \frac{1}{\gamma_s}\right) \cdot 9,807$$

$$\frac{1}{\gamma_s} = \frac{1}{16,2} - \frac{0,2226}{9,807} = 0.039 \qquad \gamma_s = 25,62 kN/m^3$$

$$n = \frac{\gamma_s - \gamma_d}{\gamma_s} \cdot 100 = \frac{25,62 - 16,2}{25,62} \cdot 100 = 36,77\%$$

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7. Dato je:

γ= 17,6 kN/m^3
γ_s= 27,0 kN/m^3
w = 10 % = 0,1

Odrediti:
γ_d = ?
e = ?
n = ?
γ_z (Sr=1) =?

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REŠENJE

$$\gamma = \gamma_d(1+w) \rightarrow \gamma_d = \frac{\gamma}{1+w} = \frac{17.6}{1+0,1} = 16,0 kN/m^3$$

$$e = \frac{\gamma_s}{\gamma_d} - 1 = \frac{27,0}{16,0} - 1 = 0.687$$

$$n = \frac{e}{e+1} = \frac{0.687}{0.687+1} = 0.407*100 = 40.7\%$$

$$w_z = \left(\frac{1}{\gamma_d} - \frac{1}{\gamma_s}\right)\cdot\gamma_w = \left(\frac{1}{16} - \frac{1}{27}\right)\cdot 9,807 = 0,249*100 = 24,90\%$$

$$\gamma_z = \gamma_d(1+w_z) = 16,0(1+0.249) = 19,98 kN/m^3$$

$$S_r = \frac{w}{w_z} = \frac{10}{24.9} = 0.40$$ -malo vlažno tlo

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8. Dato je:

Sr=1

γ = 19 kN/m3

w = 30 %

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n = ?

e = ?

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REŠENJE

$$\gamma = \gamma_d(1+w) \rightarrow \gamma_d = \frac{\gamma}{1+w} = \frac{19,0}{1+0,3} = 14,61 \text{kN/m}^3$$

$$w_z = w = 30\%$$

$$w_z = \left(\frac{1}{\gamma_d} - \frac{1}{\gamma_s}\right) \cdot \gamma_w$$

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$$\gamma_s = \frac{\gamma_d}{1 - \frac{\gamma_d}{\gamma_w} \cdot w} = \frac{14,61}{1 - \frac{14,61}{9,807} \cdot 0.3} = 26,41 \text{kN/m}^3$$

$$n = \frac{\gamma_s - \gamma_d}{\gamma_s} = \frac{26,41 - 14,61}{26,41} = 0,447$$

$$e = \frac{\gamma_s - \gamma_d}{\gamma_d} = \frac{26,41 - 14,61}{14,61} = 0,807$$

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