اللجنة الأكاديمية للهندسة المدنية

تقارير لاب السويل

مي ابو حميد

مي يوسف ابو طبيه
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Data and Results

	can #	can wt (g)	can + wet soil (g)	can + oven dry soil (g)	wc % (near the number to 2 decimal)
Fine soil	1A	30.94	64.21	56.31	31.14 %
	2A	31.21	60.8	53.82	30.87 %
	3A	30.63	51.16	46.29	31.10 %
				average =	31.04 %
Coarse soil	3B	30.95	62.27	58.95	11.86 %
	6B	31.47	76.77	71.99	11.80 %
	12B	30.59	70.85	66.74	11.37 %
				average =	11.68 %

sample of calculation

$$Wc\% \ (1A) = \frac{M_w}{M_s} * 100\% = \frac{M_{can+wet} - M_{can+oven\ dry}}{M_{can+oven\ dry} - M_{can}} * 100\%$$

$$= \frac{64.21 - 56.31}{56.31 - 30.94} * 100\% = 31.14\%$$

$$wc\%\ average\ (fine) = \frac{31.14 + 30.87 + 31.1}{3} = 31.04\%$$

specific gravity

Hint: A mean correction factor

Temperature (T, °C)	A	Temperature (T, °C)	A
16	1.0007	24	0.9991
17	1.0006	25	$\boxed{0.9988}$
18	1.0004	26	0.9986
19	1.0002	27	0.9983
20	1.0000	28	0.9980
21	0.9998	29	0.9977
22	0.9996	30	0.9974
23	0.9993		

Sample of calculation:

Temp = 25°c

Mbw = 635.33 Ms = 100

Mbws = 697.97

correction = 0.9988

$$GS = \frac{Ms * correction}{Ms + Mbw - Mbws} = \frac{100 * 0.9988}{100 + 635.33 - 697.97} = 2.67$$

Why using vacum pump in our experiment ?

To remove air voids

CIVIL ENGINEERING

Sieve and Hydrometer Analysis

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Section: 1

Date: 17 - 3 - 2021

jective:

* we use sieve analysis to make analysis to drive the particle size distribution of the soil and to classify the soil to coarse and fine use in sieve # 200 (0.075) and classify coarse soil into gravel and sand
* Hydrometer analysis to classify fine soil into silt and clay and to determine the diameter of grain of soil

Equipment:

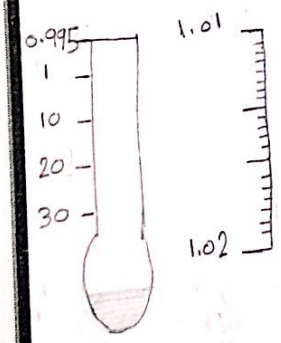
* Mechanical sieve analysis

Drying oven maintained at 110 ± 5 °c
standard sieves (with different sizes)
cleaning brush
Mechanical sieve shaker
balance , Pans

* Hydrometer analysis

Hydrometer device , water bath (tank)
Mixer (blender) , Distilled water
2 glass containers , each of 1000 ml volume (graded glass)
Mercury thermometer ranging from (0 - 104) °C
stopwatch (timer)
Agent (Hexametaphosphate) Na_3PO_4 solution
Sodium

Draw free sketch for hydrometer device and give me one reading at it is.



$1 \text{ div} = \frac{0.01}{20} = 0.0005$ for each div

$1.01 + 10 \text{ div} = 1.01 + 10 \times 0.0005 = 1.015$

$1.02 + 10 \text{div}$

$1.02 + 10 \times 0.0005 =$

1.025

$10 \rightarrow 1.01$, $20 \rightarrow 1.02$, $30 \rightarrow 1.03$

Procedure:

Mechanical sieve analysis (ASTM D-421)
Hydrometer analysis (ASTM D-422)

ve analysis:

ieve No	Sieve Diameter (mm)	Sieve Mass (g)	Sieve Mass + Soil Mass (g)	Retained Soil Mass (g)	Cumulative Retained	%Retained soil	Percentage of Finer Soil Mass %
١	٢٥	٥٥١.٥٢	٦٢٠.٤١	68.89	68.89	6.889	93.111
(٣/٤)	١٩	٥٥٥.١	٥٥٨.٥٥	3.45	72.34	7.234	92.766
(١/٢)	١٢.٥٠٠	٥٤٣.١٩	٥٨٨.٥٩	45.4	117.74	11.774	88.226
(٣/٨)	٩.٥٠٠٠	٥٤٢.٨٩	٥٤٥.٨٩	3	120.74	12.074	87.926
# ٤	٤.٧٥٠٠	٥١١.٧١	٥١٦.٣٥	4.64	125.38	12.538	87.462
# ١٠	٢.٠٠	٤٨٦.٧٤	٦٣٧.٤٧	150.73	276.11	27.611	72.389
# ٢٠	.٨٥	٤٢٠.٥٦	٥٠٩.٥٥	88.99	365.1	36.51	63.49
# ٤٠	.٤٢٥	٣٨٥.٩٦	٤١٨.٥	32.54	397.64	39.764	60.236
#٦٠	.٢٥	٣٥٨.٠٨	٣٧٣.٩٦	15.88	413.52	41.352	58.648
# ١٠٠	٠.١٥٠٠	٣٥٤.٧٢	٣٦٣.٧٦	9.04	422.56	42.256	57.744
# ٢٠٠	٠.٠٧٥٠	٣٣٩.٦٦	٣٤٩.٣٩	9.73	432.29	43.229	56.771
pan		٣٦٨.٨١	٣٦٨.٨١	0	432.29	43.229	56.771

$\Sigma M = 1000g$

Elapsed time (min)	Actual Hydrometer reading div = 0.0005	Composite correction $R_1 - R_2$	R corrected Actual - correction	Temperature (C°)	L (cm) from table	K	D	%of finer	A... fine...
.٢٥	١.٠٢+١٥ div 1.0275	0.001	1.0265	٢٦°c	9.05	0.01253	0.075	94.1	53.42
.٥	١.٠٢+١٤ div 1.027	0.001	1.026	٢٦°c	9.2	0.01253	0.0537	92.52	52.52
١	١.٠٢+١٢div 1.026	0.001	1.025	٢٦°c	9.4	0.01253	0.0384	89.35	50.72
٢	١.٠٢+٩ div 1.0245	0.001	1.0235	٢٦°c	9.85	0.01253	0.0278	84.59	48.02
٤	١.٠٢+٧div 1.0235	0.001	1.0225	٢٦°c	10.1	0.01253	0.0199	81.42	46.22
٨	١.٠٢+٢ div 1.021	0.001	1.02	٢٦°c	10.7	0.01253	0.01449	73.49	41.72
١٥	١.٠١+١٩div 1.0195	0.001	1.0185	٢٦°c	11.15	0.01253	0.0108	68.74	39.02
٢٠ hours	١.٠١+٥ div 1.0125	0.001	1.0115	٢٦°c	13	0.01253	0.0013	46.54	26.42

R_1=١+٢ div , R_2=١

drometer analysis

mple of calculation: - ***** Hydrometer sample *****

@ ٨ min

*actual Hydrometer reading = 1.02 + 2 Div.

= 1.02 + 2 * 0.0005

= 1.021

Temp(C°)	Gw
٤	١
١٦	.٩٩٨٩٧
١٧	.٩٩٨٨٠
١٨	.٩٩٨٦٢
١٩	.٩٩٨٤٤
٢٠	.٩٩٨٢٣
٢١	.٩٩٨٠٢
٢٢	.٩٩٧٨٠
٢٣	.٩٩٧٥٧
٢٤	.٩٩٧٣٣
٢٥	.٩٩٧٠٨
٢٦	.٩٩٦٨٢
٢٧	.٩٩٦٥٥
٢٨	.٩٩٦٢٧
٢٩	.٩٩٥٩٨
٣٠	.٩٩٥٦٨

**Composite Correction @

c = (W of water + disp) – (Wof water)

*** Hydrometer reading with composite correction applied

= Actual hydraulic – Composite = $R_1 - R_2$

R_1 + 1 + 2Div = 1 + 2 * 0.0005 - 1

R_2 = 1 = 0.001

**** Effective depth of hydrometer L (cm) – from table ٧-٤ = (١٥١H)

10.7 cm at actual reading = 1.021

***** Value of (K) from (table ٧.٣)

SG = 2.7 T = 26 °

K = 0.01253

****** Diameter of soil particle D (mm) = K*(L/T) ^.٥ hint: T is time in minutes

$= 0.01253 \sqrt{\frac{10.7}{8}} = 0.01449$ mm

******* Soil in Suspension

Note W= ٥٠ g GS = ٢.٧ Gw = 0.99682

P = { ((١٠٠,٠٠٠/W) * GS /(GS –Gw))}*(Rcor – Gw)

$\left(\frac{100000}{50}\right) * \left(\frac{2.7}{2.7 - 0.99682}\right) * (1.02 - 0.99682) = 73.49\ \%$

Actual P = P * (% passing sieve No ٢٠٠) = 73.49 * 0.56771 = 41.721 %

****** Mechanics Sample ******

@sieve # ١٠٠

Weight sieve empty = 354.72 g

Weight sieve full = 363.76 g

Weight retained = W full - W empty = 363.76 - 354.72 = 9.04 g

% of Retained = $\frac{\text{comulative retained on sieve \#100}}{\text{total mass}} * 100\% = \frac{422.56}{1000} * 100\%$

= 42.256%

Commutative of retained = comulative of retained on sieve #60 + retained soil mass on sieve #100 = 413.52 + 9.04 = 422.56

% passing = 100% - retained soil % = 100% - 42.256%

= 57.744%

Discussion and conclusion

*% Gravel → Retained on sieve # 4 = 12.538 %

**%sand → Retained on sieve # 200 & passed sieve # 4

43.229% - 12.538 % = 30.691 %

***%silt → Retained on D = 0.002 mm & Passed sieve # 200

56.771 % - 27 % = 29.771 %

****%clay → Finer than D = 0.002 mm (soil passed D = 0.002)

27 %

*****D١٠= can't determine , D٦٠= 0.35 mm , D٣٠= 0.0027 mm

******Cc= $\frac{(D_{30})^2}{(D_{10})(D_{60})}$ → can't determine

*******Cu= $\frac{D_{60}}{D_{10}}$ → can't determine.

Plot(%of passing)versus(diameter in(mm))for both sieve and hydrometer analysis on the same figure.

Why using the sodium hexameta phosphate (calgon)?

To neutralize the negative charge on the soil particles then the soil go down to the bottom of the bottle and to prevent the soil lumps because clay has high cohesion so this agent separate the clay particles from each other, so each particle works alone.

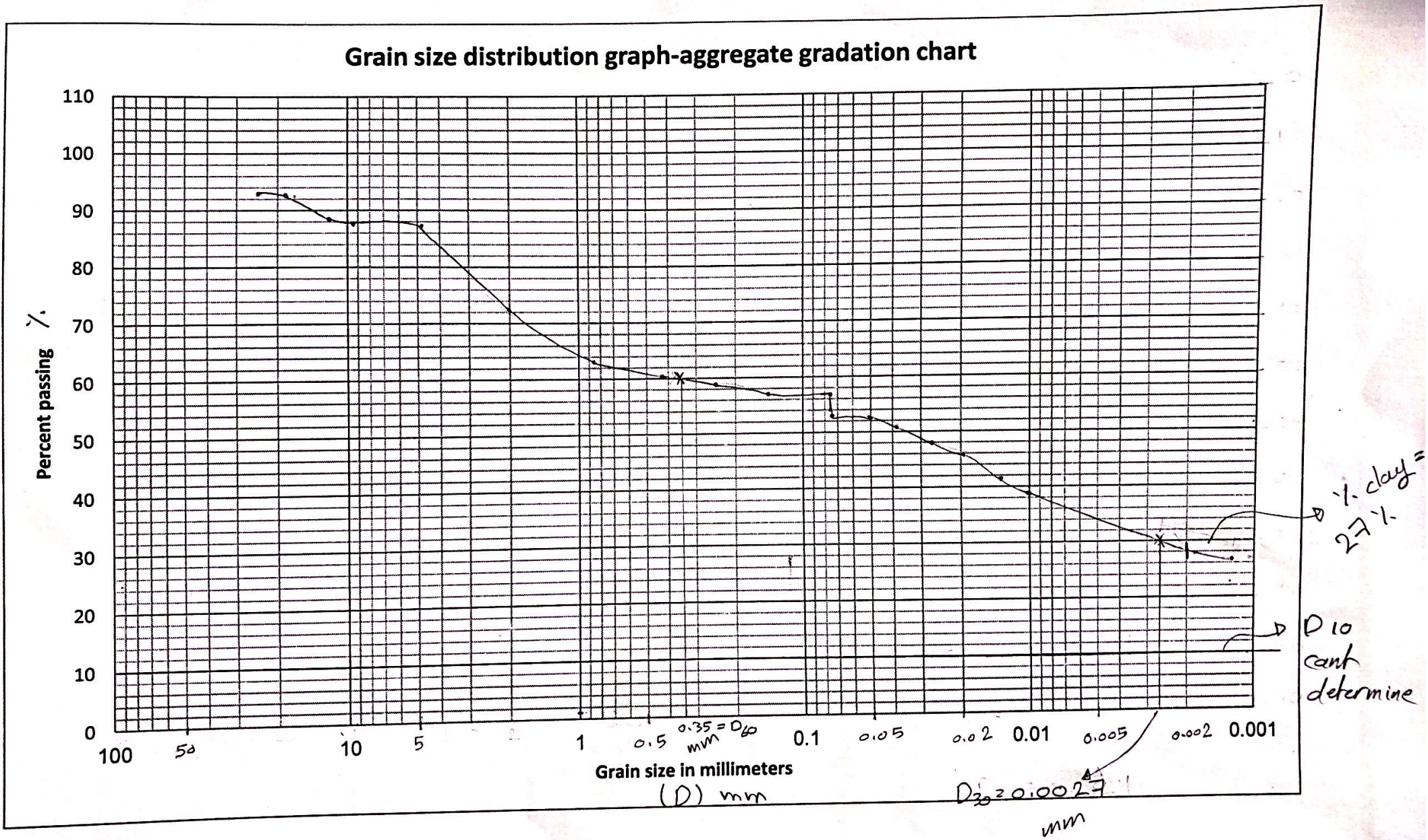


TABLE 3 Values of K for Use in Equation for Computing Diameter of Particle in Hydrometer Analysis

Temperature,° C	Specific Gravity of Soil Particles								
	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
16	0.01510	0.01505	0.01481	0.01457	0.01435	0.01414	0.01394	0.01374	0.01356
17	0.01511	0.01486	0.01462	0.01439	0.01417	0.01396	0.01376	0.01356	0.01338
18	0.01492	0.01467	0.01443	0.01421	0.01399	0.01378	0.01359	0.01339	0.01321
19	0.01474	0.01449	0.01425	0.01403	0.01382	0.01361	0.01342	0.1323	0.01305
20	0.01456	0.01431	0.01408	0.01386	0.01365	0.01344	0.01325	0.01307	0.01289
21	0.01438	0.01414	0.01391	0.01369	0.01348	0.01328	0.01309	0.01291	0.01273
22	0.01421	0.01397	0.01374	0.01353	0.01332	0.01312	0.01294	0.01276	0.01258
23	0.01404	0.01381	0.01358	0.01337	0.01317	0.01297	0.01279	0.01261	0.01243
24	0.01388	0.01365	0.01342	0.01321	0.01301	0.01282	0.01264	0.01246	0.01229
25	0.01372	0.01349	0.01327	0.01306	0.01286	0.01267	0.01249	0.01232	0.01215
26	0.01357	0.01334	0.01312	0.01291	0.01272	0.01253	0.01235	0.01218	0.01201
27	0.01342	0.01319	0.01297	0.01277	0.01258	0.01239	0.01221	0.01204	0.01188
28	0.01327	0.01304	0.01283	0.01264	0.01244	0.01255	0.01208	0.01191	0.01175
29	0.01312	0.01290	0.01269	0.01249	0.01230	0.01212	0.01195	0.01178	0.01162
30	0.01298	0.01276	0.01256	0.01236	0.01217	0.01199	0.01182	0.01165	0.01149

TABLE 2 Values of Effective Depth Based on Hydrometer and Sedimentation Cylinder of Specified Sizes[A]

Hydrometer 151H		Hydrometer 152H			
Actual Hydrometer Reading	Effective Depth, *L*, cm	Actual Hydrometer Reading	Effective Depth, *L*, cm	Actual Hydrometer Reading	Effective Depth, *L*, cm
1.000	16.3	0	16.3	31	11.2
1.001	16.0	1	16.1	32	11.1
1.002	15.8	2	16.0	33	10.9
1.003	15.5	3	15.8	34	10.7
1.004	15.2	4	15.6	35	10.6
1.005	15.0	5	15.5		
1.006	14.7	6	15.3	36	10.4
1.007	14.4	7	15.2	37	10.2
1.008	14.2	8	15.0	38	10.1
1.009	13.9	9	14.8	39	9.9
1.010	13.7	10	14.7	40	9.7
1.011	13.4	11	14.5	41	9.6
1.012	13.1	12	14.3	42	9.4
1.013	12.9	13	14.2	43	9.2
1.014	12.6	14	14.0	44	9.1
1.015	12.3	15	13.8	45	8.9
1.016	12.1	16	13.7	46	8.8
1.017	11.8	17	13.5	47	8.6
1.018	11.5	18	13.3	48	8.4
1.019	11.3	19	13.2	49	8.3
1.020	11.0	20	13.0	50	8.1
1.021	10.7	21	12.9	51	7.9
1.022	10.5	22	12.7	52	7.8
1.023	10.2	23	12.5	53	7.6
1.024	10.0	24	12.4	54	7.4
1.025	9.7	25	12.2	55	7.3
1.026	9.4	26	12.0	56	7.1
1.027	9.2	27	11.9	57	7.0
1.028	8.9	28	11.7	58	6.8
1.029	8.6	29	11.5	59	6.6
1.030	8.4	30	11.4	60	6.5
1.031	8.1				
1.032	7.8				
1.033	7.6				
1.034	7.3				
1.035	7.0				
1.036	6.8				
1.037	6.5				
1.038	6.2				

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Data and Results

PLASTIC LIMIT :

Table ١

Trial #	Can #	Can Wt. (g)	Can+Wet Soil (g)	Can+Dry Soil (g)	W %
١	١a	٣٠.٩٢	٣٣.٥٥	٣٢.٩٣	30.85
٢	٢a	٣١.٢١	٣٣.٨٣	٣٣.٢١	31
٣	٣a	٣٠.٦٢	٣٣.٩٢	٣٣.١٥	30.43
				W%AVG =	30.76

W% avg = $\frac{30.85+31+30.43}{3}$ = 30.76 %

Sample of Calculations and Results

For trial #1

$wc\% = \frac{M_w}{M_s} * 100\% = \frac{M_{can+wet} - M_{can+dry}}{M_{can+dry} - M_{can}} * 100\% = \frac{33.55-32.93}{32.93-30.92} * 100\% = 30.85\%$

$P.L = \frac{\Sigma Wc}{\#\text{ of } Wc} = \frac{30.85+31+30.43}{3} = 30.76\%$

= average of Wc%

what is the P.L of the soil sample?

Is the water content (w%) where soil starts to change semisolid state to plastic state, Casagrande defined it as the water content at which a thread of soil just crumbles when it's carefully rolled out to a diameter of 3mm (1/8").

LIQUID LIMIT:

Table ٢

Trial #	Can #	Can Wt. (g)	Can+Wet Soil (g)	Can+Dry Soil (g)	Blows #	W %
١	٥b	٣٠.٦٧	٧١.٩٧	٥٨.٢٠	٢٠	50.02
٢	٦b	٣٠.٩٦	٥٨.٤١	٤٩.٨٠	٢٣	45.70
٣	١١b	٣٠.٥٩	٧٣.١٦	٦٠.٨٧	٢٧	40.59
٤	١٢b	٣١.٤٦	٦٩.١٧	٥٩.٤٥	٣٣	34.73

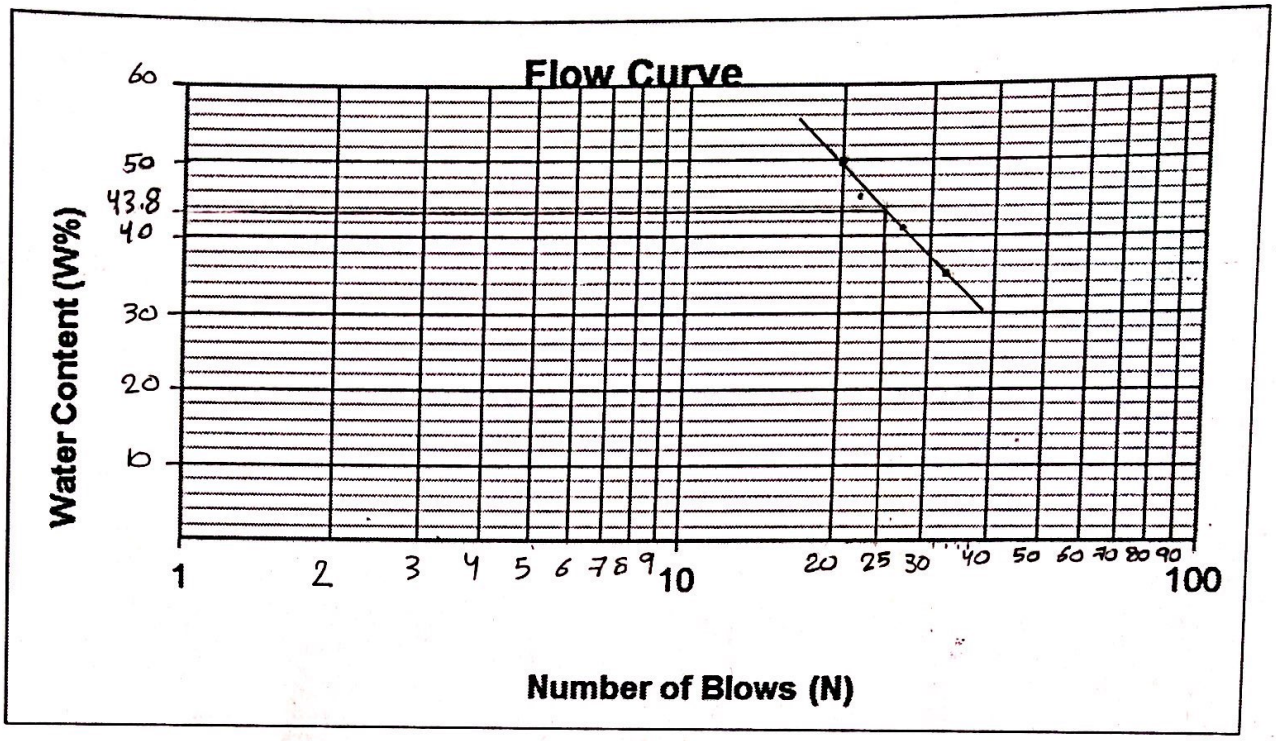
Sample of Calculations and Results

For trial #1

$Wc = \frac{M_w}{M_s} * 100\% = \frac{M_{can+wet} - M_{can+dry}}{M_{can+dry} - M_{can}} * 100\%$

$= \frac{71.97-58.20}{58.20-30.67} * 100\%$

$= 50.02\%$



A) Determine L.L by using multi-point method.

at $N = 25$

$LL = 43.8\%$

B) Determine L.L by using one point method.

$$LL = w_n \left[\frac{N}{25}\right]^{0.121} = 45.70 \left[\frac{23}{25}\right]^{0.121} = 45.24\%$$

$$w_n\% = W_{23} = \frac{58.41 - 49.80}{49.80 - 30.96} * 100\% = 45.70\%$$

CIVIL ENGINEERING

Compaction

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Section: 2

Date: 6-4-2021

Objective

* To compact soil to improve its strength
* To determine the maximum dry unit weight of compaction soil and maximum water content (optimum water content)
* and maximum dry density
* decrease permability
* increase shear strength and stability
* decrease future settlement

Equipment

1) Compaction mold
2) standard compaction hummer
3) balance
4) flat pan (mixing pan)
5) can
6) steel straight edge
7) plastic bottle (graduated cylinder)
8) hydraulic extruder Jack
9) oven

Procedure

According to ASTMD -1557 (-ASTM)

soil air dried 2000g of soil passed thru #4 sieve using proctor mold (1/30 cubic foot) place & compact soil in 3 layers each layer should receive 25 drops of the compaction hammer use straight edge after last layer to trim the excess soil leveling to the drop of the mold, determine the weight of the mold with compacted moist soil, extrude from mold and collect a sample for water content determination, repete for each sample over a range of moisture content calculate dry density and plot vs water content

no need

Data and Results

Table 1

Group #	M_m (g)	M_{m+s} (g)	Can #	Can Wt. (g)	Can+Wet Soil (g)	Can+Oven Dry Soil (g)
١	٣٢٨٢	٤٧٧٣	A١	٣٠.٨٤	١٧٢.٠٥	١٥٠.٨٥
٢	٣٢٨٧	٤٩٠٥	١٢B	٣٠.٧٢	١٣٠.٩٠	١١٣.٢٤
٣	٣٣١١	٥٠٨٧	٥A	٣١.٢٢	١٣٧.٠٠	١١٤.٩٤
٤	٣٣٢٢	٥٠٤٥	B٩	٣٠.٩٩	١٨٢.٠٠	١٤٦.٢٥

مي يوسف أبو هـد

Table ٢

Group #	W %	ρ_{wet} (g/cm^3)	ρ_{Dry} (g/cm^3)
١	17.67	1.58	1.34
٢	21.4	1.71	1.41
٣	26.35	1.88	1.49
٤	31.02	1.83	1.4

Table٣: Zero-air voids curve Determination

Group #	W % Assume >omc	ρ_{Dry} (g/cm^3)
١	30	1.49
٢	31	1.47
٣	32	1.45
٤	33	1.43

Sample of calculations

Hint: volume =٩٤٤cm^٣
GS=٢.٧

For sample 3 :

$$wc\% = \frac{M_w}{M_{s\,oven\,dry}} * 100\% = \frac{137 - 114.94}{114.94 - 31.22} * 100\% = 26.35\%$$

$$\rho_{wet} = \frac{M_{m+s} - M_s}{V} = \frac{5087 - 3311}{944} = 1.88\ g/cm^3$$

$$\rho_{dry} = \frac{\rho_{wet}}{1 + wc\%} = \frac{1.88}{1 + 0.2635} = 1.49\ g/cm^3$$

assume $wc\% = 32\%$

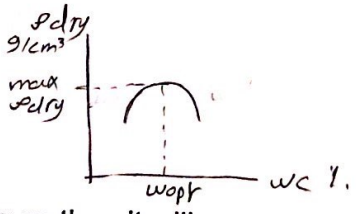
$$\rho_{dry} = \frac{\rho_w G_s}{G_s w + 1} = \frac{1 * 2.7}{2.7 * 0.32 + 1} = 1.45\ g/cm^3$$

Plot dry density (ρ_{Dry})versus moisture content%(W %) and in the same figure plot the zero air voids curve.

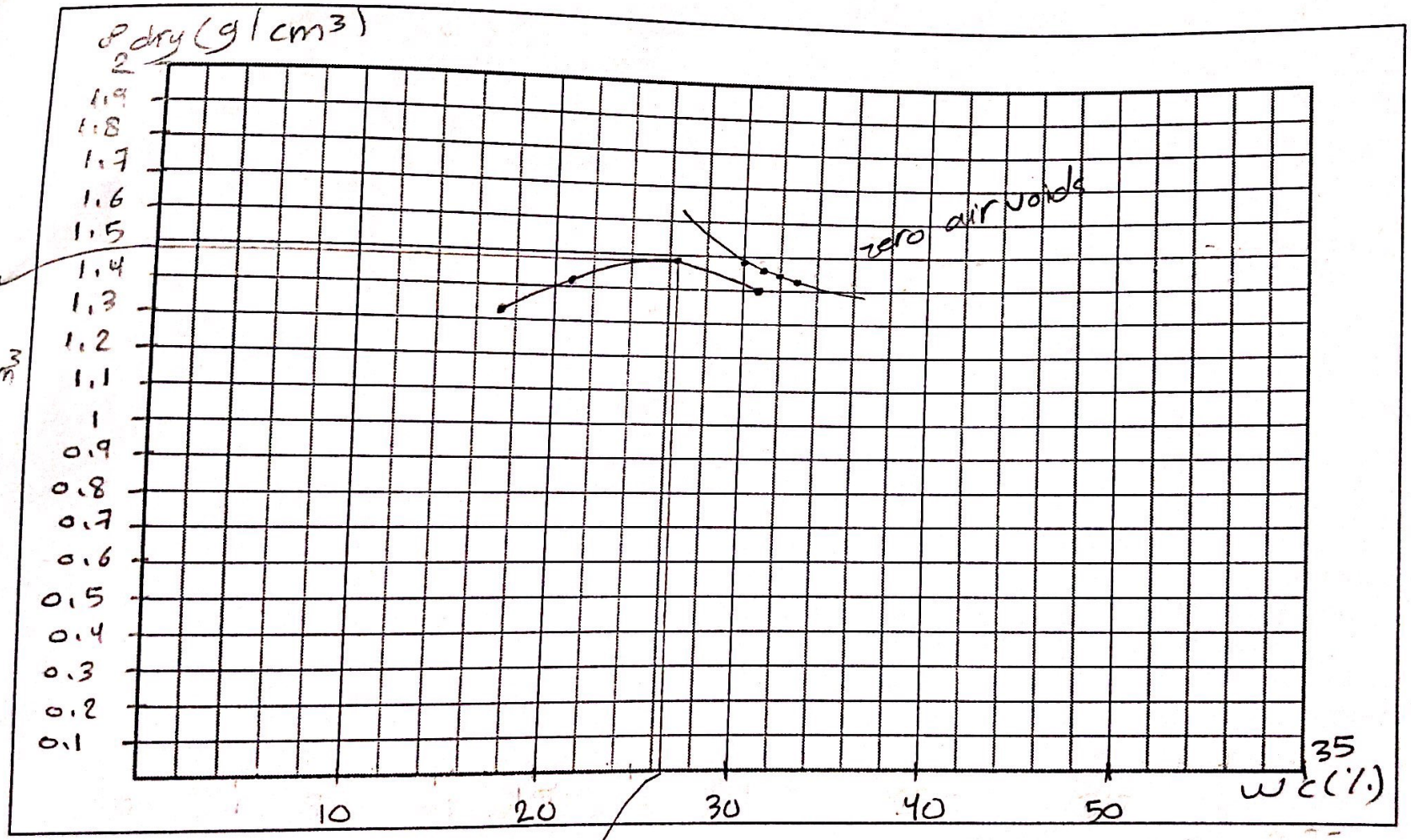
Conclusion and Discussion

Owc 26.35%

ρ_{Dry}maximum 1.49 g/cm³



Why the value of dry density will be increase up to the maximum then it will be decrease? As the water content increse, the particles develop layer water firs around them which tend to make the particles easier to move (Lubricate the particles) and reorient it into a denser configuration. Above water optimum (opt) : water starts to replace soil particles in the mold and since $\rho_w << \rho_s$ the dry density starts to decrease. w_{opt} : the density becomes to its maximum value and it doesnt increase larger than it.



ρdry max = 1.44 g/cm3

wopt = 26.35%

Name : مي ابو يوسف ابو حسين ID No: 1833304	Geotechnical Engineering Lab	Exp.Title: Field Density Test

Data and Results

Table ١

density=	١.٣٧
weight of(bottle+cone+sand)before=	٧٤٩٨
weight of(bottle+cone+sand)after=	٤٠٦٦
weight of sand in cone=	١٤٤٠g
weight of tray=	٢٣٥
weight of tray+ wet soil=	٢٥٤٤
weight of tray oven+ dry soil=	٢٣٠٨
Dry density in lab from compaction test	١.٤٩

Sample of Calculations and Results

Volume= (weight of (bottle + cone + sand) before − weight of (bottle + con + sand) after − weight of sand in con) / density (ρ))

$$= \frac{7498 - 4066 - 1440}{1.37} = \boxed{1454.01\ cm^3}$$

wc%= $\frac{M_r - M_s}{M_s} * 100\%$

$$\frac{(\text{weight of tray + wet soil} - \text{weight of tray}) - (\text{weight of tray + dry soil} - \text{weight of tray})}{\text{weight of tray + dry} - \text{weight of tray}}$$

Total density=

$$\frac{M_{soil\ compacted}}{Volume} = (\text{weight wet soil + tray} - \text{weight tray}) / \text{volume}$$

$$= (2544 - 235) / 1454.01 = 1.588\ g/cm^3$$

Dry density=

$$\frac{\rho_r}{1+wc} = \frac{1.588}{1+0.1138} = \boxed{1.4257\ g/cm^3}$$

$$RC = \frac{\rho_{dry\ field}}{\rho_{dry\ lab}} = \frac{1.4257}{1.49} \cdot 100\% = \boxed{95.68\%}$$

$$= \frac{(2544 - 235) - (2308 - 235)}{2308 - 235} * 100\% = \boxed{11.38\%}$$

Temp(C°)	ρ_w
4	1
16	.99897
17	.99880
18	.99862
19	.99844
20	.99823
21	.99802
22	.99780
23	.99757
24	.99733
25	.99708
26	.99682
27	.99655
28	.99627
29	.99598
30	.99568

Temp(C°)	Correction factor
15	1.135
16	1.106
17	1.077
18	1.051
19	1.025
20	1
21	.976
22	.953
23	.931
24	.91
25	.889
26	.869
27	.85
28	.832
29	.814
30	.797

مي يوسف أبو هنيد
1833304

Permeability

Data and Results

$D = 7cm$ Temp = 23°c

$L = 7cm$ $A\ (cm^3) = 38.4846$

$\rho_w = 0.99757\ g/cm^3 \longrightarrow$ from table at Temp = 23°c

Group #	H_1 (cm)	H_2 (cm)	Mass of water (g)	Time (sec)	Mass/ρ_w Q (cm^3)	H_2-H_1 $H\Delta$ h(cm)	QL/(Aht) K (cm/sec)
1	31.9	58	713	30	714.74	26.1	0.166
2	31.9	58	1182	45	1184.88	26.1	0.183
3	31.9	58	1587	60	1590.87	26.1	0.185

sample of Calculations and Results (for group (1)) $Q = \frac{Mass}{\rho_w} = \frac{713}{0.99757} = 714.74\ cm^3$

$$K = \frac{QL}{Aht} = \frac{714.74 * 7}{38.4846 * 26.1 * 30} = 0.166\ cm/sec$$

$$K_{avg} = \frac{\Sigma K}{n} = \frac{0.166 + 0.183 + 0.185}{3} = 0.178\ cm/sec$$

$$K @ 20c = K_{avg} * \alpha = 0.178 * 0.931 = 0.1657\ cm/sec$$

α from table at temp = 23°c $\longrightarrow \alpha = 0.931$

CIVIL ENGINEERING

Consolidation

Student Name: مي يوسف أبو حميد

ID#: 1833304

Section: 1

Date: 20-4-2021

Hint: all report must be print out and solve it manually not accepted word or exel sheet.

int: nearest to two decimal any number in the report

bjective

* Determine the coefficient of permability
  Voids ratio (e) compression index (Cc) recompression index (cr)
  Preconsolidation pressure ($\sigma'c$), coefficient of permability (k), Mv, Tv
* Determine the coefficient of consolidation and O.C.R
* Determine Cv by two methods (casagrande, taylor)

Equipment

1) Loads (kg)
2) can
3) balance
4) stop watch
5) consolidation test apparatus (odometer tester)

Procedure

Consolidation test, ASTMD - 2453

Sample of calculation

$Hs=Ms/(Gs*A*\rho_w)$	$e.= (H_t-H_s)/H_s$	$Stress_{(MPa)}= P/A$
$\frac{145}{2.7 * 38.465} =$ 13.96 mm	$\frac{20-13.96}{13.96} =$ 0.43	$\frac{50 * 9.81}{0.003847} =$ 127501.94 KPa = 0.128 MPa = 0.13 MPa

$Hf=H_t$-deformation	$Hv=H_f-H_s$	$e= H_v/H_s$
20 - 58 * 0.01 = 19.42	19.42 - 13.96 = 5.46	$\frac{5.46}{13.96} = 0.39$

= ١٤٥ g Gs=٢.٧٠ H= ٢cm

A= ٣٨.٤٦٥ cm٢ D=٧cm

٠.٠٠٣٨٤٧ m٢

Hint:(Div *.٠١)=Deformation in (mm)

Load=
٥٠kg

Time hr	Time min	Time sec	Dial Reading Div	Time (min)	Time^٠.٥ (min^٠.٥)	Deformation (mm)	Hf	Hv	e
٠	٠	٨	٥٨	٠.١٣	٠.٣٧	0.58	19.42	5.46	0.39
٠	٠	١٥	٦٤	٠.٢٥	٠.٥٠	0.64	19.36	5.4	0.39
٠	٠	٣٠	٦٩	٠.٥	٠.٧١	0.69	19.31	5.35	0.38
٠	١	٠	٧٥.٥	١	١.٠٠	0.76	19.24	5.28	0.38
٠	٢	٠	٨٠	٢	١.٤١	0.8	19.2	5.24	0.38
٠	٤	٠	٨٥.٥	٤	٢.٠٠	0.86	19.14	5.18	0.37
٠	٨	٠	٩٠.٧٥	٨	٢.٨٣	0.91	19.09	5.13	0.37
٠	١٦	٠	٩٥	١٦	٤.٠٠	0.95	19.05	5.09	0.36
٠	٣٠	٠	٩٩	٣٠	٥.٤٨	0.99	19.01	5.05	0.36
١	٠	٠	١٠٢	٦٠	٧.٧٥	1.02	18.98	5.02	0.36
٢	٠	٠	١٠٤	١٢٠	١٠.٩٥	1.04	18.96	5	0.36
٤	٠	٠	١٠٦	٢٤٠	١٥.٤٩	1.06	18.94	4.98	0.36
٨	٠	٠	١٠٧	٤٨٠	٢١.٩١	1.07	18.93	4.97	0.36
٢٤	٠	٠	١٠٨	١٤٤٠	٣٧.٩٥	1.08	18.92	4.96	0.36

Load=
١٠٠kg

Time hr	Time min	Time sec	Dial Reading Div	Time (min)	Time^٠.٥ (min^٠.٥)	Deformation (mm)	Hf	Hv	e
٠	٠	٨	١١٥	٠.١٣	٠.٣٧	1.15	18.85	4.89	0.35
٠	٠	١٥	١١٧	٠.٢٥	٠.٥٠	1.17	18.83	4.87	0.35
٠	٠	٣٠	١٢٠	٠.٥	٠.٧١	1.2	18.8	4.84	0.35
٠	١	٠	١٢٣	١	١.٠٠	1.23	18.77	4.81	0.34
٠	٢	٠	١٢٧	٢	١.٤١	1.27	18.73	4.77	0.34
٠	٤	٠	١٣١	٤	٢.٠٠	1.31	18.69	4.73	0.34
٠	٨	٠	١٣٥.٥	٨	٢.٨٣	1.36	18.64	4.68	0.34
٠	١٦	٠	١٤٠	١٦	٤.٠٠	1.4	18.6	4.64	0.33
٠	٣٠	٠	١٤٤	٣٠	٥.٤٨	1.44	18.56	4.6	0.33
١	٠	٠	١٤٨.٥	٦٠	٧.٧٥	1.49	18.51	4.55	0.33
٢	٠	٠	١٥٢	١٢٠	١٠.٩٥	1.52	18.48	4.52	0.32
٤	٠	٠	١٥٥	٢٤٠	١٥.٤٩	1.55	18.45	4.49	0.32
٨	٠	٠	١٥٨	٤٨٠	٢١.٩١	1.58	18.42	4.46	0.32
٢٤	٠	٠	١٦١	١٤٤٠	٣٧.٩٥	1.61	18.39	4.43	0.32

Load=
٢٠٠kg

Time hr	Time min	Time sec	Dial Reading Div	Time (min)	Time$^{0.5}$ (min$^{0.5}$)	Deformation (mm)	Hf	Hv	e
٠	٠	٨	١٧٠	٠.١٣	٠.٣٧	1.7	18.3	4.34	0.31
٠	٠	١٥	١٧٥	٠.٢٥	٠.٥٠	1.75	18.25	4.29	0.31
٠	٠	٣٠	١٧٩	٠.٥	٠.٧١	1.79	18.21	4.25	0.3
٠	١	٠	١٨٣	١	١.٠٠	1.83	18.17	4.21	0.3
٠	٢	٠	١٨٧.٥	٢	١.٤١	1.88	18.12	4.16	0.3
٠	٤	٠	١٩٢.٥	٤	٢.٠٠	1.93	18.07	4.11	0.29
٠	٨	٠	١٩٩	٨	٢.٨٣	1.99	18.01	4.05	0.29
٠	١٦	٠	٢٠٦.٥	١٦	٤.٠٠	2.07	17.93	3.97	0.28
٠	٣٠	٠	٢١٥	٣٠	٥.٤٨	2.15	17.85	3.89	0.28
١	٠	٠	٢٢٥	٦٠	٧.٧٥	2.25	17.75	3.79	0.27
٢	٠	٠	٢٣٣.٥	١٢٠	١٠.٩٥	2.34	17.66	3.7	0.27
٤	٠	٠	٢٣٩	٢٤٠	١٥.٤٩	2.39	17.61	3.65	0.26
٨	٠	٠	٢٤١.٥	٤٨٠	٢١.٩١	2.42	17.58	3.62	0.26
٢٢	١٤	٠	٢٤٣	١٣٣٤	٣٦.٥٢	2.43	17.57	3.61	0.26

Load=
٥٠٠kg

Time hr	Time min	Time sec	Dial Reading Div	Time (min)	Time$^{0.5}$ (min$^{0.5}$)	Deformation (mm)	Hf	Hv	e
٠	٠	٨	٢٥٠	٠.١٣	٠.٣٧	2.5	17.5	3.54	0.25
٠	٠	١٥	٢٥٣	٠.٢٥	٠.٥٠	2.53	17.47	3.51	0.25
٠	٠	٣٠	٢٥٥	٠.٥	٠.٧١	2.55	17.45	3.49	0.25
٠	١	٠	٢٥٨	١	١.٠٠	2.58	17.42	3.46	0.25
٠	٢	٠	٢٦١.٥	٢	١.٤١	2.62	17.38	3.42	0.24
٠	٤	٠	٢٦٥.٥	٤	٢.٠٠	2.66	17.34	3.38	0.24
٠	٨	٠	٢٧٠.٥	٨	٢.٨٣	2.71	17.29	3.33	0.24
٠	١٦	٠	٢٧٦.٥	١٦	٤.٠٠	2.77	17.23	3.27	0.23
٠	٣٠	٠	٢٨٥	٣٠	٥.٤٨	2.85	17.15	3.19	0.23
١	٠	٠	٢٩٦	٦٠	٧.٧٥	2.96	17.04	3.08	0.22
٢	٠	٠	٣١٠	١٢٠	١٠.٩٥	3.1	16.9	2.94	0.21
٤	٠	٠	٣١٩	٢٤٠	١٥.٤٩	3.19	16.81	2.85	0.2
٨	٠	٠	٣٢٧	٤٨٠	٢١.٩١	3.27	16.73	2.77	0.2
٢٣	٣٠	٠	٣٣١	١٤١٠	٣٧.٥٥	3.31	16.69	2.73	0.2

Load=
١٠٠٠kg

Time hr	Time min	Time sec	Dial Reading Div	Time (min)	Time$^{0.5}$ (min$^{0.5}$)	Deformation (mm)	Hf	Hv	e
٠	٠	٨	٣٤١	٠.١٣	٠.٣٧	3.41	16.59	2.63	0.19
٠	٠	١٥	٣٤٤	٠.٢٥	٠.٥٠	3.44	16.56	2.6	0.19
٠	٠	٣٠	٣٤٧	٠.٥	٠.٧١	3.47	16.53	2.57	0.18
٠	١	٠	٣٥١	١	١.٠٠	3.51	16.49	2.53	0.18
٠	٢	٠	٣٥٧	٢	١.٤١	3.57	16.43	2.47	0.18
٠	٤	٠	٣٦٣	٤	٢.٠٠	3.63	16.37	2.41	0.17
٠	٨	٠	٣٧٠	٨	٢.٨٣	3.7	16.3	2.34	0.17
٠	١٦	٠	٣٨٠	١٦	٤.٠٠	3.8	16.2	2.24	0.16
٠	٣٠	٠	٣٩٠	٣٠	٥.٤٨	3.9	16.1	2.14	0.15
١	٠	٠	٤٠٣	٦٠	٧.٧٥	4.03	15.97	2.01	0.14
٢	٠	٠	٤١٢	١٢٠	١٠.٩٥	4.12	15.88	1.92	0.14
٤	٠	٠	٤١٨	٢٤٠	١٥.٤٩	4.18	15.82	1.86	0.13
٨	٠	٠	٤٢٠	٤٨٠	٢١.٩١	4.2	15.8	1.84	0.13
٢٤	٠	٠	٤٢٢	١٤٤٠	٣٧.٩٥	4.22	15.78	1.82	0.13

Load kg	Load MPa	Final Height H_F (mm)	Height of voids (mm)	Final voids ratio	Avg. Height (mm)	Fitting Time (Min) t_{50}	Fitting Time (Min) t_{90}	Cv (mm^2/min) from t_{50}	Cv (mm^2/min) from t_{90}
٥٠	0.13	18.92	4.96	0.36	19.46	5.76	2.5	13.94	7.46
١٠٠	0.26	18.39	4.43	0.32	18.66	9	14	8.2	1.22
٢٠٠	0.51	17.57	3.61	0.26	17.98	5.76	20	11.9	0.8
٥٠٠	1.28	16.69	2.73	0.2	17.13	144	70	0.43	0.21
١٠٠٠	2.55	15.78	1.82	0.13	16.24	30.25	20	1.85	0.65

$Cv_{average}$=

$$\frac{13.94+8.2+11.9+0.43+1.85+7.46+1.22+0.8+0.21+0.65}{10}$$

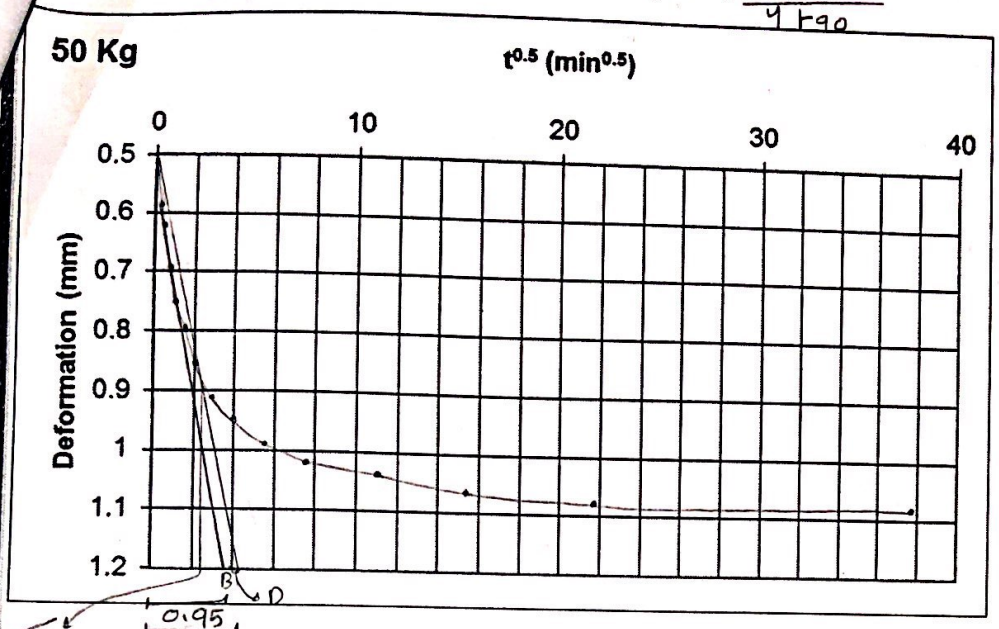
$$Cv_{average} = 4.67 \ \frac{mm^2}{min}$$

he figures shown must be very clear points, how works on it, and show me in details how to te CV.

$CB * 1.15 = CD$

$\sqrt{t_{90}}$ = tangent مع curve تقاطع الـ

$$CV = \frac{0.848\,H^2}{4\,t_{90}}$$



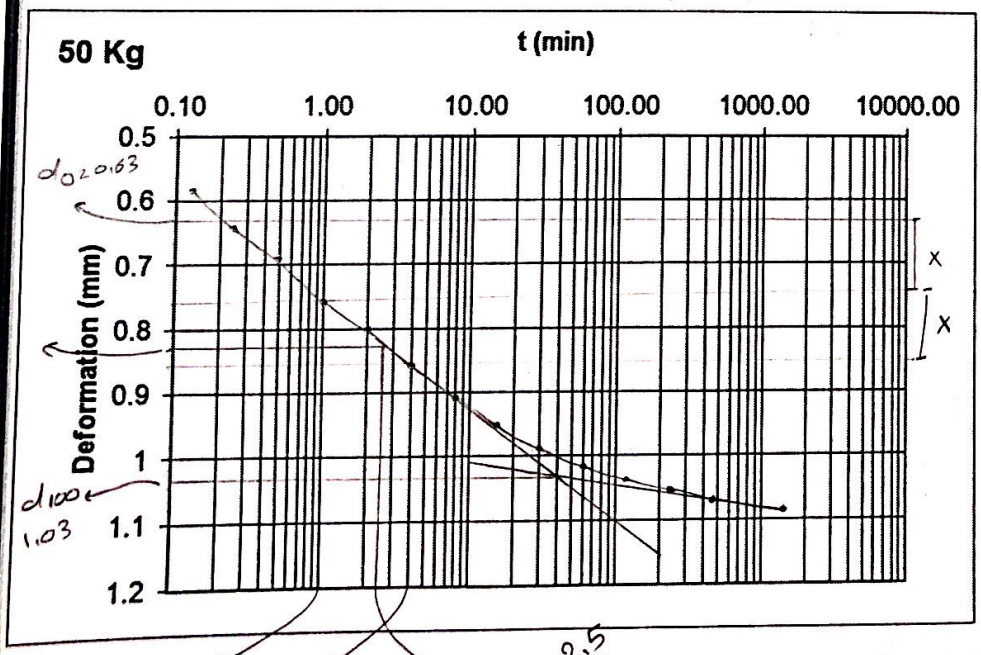
$\sqrt{t_{90}}$ 0.95 1.09

$D = 0.95 * 1.15 = 1.09$

$$CV = \frac{0.848 * 19.46^2}{4 * 5.76} = 13.94 \ \frac{mm^2}{min}$$

$\sqrt{t_{90}} = 2.4$

$t_{90} = 5.76$ min



$d_{100} = 1.03$ mm

$t_1 = 1$ min

$t_2 = 4 * t_1 = 4 * 1 = 4$ min

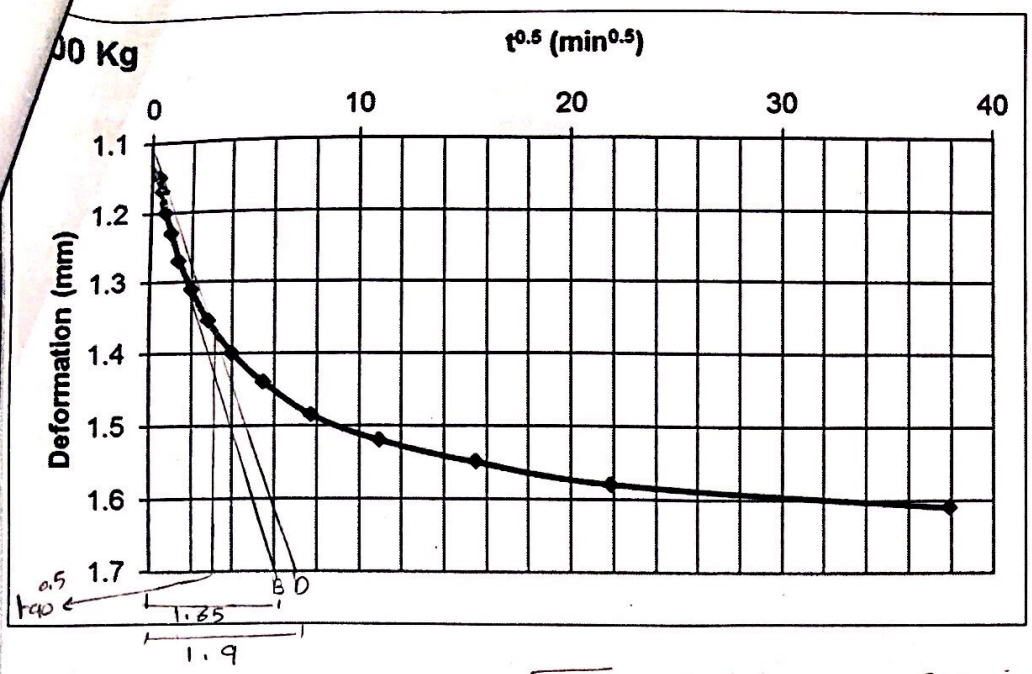
$X = 0.9$ cm

$d_0 = 0.63$

$$d_{50} = \frac{d_0 + d_{100}}{2} = \frac{0.63 + 1.03}{2} = 0.83 \text{ mm}$$

$$CV = \frac{0.197\,H^2}{4\,t_{50}} = \frac{0.197 * 19.46^2}{4 * 2.5}$$

$7.46 \ mm^2/min$



$D = 1.65 * 1.15 = 1.9\ cm$

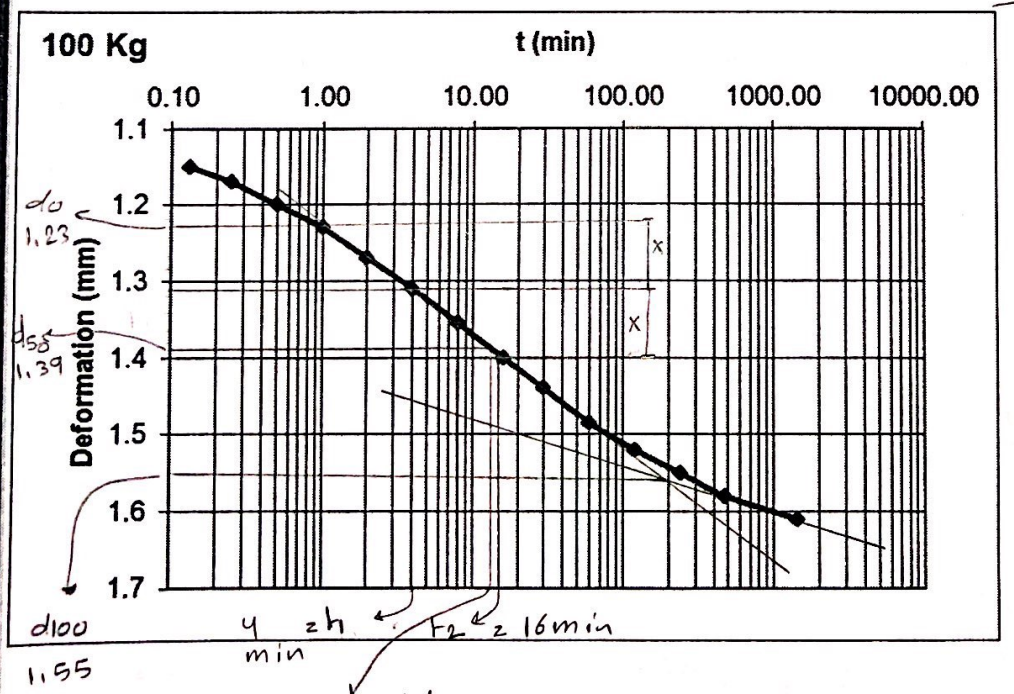
$\sqrt{t_{90}} = 3$

$t_{90} = 9\ min$

$$CV = \frac{0.848 * H_{avg}^2}{4 t_{90}}$$

$$= \frac{0.848 * 18.66^2}{4 * 9}$$

$$= 8.2\ \frac{mm^2}{min}$$



$d_{100} = 1.55\ mm$

$t_1 = 4\ min$

$t_2 = 4t_1 = 4 * 4 = 16\ min$

$X = 0.85\ cm$

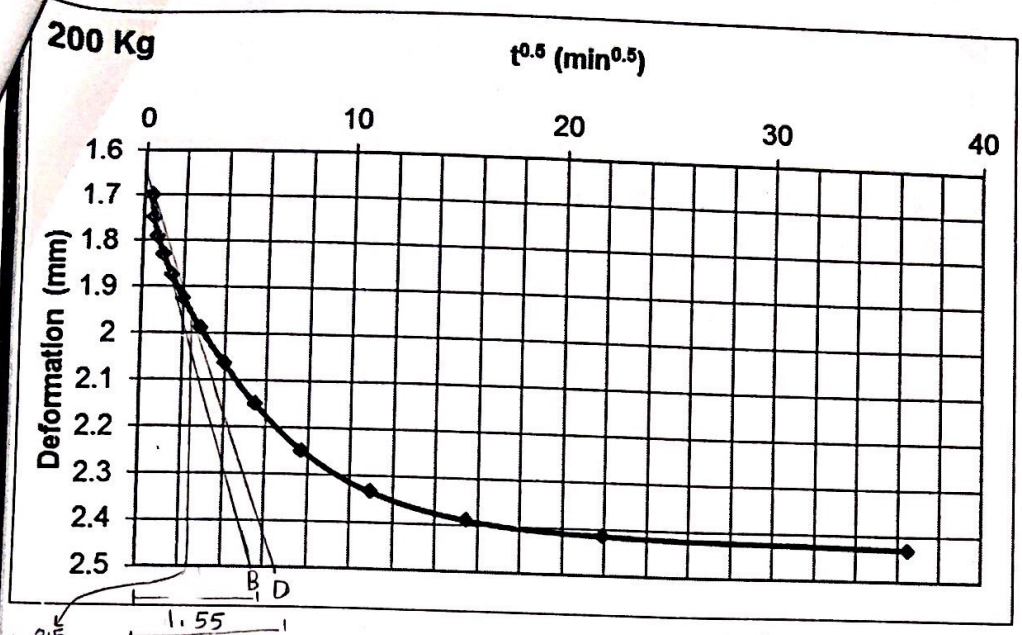
$d_0 = 1.23\ mm$

$$d_{50} = \frac{d_0 + d_{100}}{2}$$

$$= \frac{1.23 + 1.55}{2}$$

$$= 1.39\ mm$$

$t_{50} = 14\ min$, $CV = \frac{0.197 * H^2}{4 t_{50}} = \frac{0.197 * 18.66^2}{14 * 4} = 1.22\ \frac{mm^2}{min}$



$t_{90}^{0.5}$

1.55

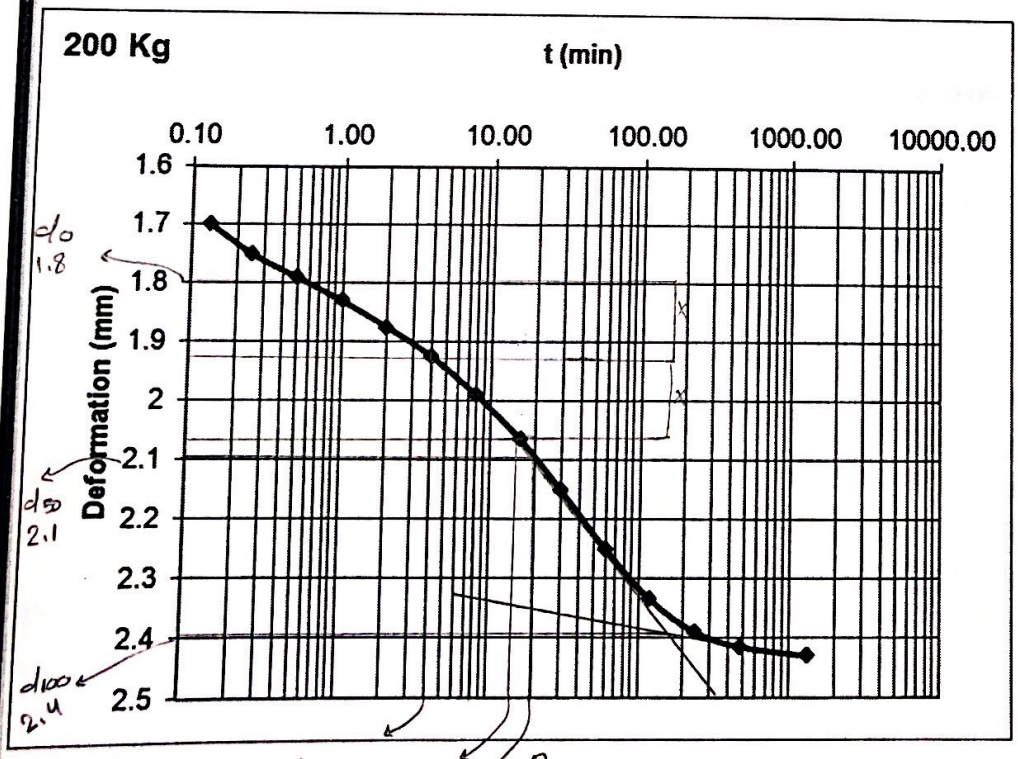
1.78

$D = 1.55 * 1.15 = 1.78$ cm

$\sqrt{t_{90}} = 2.4$

$t_{90} = 5.76$

$$C_v = \frac{0.848 * 17.98^2}{4 * 5.76} = 111.9 \ \frac{mm^2}{min}$$



$d_{100} = 2.4$ mm

$t_1 = 4$ min

$t_2 = 4 * 4 = 16$ min

$x = 1$ cm

$d_0 = 1.8$ mm

$$d_{50} = \frac{1.8 + 2.4}{2} = 2.1 \text{ mm}$$

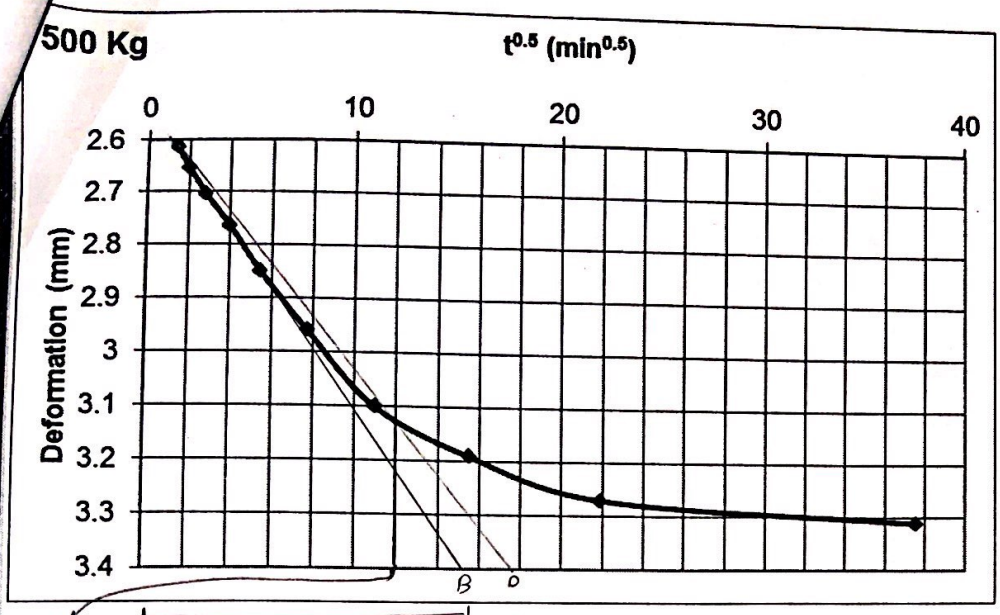
$t_{50} = 20$ min

$$C_v = \frac{0.197 * 17.98^2}{4 * 20} = 0.8 \ \frac{mm^2}{min}$$

4min = t_1

16 min = t_2

$t_{50} = 20$ min



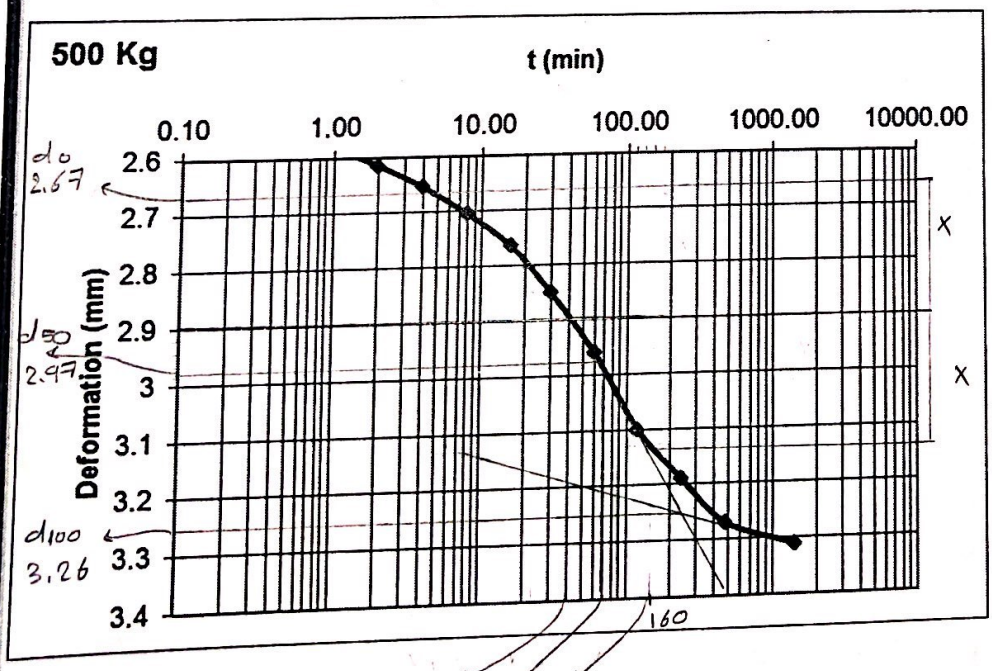
$t_{90}^{0.5}$ 4.2 4.83

$D = 4.2 * 1.15 = 4.83\,cm$

$\sqrt{t_{90}} = 12$

$t_{90} = 144\,min$

$$C_v = \frac{0.848 * 17.13^2}{4 * 144} = 0.43\ \frac{mm^2}{min}$$



40 min = t_1

t_{50} = 70 min

t_2 160 min

$d_{100} = 3.26\,mm$

$t_1 = 40\,min$

$t_2 = 4 * 40 = 160\,min$

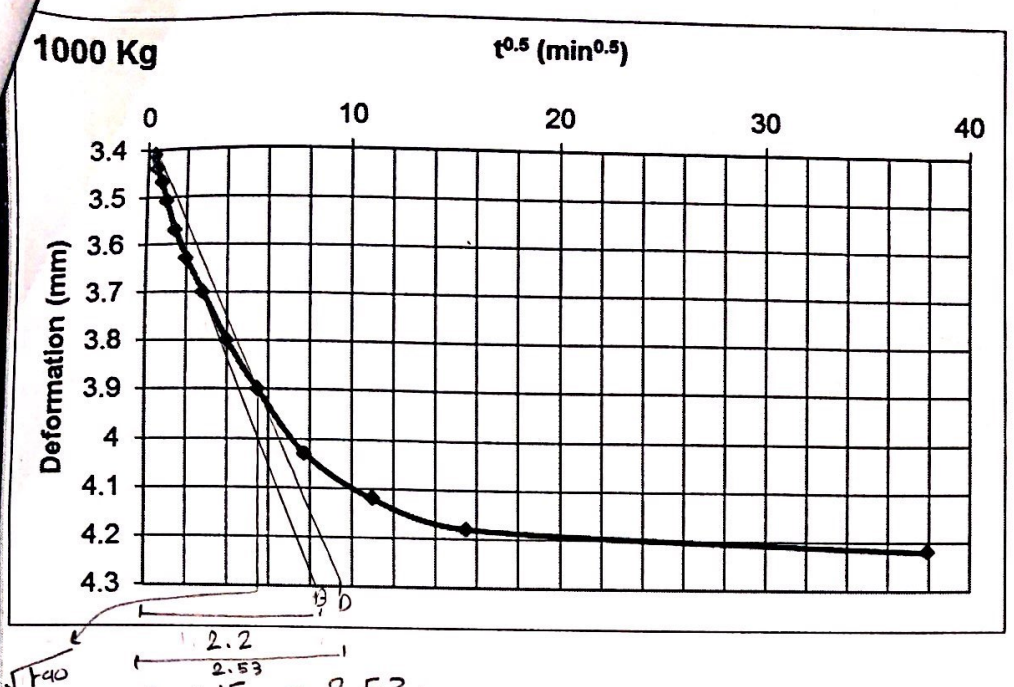
$X = 1.7\,cm$

$d_o = 2.67$

$$d_{50} = \frac{3.26 + 2.67}{2} \doteq 2.97\,mm$$

$t_{50} = 70\,min$

$$C_v = \frac{0.197 * 17.13^2}{4 * 70} = 0.21\ mm^2/min$$

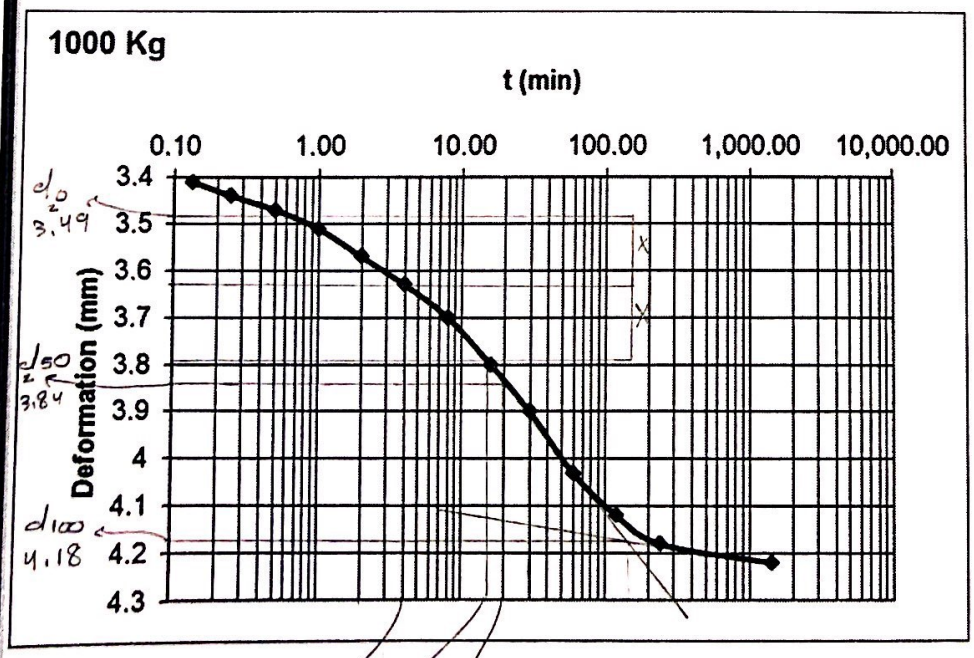


$D = 2.2 * 1.15 = 2.53$

$\sqrt{t_{90}} = 5.5$

$t_{90} = 30.25$ min

$$C_v = \frac{0.848 * 16.24^2}{4 * 30.25} = 1.85 \ \frac{mm^2}{min}$$



4 min = t_1

16 min = t_2

t_{50} 20 min

$d_{100} = 4.18$ mm

$t_1 = 4$ min

$t_2 = 4 * 4 = 16$ min

$X = 0.9$ cm

$d_0 = 3.49$ mm

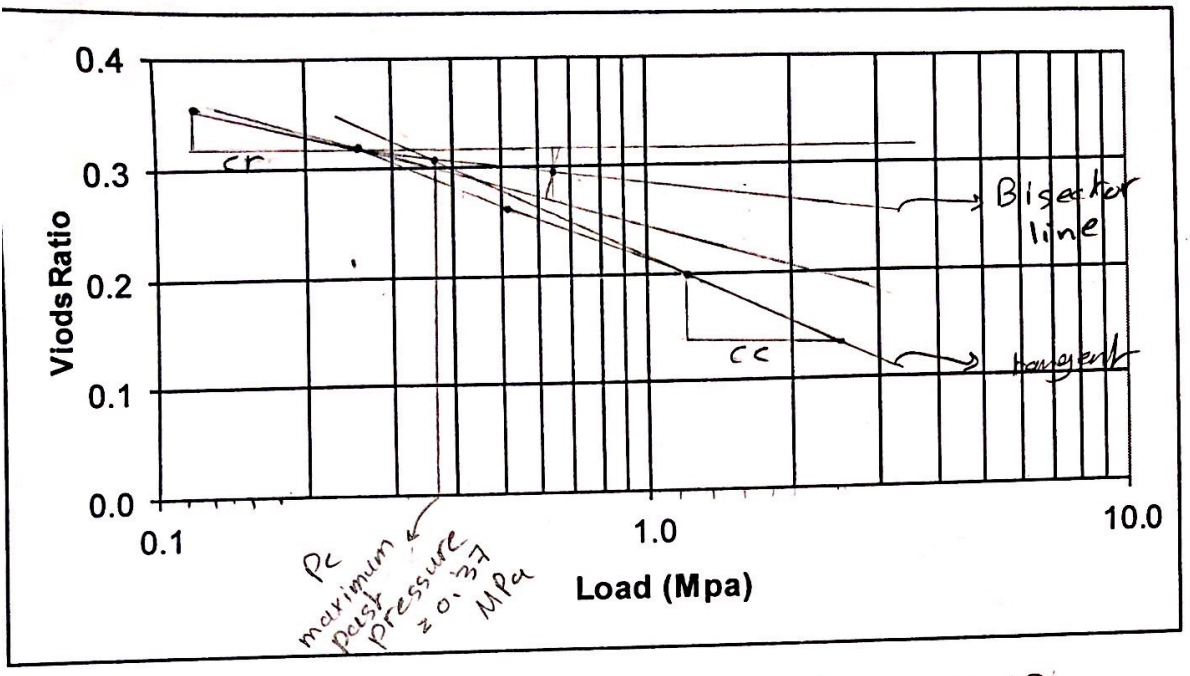
$$d_{50} = \frac{4.18 + 3.49}{2} = 3.835 = 3.84 \text{ mm}$$

$t_{50} = 20$ min

$$C_v = \frac{0.197 * 16.24^2}{4 * 20} = 0.65 \ mm^2/min$$

1.

mpute the value of CC, Cr, and maximum past pressure value in clear steps.



intersect between bisector line and the tangent of lower portion is Pc

$$Cr = \frac{\Delta e}{\log\left(\frac{\sigma'_2}{\sigma'_1}\right)} = \frac{0.36 - 0.32}{\log\left(\frac{0.26}{0.13}\right)} = 0.13$$

$$\Delta e = e_1 - e_2$$

$$Cc = \frac{\Delta e}{\log\left(\frac{\sigma'_4}{\sigma'_3}\right)} = \frac{0.2 - 0.13}{\log\left(\frac{2.55}{1.28}\right)} = 0.23$$

$$\Delta e = e_3 - e_4$$

$$P_c = 0.37 \text{ MPa}$$

CIVIL ENGINEERING

Direct Shear

Student Name: مي يوسف ابو عيد

ID#: 1833304

Section: 1

Date: 4-5-2021

Objective

Determine the shear strength parameters (φ, c)

Determine I.f , Iresidual

Equipment

1) Direct shear device
2) Loads
3) trowel
4) mold
5) dialgage
6) callibers
7) balance
8) pan filled with soil

Procedure

According to ASTMD - 3080

Hint: nearest all number to two decimel

load=DIV*.٠٠١*٢٢٠٠ N

l=٦ cm
w=٦ cm

Table (١): load=٢٠ kg

H	V	T	H(.٠١)mm	V.٠١mm	T.٠٠١mm	T(N)	AC(mm)	τ(Kpa)
١٠	-٣	١	0.1	-0.03	0.001	2.2	3600	0.61
٢٠	-٤	١٠	0.2	-0.04	0.01	22	3600	6.11
٣٠	-٥	١٩	0.3	-0.05	0.019	41.8	3600	11.61
٤٠	-٥	٢٦	0.4	-0.05	0.026	57.2	3600	15.89
٥٠	-٤	٣٤	0.5	-0.04	0.034	74.8	3600	20.78
٦٠	-٤	٣٩	0.6	-0.04	0.039	85.8	3600	23.83
٧٠	-٣	٤٥	0.7	-0.03	0.045	99	3600	27.5
٨٠	-٣	٤٩	0.8	-0.03	0.049	107.8	3600	29.94
٩٠	-٢	٥٤	0.9	-0.02	0.054	118.8	3600	33
١٠٠	-١	٥٩	1	-0.01	0.059	129.8	3600	36.06
١٢٠	١	٦٥	1.2	0.01	0.065	143	3600	39.72
١٤٠	٤	٧٠	1.4	0.04	0.07	154	3600	42.78
١٦٠	٨	٧٥	1.6	0.08	0.075	165	3600	45.83
١٨٠	١٣	٧٩	1.8	0.13	0.079	173.8	3600	48.28
٢٠٠	١٨	٨١	2	0.18	0.081	178.2	3600	49.5
٢٢٠	٢٣	٨٥	2.2	0.23	0.085	187	3600	51.94
٢٤٠	٢٧	٨٦	2.4	0.27	0.086	189.2	3600	52.56
٢٦٠	٣٢	٨٨	2.6	0.32	0.088	193.6	3600	53.78
٢٧٠	٣٥	٩٠	2.7	0.35	0.09	198	3600	55
٣٠٠	٤٠	٩١	3	0.4	0.091	200.2	3600	55.61
٣٢٠	٤٣	٩٢	3.2	0.43	0.092	202.4	3600	56.22
٣٤٠	٤٧	٩٣	3.4	0.47	0.093	204.6	3600	56.83
٣٦٠	٥٠	٩٤	3.6	0.5	0.094	206.8	3600	57.44
٣٨٠	٥٣	٩٤	3.8	0.53	0.094	206.8	3600	57.44
٤٠٠	٥٦	٩٤	4	0.56	0.094	206.8	3600	57.44
٤٥٠	٦٣	٩٤	4.5	0.63	0.094	206.8	3600	57.44
٥٠٠	٦٩	٩٤	5	0.69	0.094	206.8	3600	57.44
٥٥٠	٧٣	٩٤	5.5	0.73	0.094	206.8	3600	57.44
٦٠٠	٧٨	٩٤	6	0.78	0.094	206.8	3600	57.44
٦٥٠	٨٠	٩٤	6.5	0.8	0.094	206.8	3600	57.44
٧٠٠	٨١	٩٤	7	0.81	0.094	206.8	3600	57.44
٧٥٠	٨٣	٩٤	7.5	0.83	0.094	206.8	3600	57.44
٨٠٠	٨٦	٩٤	8	0.86	0.094	206.8	3600	57.44
٨٥٠	٨٧	٩٤	8.5	0.87	0.094	206.8	3600	57.44
٩٠٠	٨٩	٩٤	9	0.89	0.094	206.8	3600	57.44
٩٥٠	٨٩	٩٤	9.5	0.89	0.094	206.8	3600	57.44
١٠٠٠	٨٩	٩٤	10	0.89	0.094	206.8	3600	57.44
١٠٥٠	٨٩	٩٤	10.5	0.89	0.094	206.8	3600	57.44
١١٠٠	٨٩	٩٤	11	0.89	0.094	206.8	3600	57.44
١١٥٠	٨٩	٩٤	11.5	0.89	0.094	206.8	3600	57.44
١٢٠٠	٨٩	٩٤	12	0.89	0.094	206.8	3600	57.44

Table (٢): load=٤٠ kg

H	V	T	H(.٠١)mm	V.٠١mm	T.٠٠١mm	T(N)	AC(mm)	τ(Kpa)
١٠	-٨	٢	0.1	-0.08	0.002	4.4	3600	1.22
٢٠	-١٠	٧	0.2	-0.1	0.007	15.4	3600	4.28
٣٠	-١٠	٤٢	0.3	-0.1	0.042	92.4	3600	25.67
٤٠	-١١	٥٢	0.4	-0.11	0.052	114.4	3600	31.78
٥٠	-١٠	٦٤	0.5	-0.1	0.064	140.8	3600	39.11
٦٠	-١٠	٧٣	0.6	-0.1	0.073	160.6	3600	44.61
٧٠	-٩	٨٢	0.7	-0.09	0.082	180.4	3600	50.11
٨٠	-٨	٨٧	0.8	-0.08	0.087	191.4	3600	53.17
٩٠	-٦	٩٢	0.9	-0.06	0.092	202.4	3600	56.22
١٠٠	-٥	٩٧	1	-0.05	0.097	213.4	3600	59.28
١٢٠	-١	١٠٤	1.2	-0.01	0.104	228.8	3600	63.56
١٤٠	٣	١١٢	1.4	0.03	0.112	246.4	3600	68.44
١٦٠	٦	١١٩	1.6	0.06	0.119	261.8	3600	72.72
١٨٠	١٢	١٢٦	1.8	0.12	0.126	277.2	3600	77
٢٠٠	١٦	١٣١	2	0.16	0.131	288.2	3600	80.06
٢٢٠	٢٠	١٣٥	2.2	0.2	0.135	297	3600	82.5
٢٤٠	٢٥	١٣٩	2.4	0.25	0.139	305.8	3600	84.94
٢٦٠	٣١	١٤١	2.6	0.31	0.141	310.2	3600	86.17
٢٧٠	٣٤	١٤١	2.7	0.34	0.141	310.2	3600	86.17
٣٠٠	٣٧	١٤١	3	0.37	0.141	310.2	3600	86.17
٣٢٠	٤١	١٤٤	3.2	0.41	0.144	316.8	3600	88
٣٤٠	٤٤	١٤٤	3.4	0.44	0.144	316.8	3600	88
٣٦٠	٤٨	١٤٤	3.6	0.48	0.144	316.8	3600	88
٣٨٠	٥١	١٤٤	3.8	0.51	0.144	316.8	3600	88
٤٠٠	٥٤	١٤٤	4	0.54	0.144	316.8	3600	88
٤٥٠	٦١	١٤٤	4.5	0.61	0.144	316.8	3600	88
٥٠٠	٦٦	١٤٤	5	0.66	0.144	316.8	3600	88
٥٥٠	٧١	١٤٤	5.5	0.71	0.144	316.8	3600	88
٦٠٠	٧٧	١٤٤	6	0.77	0.144	316.8	3600	88
٦٥٠	٨٠	١٤٤	6.5	0.8	0.144	316.8	3600	88
٧٠٠	٨٣	١٤٤	7	0.83	0.144	316.8	3600	88
٧٥٠	٨٤	١٤٤	7.5	0.84	0.144	316.8	3600	88
٨٠٠	٨٦	١٤٤	8	0.86	0.144	316.8	3600	88
٨٥٠	٨٨	١٤٤	8.5	0.88	0.144	316.8	3600	88
٩٠٠	٨٨	١٤٤	9	0.88	0.144	316.8	3600	88
٩٥٠	٨٨	١٤٤	9.5	0.88	0.144	316.8	3600	88
١٠٠٠	٨٨	١٤٤	10	0.88	0.144	316.8	3600	88
١٠٥٠	٨٨	١٤٤	10.5	0.88	0.144	316.8	3600	88
١١٠٠	٨٨	١٤٤	11	0.88	0.144	316.8	3600	88
١١٥٠	٨٨	١٤٤	11.5	0.88	0.144	316.8	3600	88

Table (٣): load=٦٠ kg

H	V	T	H(.٠١)mm	V.٠١mm	T.٠٠١mm	T(N)	AC(mm)	τ(Kpa)
١٠	-٣	٤	0.1	-0.03	0.004	8.8	3600	2.44
٢٠	-٤	١٠	0.2	-0.04	0.01	22	3600	6.11
٣٠	-٥	٣٢	0.3	-0.05	0.032	70.4	3600	19.56
٤٠	-٥	٤٨	0.4	-0.05	0.048	105.6	3600	29.33
٥٠	-٥	٦٣	0.5	-0.05	0.063	138.6	3600	38.5
٦٠	-٥	٨٠	0.6	-0.05	0.08	176	3600	48.89
٧٠	-٥	٩٦	0.7	-0.05	0.096	211.2	3600	58.67
٨٠	-٥	١١٠	0.8	-0.05	0.11	242	3600	67.22
٩٠	-٤	١٢٢	0.9	-0.04	0.122	268.4	3600	74.56
١٠٠	-٣	١٣٥	1	-0.03	0.135	297	3600	82.5
١٢٠	-١	١٥٦	1.2	-0.01	0.156	343.2	3600	95.33
١٤٠	٢	١٧٣	1.4	0.02	0.173	380.6	3600	105.72
١٦٠	٦	١٨٨	1.6	0.06	0.188	413.6	3600	114.89
١٨٠	١٠	٢٠٠	1.8	0.1	0.2	440	3600	122.22
٢٠٠	١٥	٢٠٩	2	0.15	0.209	459.8	3600	127.72
٢٢٠	١٩	٢١٥	2.2	0.19	0.215	473	3600	131.39
٢٤٠	-١	٢١٨	2.4	-0.01	0.218	479.6	3600	133.22
٢٦٠	٢٧	٢٢٠	2.6	0.27	0.22	484	3600	134.44
٢٧٠	٣١	٢١٩	2.7	0.31	0.219	481.8	3600	133.83
٣٠٠	٣٤	٢٢٥	3	0.34	0.225	495	3600	137.5
٣٢٠	٣٨	٢٢٧	3.2	0.38	0.227	499.4	3600	138.72
٣٤٠	٤٣	٢٣٠	3.4	0.43	0.23	506	3600	140.56
٣٦٠	٤٦	٢٣٠	3.6	0.46	0.23	506	3600	140.56
٣٨٠	٤٩	٢٣٠	3.8	0.49	0.23	506	3600	140.56
٤٠٠	٥٣	٢٣٠	4	0.53	0.23	506	3600	140.56
٤٥٠	٥٨	٢٣٠	4.5	0.58	0.23	506	3600	140.56
٥٠٠	٦٢	٢٣٠	5	0.62	0.23	506	3600	140.56
٥٥٠	٧٢	٢٣٠	5.5	0.72	0.23	506	3600	140.56
٦٠٠	٧٠	٢٣٠	6	0.7	0.23	506	3600	140.56
٦٥٠	٦٩	٢٣٠	6.5	0.69	0.23	506	3600	140.56
٧٠٠	٦٩	٢٣٠	7	0.69	0.23	506	3600	140.56
٧٥٠	٧٠	٢٣٠	7.5	0.7	0.23	506	3600	140.56
٨٠٠	٧٠	٢٣٠	8	0.7	0.23	506	3600	140.56
٨٥٠	٧٠	٢٣٠	8.5	0.7	0.23	506	3600	140.56
٩٠٠	٧٢	٢٣٠	9	0.72	0.23	506	3600	140.56
٩٥٠	٧٢	٢٣٠	9.5	0.72	0.23	506	3600	140.56
١٠٠٠	٧٢	٢٣٠	10	0.72	0.23	506	3600	140.56
١٠٥٠	٦٤	٢٣٠	10.5	0.64	0.23	506	3600	140.56
١١٠٠	٦٢	٢٣٠	11	0.62	0.23	506	3600	140.56
١١٥٠	٦١	٢٣٠	11.5	0.61	0.23	506	3600	140.56

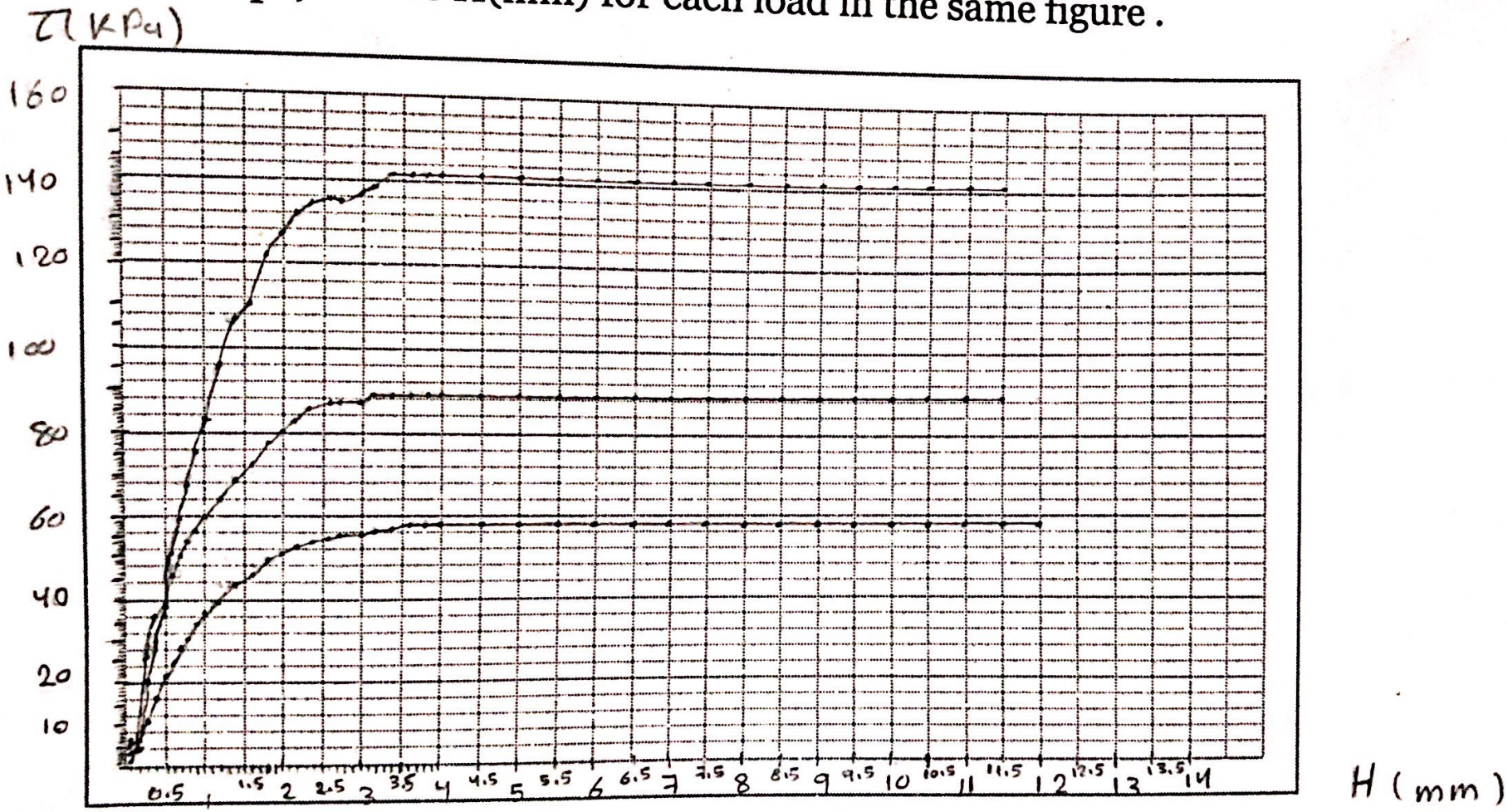
Sample of calculations

σn (kPa)	τ(Kpa)
54.5	57.44
109	88
163.5	140.56

For table one :-

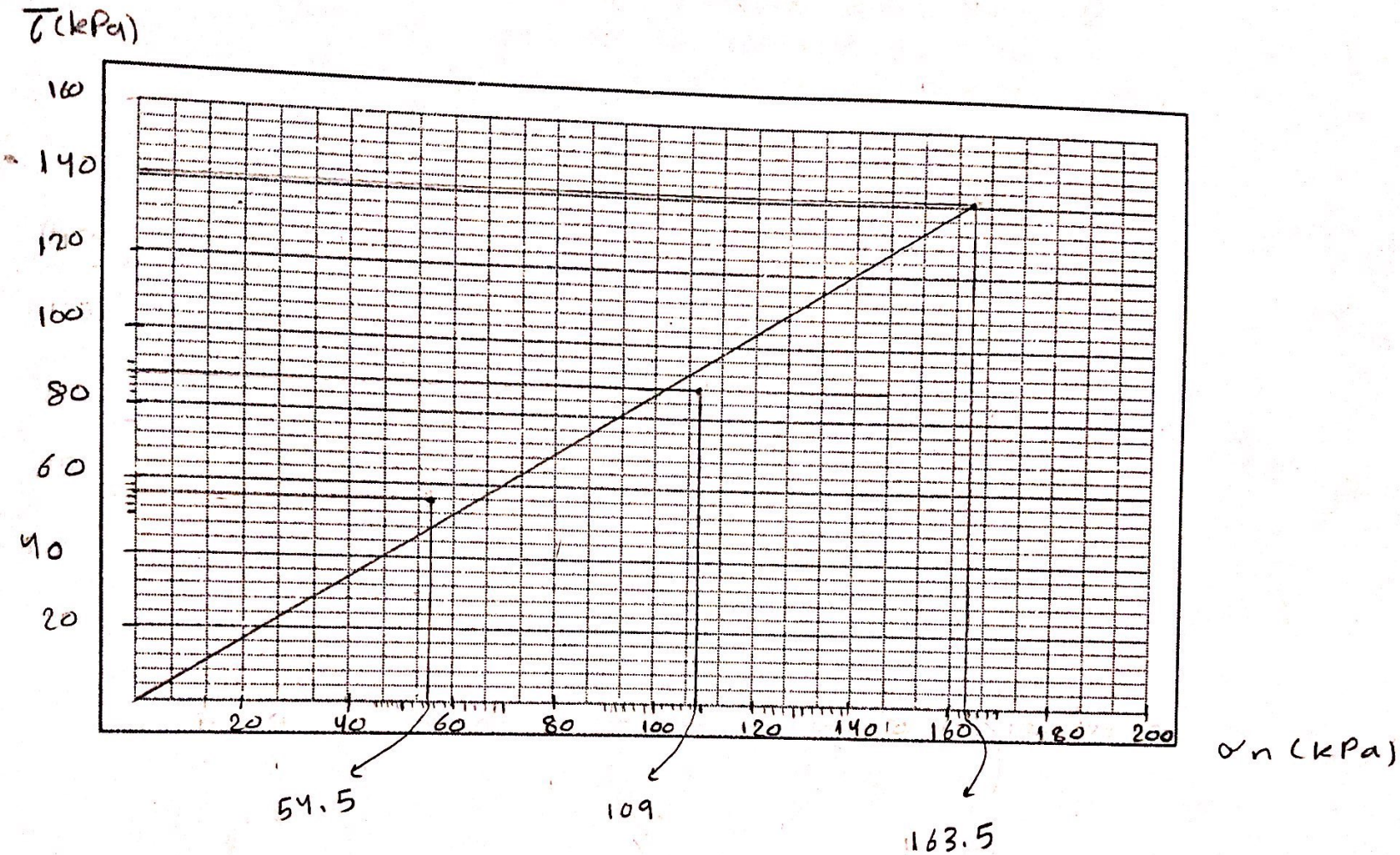
A (mm) =	σn = $\frac{P}{A}$	T(N) =	τ(Kpa) = $\frac{T}{A}$
$6 * 6 = 36\,cm^2$ $= 3.6 * 10^{-3}\,m^2$ $= 3600\,mm^2$	$= \frac{20 * 9.81}{3.6}$ $= 54.5$ kPa	T(mm) * 2200 $0.001 * 2200$ $= 2.2$ N	$= \frac{2.2}{3.6} = 0.61$ kPa

-Plot τ(Kpa) versus H(mm) for each load in the same figure .



-Plot τ(Kpa) versus σn .

-Plot τ(Kpa) versus σn .



$$\text{slope} = \frac{120 - 40}{140 - 46} = 0.85$$

points (140, 120) (46, 40)

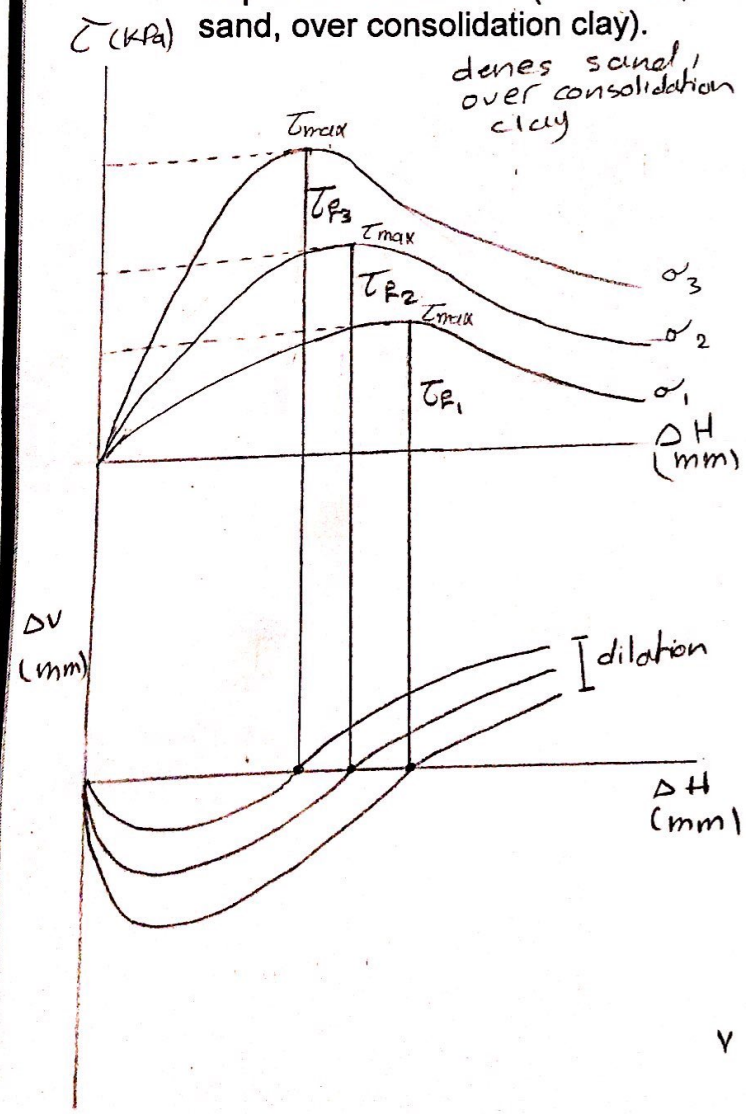
Discussion and Conclusion

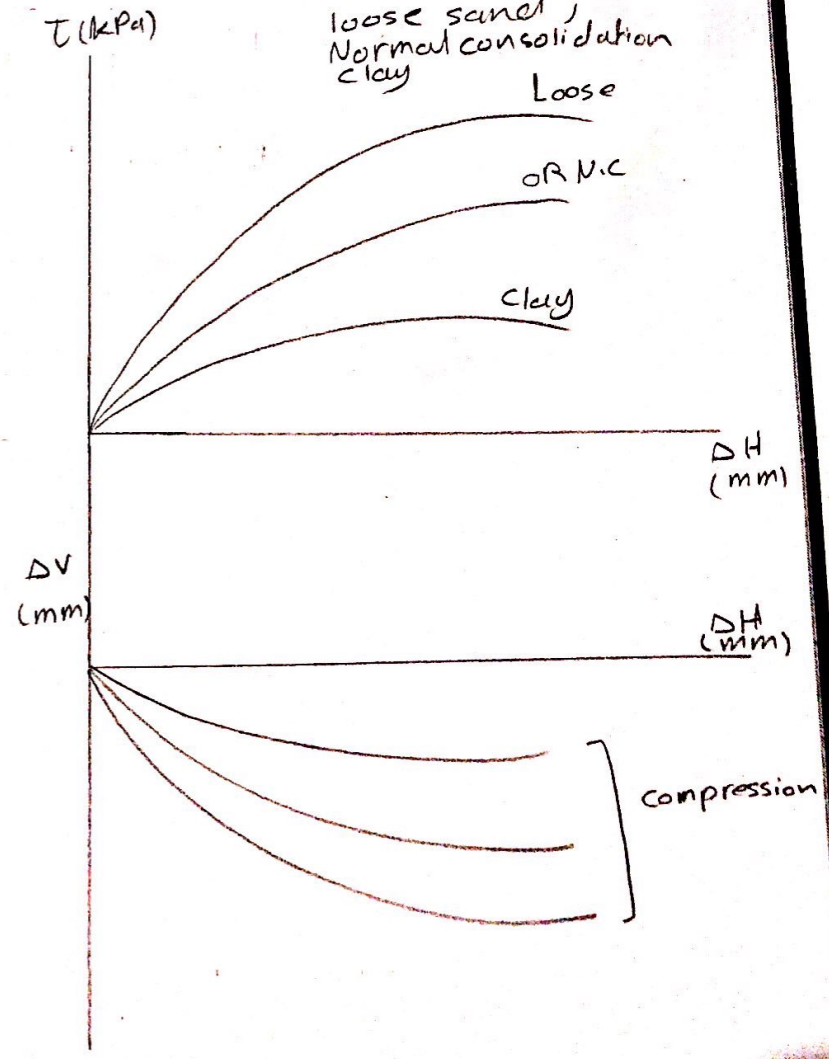
١-the value of(c & Ø) discuss these value (the type of soil depend on these value).

$c = 0$ loose sand $\phi = \tan^{-1}(\text{slope})$

$\phi = \tan^{-1}(0.85) = 40.36°$

٢-draw the free sketch between shear stress versus horizontal displacement curve, and vertical displacement versus horizontal displacement for both (loss sand, normal consolidation clay) & (dense sand, over consolidation clay).





Name: مي يوسف ابو طيه ID#: 1833304	Geotechnical Engineering Lab	Unconfined Compression Test &Triaxial Compression Test(UU)

Hint: D=٣٨mm, H=٢D=٧٦mm, A٠ =١١٣٤.١١٥mm٢, ١ Div. = ٠.٠١ mm

LOAD(KN)=DIV*.٠١*.٥٣٦٤

١. Fill the table below for unconfined compression test

Table ١.١

		Div*٠.٠١	Div*٠.٠١	Table	ΔL/L	A./(١-ε)	
Δ L (div.)	**Δ P (div.)**	**Δ L (mm)**	**Δ P (mm)**	**Δ P (KN)**	**ε**	**Ac (mm٢)**	**σ (kpa)**
١٠	٢٤	0.1	0.24	0.13	$1.32*10^{-3}$	1135.61	114.48
٢٠	٢٩	0.2	0.29	0.16	$2.63*10^{-3}$	1137.11	140.71
٣٠	٣٥	0.3	0.35	0.19	$3.94*10^{-3}$	1138.6	166.87

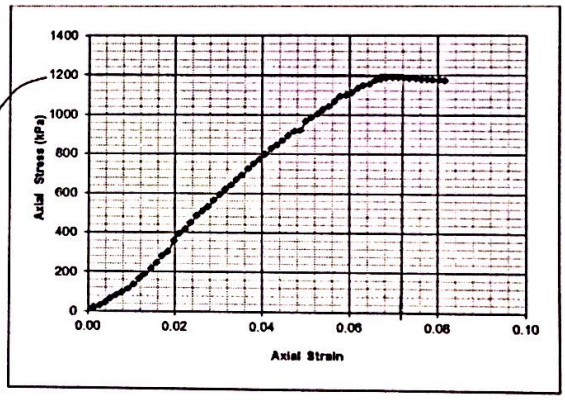
٢. Sample of calculation

Strain $= \frac{\Delta L}{L} = \frac{0.2}{76} = 2.63*10^{-3}$

Area corrected $= \frac{A_o}{1-\varepsilon}$

$= \frac{1134.115}{1-(2.63*10^{-3})} = 1137.11\ mm^2$

$\sigma_1 = q_u$



Stress $= \frac{\Delta P}{A_c} = \frac{0.16}{1137.11*10^{-6}} = 140.71\ KPa$

Figure ١.stress vs. strain

٣. From the figure ١.

-Determine deviator stress. = 1200 kPa

٤. Draw figure ٢. Mohr's circle

- Determine σ١, and Su, σ٣=١٠٠

$\sigma_1 = \sigma_3 + q_u =$

$\sigma_1 = \sigma_3 + \sigma_1 =$

$= 100 + 1200 = 1300\ kpa$

$S_u = \frac{\sigma_1 + \sigma_3}{2} = \frac{1300+100}{2}$

$= 700\ kpa$