GEOtExcel : Soil Mechanics

Soil Phase Relationships : Problem 02

In a soil, the void ratio is equal to e , and the specific gravity of solid particles is G_s . The degree of saturation of the soil is S_r .

A) What is the moisture content of this soil?

B) If V_s=10 cm^3, what are the values of V_v ,V_w ,V_a ,W_w, and W_s ?

C) How much water should be added to saturate it?

After saturation, what will be the moisture content of the soil?

Student ID	e	G_s	S_r %
Public	0.60	2.65	20
0001	0.61	2.66	22
0002	0.62	2.67	24
0003	0.63	2.68	26
0004	0.64	2.69	28
0005	0.65	2.70	30
0006	0.66	2.71	32
0007	0.67	2.72	34
0008	0.68	2.73	36
0009	0.69	2.74	38
0010	0.70	2.75	40
0011	0.71	2.76	42
0012	0.72	2.77	44
0013	0.73	2.78	46
0014	0.74	2.79	48
0015	0.75	2.80	50
0016	0.76	2.81	52
0017	0.77	2.82	54
0018	0.78	2.83	56
0019	0.79	2.84	58
0020	0.80	2.85	60
0021	0.81	2.86	62
0022	0.82	2.87	64
0023	0.83	2.88	66
0024	0.84	2.89	68
0025	0.85	2.90	70
0026	0.86	2.91	72
0027	0.87	2.92	74
0028	0.88	2.93	76
0029	0.89	2.94	78
0030	0.90	2.95	80

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Soil Phase Relationships : Problem 02

In a soil, the void ratio is equal to 0.60 , and the specific gravity of solid particles is 2.65 . The degree of saturation of the soil is 20% .

A) What is the moisture content of this soil?

B) If V_s=10 cm^3, what are the values of V_v ,V_w ,V_a ,W_w, and W_s ?

C) How much water should be added to saturate it?

After saturation, what will be the moisture content of the soil?

Solution:

Part A:

Specific Gravity	G_s= 2.65	$w \cdot G_S = S_r \cdot e$
Void ratio	e= 0.60	$w = \frac{S_r \times e}{G_s} = \frac{0.20 \times 0.60}{2.65} = 0.0453$
Saturation rate	S_r = 0.20 = 20 %	
Moisture content	w = ?	w = 0.0453 = 4.53 %

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Soil Phase Relationships : Problem 02

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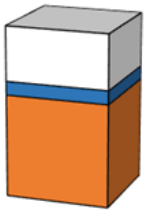
C) How much water should be added to saturate it?

After saturation, what will be the moisture content of the soil?

Solution:

Part B:

Moist Soil

V_a= ?		W_a=
V_w= ?		W_w= ?
V_s= 10 cm^3		W_s= ?
$V_v = V_a + V_w$ = ?		

$G_s = W_s / V_S$=	2.65	☑ $W_s = G_s . V_s$ =	2.65	×	10	= 26.5	g
$e = V_V / V_S$ =	0.60	☑ $V_v = e . V_s$ =	0.60	×	10	= 6.0	cm^3
$S_r = V_w / V_V$=	0.20	☑ $V_w = S_r . V_v$ =	0.20	×	6.0	= 1.2	cm^3
$w = W_w / W_s$=	0.0453	☑ $W_w = w . W_s$ =	0.0453	×	26.5	= 1.2	g
www.GEOtExcel.com		☑ $V_a = V_v - V_w$ =	6.00	-	1.20	= 4.80	cm^3

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Soil Phase Relationships : Problem 02

In a soil, the void ratio is equal to 0.60 , and the specific gravity of solid particles is 2.65 . The degree of saturation of the soil is 20% .

A) What is the moisture content of this soil?

B) If V_s=10 cm^3, what are the values of V_v ,V_w ,V_a ,W_w, and W_s ?

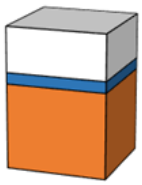
C) How much water should be added to saturate it?

After saturation, what will be the moisture content of the soil?

Solution: Part C :

Moist Soil

V_a=	4.80	cm^3
V_w=	1.20	cm^3
V_s=	10	cm^3
$V_v = V_a + V_w$ =	6.00	cm^3



W_a=	0	
W_w=	1.20	g
W_s=	26.50	g

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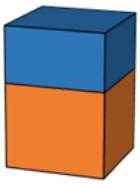
$G_s = W_s / V_s$=	2.65	
$e = V_v / V_s$ =	0.60	
$S_r = V_w / V_v$=	0.20	20%
$w = W_w / W_s$=	0.0453	

$W_s = G_s . V_s$ =	2.65	×	10.00	=	26.50	g
$V_v = e . V_s$ =	0.60	×	10.00	=	6.00	cm^3
$V_w = S_r . V_v$ =	0.20	×	6.00	=	1.20	cm^3
$W_w = w . W_s$ =	0.0453	×	26.50	=	1.20	g

Saturated Soil

V_a=	0.00	cm^3
V_w=	6.00	cm^3
V_s=	10	cm^3
$V_v = V_a + V_w$ =	6.00	cm^3



W_a=	0	
W_w=	6.00	g
W_s=	26.50	g

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$G_s = W_s / V_s$=	2.65	
$e = V_v / V_s$ =	0.60	
$S_r = V_w / V_v$=	1.00	100%
$w = W_w / W_s$=	0.2264	

$W_s = G_s . V_s$ =	2.65	×	10.00	=	26.50	g
$V_v = e . V_s$ =	0.60	×	10.00	=	6.00	cm^3
$V_w = S_r . V_v$ =	1.00	×	6.00	=	6.00	cm^3
$W_w = w . W_s$ =	0.2264	×	26.50	=	6.00	g

V_{w1} =	1.20	cm^3	Moist Soil
V_{w2} =	6.00	cm^3	Saturated Soil
ΔV_w =	6.00 - 1.20 =	4.80	cm^3
γ_w =	1.00	g / cm^3	

To saturate the soil: $\Delta W_w = (V_{w2} - V_{w1}) * \gamma_w$ = 4.80 g