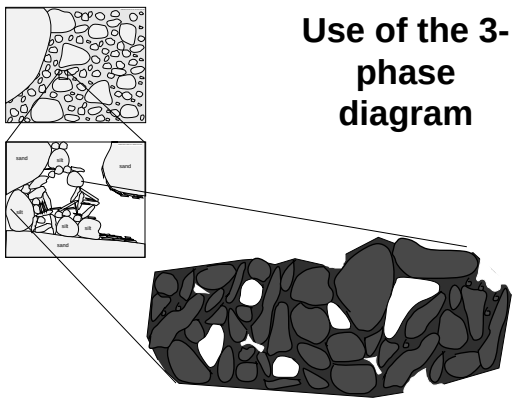
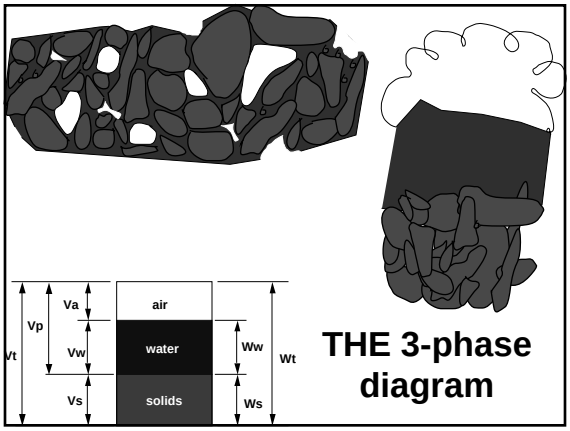
Use of the 3-phase diagram

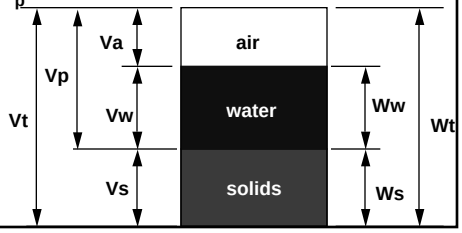




THE 3-phase diagram

Soil Relationshhips

- $V_t=V_a+V_w+V_s$
- $W_t=W_w+W_s$
- $W_w=V_wD_w$ ($=V_w$*1 g/cc)
- $W_s=V_sD_p$



Definitions

Void ratio	= e	=	V_p/V_s
Porosity	= n	=	V_p/V_t
Water content (moisture content)	= θ_m	=	W_w/W_s
% moisture	= W_w/W_t		
% solids	= W_s/W_t		
Degree of saturation	= S	=	V_w/V_p
Particle density (specific gravity)	= D_p	=	W_s/V_s
Bulk density	= D_b	=	W_s/V_t

Note: all of these are normally expressed as a "%", i.e., times 100%

Example 1

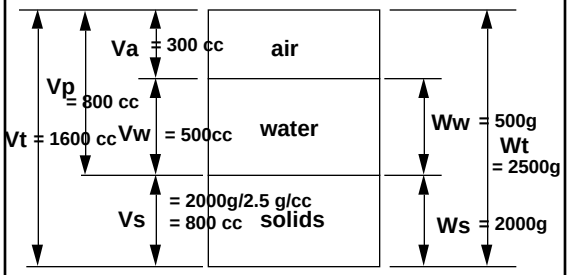
A soil has the following characteristics:

- wet weight = 2500 g
- dry weight = 2000 g
- void ratio = 100%
- particle density = 2.5

wet weight = 2500 g
dry weight = 2000 g
void ratio = 100%
particle density = 2.5 g/cc

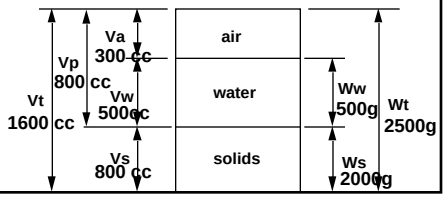
$e = V_p/V_s$
= 100%

Vp = 800 cc



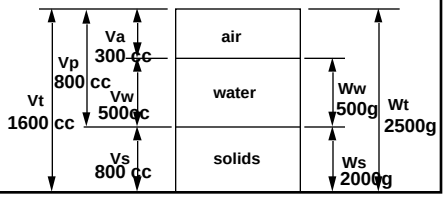
Find

Water content = θ_m = W_w/W_s*100%
(moisture content)
= 500 g/2000 g * 100%
= 25%



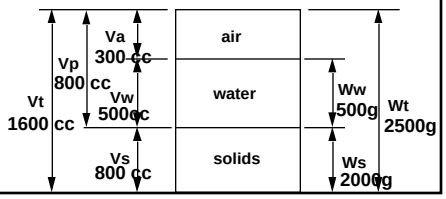
Find

% moisture = W_w/W_t
= 500 g/2500 g * 100%
= 20%



Find

% solids = W_w/W_t
= 2000 g/2500 g * 100%
= 80%



MOISTURE RELATIONSHIPS

Water (moisture) content = 25%
% moisture = 20%
% solids = 80%
Therefore:
% moisture = 100% - % solids

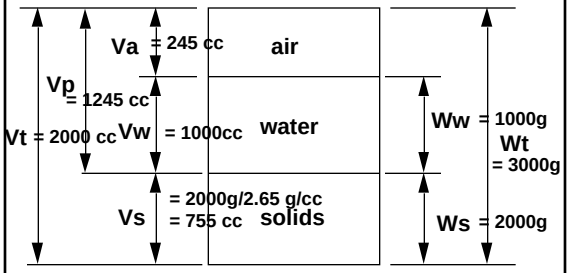
Example 2

A soil has the following characteristics:

- **Dry weight = 2000 g**
- **Moisture content= 50%**
- **Volume = 2000 cc**
- **Particle density = 2.65 g/cc**

- **Dry weight = 2000 g**
- **Moist. content = 50%**
- **Volume = 2000 cc**
- **Particle density = 2.65 g/cc**

$\theta_m = W_w/W_s$
50% = W_w /2000g
W_w = 1000 cc

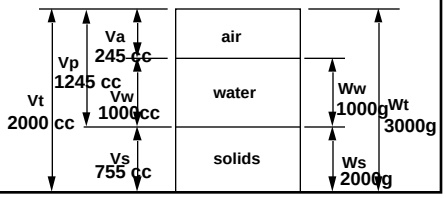


Find

Porosity = n = V_p/V_t

= 1245cc/2000cc * 100%

= 62%

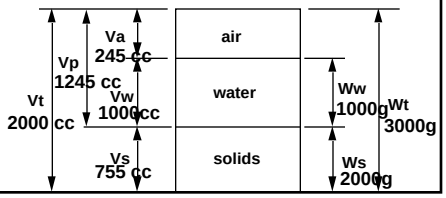


Find

Void ratio = e = V_p/V_s

= 1245cc/755cc * 100%

= 165%

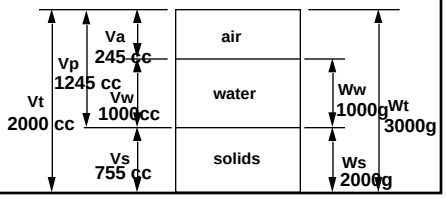


Find

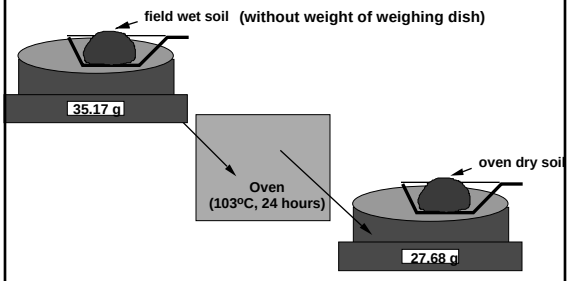
Degree of saturation = S = V_w/V_p

= 1000cc/1245cc * 100%

= 80%



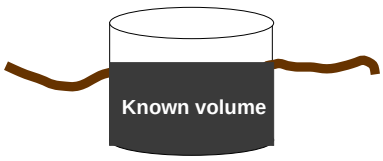
Measuring water in soil



% moisture = W_w/W_t

% solids = W_s/W_t

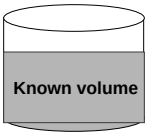
Measuring bulk density



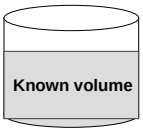
Determine oven dry weight

Db = Ws/Vt

Measuring pore space



Oven dry sample
determine dry weight

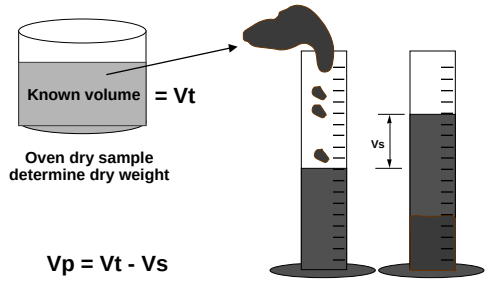


fill up with water - fill all
voids (till saturation)

Vp = volume of water used to entirely fill up voids

Dp = Ws/(Vt-Vp)

Alternate for measuring pore space



Oven dry sample
determine dry weight

$Vp = Vt - Vs$

$Dp = Ws/(Vs)$