Exp #1 : water Content

Wc : amount of water present in a quantity of soil interms of its Dry mass.

← يستخدم مع ال soil ما عدا ال organic & gebsuim ← لأنه بتحترق اذا دخلته الفرن.

$$\Rightarrow \quad W_c = \frac{M_w}{M_s} * 100\% \quad \Leftarrow$$

→ Wc
- → Sandy or gravely > (15 − 20)%
- → Fine-gravel soil > (80 − 100)%
- → highly Organic clay > (500)%

* $Wc_{Fine} > Wc_{coarse}$ → at same Condition.-

→ $M_w = M_{wet} - M_{Dry}$

Exp #2: Specific Gravity

→ to compute void ratio (e).

→ G_s is used in hydrometer analysis, compaction permeability.

→ Solid Soil Density $\rho_s = \frac{M_s}{V_s}$

$$\Rightarrow G_s = \frac{\rho_s}{\rho_w} = \frac{M_s / \cancel{V_s}}{M_w / \cancel{V_w}} = \frac{M_s}{M_w} \Bigg] \rightarrow \text{Constant Volume ---}$$

* Archimedes principle:-

"A Body Submarged in a volume of water will displace a volume of water equal to the volume of the submerged Body"

$$\rightarrow G_s = \frac{M_s * \alpha}{M_s + M_{bottle+water} - M_{bottle+water+soil}} \qquad \alpha = \frac{\eta_t}{\eta_{20}} \rightarrow \text{Viscousity}$$

→ air ↑ → M_{bws} ↓ → G_s ↓

⟶ So, lazem a3mal vaccuming la2a asheel kol el hawa ...

* Vaccum & or heating to Remove Air From Soil ..!

→ Exp #2 :-

→ $G_s \Rightarrow \in (2.6 - 2.8)$.

G_s	Soil Type
2.65 - 2.67	Sand
2.7 - 2.8	clay
1 - 2.6	Organic
2.75 - 3	Soil with Mica or Iron

→ Specific gravity depends on Temp.

→ Standard Temp (20°C)

Exp #3 : A) Mechanical Sieve Analysis

→ Classifying soil According to its size.

→ For coarse soil.

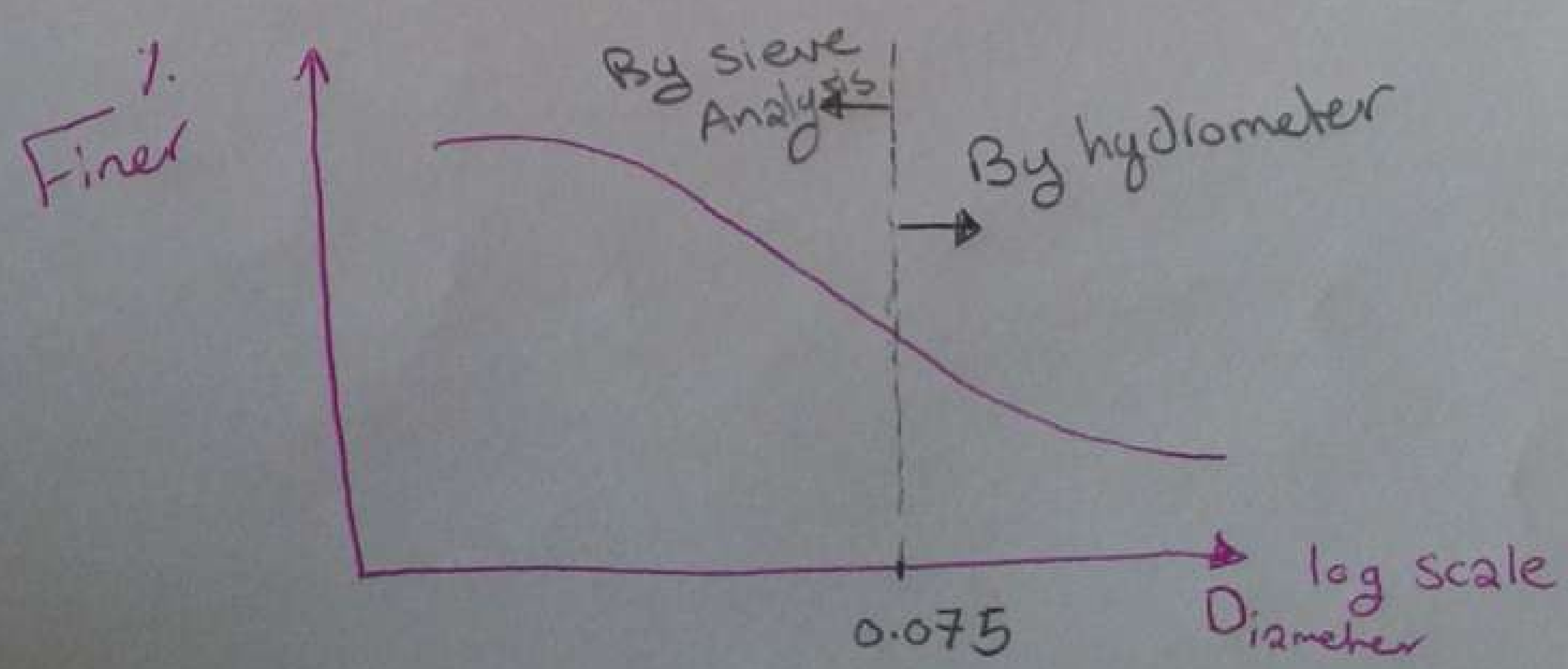
Sieve No.	(mm) Diameter	wt. of sieve	wt sieve + soil	wt of Retain soil	Comm. Ret.	Percent Ret	% Fin
		a	b	b − a = C			
---	---						
---	---						
#4	4.75				C	$\frac{C}{Sample} * 100\%$	100 −
---	---						
---	---			D	C+D	$\frac{C+D}{Sample} * 100\%$	100 −
#40	0.425			E	C+D+E		
---	---						
---	---						
#200	0.075						

→ % Gravel → retained on sieve #4

% Sand → pass #4, Retained on #200.

% silt → pass #200, Retained (> D = 0.002 mm)

% clay → pass (< D = 0.002 mm).



→ Exp #3 : B] Hydrometer Analysis

→ Classifying the Fine Soil. "silt & clay"
→ Determine the Diameter of grain of soil.

→ Use Material called "Na_3PO_4" soudium hexan Meta Phosphite.

$$\rightarrow V = \frac{2}{9}\,\frac{G_s - G_f}{\eta}\,(D/2)^3$$

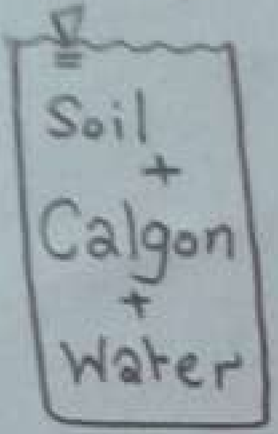
- V → Velocity cm/sec
- g → 980.7 cm/sec²
- G_s → S.G of sphere
- G_f → S.G of Fluid
- η → Absolute viscousity of Fluid [dyn.s/cm²)
- D → Diameter of sphere

→ Sp. Gravity of water at 4°C ⇒ 1 cm/g

→ We Use "Na_3PO_4" to Neotralize of charges.
"حتى ال particles يتفككوا عن بعض وما يعملوا كتل" !

→ Time ↑ → ترسب soil → S.G ↓ الى أن أوصل الى كثافة الماء نفسه !!

Exp #3 : B



R_{Actual} ⇒ ~~Function of~~ Temp + Time

بتأثر بـ

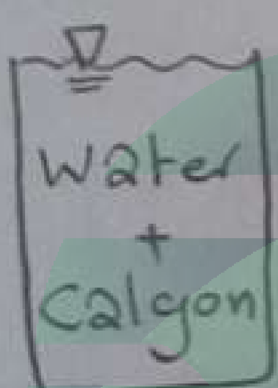
[*] → Silt → size ↑ → ترسب أسرع

⇒ $D_{mm} = K\sqrt{\frac{L}{T}}$

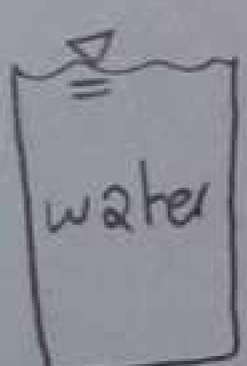
L → effictive length ; $F(R_{Act.})$

K → constant, Function of (Gs, Temp)

T → elapsed time (min)



R_1 ⇒ بتأثر بـ Temp. Only !



R_2 ⇒ بتأثر بـ Temp. only !

⇒ $R_{corrected} = R_{Actual} - \underbrace{(R_1 - R_2)}_{\text{Composite correction}}$

→ بعمل هيك مشان ألغي تأثير الـ Calgon واعرف تصرف الـ soil لحاله !!

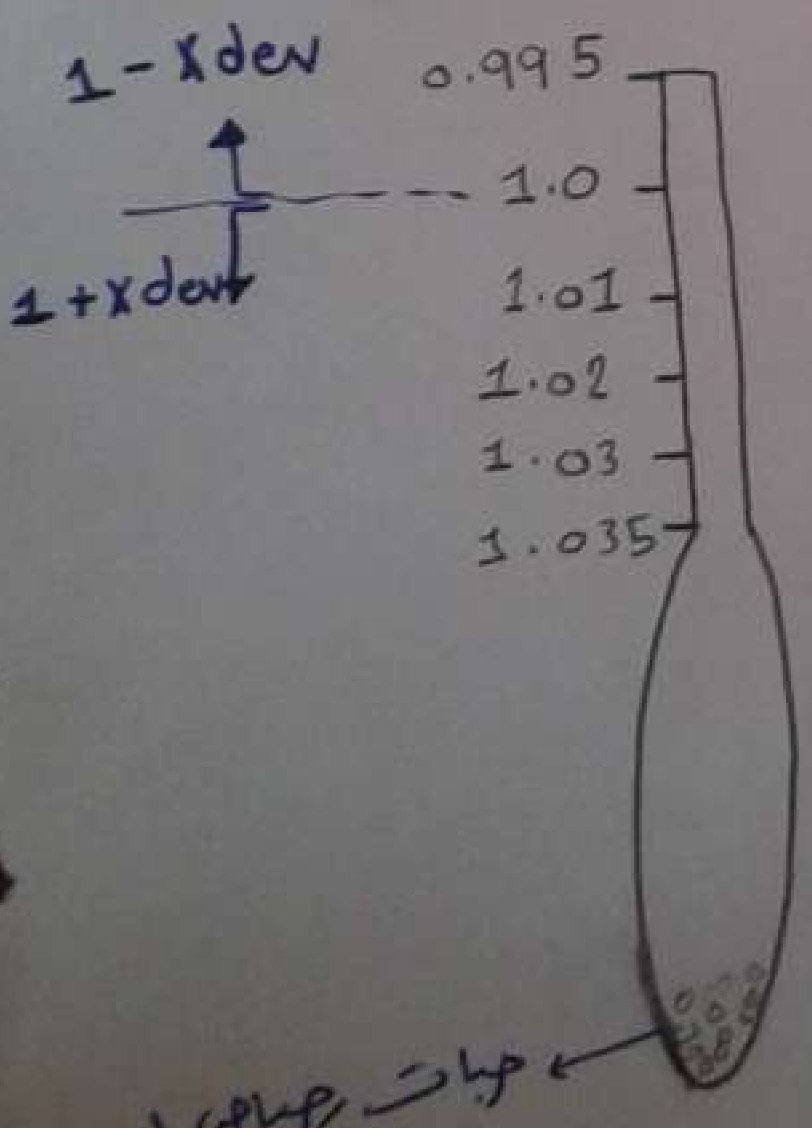
→ Exp #3 : B

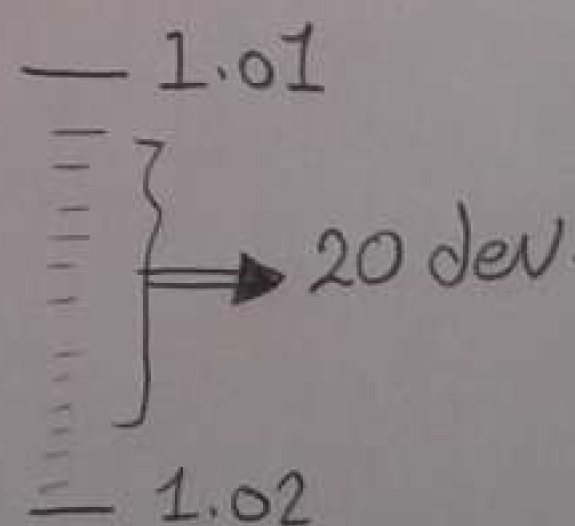
➡ $\% \text{Finer} = P_F\% = \left[\dfrac{\dfrac{100{,}000 * G_s}{M_s}}{G_s - G_w} \right] \left[R_{corr.} - G_w \right]$

➡ $P_{F\,actual} = P_F * \text{Fraction Passed}$ sieve # 200

يعني اكبر نسبة ممكن اوصلها لل P_F هي انه كل ال Fine
الي طلع معي من العينة الاصلية من كل مخلفاتهم عشان اعمل
sieve Analysis أو hydrometer

→ hydrometer :-

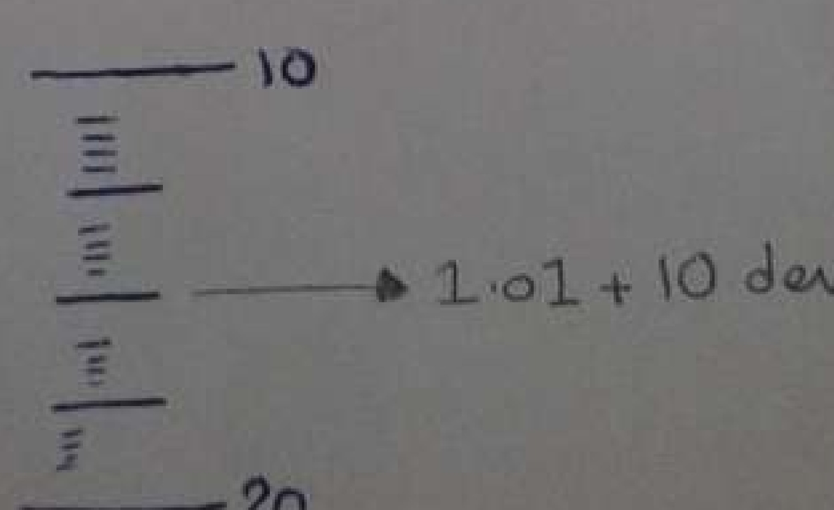




1 → 1	
10 → 1.01	
20 → 1.02	
30 → 1.03	

each dev = 0.0005

ex:



→ Exp 3 :-

Elapsed time	R_{Actual}	Temp	$R_1 - R_2$	$R_{corrected}$	K	D	L	%
1/4	A		B	A - B	table	حل	table	
1/2								
1								
2								
4								
⋮								

$R_1 - R_2$: ثابت لكل طالما الحرارة ثابتة

K: ثابت لكل !!

L: مختلف

← نستخدمهم عشان اعرف ال D ـــ واعرف الفاصل بين ال clay & silt
عند D=0.002

← المفروض ما يطلع عندي D اكبر من 0.075 لانه اصلاً كلهم
مروا من sieve #200 "لانه ال Test ← لل Fine soil"

K

Temp	S.G				
⋮	K value				

L "effective Depth"

Hydrometer 151H

R_{Actual}	L (cm)
⋮	L value

→ Exp 3 :-

Sample Xg

Retained — at sieve #200 — Passed

Retained: yg

Passed: Zg

على الجدول

- Gravel: Retained #4
- Sand: Pass 4, Ret. 200

على الرسم

- Silt: Pass 200, > 0.002
- Clay: < D = 0.002

Gravel % + Sand % + silt % + clay % = 100 %

ΣWt = Wt. sample (Xg).

D_{10}, D_{15}, D_{30}

D_{60}, D_{85}

C_u : coefficient of Uniformity

$$= \frac{D_{60}}{D_{10}}$$

C_c : Coeff. of curvature

$$= \frac{D_{30}^2}{D_{10} * D_{60}}$$

Well

$1 < C_c < 3$, $C_u \geq 4$ / Gravel

$1 < C_c < 3$, $C_u \geq 6$ / sand

Exp #4: liquid limit & Plastic limit

→ classification, Activity, Some correlations ---

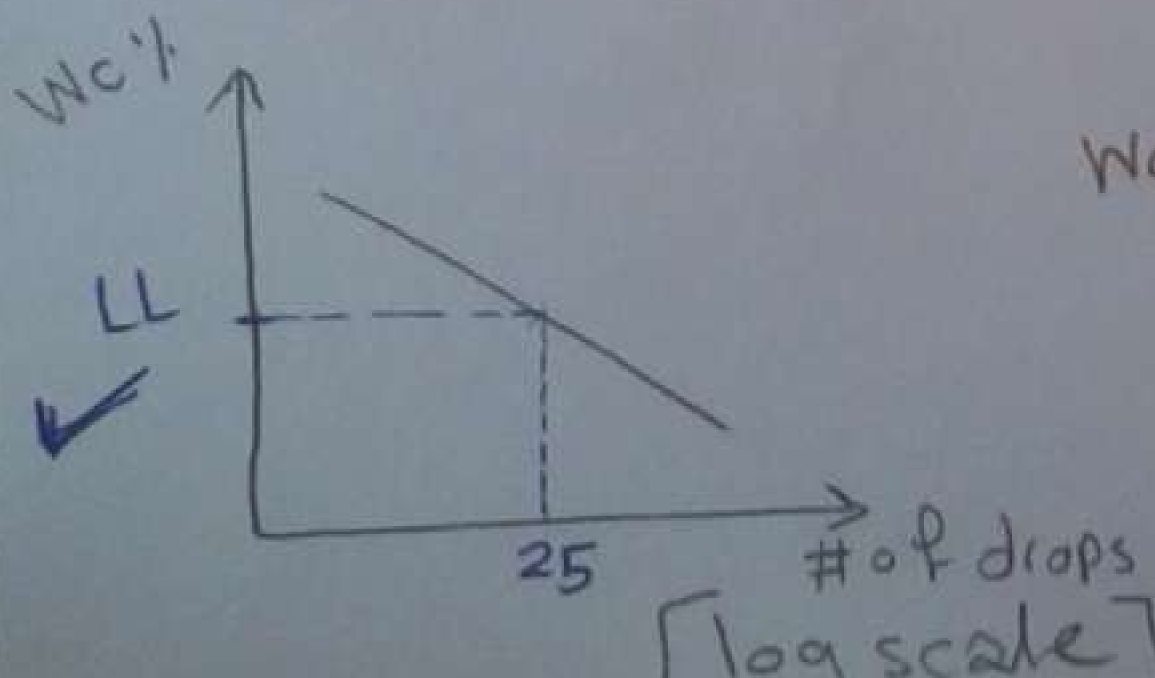
→ LL: Casagrade Method.
PL: Rolling Method.

	Liquid state
LL	
	Plastic
PL	
	semi-solid
SL	
	Solid

→ **liquid limit:-**
water content at which a pat of soil placed in a brass cup [casagrande cup] cut with a standard groove, & then dropped from a hight of 10mm will undergo a groove closure of 12.7 mm, when the cup of soil dropped 25 blows at rate of 120 drop/min.

Casagrande

Multipoint Method More accurate
$10 \leq N \leq 40$



$Wc\uparrow \rightarrow \#\ Blows\downarrow$

One-point Method
$20 \leq N \leq 30$

$LL = W_n \left(\frac{N}{25}\right)^{0.121}$

Moisture content

Not exact value

→ Exp # 4 :-

Plastic limit: water content at which a soil thread just crumbles when is rolled down to a diameter 3mm ($\frac{1}{8}$)", at rate 80 stroke/min.

اذا ظهر Cracks

→ قبل, يعني d أكبر ← Semi-solid

→ بعد, يعني d أقل ← liquid, plastic

→ Soil should pass sieve #40

← مشان ما انضطر اعمل washing وافصل coarse, Fine

← لو كبير شوي لكسه عليه lumps يعتبر Fine !

→ Plasticity Index: $PI = LL - PL$

→ liquidety Index: $LI = \frac{W_n - PL}{PI}$; W_n: natural Wc %

↳ < 0 → -ve → $W_n < PL$ → Solid "Brittle"

↳ $0 < LI < 1$ → plastic solid

↳ $LI > 1$ → $W_n > PL$ → plastic.

↳ $LI \gg 1$ → Viscous liquid.

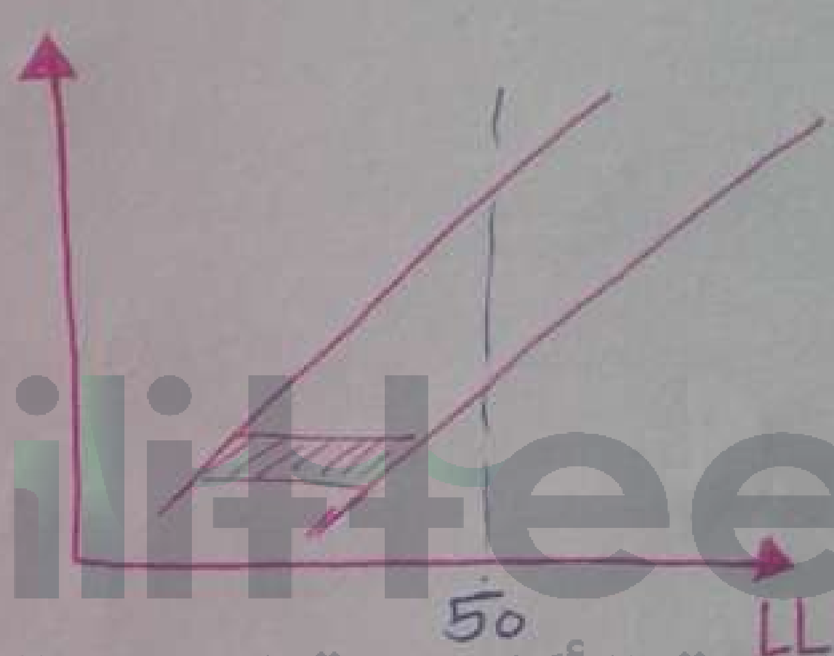
↳ $LI = 1$ → at LL

Exp #4

→ Soil Activity: $A = \frac{PI}{\%\text{ of clay size}}$

- $0.75 < A < 1.25$, Normal clay
- $A < 0.75$, Inactive clay
- $A > 1.25$, Active clay

→ Classify the Soil:

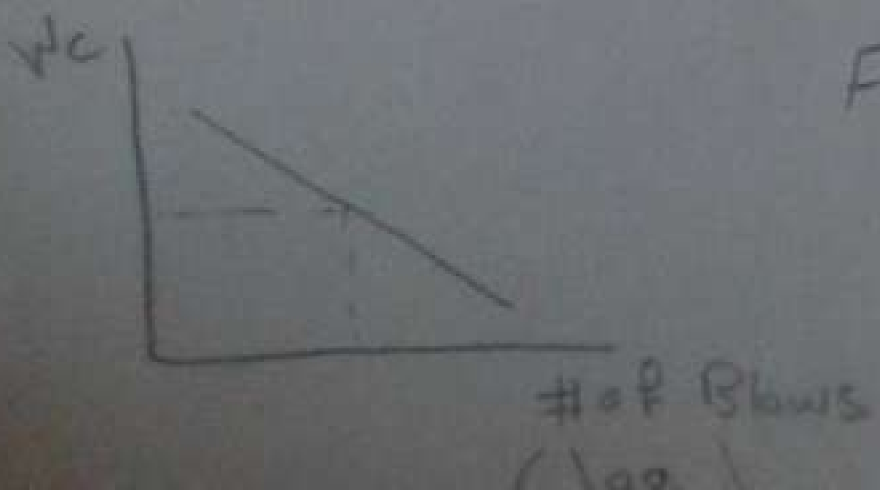


Fine (>50% pass #200)

- LL<50 Low (L)
  - PI > A line CL
  - PI < A line ML
  - 4<PI<7 CL-ML
- LL>50 High (H)
  - PI > A line CH
  - PI < A line MH

→ A-line = 0.73 (LL-20)

Note "Multipoint Method LL"



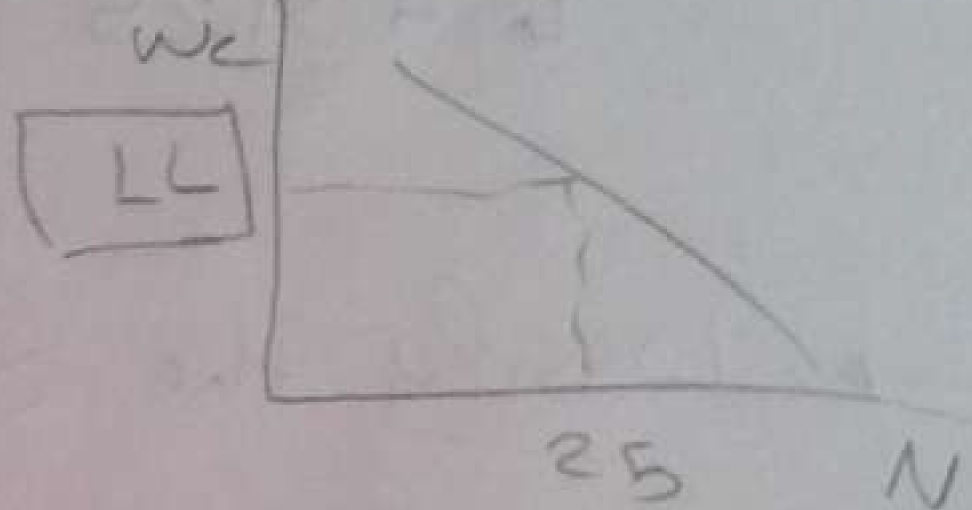
$$\text{Flow Index} = I_F = \frac{W_1 - W_2}{\log(N_2 / N_1)}$$

"slope" "absolute value"

LL ⇒

Can wt	Can + wet Soil	Can + Dry Soil	N	Wc%
C	A	B		

$$W_c = \frac{A-B}{B-C} * 100\%$$



PL ⇒

Wcan	Can + wet Soil	Can + Dry Soil	Wc%
C	A	B	

$$W_c = \frac{A-B}{B-C} * 100\%$$

$$\boxed{PL} = \frac{\sum W_c}{\# \text{ of } W_c}$$

* LL

Can wt	Can + wet Soil	Can + Dry Soil	N	Wc %
C	A	B	⋮	⋮

$$W_c = \frac{A - B}{B - C} * 100\%$$

$\hookrightarrow W_{c_1}, W_{c_2}, W_{c_3}, \ldots\ldots$

* PL :-

Wcan	Can + wet Soil	Can + Dry Soil	Wc %
C	A	B	W_{c_1}
⋮	⋮	⋮	W_{c_2}
			W_{c_3}

$$W_c = \frac{A - B}{B - C} * 100\%$$

$$PL = \frac{\sum W_c}{\# \text{ of } W_c} \quad \text{i.e.:} \quad \frac{W_{c_1} + W_{c_2} + W_{c_3}}{3}$$

Exp #5: Moisture Unit weight relationship "Compaction"

→ Standard Proctor test:

1- Volume of mold 1/30 ft^3 ($944 cm^3$)
2- hammer weight 5.5 Ib (2.54 kg)
3- height of hammer 12"
4- 3 layers.
5- 25 Blows per layer.

⇒ $\rho_d = \dfrac{G_s}{1+e}\rho_w$

** $G_s w = S_r e$, $S_r \Downarrow 1$

↳ $\rho_d = \dfrac{G_s}{1+wG_s}\rho_w$

⇒ $\rho_{d\,\text{Zero Void}} = \dfrac{1}{\frac{1}{G.S}+W_c}\rho_w$

⇒ $\rho_d = \dfrac{\rho_t}{1+W}$

→ To Find ρ_{max}

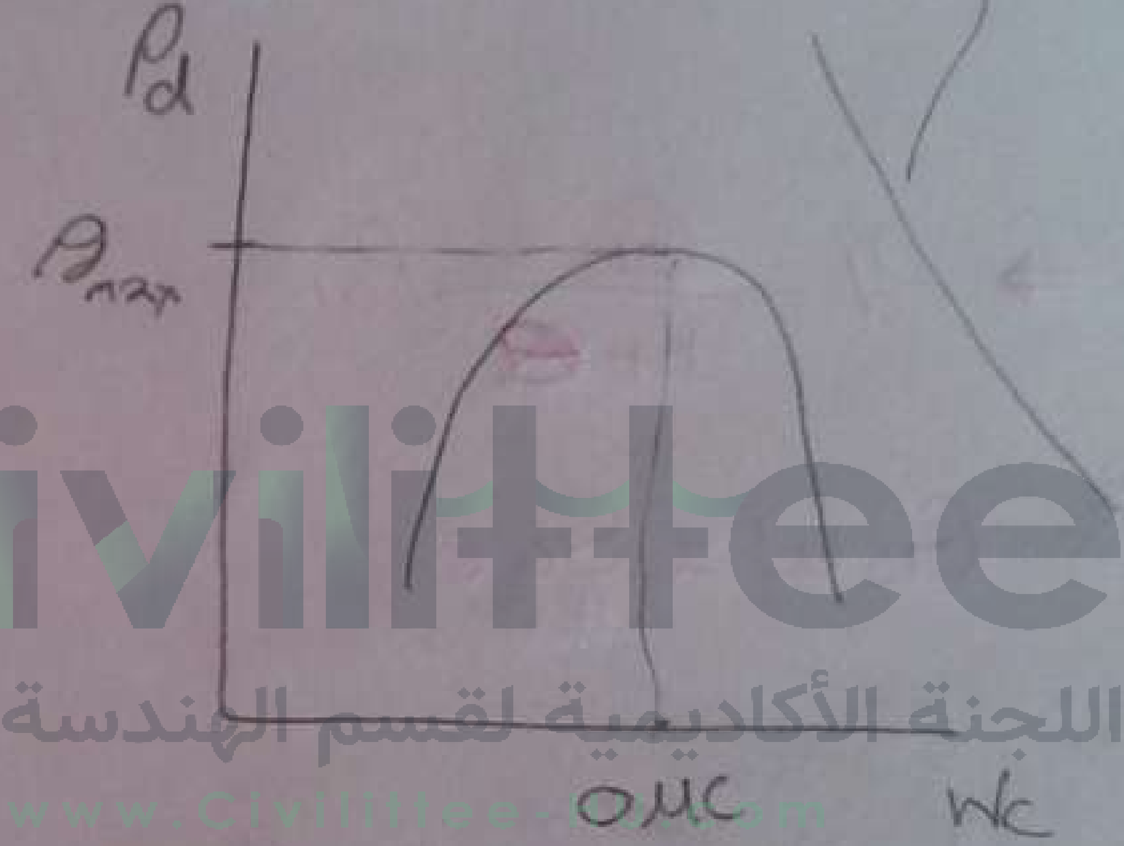
Zero Air Voids ⇒ $S_r = 100\%$

$$* \quad \rho_t = \frac{M_t \rightarrow W_{mold+wet\ soil} - W_{mold}}{V \rightarrow 944\ cm^3}$$

$$* \quad W_c = \frac{M_w - M_s}{M_s}$$

$$* \quad \rho_d = \frac{\rho_t}{1+w}$$

$$\rho_d = \frac{1}{\frac{1}{G_s}+w}\rho_w$$



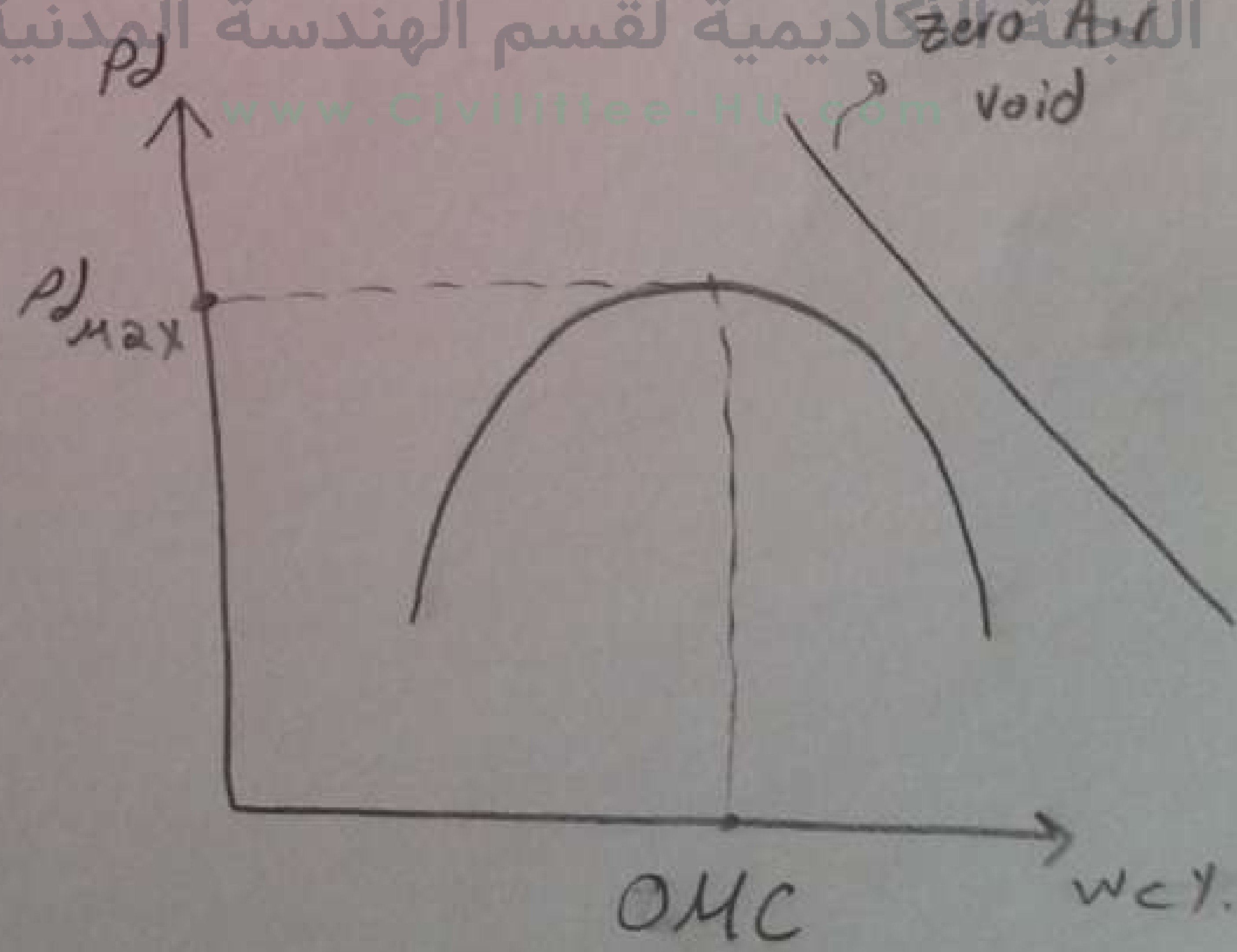
To Find $\rho_{d\,max}$:

Zero Air Voids $\Longrightarrow S_r = 100\% = 1$

$$* \quad \rho_t = \frac{M_t}{V} \qquad M_t \rightarrow W_{mold + wet\ soil} - W_{mold} \qquad V \rightarrow 944\ cm^3$$

$$* \quad W_c = \frac{M_w - M_s}{M_s}$$

$$* \quad \rho_d = \frac{\rho_t}{1 + w}$$

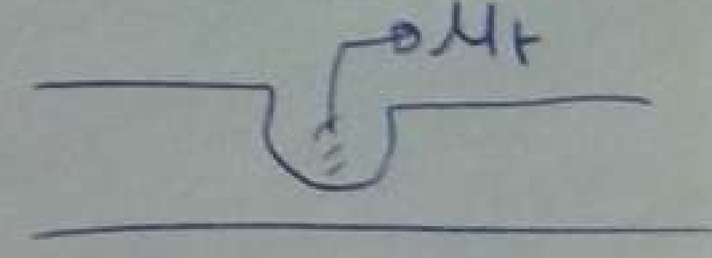


* Zero Air Voids :-

$$\rho_d = \frac{1}{\frac{1}{G_s} + w}\,\rho_w$$

Exp # 5: In-place Soil Density, Sand Cone Method

$$\rho_t = \frac{M_t}{V_t}$$



$$\rho_d = \frac{\rho_t}{1 + W_c}$$

$$W_c = \frac{M_t - M_s}{M_s}$$

→ Calibration of Sand :-

1. Dry, clean, rounded pratides.
2. Uniform size (Poorly grade) [SP]
3. pass sieve # 10 & Retained on # 60
   → our Test (pass # 20, Retained on # 30).

← بال Standard Mold نحسب ال ρ_{sand} !! لانه الحجم ال Mold معروف!

← نحسب كم ال sand الي بعبي ال cone ...

$$\Rightarrow V_{hole} = \underbrace{\begin{bmatrix} Wt \\ \text{bottle + cone} \\ + \text{sand} \end{bmatrix}}_{\text{Before}} - \underbrace{\begin{bmatrix} Wt \\ \text{bottle + cone} \\ + \text{sand} \end{bmatrix}}_{\text{After}} - \begin{bmatrix} \text{Wt of} \\ \text{Sand in} \\ \text{Cone} \end{bmatrix}$$

$$\rho_{sand}$$

V_{hole} ✓

M_{soil} ✓
From site

$$\Rightarrow \rho_{field} = \frac{M}{V}$$

→ Exp #6 :

→ $R.C = \dfrac{\rho_{d\,Field}}{\rho_{d\,max\,\text{"lab"}}} * 100\%$

↳ RC (90 - 100)%.

→ $W_{c\,Field} = O.M.C \mp (2-3)\%$ (check!)

← لازم الجو بال Field دل lab شي بسيط!

← ما لازم يكون في Vibration

← لما اعمل ال hole بال site اذا طلع معي حجار او اشياء حجمها كبير لازم ما اخذها وبرجعها ع ال hole لانه هاي ال حجار ما دخلت معي بال Compaction Test !!

← مزايا ← Very Accurate

سلبيات ← بطيئة لانه بطول لتاني يوم لحتى اوجد النتائج لانه في Wc ونتاج $(M_s)_{dry}$

← لا يمكن استخدامه للاماكن الكبيرة!

* Exp # 7 :- Coefficient of Permeability

Permeability : Measure the ease of water Flow in Soil ...

K :- need for

1. Calculate seepage loss through Found of dam.
2. Calculate quantity of water loss through the dam.
3. Calculate seepage flow under sheet pile.
4. Calculate the time-rate of selt of clay deposite.
5. Rate of leakage from toxic (waste deposite).

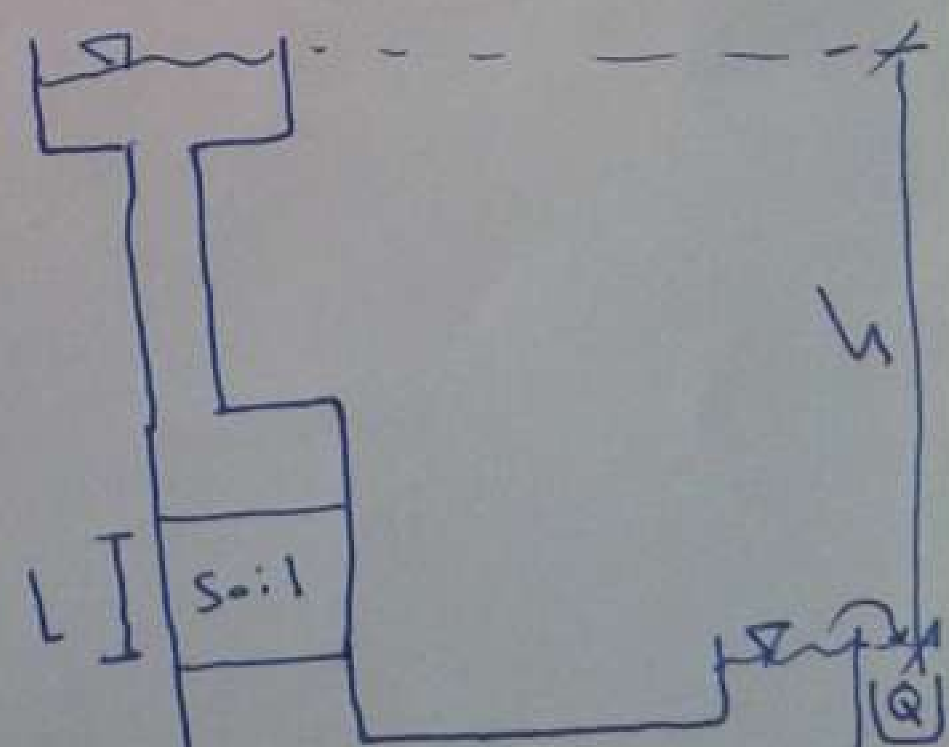
$\Rightarrow v = K i$

$Q = q t = vA$

$Q = K i A t$

$i = \dfrac{\Delta h}{L}$

$K = \dfrac{Q L}{\Delta h A t}$; cm/s



* Relations :-

- Viscousity of fluid water

$T\uparrow \rightarrow K\uparrow$

- Void ratio

$e\uparrow \rightarrow K\uparrow$

- size & shape of pore

Angular $\uparrow \rightarrow K\uparrow$

rounded $\uparrow \rightarrow K\downarrow$

- porosity

size of particle $\downarrow$

→ size of pore $\downarrow$

→ $K\downarrow$

* Seepage velocity:

$$V_{seepage} = \frac{V_{Darcy}}{n} = \frac{Ki}{n}$$

$i = \frac{\Delta h}{L}$ $n = \frac{e}{1+e}$ $\rho_d = \frac{G_s}{1+e}\rho_w$

* we have:

Time	h_1	h_2	Mass(water)	Temp
30 sec	—	—	—	—
1 min	—	—	—	—
2 min	—	—	—	—

* D: standard = 7cm. , ρ_d , G.S
  L: 7cm , ρ_w , α

* $A = \frac{\pi}{4} D^2 = 38.48 \text{ cm}^2$

* $K = \frac{q L}{\Delta h * A * t}$; $q = \frac{Mass}{\rho_w}$: Volume.

  $\Delta h = h_2 - h_1$

  t : time in sec.

$\Rightarrow K_1, K_2, K_3$ ----

$K_{Avg} = \frac{\Sigma}{\#} \Rightarrow \boxed{K_{Avg}}$

$K_{20} = K_{Avg} * \alpha = \boxed{K_{20}}$

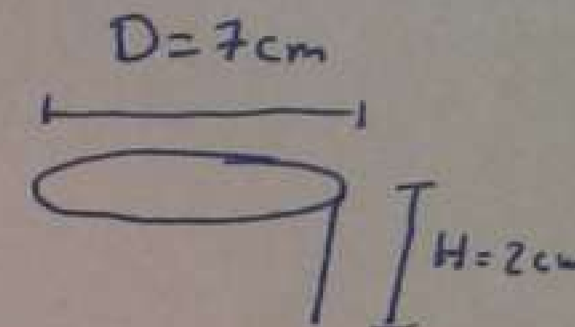
$V = \frac{K i}{n} = \frac{K \Delta h / L}{n}$; $n = \frac{e}{1+e}$

$e \Rightarrow \rho_d = \frac{Gs}{1+e} \rho_w$

* Exp #8: Consolidation Test

→ Calculate Consolidation settlement.

* Conditions :-
  1. Fine grained soil.
  2. Full saturation.
  3. load.
  4. Drainage path.

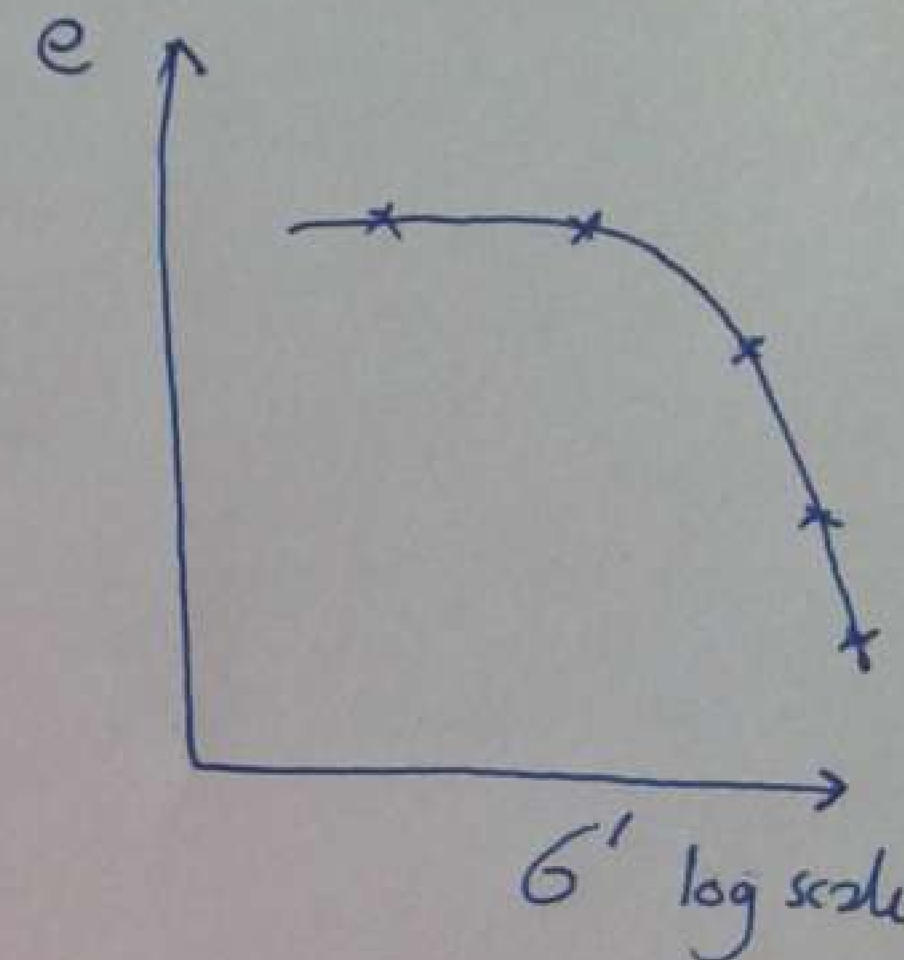


* Fully saturation ⇒ U = zero
  Wc : constant

* Dial gage "ثبت" ← بالتالي وصلنا للـ effective stress
  ما في زيادة sett. ...

* بنزيد ال load لحتى يرجع يثبت ال Dial gage
  وهكذا وبتكون زيادة ال load للضعف كل مرة
  5 → 10 → 20 → ....

$$\text{eff. stress} = \frac{\text{load}}{\text{Area}}$$

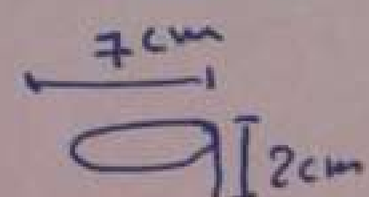


$$e = e_o - \Delta e$$

$$G_s = \frac{M_s}{V_s \, \rho_w} = \frac{\rho_s}{\rho_w}$$

$$e_o = \frac{V_v}{V_s} = \frac{V_T - V_s}{V_s}$$

$V_T \Rightarrow$ حجم ال Ring بالجهاز



$$V_T = \frac{\pi}{4} D^2 H$$

Dial gage reading at 100% cons

$$\Delta e = \frac{\Delta V_v}{V_s} = \frac{\Delta H_v}{H_s}$$

$H_s \longrightarrow$ constant

***Notes:-** آخر اشي

load ↑ → Deformation ↑
→ Avg Hieght ↓
→ Final Hieght ↓

من آخر نقطة قبل نزول ال curve

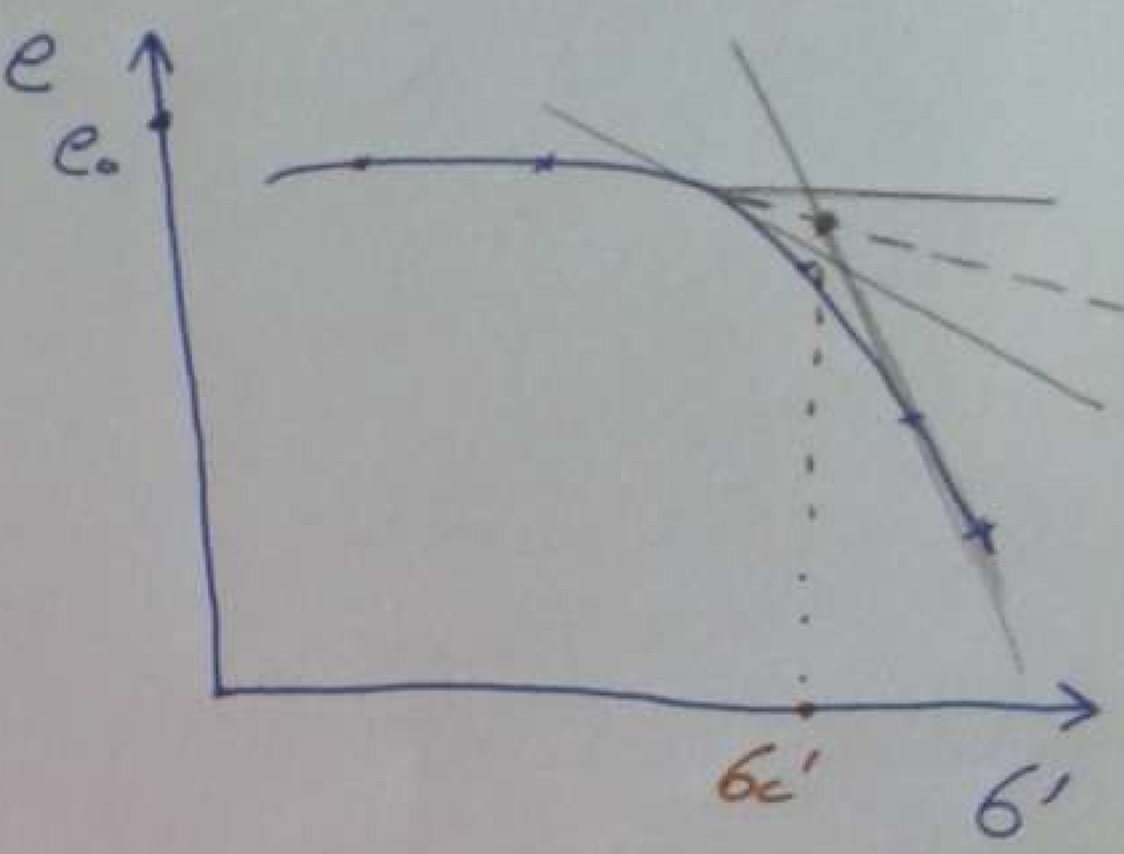
← خط أفقي

← مماس للنقطة

← تنصيف الزاوية بينهما

← امتداد مماس للجزء السفلي من ال curve.

← نقطة التلاقي ← σ_c'



Max past pressure.

* دائماً خارج ال curve لانها لازم تكون اكبر من اي قيمة موجودة لانه بال lab ما سمحنا تتعداها...

→ $e_0 = \dfrac{H_T - H_s}{H_s}$

→ σ_c' ✓

→ C_c: Compression Index "slope lower portion"

$$= \frac{\Delta e}{\log \sigma_1 / \sigma_2}$$

→ C_r : recompression Index $\equiv C_s$: swelling Index
"slope upper portion"

* → $OCR = \dfrac{\sigma_c'}{\sigma v_0'}$; σ_c' ← م ✓, $\sigma v_0'$ → γz

$OCR = 1$ → Normal Cons.

$OCR > 1$ → over cons. clay

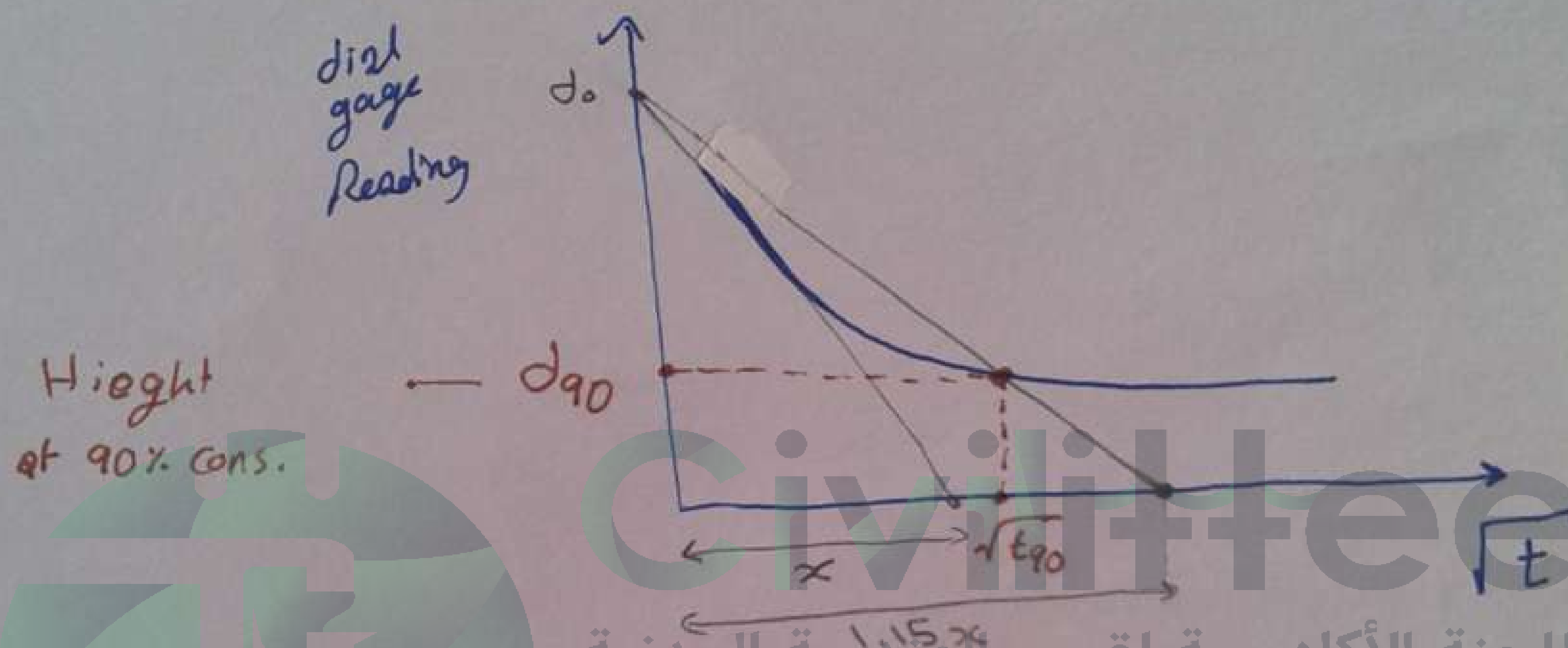
مستحيل أقل من (1) OCR لانه
σ_c' اكبر stress تعرضت اله العينة.

* Coefficient of Consolidation: CV

2 Method

Taylor "square root" | Casagrande "log time"

I Taylor



$d_0 = ---$

x , $1.15x$

$d_{90} = ---$

$\sqrt{t_{90}} = ---$, $t_{90} = \dots$

* $T_v = -0.933 \log(1-U) - 0.085$ $U > 60$; $T_v = 0.848$

$$T_v = \frac{C_v * t}{(d)^2}$$

d → double ÷2
d → one H_{avg}

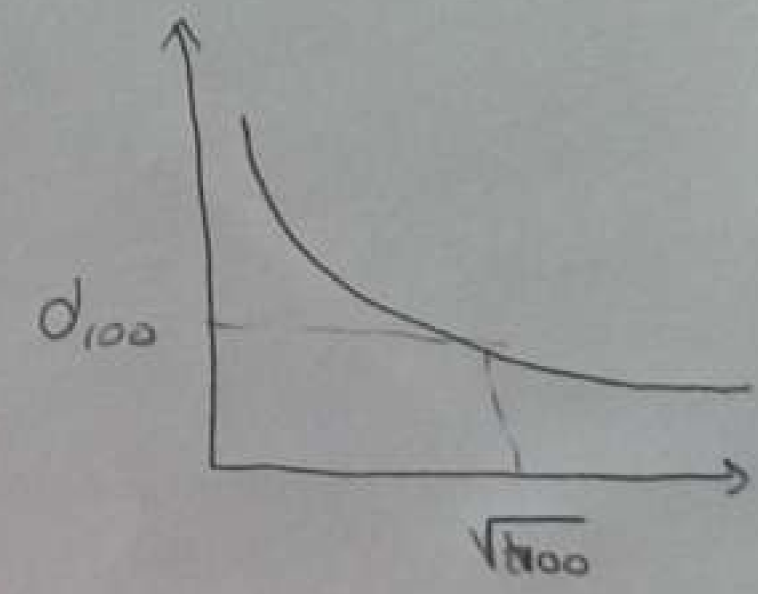
$$d = H_{avg} = \frac{H_0 + H_1}{2}$$

double drainage ⇒ $d = \dfrac{H_0 + H_1}{4}$

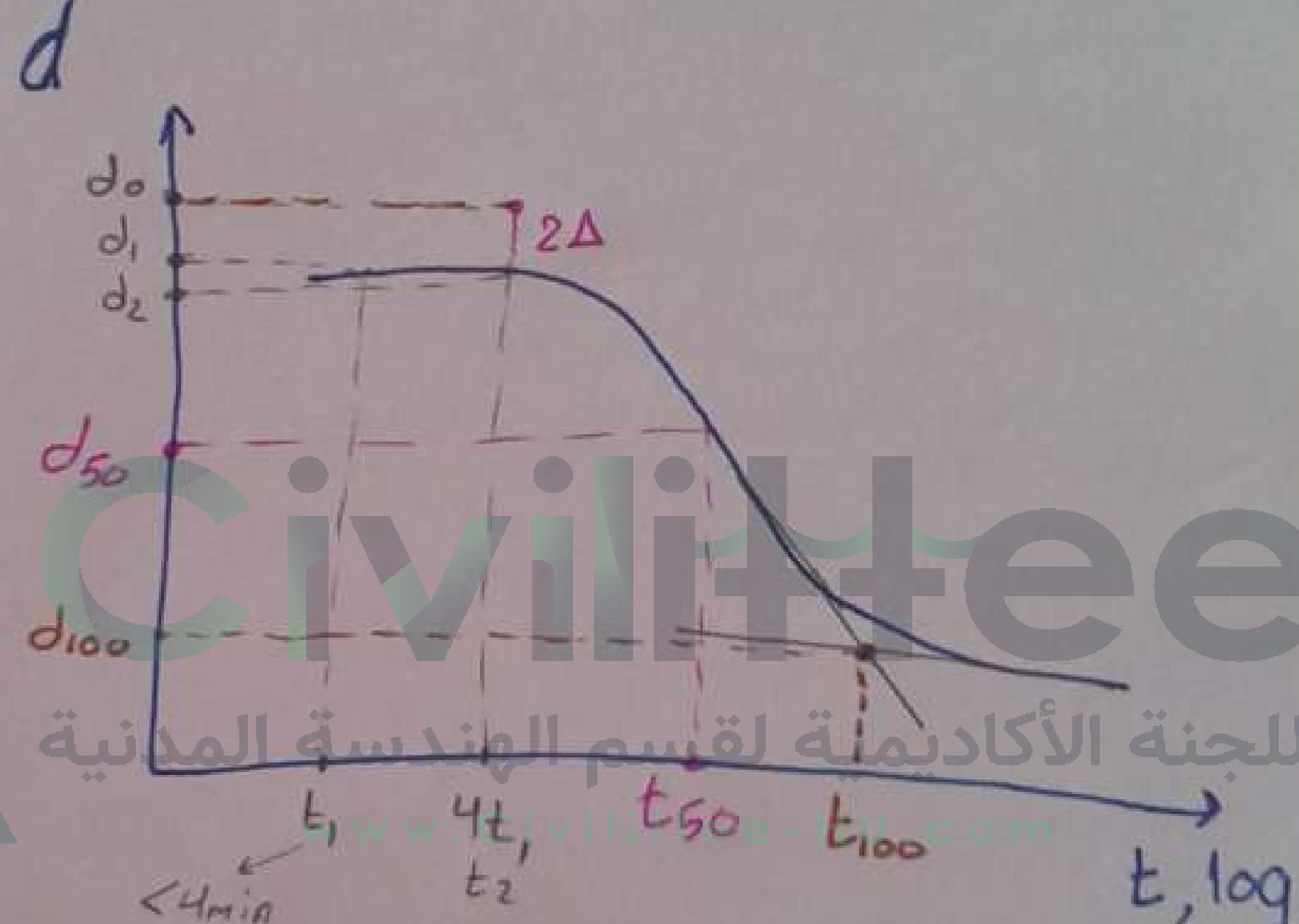
$\Rightarrow \quad d = H_{avg} = \dfrac{H_1 + H_2}{4}$

$H_2 = H_0 - \Sigma H_v$ تكرار 5 مرات

$\approx \quad d_{100} = d_0 + \dfrac{10}{9}(d_{90} - d_0)$



$\boxed{2}$ Casagrande



→ $\Delta = d_2 - d_1$

→ 2Δ

→ d_0 , d_{100}

→ $d_{50} = \dfrac{d_0 + d_{100}}{2}$

→ t_{50} ✓

→ $T_v = \dfrac{\pi}{4} U^2$, $U < 60$; $T_{v_{50}} = 0.197$

→ $T_v = \dfrac{C_v \, t}{d^2}$

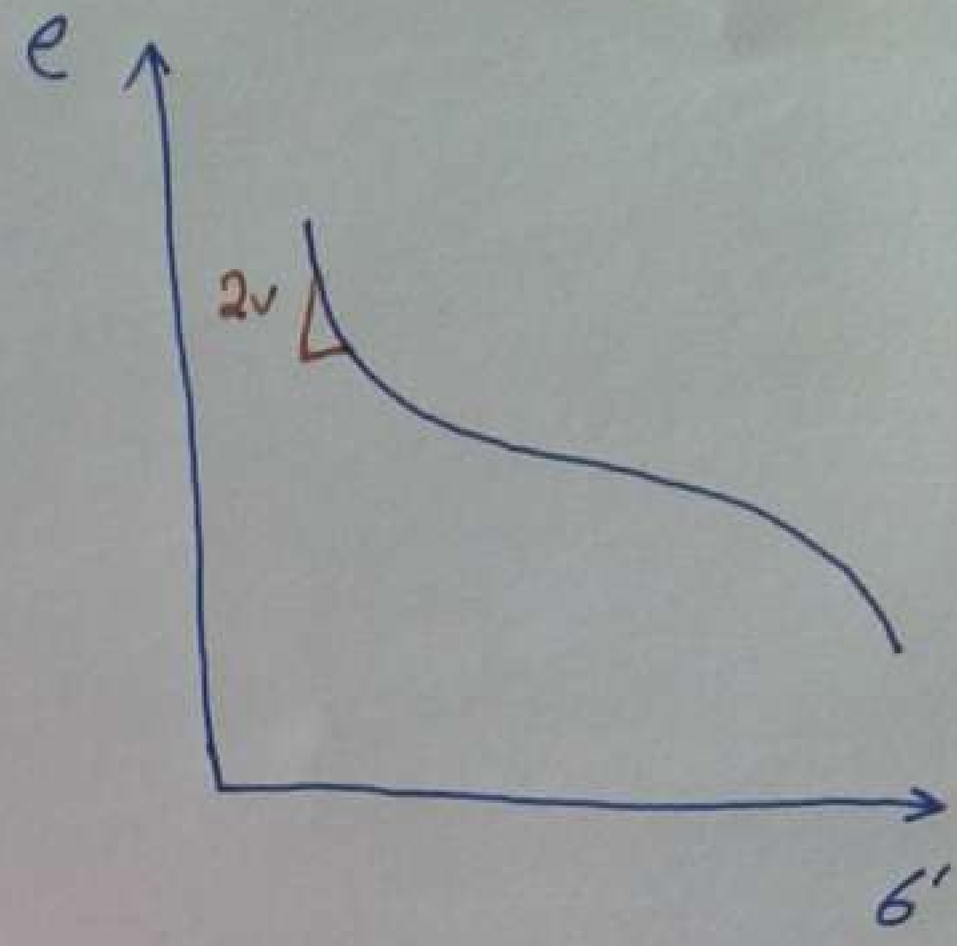
→ تكرار 5 مرات $\Rightarrow$ Taylor ← 5_{cv} صار عنا
Casagrande ← 5_{cv}

$\Downarrow$

$C_{v_{Avg}} = \dfrac{\sum_1^{10}}{10} = \boxed{C_v}$

e_0 ✓ σ_0

e_1 σ_1



$$m_v = \frac{1}{1+e_0}\left(\frac{e_0 - e_1}{\sigma_1 - \sigma_0}\right)$$

$$m_v = \frac{a_v}{1+e_0}$$

$$K = m_v * C_v * \rho_w$$

Dial gage $\longrightarrow$ Deformation (mm)

$* 0.01$

الحسابات

stress (σ)	Final Def	ΔH	Final H	e_1	H_{Avg}
P/A	last reading in each Sample	d_1	$H_0 - \Delta H$	$\frac{H_v}{H_s}$	$\frac{H_0 + H_F}{2}$
	d_1	$d_2 - d_1$	mold 20mm		
	d_2	$d_3 - d_2$			
	d_3				

$* H_s$: constant $= \frac{M_s}{G_s * A * \rho_w}$

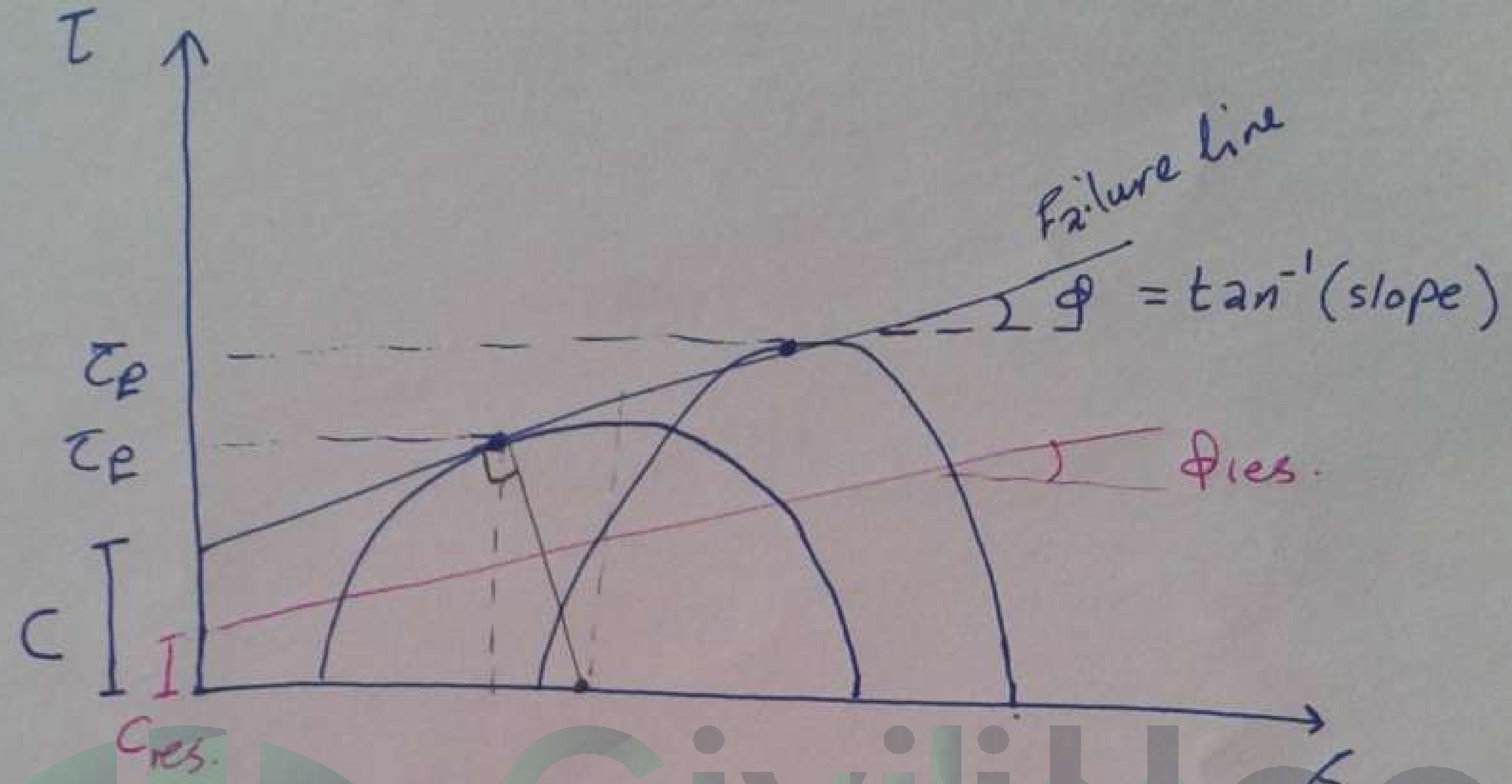
$* e_0 = \frac{H_T - H_s}{H_s}$

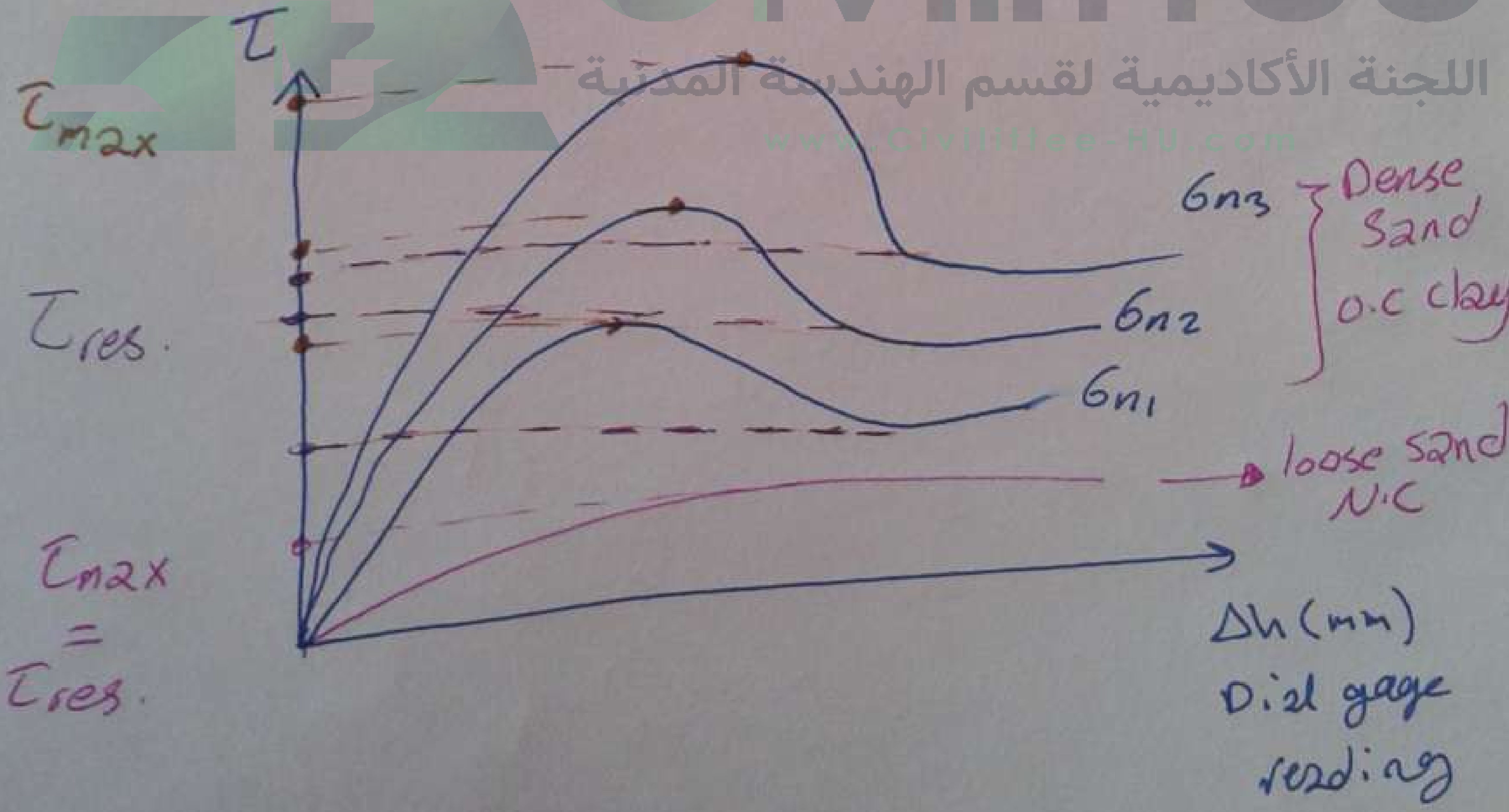
$* H_v = H_F - H_s$

Final Hieght

*Exp#9: Direct shear

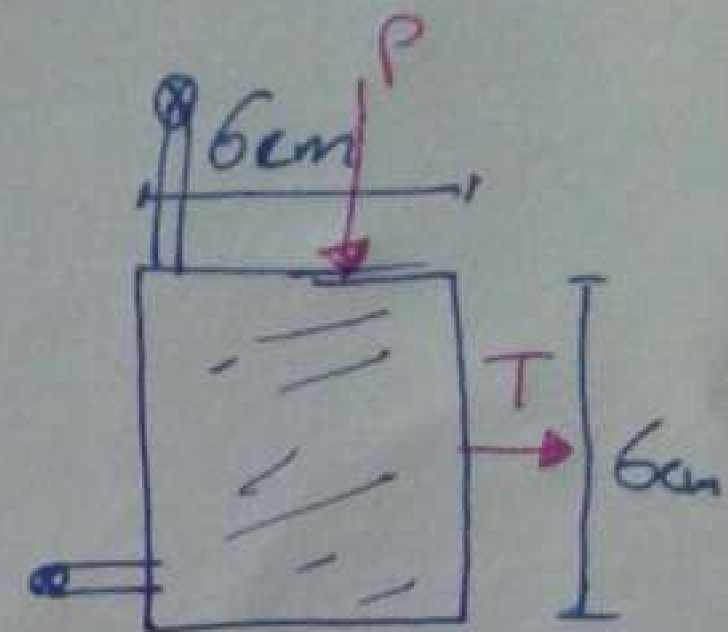
→ To estimate shear strength parameter C, ϕ

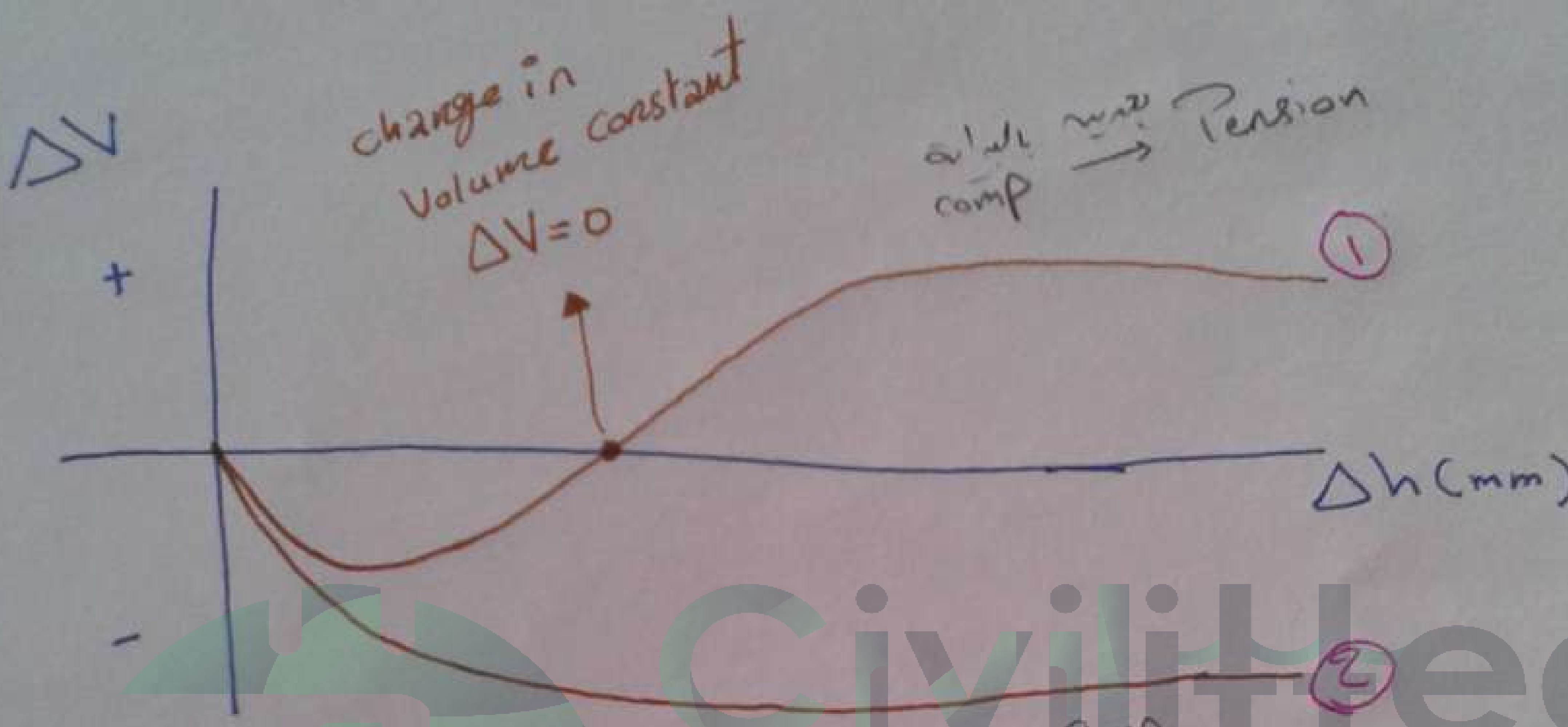




$$\sigma_n = \frac{P}{A}$$

$$\tau = \frac{\tau}{A}$$





ما في نقطة بتثبت عندها التغير بالحجم بضل يزيد حتى يثبت

① Dense Sand or over Consolidation clay

-ve → +ve

② loose Sand or Normal cons. clay

-ve

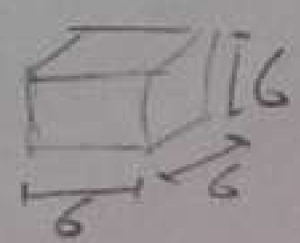
د ٣ عينات

H	V	T	load	τ
*0.01	*0.01	*0.001	From table	load/A

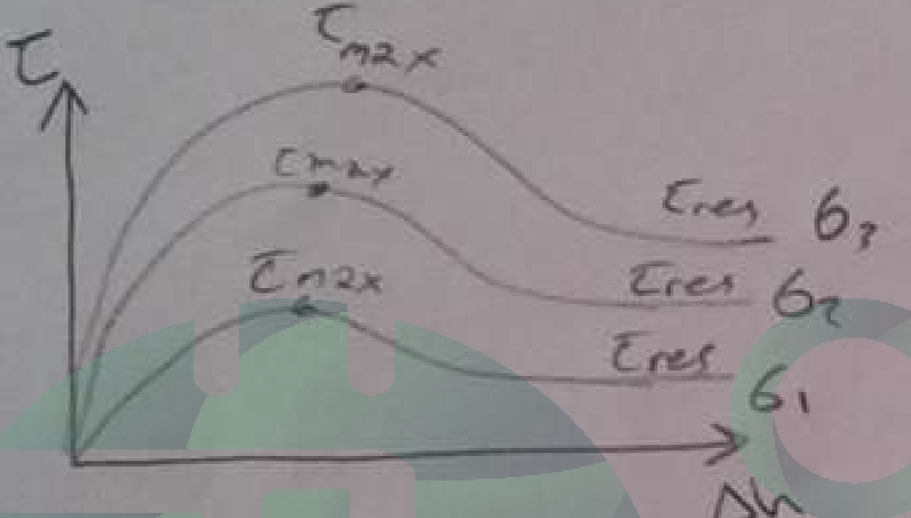
* $\sigma_1, \sigma_2, \sigma_3$

$$\sigma = \frac{P}{A}$$

* $A = 6 \times 6$

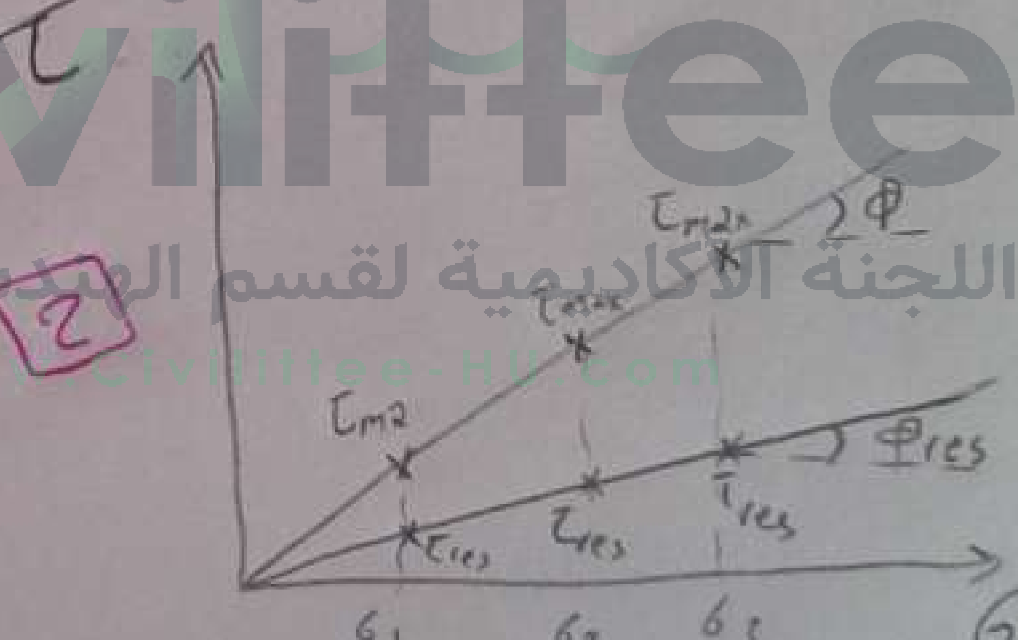


1



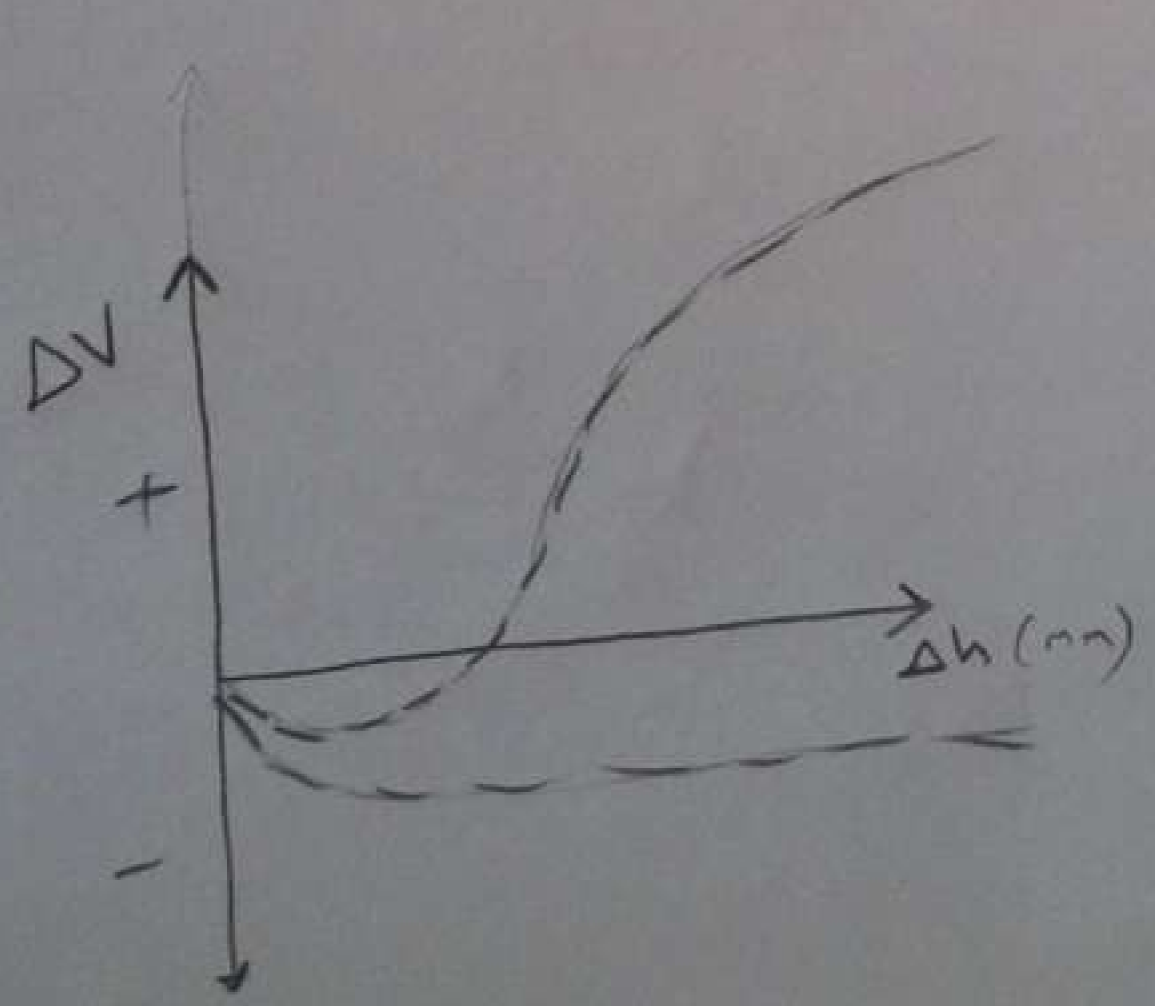
$\sigma_1 < \sigma_2 < \sigma_3$

2



Sandy soil $\Rightarrow C = 0$

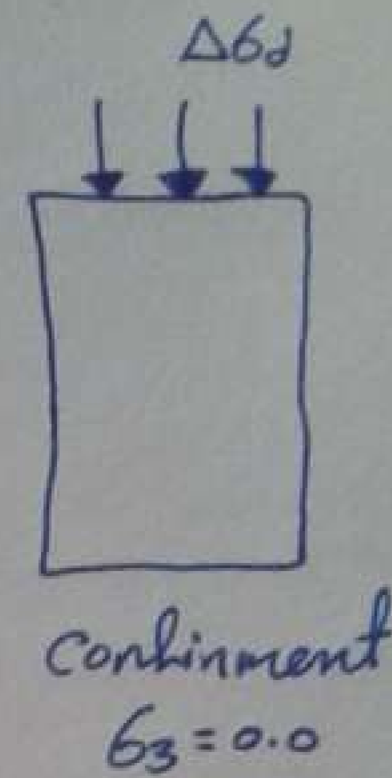
ϕ , ϕ_{res} ✓



* Exp # 10, 11 : UnConfined Compressive strength
Triaxial test (UU - Test)

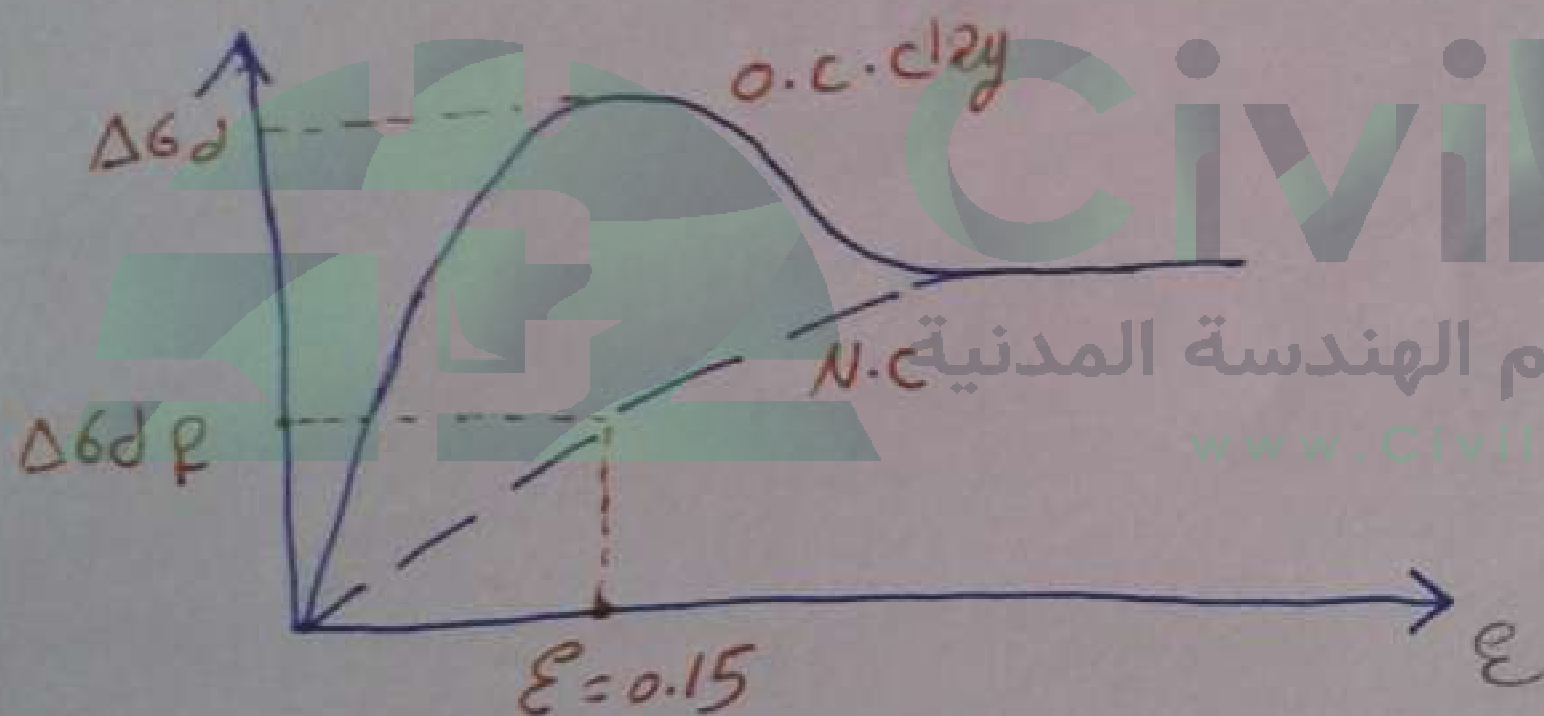
$\Delta\sigma_d = \dfrac{P}{A_c}$

, $D_o = 38\,mm$
$L_o = 76\,mm$
A_c : Area "corrected"



$A_o L_o = A_c * (L_o - \Delta L)$

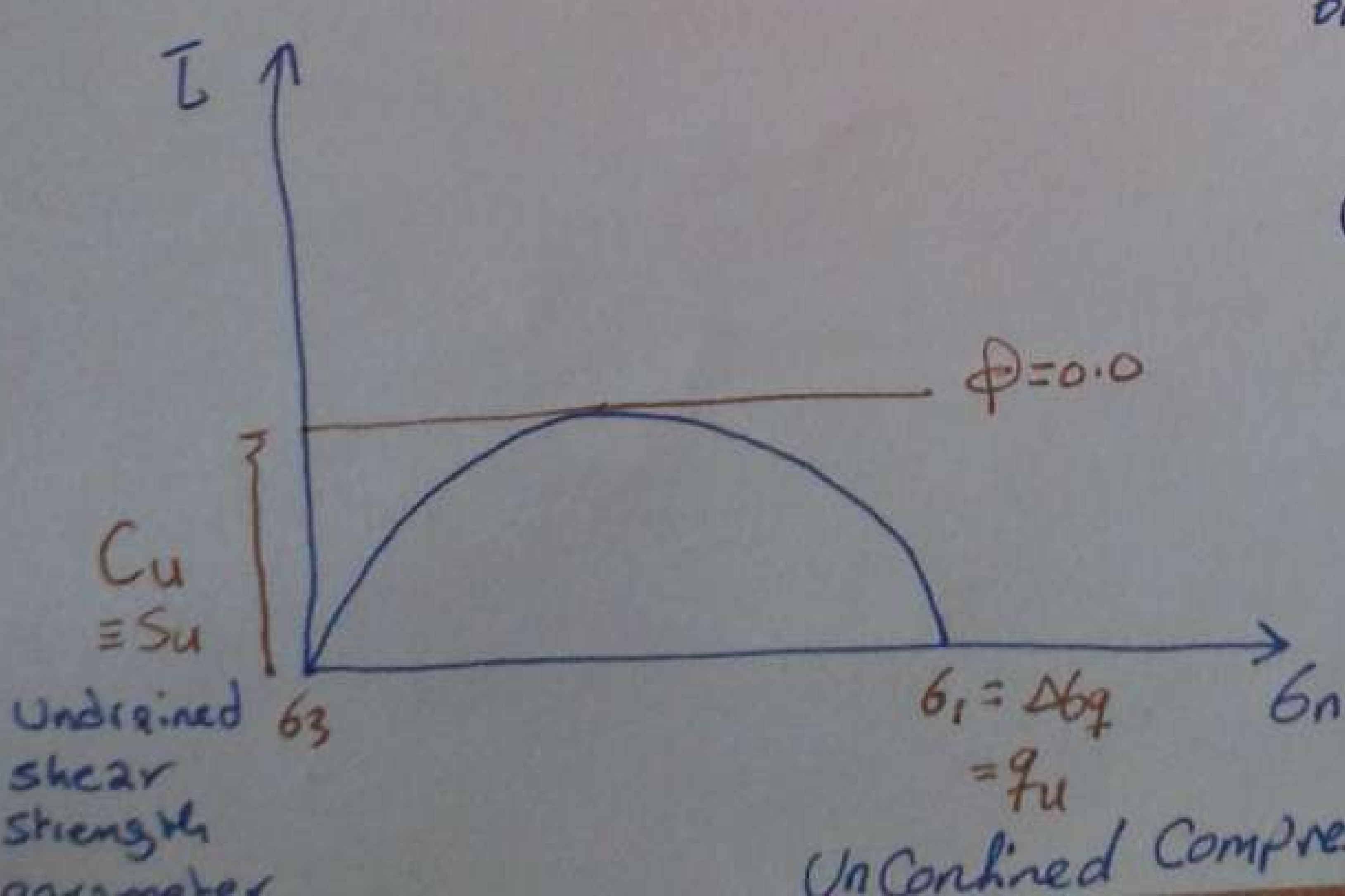
$\Rightarrow A_c = \dfrac{A_o}{1 - \varepsilon_o}$; $\varepsilon_o = \dfrac{\Delta L}{L_o}$



$\therefore$

$\sigma_1 = \cancel{\sigma_3} + \Delta\sigma_{df}$

$C_u = S_u = \dfrac{\sigma_1}{2}$
$= \dfrac{\Delta\sigma_d}{2}$
$= \dfrac{q_u}{2}$



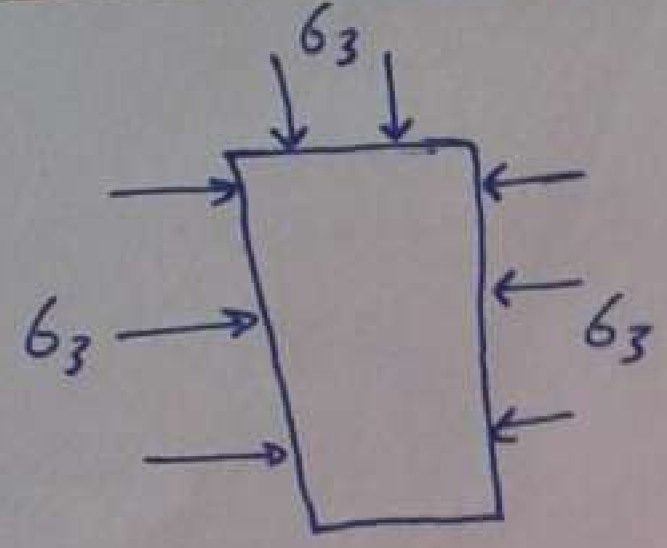
Unconfined Compressive strength

* θ = Failure plane.

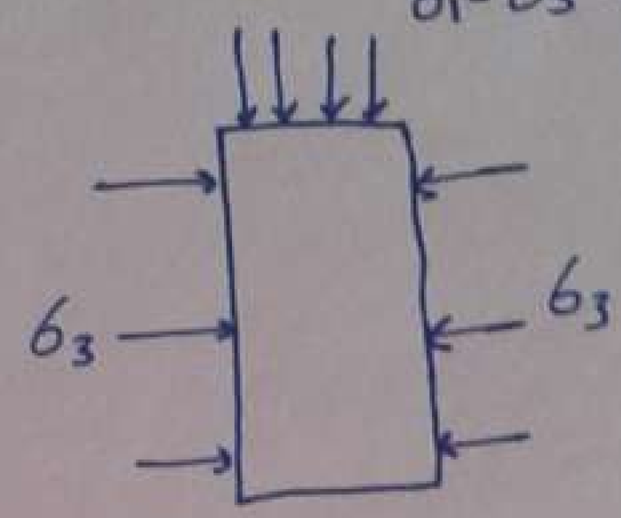
$$\theta = 45 + \frac{\phi}{2} \quad ; \text{here} \rightarrow \theta = 45^\circ .$$

** UU - Test :-

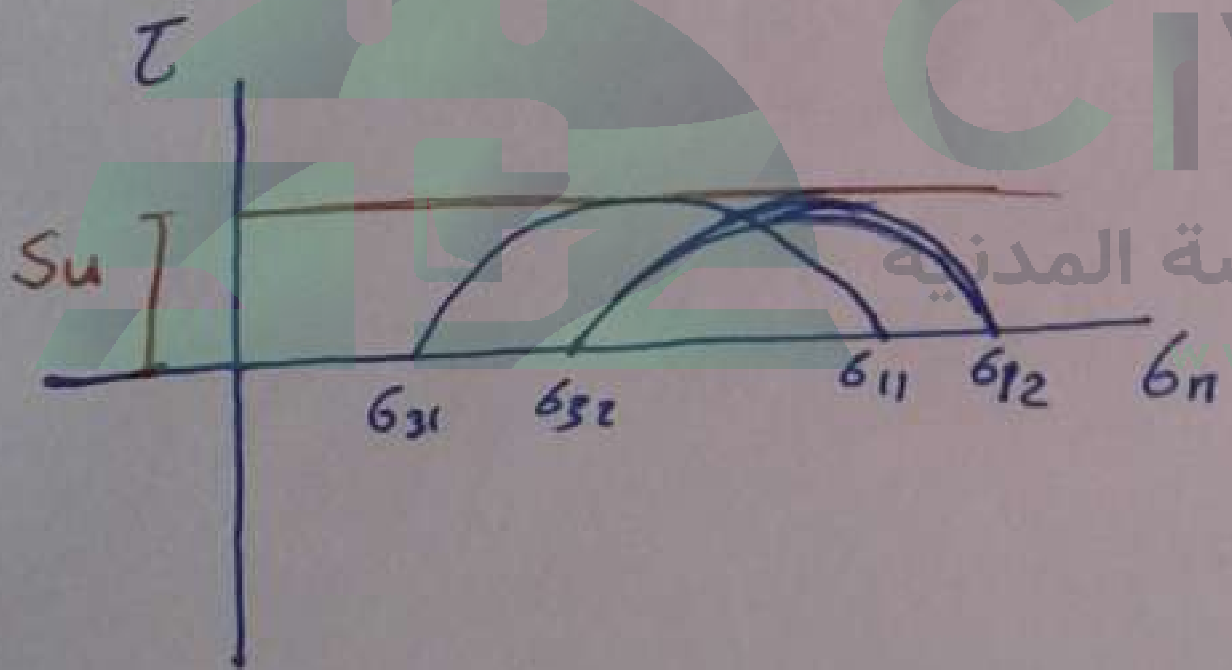
$$\sigma_1 = \sigma_3 + \Delta\sigma_d = \frac{P}{A_c}$$



1) Confinement



2) shearing



* τ: constant

لانه حتى لو زدت ال load مش مسموح للماء بطلع والعينة اصلاً full sat. بالتالي مطرح اللي رح تتحمل ال load الزيادة هي الماي

* $\phi = 0$, $Su \neq 0$

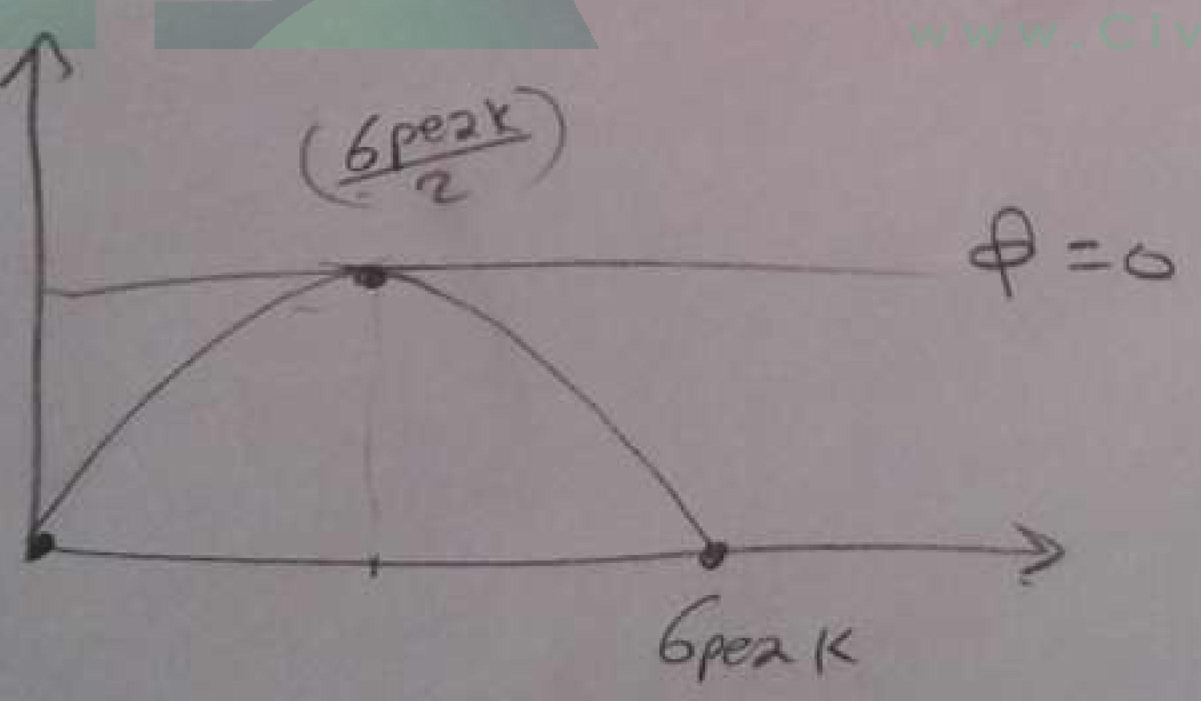
مع انه المفروض ال Sand يمر بال origin لكن هون ما كان zero لانه العينة full sat. بالتالي ما رح تحتك ال particles رح يجي بالتالي

Friction Angle = ϕ = 0.0

ΔL	ΔP	ΔP (KN)	ε	A_c	σ
$*0.01$	$*0.01$	table	$\frac{\Delta L}{L_o}$	$\frac{A_o}{1-\varepsilon}$	$\frac{\Delta P}{A_c}$

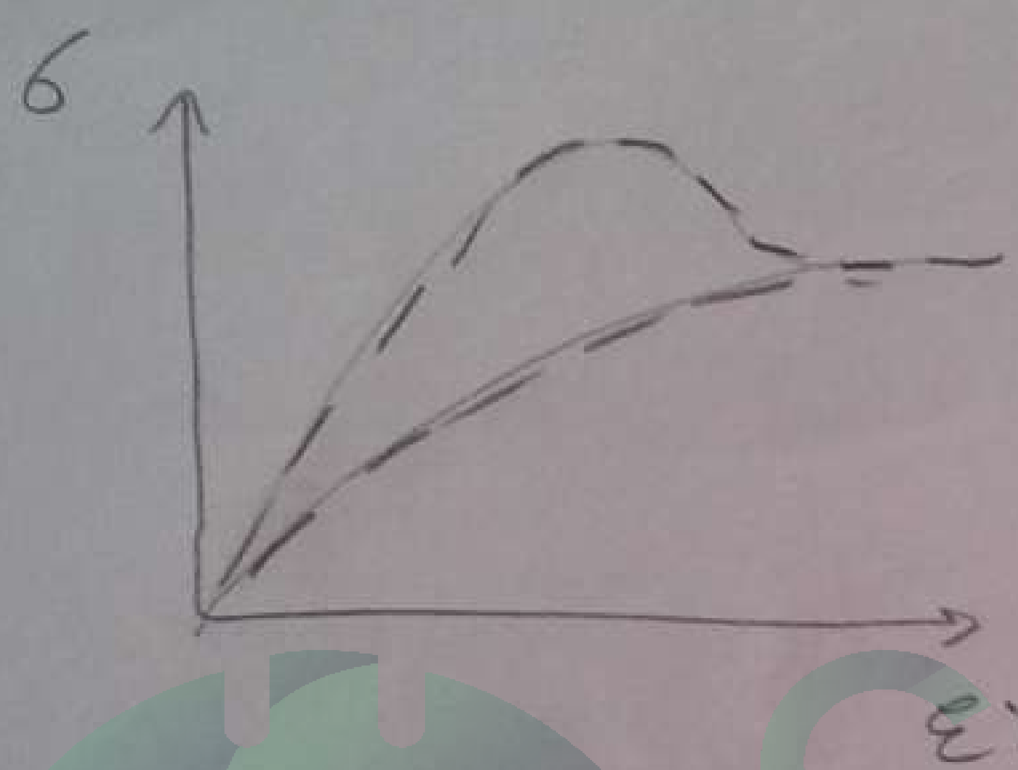
$* \; A_o = \frac{\pi}{4} D_o^2$

$\Rightarrow$ peak (σ) ✓



ΔL	ΔP	$\Delta P (kN)$	ε	A_c	σ
$*0.01$	$*0.01$	table	$\frac{\Delta L}{L_o}$	$\frac{A_o}{1-\varepsilon}$	$\frac{\Delta P}{A_c}$

$* \ A_o = \frac{\pi}{4} D_o^2$



$\Rightarrow$ peak(σ) ✓