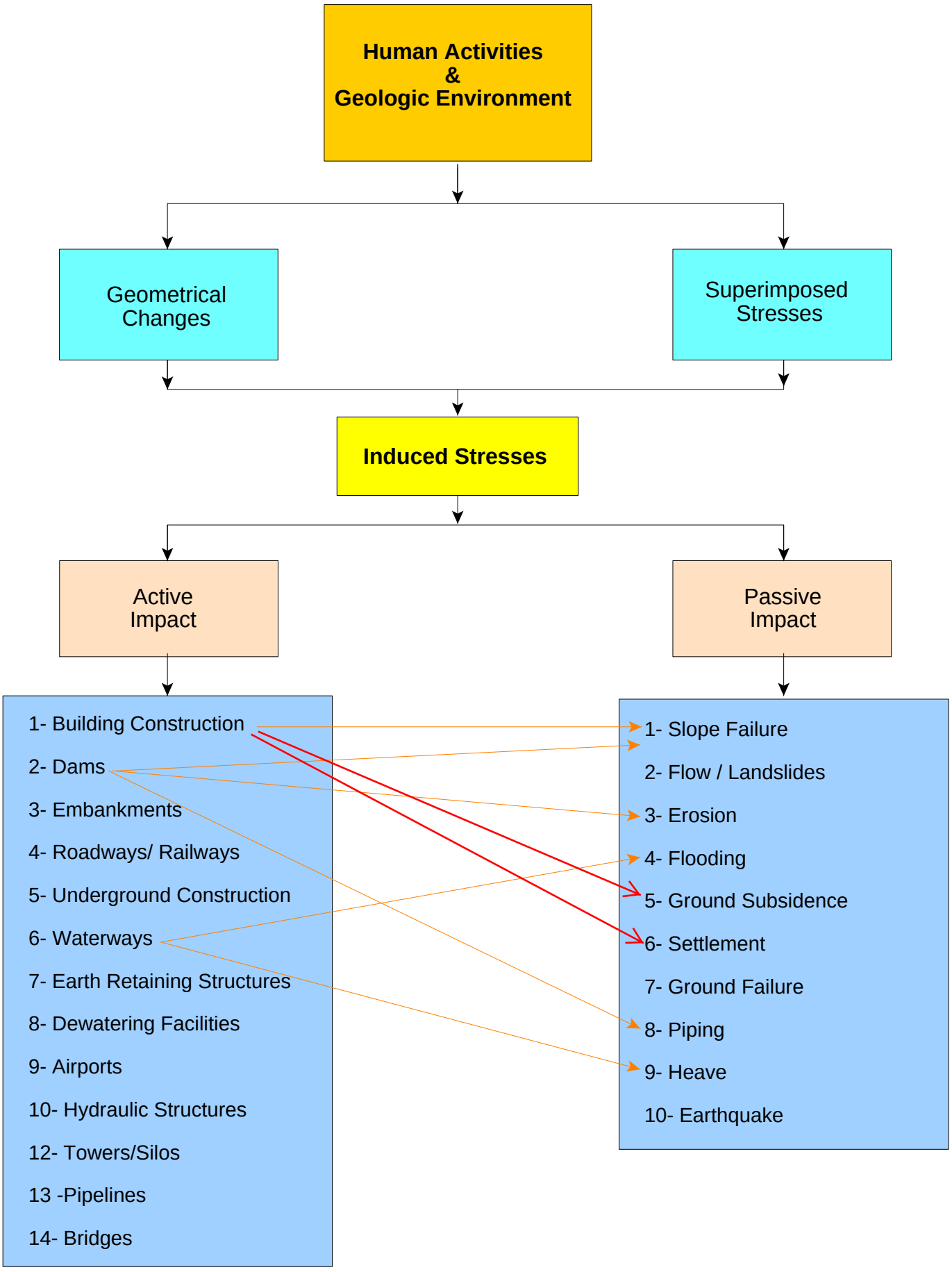

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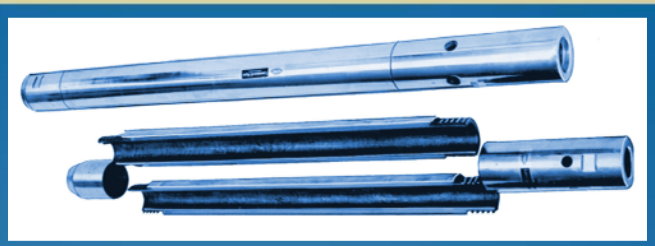
Geotechnical Investigation

5. Sample Recovery



5.1 Methods of Sample Recovery

1. *Hand auger*
2. *Split spoon*
3. *Backhoe*
4. *Thin wall tube (Shelby tube)*

5.2 Soil samples obtained during sectioning are either:

1. ***Disturbed***
2. ***Undisturbed***

Disturbed soil samples are used for

1. *Grain size analysis*
2. *Determination of index properties*
3. *Organic content*
4. *Specific gravity*

Undisturbed samples are used for

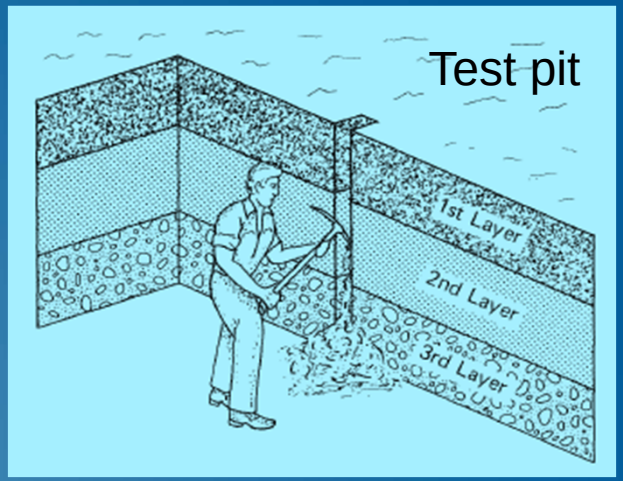
1. *As for disturbed sample*
2. *Determining mechanical properties*
3. *Determining hydraulic properties*

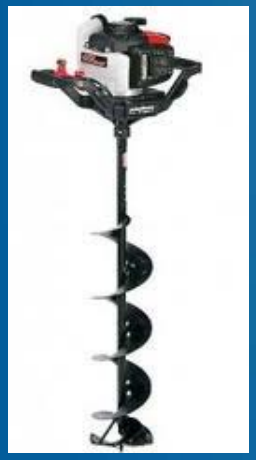
Geotechnical Investigation

Methods of Sample Recovery

1. *Hand auger*

The practical depth of investigation using a hand auger depends upon the soil properties and depth of investigation.





Geotechnical Investigation

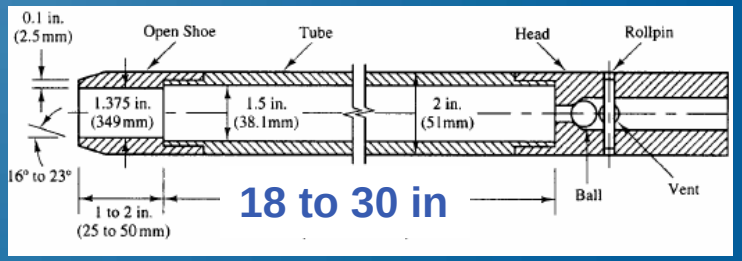
Methods of Sample Recovery

2. *Split spoon*

- Split spoon sampling methods are used primarily to collect shallow and deep subsurface soil samples.
- All split spoon samplers, regardless of size, are basically split cylindrical barrels that are threaded on each end.
- Split spoon sampling method is used to obtain **<u>disturbed</u>** and **<u>undisturbed samples.</u>**
  - *The sampler is driven in into the soil by a hammer*
  - *The weight of the hammer is 140 lb*
  - *The number of blows (N) required to penetrate the spoon of three 6 in. intervals are added and recorded.*

This procedure is called the Standard Penetration Test (SPT)

Actually, the Standard Penetration Number N is the number of blows of the last two intervals (12 in.) The first interval (6 in.) is usually discarded (why??????????)



Geotechnical Investigation

THE STANDARD PENETRATION TEST (SPT) ASTM D1586

- The SPT is one of the most popular and economical means to obtain subsurface information.

- The testing method was standardized in 1958 as ASTM D1568

The test consists of:

* A 140 lb driving mass falling from a height of 30 in.

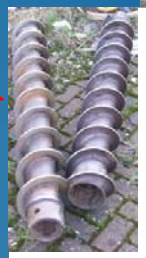
* Drive the standard split spoon sampler a distance of 18 in. into the soil

* Counting the number of blows (N) to drive the sampler 12 in. (6 in. + 6 in.)

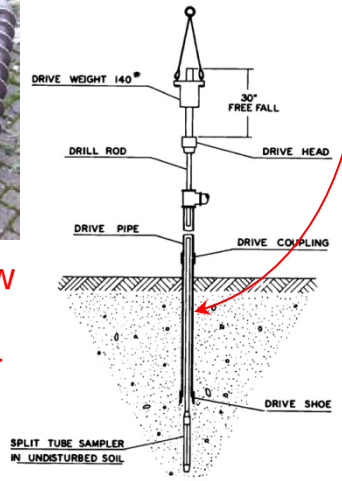
* The boring log should show "refusal" and should be halted if:

a- 50 blows are required for any 150 mm increment
b- 100 blows are obtained
c- 10 successful blows produce no advance

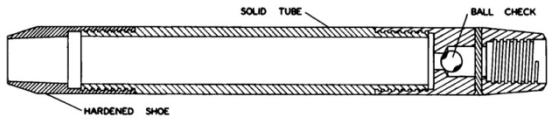
* N should be corrected for the increase of the overburden pressure



Hollow Stem Auger

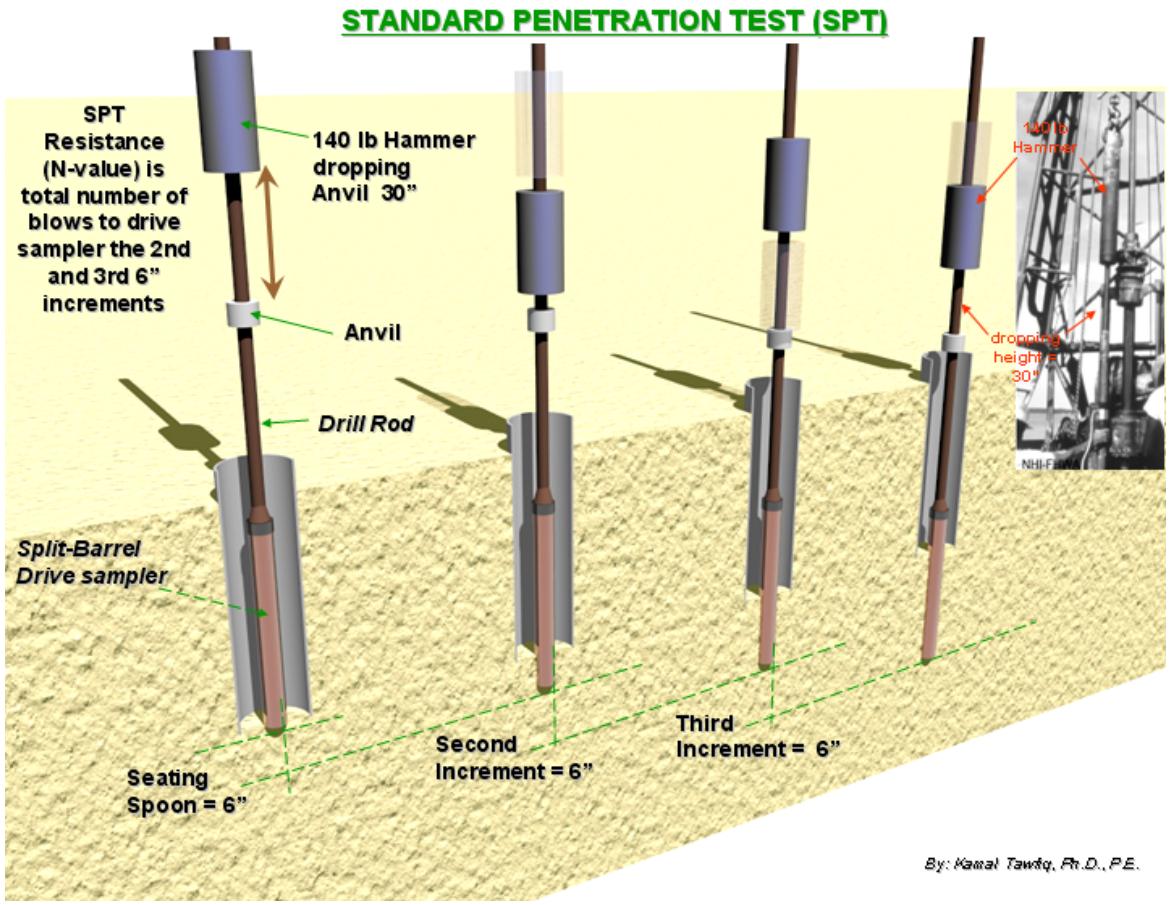


Driving sample



Solid tube sampler

THE STANDARD PENETRATION TEST (SPT) ASTM D1586



STANDARD PENETRATION TEST (SPT)

SPT vs. Relative Density of Sand — Meyerhoff (1956)

State of Packing	Relative Density	Standard Penetration Resistance (N)	Static Cone Resistance (q_c)	Angle of Internal Friction (ϕ')
	Percent	Blows / ft	Tsf or kgf/cm^2	Degrees
Very Loose	< 20	< 4	< 20	< 30
Loose	20 – 40	4 –10	20 – 40	30 – 35
Compact	40 – 60	10 –30	40 – 120	35 – 40
Dense	60 – 80	30 – 50	120 – 200	40 – 45
Very Dense	> 80	> 50	> 200	> 45

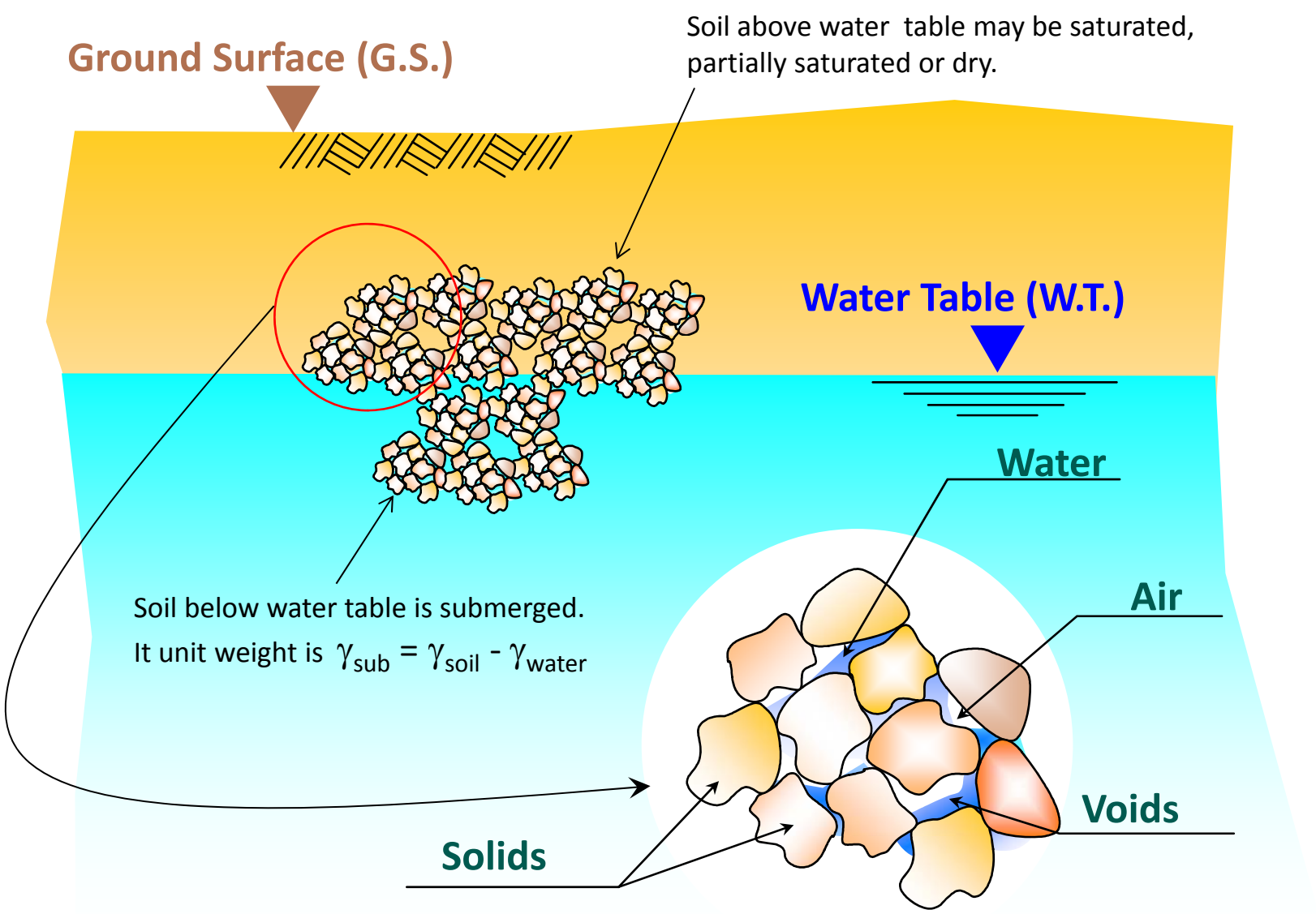
SPT vs. Undrained Shear Strength

Soil Consistency	SPT N	S_u (psf)	S_u (kPa)
Very Soft	< 4	< 250	< 12
Soft	2 – 4	250 – 500	12 – 25
Medium	4 - 8	500 – 1000	25 – 50
Stiff	8 – 15	1000 – 2000	50 – 100
Very Stiff	15 – 30	2000 – 4000	100 – 200
Hard	> 30	> 4000	> 200

Terzaghi et al. (1996)

See attached SPT video

SOIL - WATER RELATIONSHIPS



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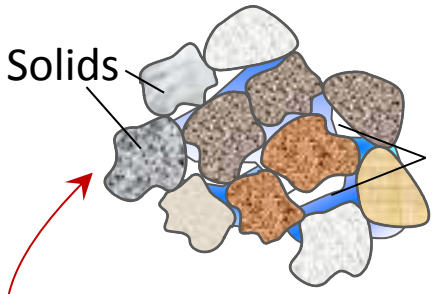
Phase Diagram

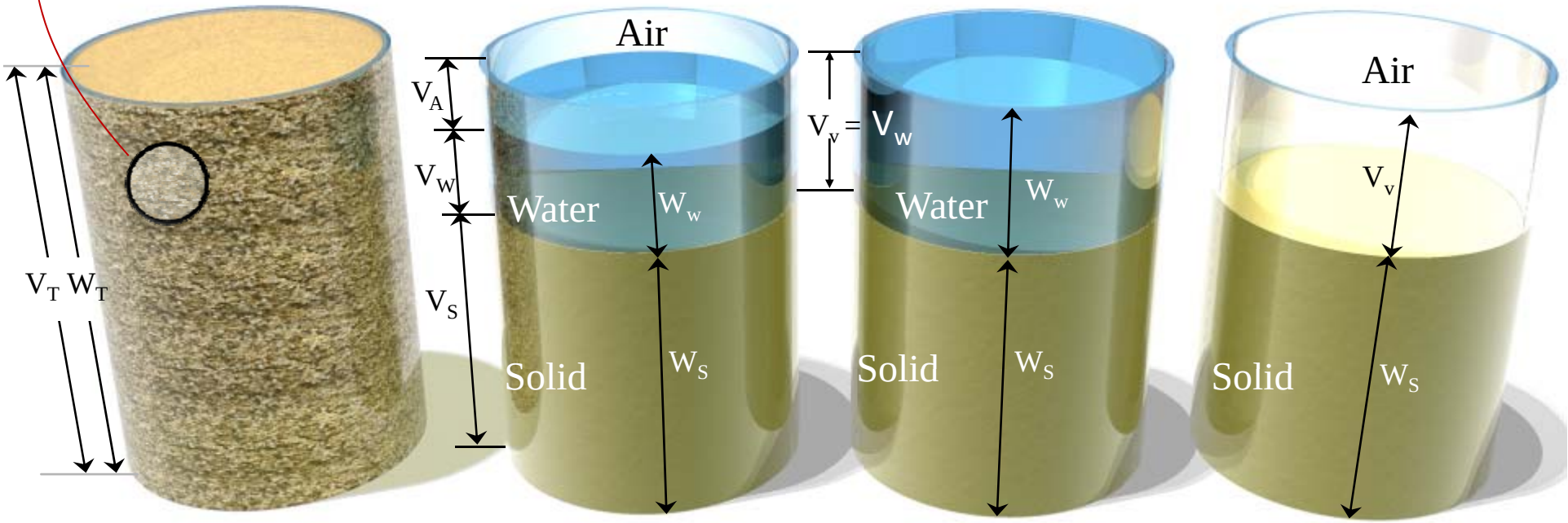


Voids
May be Filled with water or air Or both

Soil Skeleton

V_A = Volume of Air V_w = Volume of Water V_v =Volume of Voids V_T =Total Volume
W_w = Weight of water W_s = Weight of solids W_T =Total weight

Partially Saturated Soil Fully Saturated Soil Dry Soil



1. $\gamma_{soil} = W_T/V_T$
2. $e = V_v/V_s$
3. $n = V_v/V_T$
4. $W_c = (W_w / W_s)$ x 100%
5. $S_r = (V_w / V_v)$ x 100%
6. $G_s = \gamma_s / \gamma_w$
7. $D_r = e_{max} - e_{field} / e_{max} - e_{min}$

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