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New 2018

تقارير

مختبر هندسة جيوتقنية

محمد عوده

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Civilittee Hashemite

www.civilittee-hu.com

20/20

CIVIL ENGINEERING

Sieve and Hydrometer Analysis

Student Name: محمد عصام محمد عوده

ID#: 1732471

Section: 1

Date: 5/2/2019

مختبر هندسة جيوتقنية
الشعبة - الأحد + الثلاثاء
م. شريف لطاينة
٢٠١٩/١/٢٧

Objective:

- We use sieve analysis & Hydrometer analysis for Soil Classification
- Sieve analysis: to classify the soil to coars & fine using Sieve #200 (0.075) & classify coars soil into gravel & sand.
- Hydrometer analysis: to classify the soil into silt & clay.

Equipment:

* Mechanical sieve analysis

① Sieve Shaker

② Balance.

③ Sieve with different sizes.

* Hydrometer analysis

① Hydrometer device.

② Thermometer.

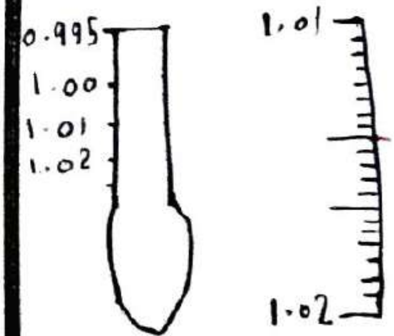
③ Timer.

④ graded glass

⑤ Tank

⑥ Na_3PO_4 solution.

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



8

$$1\ Div = \frac{0.01}{20} = 0.0005$$

$$1.01 + 7(Div) = 1.01 + 7 * 0.0005$$

$$= 1.0135$$

-0.25

Procedure:

Mecanical sieve analysis (ASTM D-421)

Hydrometer analysis (ASTM D-422)

Sieve analysis:

Sieve 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 %
1	25	551.32	618.40	67.08	67.08	6.708	93.292
(3/4)	19	554.9	590.63	35.73	102.81	10.281	89.719
(1/2)	12.500	542.99	580.36	37.37	140.18	14.018	85.982
(3/8)	9.5000	542.7	570.87	28.17	168.35	16.835	83.165
# 4	4.7500	511.5	559.21	47.71	216.06	21.606	78.394
# 10	2.00	487.06	519.5	32.44	248.5	24.85	75.15
# 20	.85	422.26	436.66	14.4	262.9	26.29	73.71
# 40	.425	386.68	393.2	6.52	269.42	26.942	73.058
#60	.25	359.1	361.47	2.37	271.79	27.179	72.821
# 100	0.1500	354.62	354.85	0.23	272.02	27.202	72.798
# 200	0.0750	339.52	344.6	5.08	277.1	27.71	72.29
pan		368.64	368.83	0.19	277.29	27.729	72.271
				$\boxed{277.29}$			

☆ $M_{total} = 1000\,g$

% finer = 100 − % Ret

Elapsed time (min)	Actual Hydrometer reading	Composite correction $R_1 - R_2$	R corrected AC - Co	Temperature (C°)	L (cm)	K	D	%of finer	Actual % of finer
.25	1.02 +3Div =1.0215	0.0025 ~~0.0025~~	~~1.021~~ 1.019	16°	10.6	0.01414	0.0921	63.586	45.966%
.5	1.02+3Div =1.0215	0.0025 ~~0.0025~~	~~1.021~~ 1.019	16°	10.6	0.01414	0.0651	63.586	45.966%
1	1.02+3Div =1.0215	0.0025 ~~0.0025~~	1.019 ~~1.021~~	16°	10.6	0.01414	0.0460	63.586	45.966%
2	1.02+3Div =1.0215	0.0025 ~~0.0025~~	1.019 ~~1.021~~	16°	10.6	0.01414	0.0326	63.586	45.966%
4	1.02+3Div =1.0215	0.0025 ~~0.0025~~	1.019 ~~1.021~~	16°	10.6	0.01414	0.0230	63.586	45.966%
8	1.02+2Div =1.021	0.0025 ~~0.0025~~	1.0185 ~~1.0205~~	16°	10.7	0.01414	0.0164	61.999	44.819%
15	1.02+1Div =1.0205	0.0025 ~~0.0025~~	1.018 ~~1.02~~	16°	10.85	0.01414	0.0120	60.412	43.672%
30	1.02	0.0025 ~~0.0025~~	1.0175 ~~1.0195~~	16°	11	0.01414	0.0086	58.824	42.524%
1080	1.01+11Div =1.0155	0.0025 ~~0.0025~~	1.013 ~~1.015~~	16°	12.2	0.01414	0.0015	44.539	32.197%

Hydrometer analysis

Sample of calculation: - ***** Hydrometer sample *****

@ 8 min

*actual Hydrometer reading = 1.02 + 2 Div.

= 1.02 + 2(0.0005)

= 1.021

Temp(C°)	G_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

**Composite Correction @

c = (W of water + disp) – (Wof water)

*** Hydrometer reading with composite correction applied
= Actual hydraulic – Composite

$R_1 = 1 + 5$ Div

$R_2 = 1$

$R_1 - R_2$

$= 1 + 5(0.0005) - 1$

$= 0.0025$

**** Effective depth of hydrometer L (cm) – from table 7-4 = (151H)

L = 10.7 at actual reading 1.021

***** Value of (K) from (table 7.3)

K = 0.01414

G.S = 2.7

T = 16°

****** Diameter of soil particle D (mm) = K*(L/T) ^.5 hint: T is time in minutes

$$D_{mm} = K * \sqrt{\frac{L}{T}} = 0.01414 * \sqrt{\frac{10.7}{8}} = 0.0164$$

******* Soil in Suspension

Note W= 50 g GS = 2.7 G_w = .99897

P = {((100,000/W) * GS /(GS – G_w))}*(Rcor – G_w)

$$= \left(\frac{\frac{100{,}000 * 2.7}{50}}{2.7 - .99897} \right) * (1.0185 - .99897) = 61.999\%$$

Actual P = P * (% passing sieve No 200)

$= 61.999 * 0.7229 = 44.819\%$

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

@sieve # 100

Weight sieve empty = 354.62

Weight sieve full = 354.85

Weight retained = W full - W empty

= 354.85 - 354.62 = 0.23

% of Retained =

$$\frac{\text{cumulative Retained sieve \#100}}{\text{total weight of soil}} * 100\% = \frac{272.02}{1000} \times 100\% = 27.202$$

Commutative of retained =

271.79 + 0.23 = 272.02

cumulative retained on sieve #60
+ Retained soil mass on sieve #100

% passing =

100% − 27.202 = 72.798%

Discussion and conclusion

*% Gravel 21.606% retained on sieve #4.

**%sand retained on sieve #200 & Passed sieve #4

27.71 - 21.606 = 6.104 %

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

72.29% - 34% = 38.29

****%clay finer than D = 0.002mm = 34%

*****D10= can't be determined, D60= 0.08 , D30= cant be determined, D85= 11 , D50= 0.09

******Cc= $\frac{(D_{30})^2}{(D_{10})(D_{60})}$ → Can't be determined.

*******Cu= $\frac{D_{60}}{D_{10}}$ → Can't be determined.

******** Soil classification the soil is fine graded because the Pass from sieve #200 is more than 50% from the total sample

72.29 > 50 %

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 goes down to the bottom of the bottle & To Prevent the soil Lumps

Seive Analysis

شعبة الانشاء ٢٩/١/٢٠١٩

Data sheet
Sieve analysis

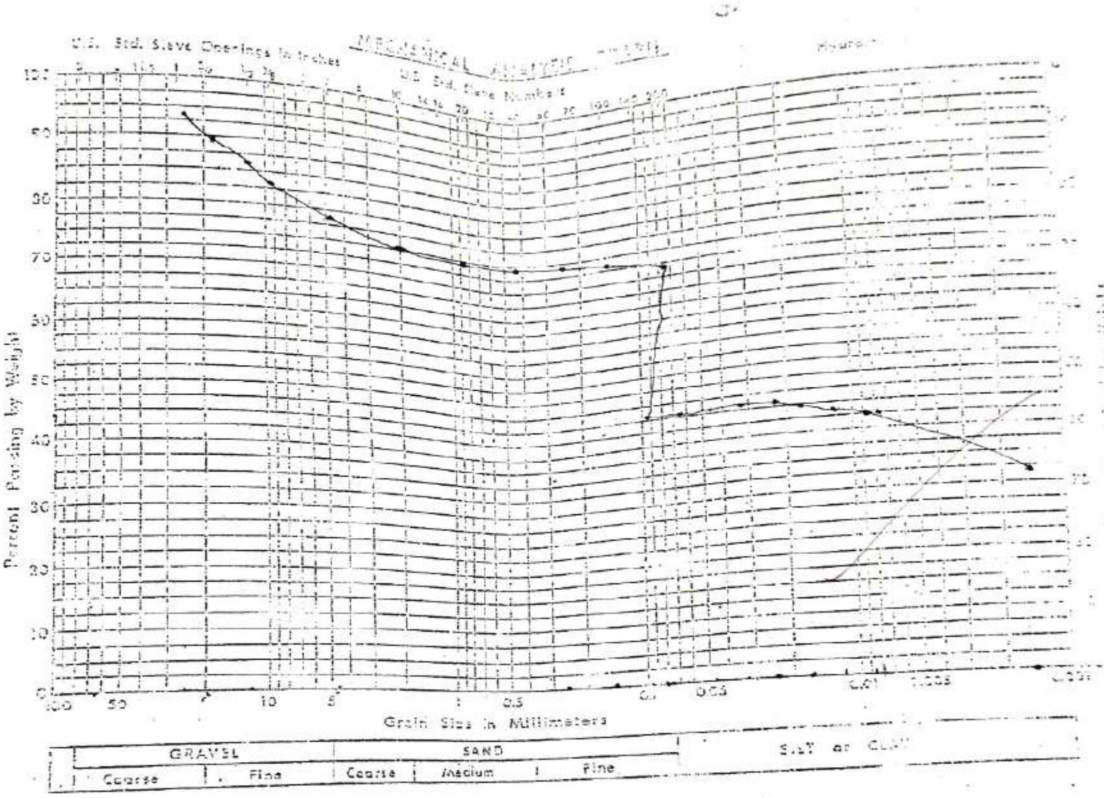
Sieve No	Sieve Diameter (mm)	Sieve Mass (g)	Sieve Mass + retained Soil Mass (g)
1	25	551.32	618.40
(3/4)	19	554.9	590.63
(1/2)	12.500	542.99	580.36
(3/8)	9.5000	542.7	570.87
# 4	4.7500	511.5	559.21
# 10	2.00	487.06	519.5
# 20	.85	422.26	436.66
# 40	.425	386.68	393.2
#60	.25	359.1	361.47
# 100	0.1500	354.62	354.85
# 200	0.0750	339.52	344.6
pan		368.64	368.83

34%

Data sheet
Hydrometer analysis

R1= 1+5 Div **R2=** 1 **T=** 16°

elapsed time (min)	actual hydrometer reading	composite correction
15sec=0.25	1.02 + 3 Div	0.0025
30sec=0.5	1.02 + 3 Div	0.0025
1	1.02 + 3 Div	0.0025
2	1.02 + 3 Div	0.0025
4	1.02 + 3 Div	0.0025
8	1.02 + 2 Div	0.0025
15	1.02 + 1 Div	0.0025
30	1.02	0.0025
1080	1.01 + 11 Div	0.0025



D_{10} = ________
D_{15} = ________ $5D_{15}$ = ________ $20D_{15}$ = ________
D_{30} = ________
D_{60} = ________
D_{85} = ________ $5D_{85}$ = ________

$C_u = \frac{D_{60}}{D_{10}} = \frac{(\quad)}{(\quad)} =$

$C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})} = \frac{(\quad)^2}{(\quad)(\quad)} =$

Weight of container plus air-dried soil for hydrometer analysis = 170.49 g

Weight of container = 110.21 g

Sieve Size	Weight Retained (g)
No. 10	0
No. 40	5.13
No. 100	5.31
No. 200	5.19

TABLE 7-4 Values of Effective Depth Based on Hydrometer and Sedimentation Cylinder of Specified Sizes [1]

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	36	10.4
1.006	14.7	6	15.3	37	10.2
1.007	14.4	7	15.2	38	10.1
1.008	14.1	8	15.0	39	9.9
1.009	13.9	9	14.8	40	9.7
1.010	13.7	10	14.7	41	9.6
1.011	13.4	11	14.5	42	9.4
1.012	13.1	12	14.3	43	9.2
1.013	12.9	13	14.2	44	9.1
1.014	12.6	14	14.0	45	8.9
1.015	12.3	15	13.8	46	8.8
1.016	12.1	16	13.7	47	8.6
1.017	11.8	17	13.5	48	8.4
1.018	11.5	18	13.3	49	8.3
1.019	11.3	19	13.2	50	8.1
1.020	11.0	20	13.0	51	7.9
1.021	10.7	21	12.9	52	7.8
1.022	10.5	22	12.7	53	7.6
1.023	10.2	23	12.5	54	7.4
1.024	10.0	24	12.4	55	7.3
1.025	9.7	25	12.2	56	7.1
1.026	9.4	26	12.0	57	7.0
1.027	9.2	27	11.9	58	6.8
1.028	8.9	28	11.7	59	6.6
1.029	8.6	29	11.5	60	6.5
1.030	8.4	30	11.4		
1.031	8.1				
1.032	7.8				
1.033	7.5				
1.034	7.3				
1.035	7.0				
1.036	6.8				
1.037	6.5				
1.038	6.2				

9. Grain-size analysis results are normally presented in graphical form with grain diameter along the abscissa on a logarithmic scale that increases from right to left and "percentage passing" along the ordinate, on an arithmetic scale. Such a graph is referred to as the "grain-size distribution curve."

7-3 Values of K for Use in Equation for Computing Diameter of Particle in Hydrometer Analysis [1]

re	Specific Gravity of Soil Particles								
	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
5	0.01510	0.01505	0.01481	0.01457	0.01435	0.01414	0.01394	0.01374	0.01356
7	0.01511	0.01486	0.01462	0.01439	0.01417	0.01396	0.01376	0.01356	0.01338
!	0.01492	0.01467	0.01443	0.01421	0.01399	0.01378	0.01359	0.01339	0.01321
1	0.01474	0.01449	0.01425	0.01403	0.01382	0.01361	0.01342	0.01323	0.01305
0	0.01456	0.01431	0.01408	0.01386	0.01365	0.01344	0.01325	0.01307	0.01289
1	0.01438	0.01414	0.01391	0.01369	0.01348	0.01329	0.01309	0.01291	0.01273
2	0.01421	0.01397	0.01374	0.01353	0.01332	0.01312	0.01294	0.01276	0.01258
3	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
5	0.01372	0.01349	0.01327	0.01306	0.01286	0.01267	0.01249	0.01232	0.01215
6	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	0.01255	0.01239	0.01221	0.01204	0.01189
28	0.01327	0.01304	0.01283	0.01264	0.01244	0.01225	0.01208	0.01191	0.01175
9	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

NUMERICAL EXAMPLE A laboratory test was conducted according to the procedure described previously. The following data were obtained:

Weight of total air-dried soil = 540.94 g

Weight of fraction retained on No. 10 sieve (washed and oven-dried) = 2.20 g

For sieve analysis:

Sieve Size	Weight Retained (g)
$\frac{3}{8}$ in.	0
No. 4	0.97
No. 10	1.23

For hygroscopic moisture correction factor:

Weight of container plus air-dried soil = 109.57 g

Weight of container plus oven-dried soil = 105.35 g

Weight of container = 59.57 g

For sieve analysis of fine aggregate:

شعبة الأحد
د. الشرزار

CIVIL ENGINEERING

14/15

Compaction

Student Name: محمد عصام محمد عوده

ID#: 1732471

Section: 1

Date: 19/2/2019

Eng. Shereen Batayneh

Objective

- to determine maximum density & optimum water content of soil that is obtained from compaction test.
- Decrease future settlements.
- increas shear strength.
- Decrease Permeability.

Equipment

1) balance.
2) compaction mold.
3) Pan for mixing.
4) Cans
5) compaction hammer.
6) Graduated cylinder.

Procedure

According to ASTMD-1557.

2

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)
1	3281	4789	651	30.39	130.66	114.50
2	3038	4768	652	32.68	151.10	129.93
3	3310	5069	652	31.02	126.50	106.10
4	3285	4998	654	49.39	205.13	169.73

$w c = \frac{1-3}{3-2} \times 100\%$

1.597

Table 2

Group #	W %	ρwet (g/cm³)	ρDry (g/cm³)
1	19.2	1.597	1.34
2	21.8	1.833	1.56
3	27.2	1.863	1.46
4	29.4	1.815	1.40

Table3: Zero-air voids curve Determination

Group #	W % Assume >omc	ρDry (g/cm³)
1	28	1.54
2	29	1.51
3	30	1.49
4	31	1.47

Sample of calculations

Hint: volume =944cm^3 #1

GS=2.7

$$Wc\% = \frac{Mw}{Ms_{oven\ dry}} \times 100\% = \frac{130.66 - 114.50}{114.50 - 30.39} = 19.2\%$$

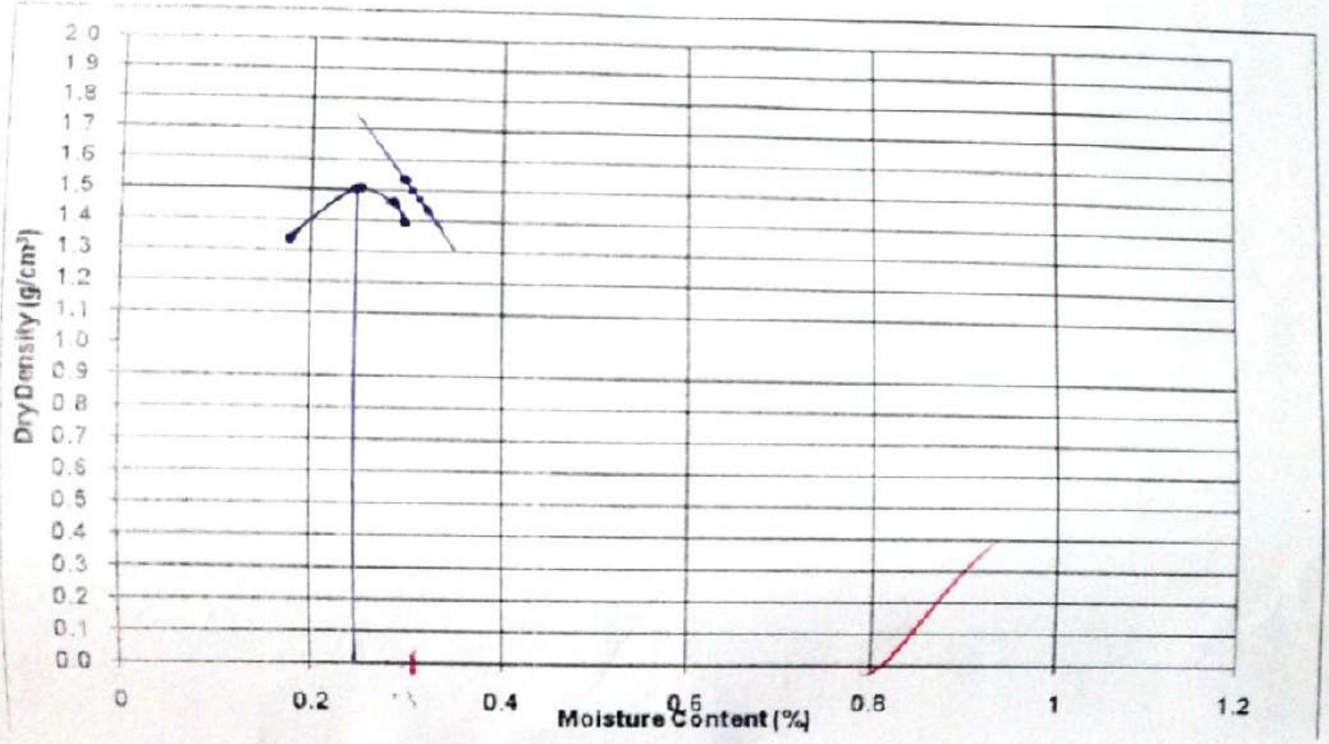
$$\rho_{wet} = \frac{W_2 - W_1}{V} = \frac{4789 - 3281}{944} = 1.597\ g/cm^3$$

$$\rho_{dry} = \frac{\rho_{wet}}{1 + Wc\%} = \frac{1.597}{1 + 0.192} = 1.34$$

Assume = 28%

$$\rho_{dry} = \frac{\rho_w G.S}{G.S * W + 1} = \frac{1 * 2.7}{2.7 * 0.28 + 1} = 1.54$$

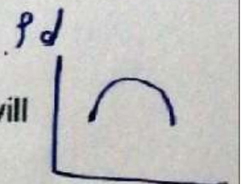
Plot dry density (ρ_{Dry})versus moisture content%(W %) and in the same figure plot the zero air voids curve.



Conclusion and Discussion

OMC = 21.8 %

ρ_{Dry}maximum = 1.5 (g/cm³)



Why the value of dry density will be increase up to the maximum then it will be decrease? as the water content increas, the Particles develop Larger water firs around them wich tend to make the Particles easier to move (Lubricate the Particles) & reorient it into a Tenser configuration.
above water opt:- water starts to replace soil Particles in the mold & since $\rho_w << \rho_s$ the dry density starts to decrease.
at wopt:- the density becomes to its maximum Value & it dosen't increase Greater than it.

مختبر تربة

م. سشوين بطاينه

شعبة الثلاثاء

Dr. Samer

17/20

CIVIL ENGINEERING

17/20

Consolidation

Student Name: محمد عصام عودة

ID#: 1732471

Section: 1

Date: 19/3/2019

Hint: nearest to two decimal any number in the report

Objective

*Determine the coefficient of Permability:

(1). voids ratio(e), compression index(Cc), Recompression index(Cr), Preconsolidation Pressure(σc), coefficient of Permability (K) Mv, Tv.

(2) Determine coefficient of consolidation & O.C.R.

(3) Determine Cv by two methods (casegrande, taylor).

Equipment

(1) Loads (Kg).

(2) Can

(3) Balance.

(4) consolidation test apparatus (a dometer tester).

(5). stop watch.

Procedure

consolidation test, ASTM D-2435.

Consolidation Test

Ms= 143 g Gs=2.70 H= 2cm
D=7cm

A= 38.465 cm^2
0.003847 m^2

Hint:(Div *.01)=Deformation in (mm)

Load= 50kg

Time hr	min	sec	Dial Reading Div	Time (min)	$Time^{0.5}$ ($min^{0.5}$)	Deformation (mm)	Hf	Hv	e
0	0	8	55	0.13	0.37	0.55	19.45	5.68	0.41
0	0	15	61	0.25	0.50	0.61	19.39	5.62	0.41
0	0	30	66	0.5	0.71	0.66	19.34	5.57	0.40
0	1	0	72.5	1	1.00	0.725	19.28	5.51	0.40
0	2	0	77	2	1.41	0.77	19.23	5.46	0.40
0	4	0	82.5	4	2.00	0.825	19.17	5.40	0.39
0	8	0	87.75	8	2.83	0.8775	19.12	5.35	0.39
0	16	0	92	16	4.00	0.92	19.08	5.31	0.39
0	30	0	96	30	5.48	0.96	19.04	5.27	0.38
1	0	0	99	60	7.75	0.99	19.01	5.24	0.38
2	0	0	101	120	10.95	1.01	18.99	5.22	0.38
4	0	0	103	240	15.49	1.03	18.97	5.20	0.38
8	0	0	104	480	21.91	1.04	18.96	5.19	0.38
24	0	0	105	1440	37.95	1.05	18.95	5.18	0.38

Load= 100kg

Time hr	min	sec	Dial Reading Div	Time (min)	$Time^{0.5}$ ($min^{0.5}$)	Deformation (mm)	Hf	Hv	e
0	0	8	117	0.13	0.365148	1.17	18.83	5.06	0.37
0	0	15	119	0.25	0.5	1.19	18.81	5.04	0.37
0	0	30	122	0.5	0.707107	1.22	18.78	5.01	0.36
0	1	0	125	1	1	1.25	18.75	4.98	0.36
0	2	0	129	2	1.414214	1.29	18.71	4.94	0.36
0	4	0	133	4	2	1.33	18.67	4.9	0.36
0	8	0	137.5	8	2.828427	1.38	18.62	4.85	0.35
0	16	0	142	16	4	1.42	18.58	4.81	0.35
0	30	0	146	30	5.477226	1.46	18.54	4.77	0.35
1	0	0	150.5	60	7.745967	1.51	18.49	4.72	0.34
2	0	0	154	120	10.95445	1.54	18.46	4.69	0.34
4	0	0	157	240	15.49193	1.57	18.43	4.66	0.34
8	0	0	160	480	21.9089	1.60	18.4	4.63	0.34
24	0	0	163	1440	37.94733	1.63	18.37	4.6	0.33

Load= 200kg

Time			Dial Reading	Time	$Time^{0.5}$	Deformation	Hf	Hv	e
hr	min	sec	Div	(min)	($min^{0.5}$)	(mm)			
0	0	8	204	0.13	0.365148	2.04	17.96	4.19	0.30
0	0	15	209	0.25	0.5	2.09	17.91	4.14	0.30
0	0	30	213	0.5	0.707107	2.13	17.87	4.10	0.30
0	1	0	217	1	1	2.17	17.83	4.06	0.30
0	2	0	221.5	2	1.414214	2.22	17.78	4.01	0.29
0	4	0	226.5	4	2	2.27	17.73	3.96	0.29
0	8	0	233	8	2.828427	2.33	17.67	3.90	0.28
0	16	0	240.5	16	4	2.41	17.59	3.82	0.28
0	30	0	249	30	5.477226	2.49	17.51	3.74	0.27
1	0	0	259	60	7.745967	2.59	17.41	3.64	0.26
2	0	0	267.5	120	10.95445	2.68	17.32	3.55	0.26
4	0	0	273	240	15.49193	2.73	17.27	3.50	0.25
8	0	0	275.5	480	21.9089	2.76	17.24	3.47	0.25
22	14	0	277	1334	36.52396	2.77	17.23	3.46	0.25

Load= 500kg

Time			Dial Reading	Time	$Time^{0.5}$	Deformation	Hf	Hv	e
hr	min	sec	Div	(min)	($min^{0.5}$)	(mm)			
0	0	8	301	0.13	0.365148	3.01	16.99	3.22	0.23
0	0	15	304	0.25	0.5	3.04	16.96	3.19	0.23
0	0	30	306	0.5	0.707107	3.06	16.94	3.17	0.23
0	1	0	309	1	1	3.09	16.91	3.14	0.23
0	2	0	312.5	2	1.414214	3.13	16.87	3.1	0.23
0	4	0	316.5	4	2	3.17	16.83	3.06	0.22
0	8	0	321.5	8	2.828427	3.22	16.78	3.01	0.22
0	16	0	327.5	16	4	3.28	16.72	2.95	0.21
0	30	0	336	30	5.477226	3.36	16.64	2.87	0.21
1	0	0	347	60	7.745967	3.47	16.53	2.76	0.20
2	0	0	361	120	10.95445	3.61	16.39	2.62	0.19
4	0	0	370	240	15.49193	3.70	16.3	2.53	0.18
8	0	0	378	480	21.9089	3.78	16.22	2.45	0.18
23	30	0	382	1410	37.54997	3.82	16.18	2.41	0.18

Load= 1000kg

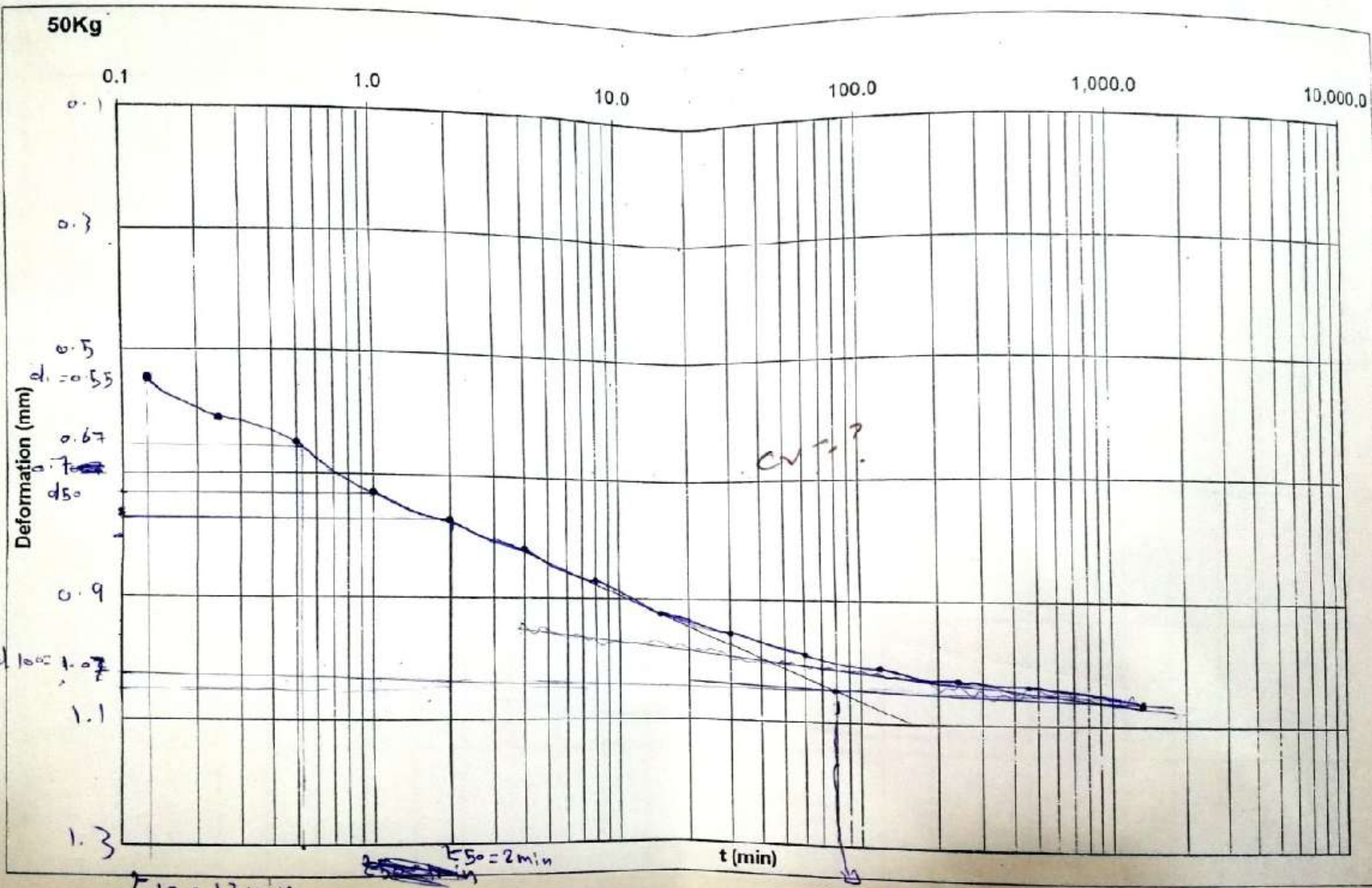
Time			Dial Reading	Time	$Time^{0.5}$	Deformation	Hf	Hv	e
hr	min	sec	Div	(min)	($min^{0.5}$)	(mm)			
0	0	8	418	0.13	0.365148	4.18	15.82	2.05	0.15
0	0	15	421	0.25	0.5	4.21	15.79	2.02	0.15
0	0	30	424	0.5	0.707107	4.24	15.76	1.99	0.15
0	1	0	428	1	1	4.28	15.72	1.95	0.14
0	2	0	434	2	1.414214	4.34	15.66	1.89	0.14
0	4	0	440	4	2	4.40	15.60	1.83	0.13
0	8	0	447	8	2.828427	4.47	15.53	1.76	0.13
0	16	0	457	16	4	4.57	15.43	1.66	0.12
0	30	0	467	30	5.477226	4.67	15.33	1.56	0.11
1	0	0	480	60	7.745967	4.80	15.2	1.43	0.10
2	0	0	489	120	10.95445	4.89	15.11	1.34	0.10
4	0	0	495	240	15.49193	4.95	15.05	1.28	0.10
8	0	0	497	480	21.9089	4.97	15.03	1.26	0.10
24	0	0	499	1440	37.94733	4.99	15.01	1.24	0.10

	P/A	Cum.	$H_{F(n-1)} - \Delta H$	$H_F - H_S$	$(H_F - H_S)/H_S$	$(H_{F(n-1)} + H_{F(n)})/2$	Figures		$0.848*H^2_{avg}/(4*t_{90})$	$0.197*H^2_{avg}/(4*t_{50})$
Load kg	Load MPa	Final Def. ΔH_{cum} (mm)	Final Height H_F (mm)	Height of voids (mm)	Final voids ratio	Avg. Height (mm)	Fitting Time (Min) t_{90}	t_{50}	Cv (mm^2/min) from t_{90}	t_{50}
50	0.128	1.05	18.95	5.18	0.38	19.475	1	2	80	9.34
100	0.255	1.63	18.37	4.60	0.33	19.185	2	8	39	2.27
200	0.51	2.77	17.23	3.46	0.25	18.615	2	10	36.7	1.71
500	1.275	3.82	16.18	2.41	0.18	18.09	1.70	44	40.8	0.37
1000	2.55	4.99	15.01	1.24	0.10	17.51	1	20	65	0.76

Sample of calculation

$Hs=Ms/(Gs*A*\rho_w)$	$e_0= (H_t-H_s)/H_s$	$Stress_{(MPa)}= P/A$
$\frac{143}{2.7*38.465*1}$ $= 13.77$ mm	$\frac{20-13.77}{13.77}$ $= 0.45$	$\frac{50*9.81}{0.003847}$ $= 0.128$ MPA

. $Hf=H_t$-deformation	$Hv=H_f-H_s$	$e= H_v/H_s$
$20-(0.01*55)$ $= 19.45$ mm	$19.45-13.77$ $= 5.68$ mm	$\frac{5.68}{13.77} = 0.41$



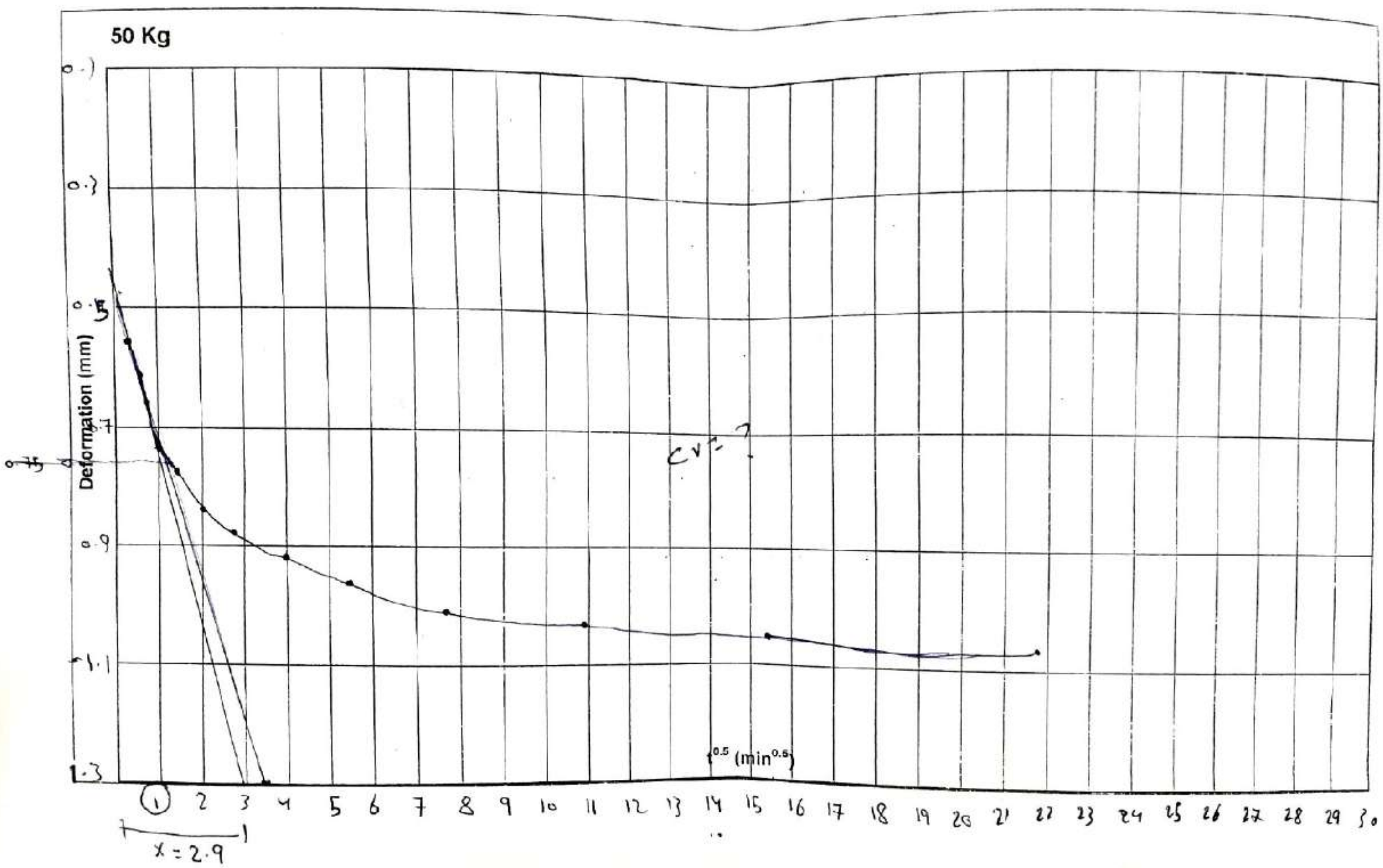
$t_1 = 0.13$ min

$4t_1 = 0.52$ min

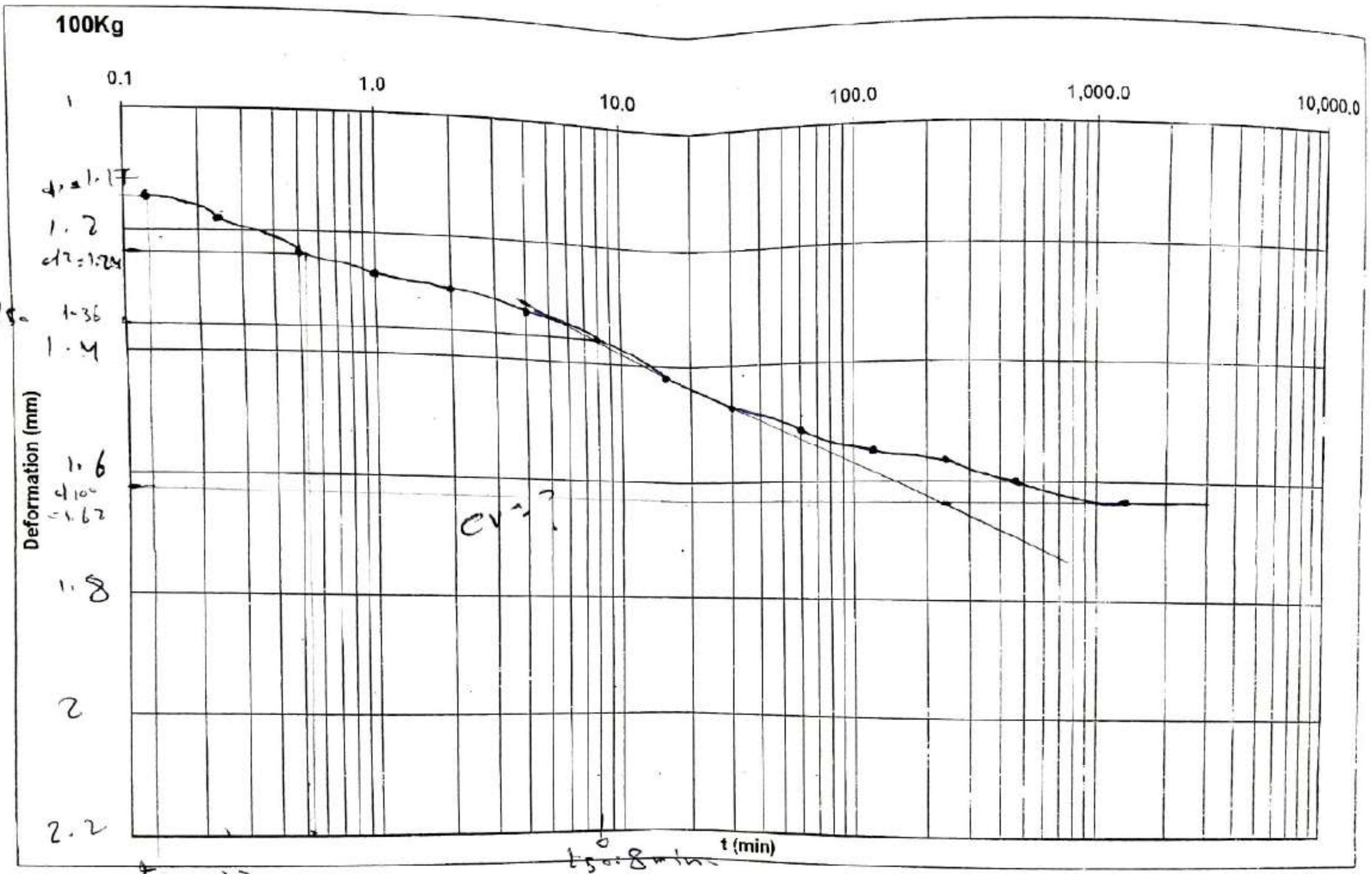
$d_2 - d_1 = 0.67 - 0.55 = 0.12$

$d_{50} = \frac{0.43 + 1.07}{2} = 0.75$

$t_{100} = 80$ min



x = 2.9 x 1.15
= 3.34

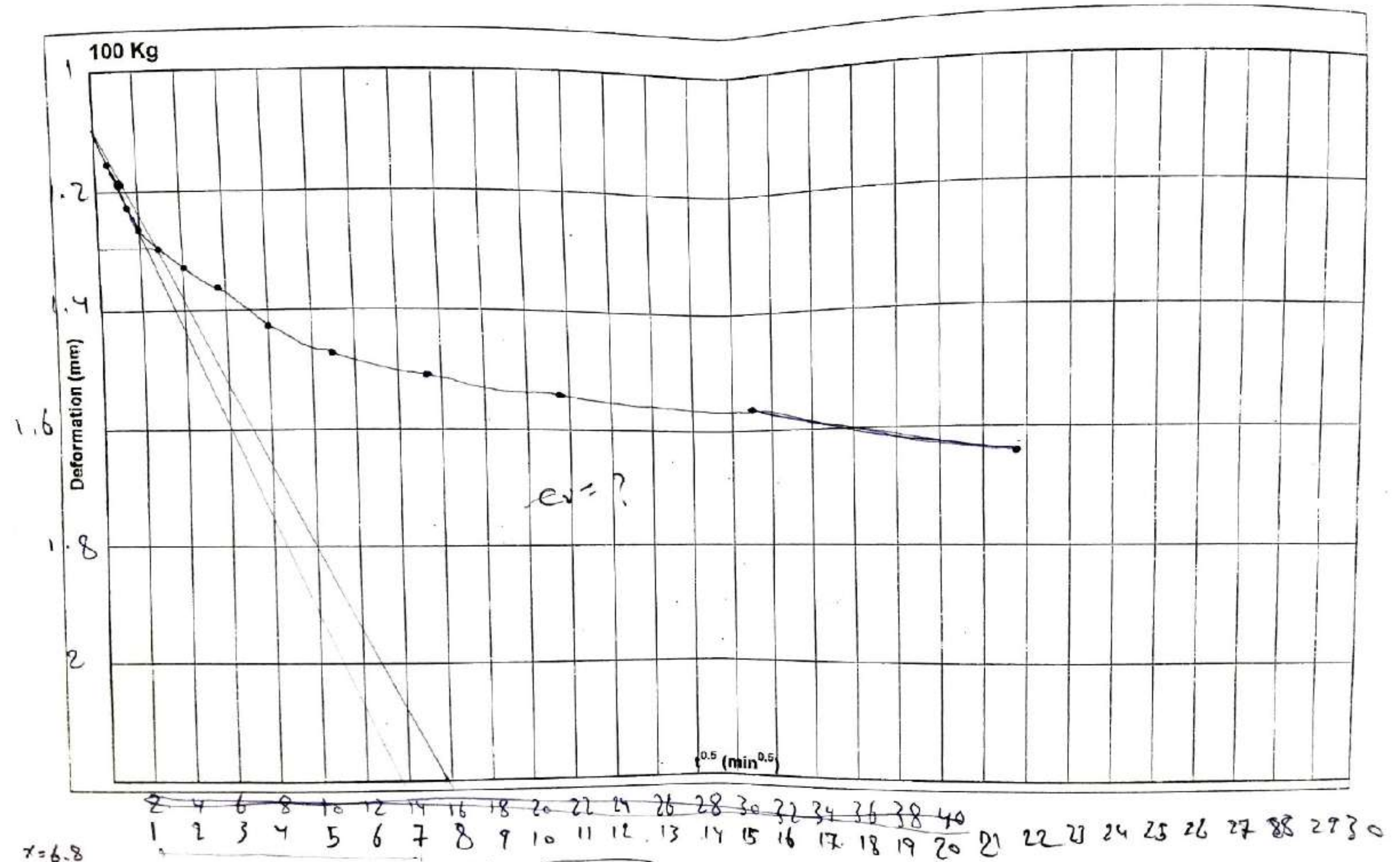


$t_1 = 0.13$

$4t_1 = 0.52$

$d_2 - d_1 = 0.07$

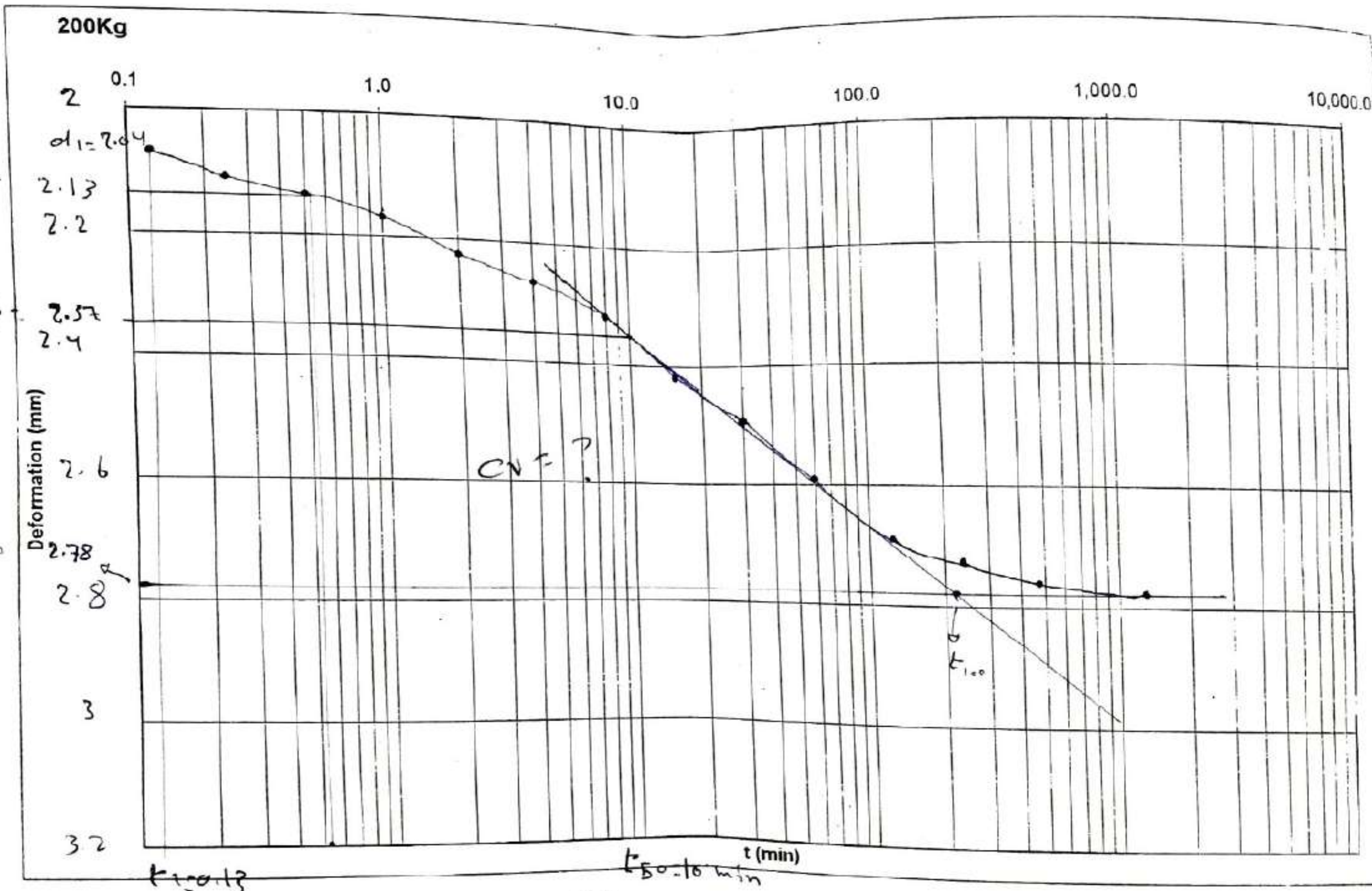
$$d_{50} = \frac{1.1 + 1.62}{2} = 1.36$$



$x = 6.8$

$x = 6.8 \times 1.15 = 7.82$

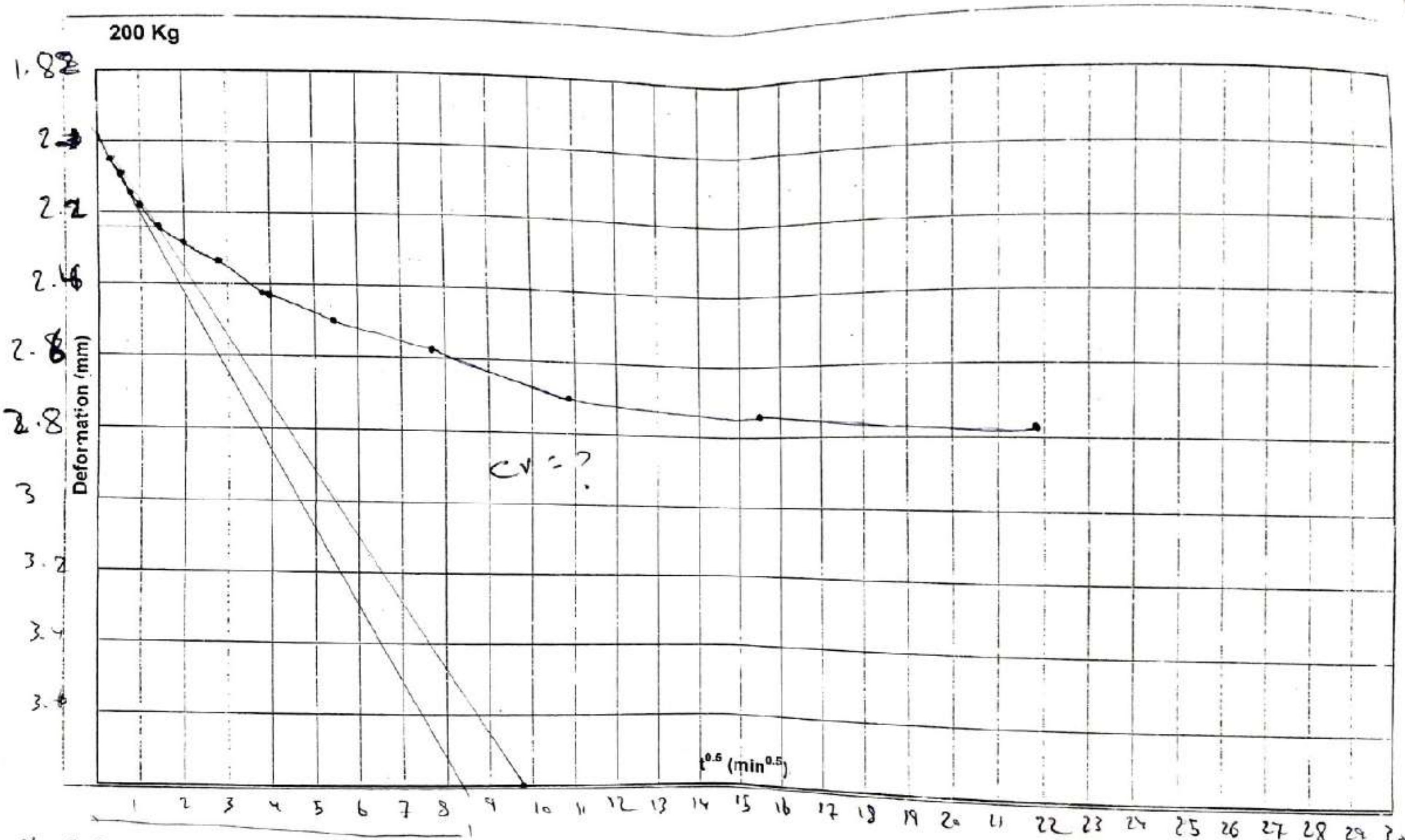
$\sqrt{t_{90}} = \sqrt{1.41} \rightarrow \boxed{t_{90} = 2}$



$4t_1 = 0.52$

$$d_{50} = \frac{1.95 + 2.78}{2} = 2.37$$

$d_2 - d_1 = 2.13 - 2.04 = 0.09$



$x = 8.5$

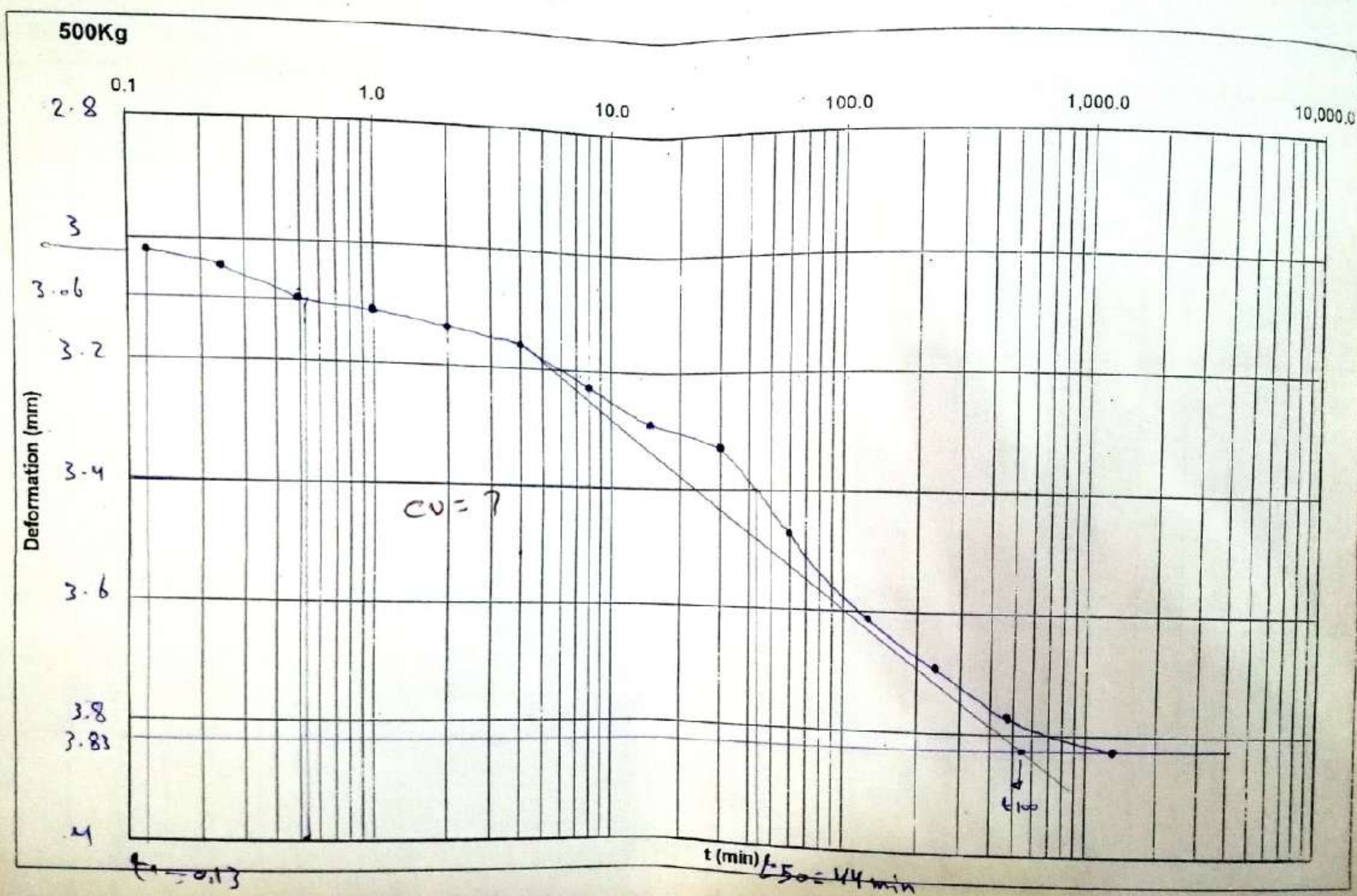
$x = 8.5 \times 1.15 = 9.78$

$\sqrt{t_{90}} = \sqrt{1.41}$

$t_{90} = 2$

$d_1 = 3.01$

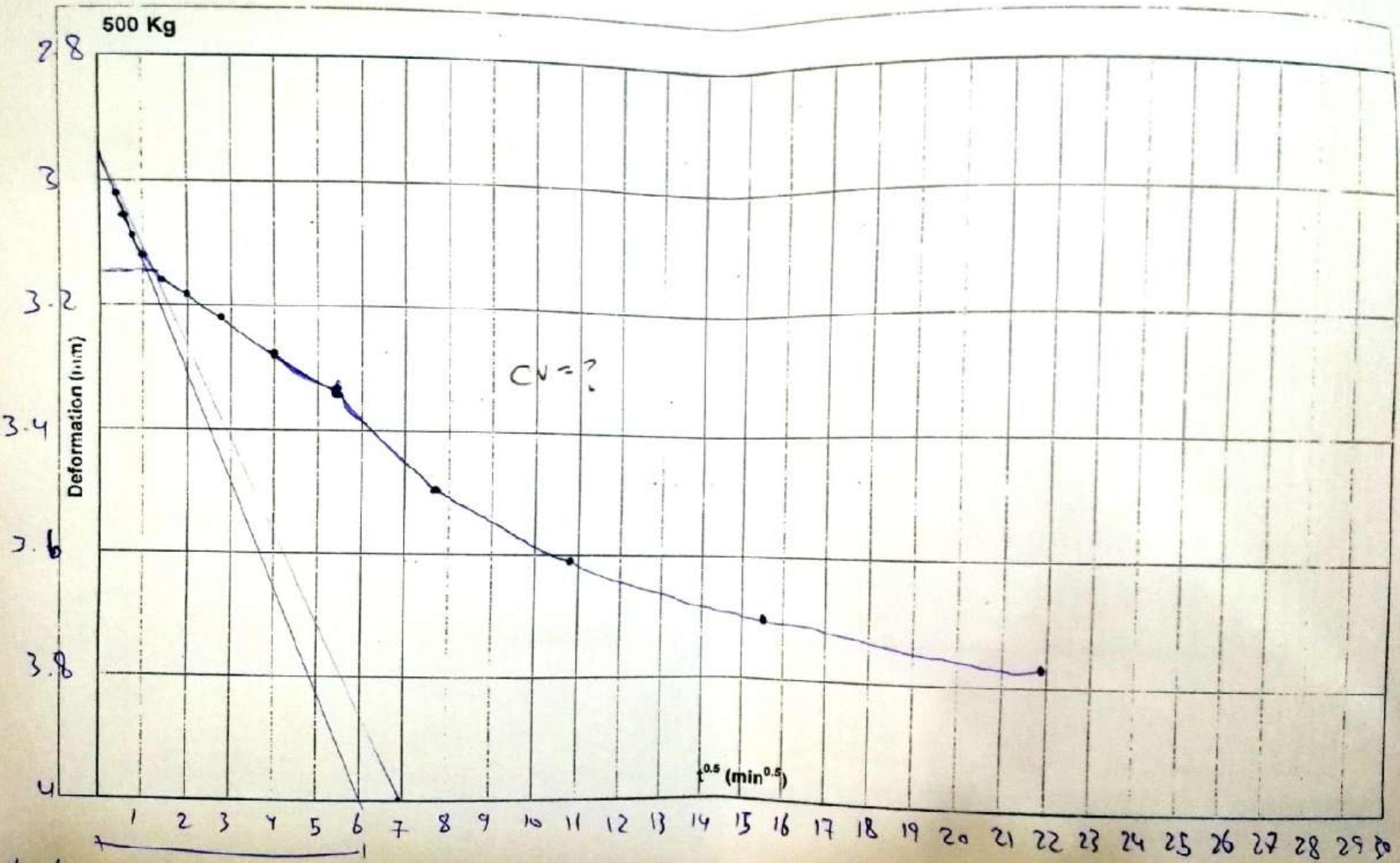
$d_2 =$



$4t_1 = 0.52$

$d_{50} = \frac{2.96 + 3.83}{2} = 3.4$

$d_2 - d_1 = 0.05$

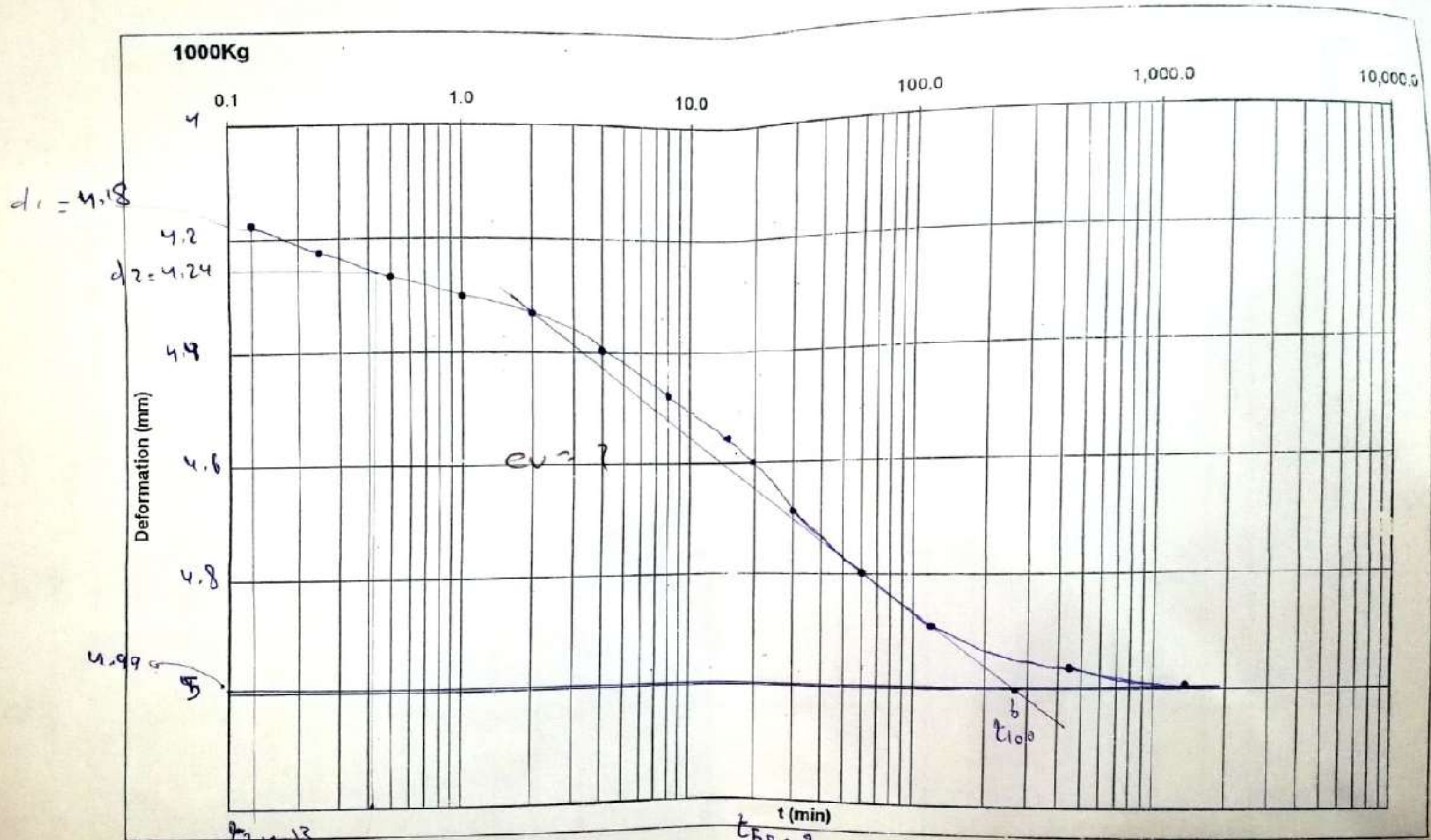


$x = 6$

$x = 6 \times 1.15 = 6.9$

$\sqrt{t_{90}} = \sqrt{1.3}$

$t_{90} = 1.70$ min



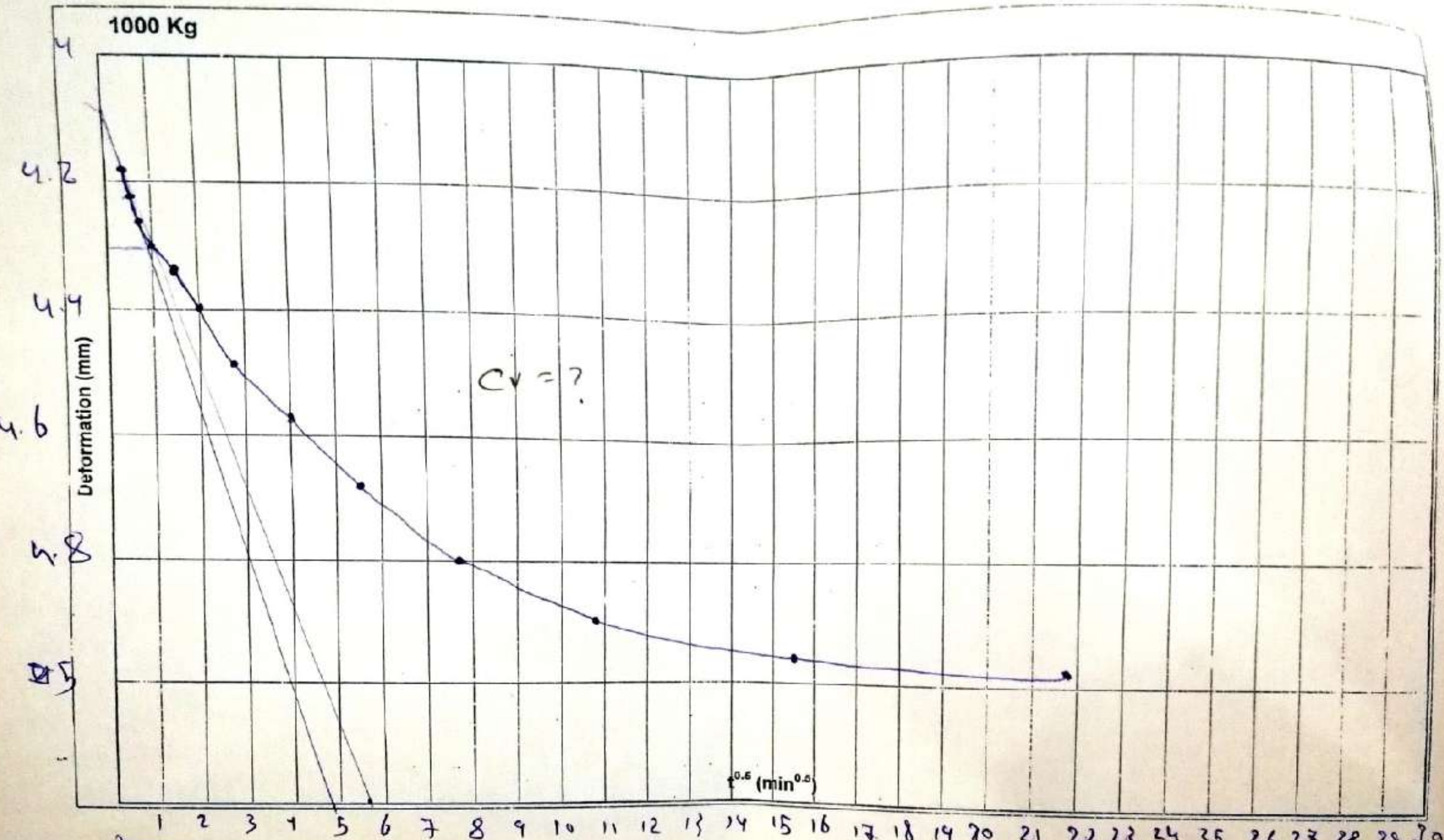
$t_1 = 0.13$

$t_{50} = 20$ min

$4t_1 = 0.52$

$$d_{50} = \frac{4.12 + 4.99}{2} = 4.6$$

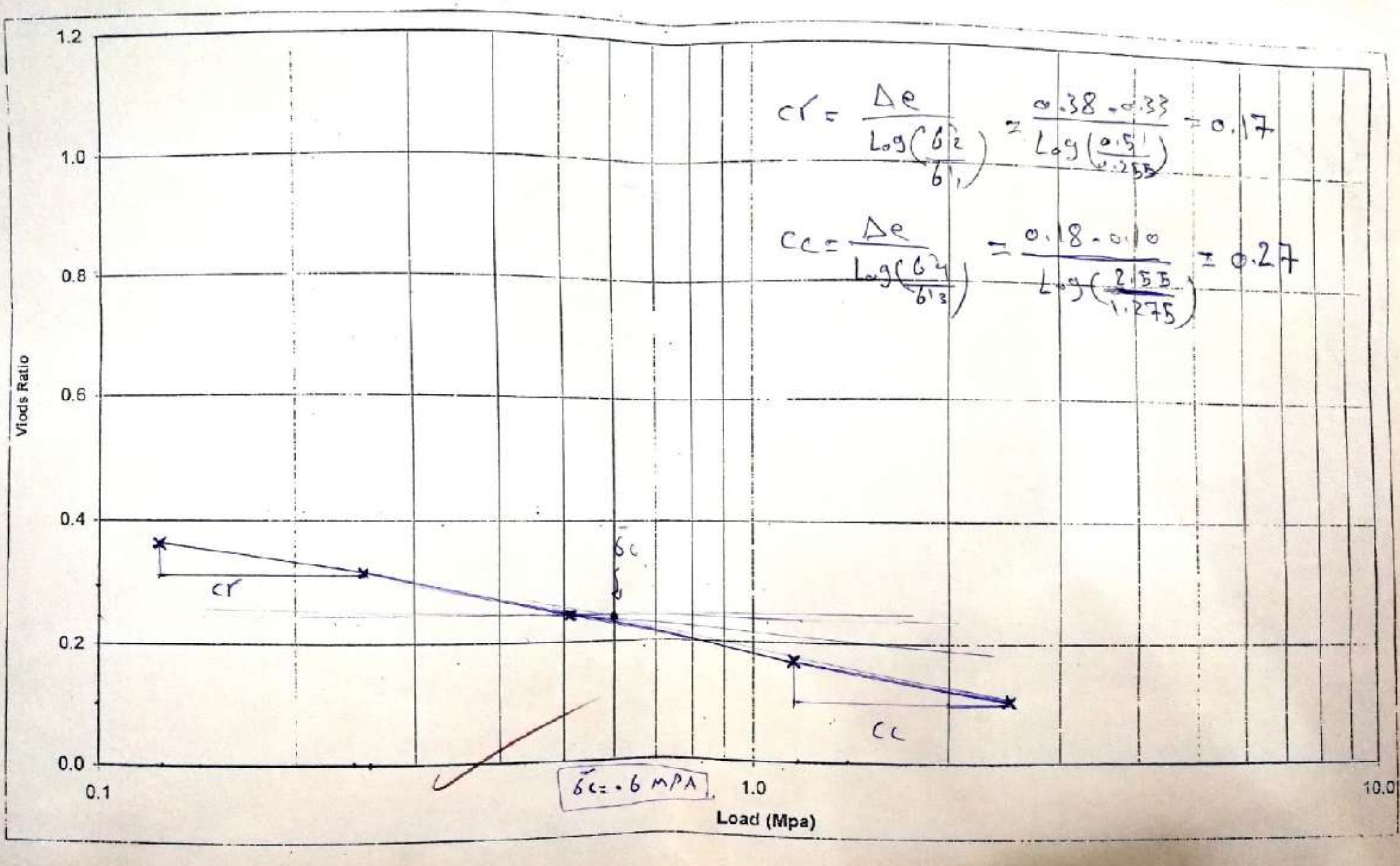
$d_2 - d_1 = 0.06$



x = 4.8

t90 = 1

x = 4.8 × 1.15 = 5.52



Cr = Δe / Log(σ'2 / σ'1) = (0.38 - 0.33) / Log(0.51 / 0.255) = 0.17
Cc = Δe / Log(σ'4 / σ'3) = (0.18 - 0.10) / Log(2.55 / 1.275) = 0.27
σc
Cr
Cc
σc = .6 MPA
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.1
1.0
10.0
Viods Ratio
Load (Mpa)