Experiment No: 06

Experiment Name: Unconsolidated Undrained Triaxial Compression Test.

Aim: To determine the cohesion and angle of internal friction of sandy-clay to obtain stress strain characteristics of the soil sample.

Standard Reference: ASTM D 2850-03a

Significance: Shear strength is the most important engineering property of soils. It represents the ability of soils to withstand shear stresses. Knowledge of shear strength is necessary for the solution of a large number of different engineering problems like stability of slopes, the bearing capacity of foundations, the lateral pressure exerted by soil on retaining walls etc.

Shear strength is perhaps, also the most complex engineering property of soil. At present the most versatile and useful way to measure the shear strength of soil is by triaxial compression test.

Types of Triaxial compression Test

Sl. No	Drainage conditions during the two stages of the test: Stage 1: Application of cell pressure only	Stage 2: Application of additional axial cell pressure	Type of the test
1	Drainage allowed, therefore consolidated	Drainage allowed, therefore drained	Consolidated Drained (CD)
2	Drainage ~~not~~ allowed therefore consolidated	Drainage not allowed, therefore undrained	Consolidated undrained (CU)
3	Drainage not allowed, there unconsolidated	Drainage not allowed, therefore undrained	Unconsolidated Undrained (UU)

Equipment:

1. Triaxial compression test apparatus comprising of loading frame, cell assembly with loading plunger, loading pad, Perspex discs, porous stones, rubber membranes, rubber O rings.
2. Sand former
3. Sheath stretcher

4. lateral pressure assembly
5. Proving ring
6. Dial gauge

Test Procedure:

i) The quantity of dry sample was weighed to make the sample volume at the density specified.

ii) The sheath was binded to cell base pedestal, which is covered by a porous stone with two rubber o-rings. The split sand former was clamped around the sheath and turn the top end of the sheath over the top of the sand former.

iii) The soil was placed in the sand former in layers and each layers was tamped carefully.

iv) The porous stone and perspex disc was placed on top of soil.

v) The cell was assembled by placing the loading plunger touching top of the specimen and cell was filled with water.

vi) The assembled cell was placed on loading frame. Appropraite water connections was made from the pressure assembly to cell base.

vii) The air vent was opened on the top of cell and ensured that top was filled with water.

viii) The lateral pressure specified was applied.

ix) The loading platform of the testing machine was raised to bring the loading plunger in ~~xii) Loan~~ contact with the top of surface.

x) Deformation dial gauge was fitted and was set to zero.

xi) Axial load was applied using constant rate of strain of 1% to 2% per minute.

xii) Loading was continued and observation was taken untill specimen fails.

xiii) The test was repeated for other specified cell pressures.

Observations: Sample - 1

Diameter of the sample = 70 mm = 7 cm

Sample height = 140 mm = 14 cm

Weight of sample = 0.2 kN

Cell pressure = 100 kpa   Area = $\frac{\pi}{4} \times 7^2 = 38.48\ cm^2$

Vertical displacement Dial reading (CF x 0.01mm)	Change in length (cm)	Axial strain ε (%)	$A = \frac{A_0}{1-\varepsilon}$ (cm²)	Load (KN)	Axial stress (KN/cm²)
0	0	0	38.48	0.00	0
5	0.005	0.036	39.49	0.19	0.0049
10	0.01	0.071	38.51	0.45	0.0116
15	0.015	0.107	38.52	0.83	0.022
20	0.02	0.143	38.54	1.03	0.027
25	0.025	0.179	38.55	1.40	0.036
30	0.03	0.214	38.56	1.85	0.047
35	0.035	0.25	38.58	2.19	0.056
40	0.04	0.286	38.59	2.47	0.064
50	0.05	0.357	38.62	3.04	0.079
60	0.06	0.429	38.65	3.44	0.089
70	0.07	0.5	38.67	3.43	0.089
80	0.08	0.571	38.70	3.53	0.091
90	0.09	0.643	38.73	3.55	0.092
100	0.10	0.714	38.76	3.50	0.090
110	0.11	0.786	38.78	3.49	0.089
120	0.12	0.857	38.81	3.45	0.088
130	0.13	0.929	38.84	3.40	0.088
140	0.14	1	38.87	3.38	0.087
150	0.15	1.07	38.89	3.35	0.086

sample No = 02

sample diameter = 70mm = 7cm

sample height = 140mm = 14cm

weight of sample = 9.5 N

cell pressure = 200kPa

Vertical displacement Dial reading CF×0.01mm	Change in length (cm)	Axial Strain, ε (%)	$A = \frac{A_0}{1-\varepsilon}$ (cm^2)	Load (kN)	Axial stress kN/cm^2
0	0	0	38.48	0.00	0
5	0.005	0.036	38.49	0.02	0.0005
10	0.01	0.071	38.51	0.03	0.0008
15	0.015	0.107	38.52	0.08	0.0021
20	0.02	0.143	38.54	0.24	0.0062
25	0.025	0.179	38.55	0.56	0.014
30	0.03	0.214	38.56	0.87	0.023
35	0.035	0.25	38.58	1.79	0.046
40	0.04	0.28	38.59	3.05	0.079
50	0.05	0.36	38.62	4.72	0.122
60	0.06	0.43	38.65	6.42	0.166
70	0.07	0.50	38.67	8.03	0.208
80	0.08	0.57	38.70	9.44	0.244
90	0.09	0.64	38.73	8.73	0.225
100	0.10	0.71	38.76	8.62	0.222
110	0.11	0.79	38.79	8.57	0.221
120	0.12	0.86	38.81	8.50	0.219
130	0.13	0.93	38.84	8.50	0.219
140	0.14	1.0	38.87	8.49	0.218
150	0.15	1.07	38.89	8.02	0.206

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sample No : 03

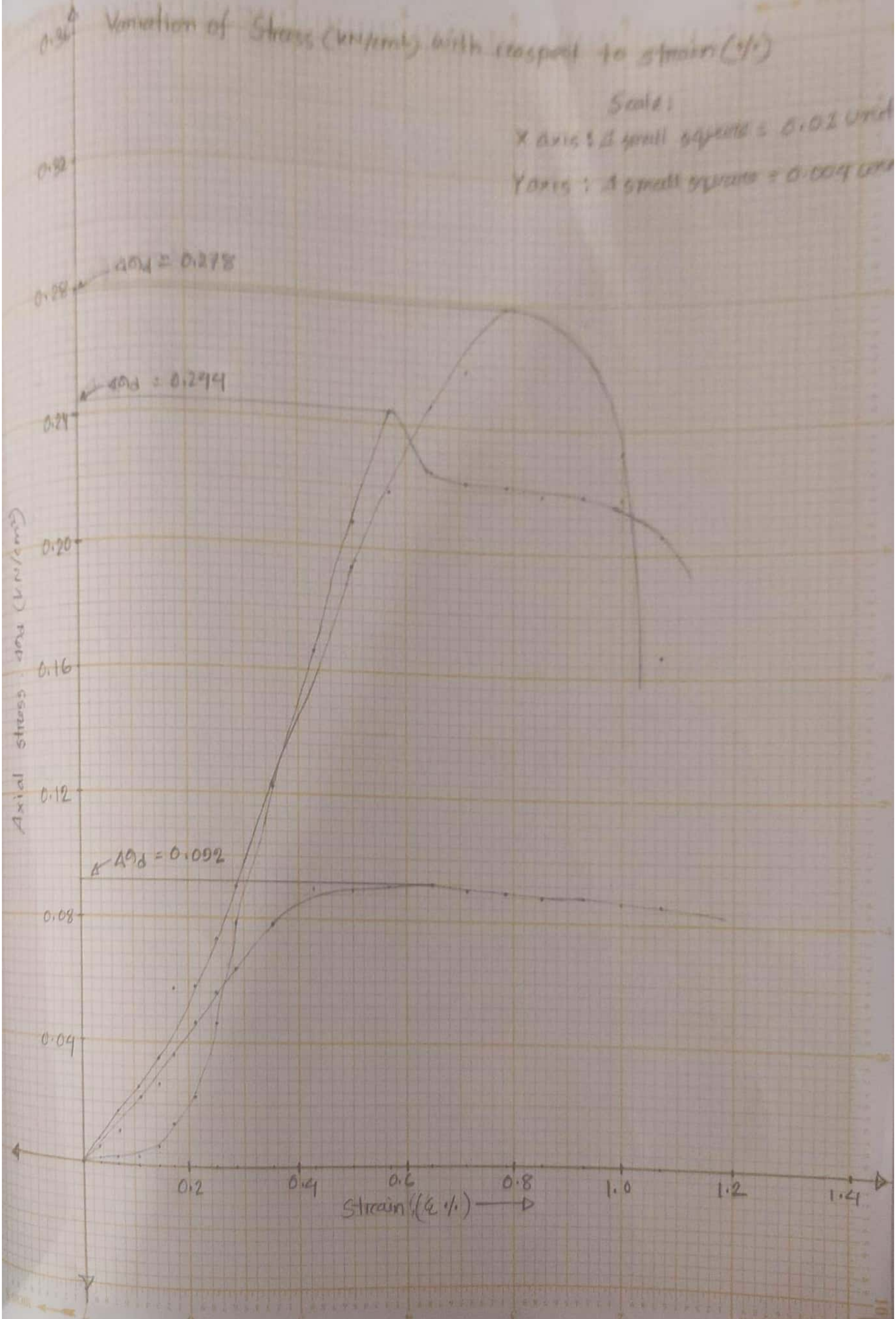
sample diameter : 70 mm = 7cm

sample height : 140 mm = 14cm

weight of sample : 9.3 N

cell pressure : 400 kPa

Vertical displacement dial gauge CF x 0.01 mm	Change in length (cm)	Axial Strain ε (%)	$A = \frac{A_0}{1-\epsilon}$ (cm^2)	Load (KN)	Axial stress (kN/cm^2)
0	0	0	38.48	0.00	0
5	0.005	0.036	38.49	0.32	0.0083
10	0.01	0.071	38.51	0.65	0.0169
15	0.015	0.107	38.52	0.96	0.0249
20	0.02	0.143	38.54	1.35	0.035
25	0.025	0.179	38.55	2.20	0.057
30	0.03	0.214	38.56	2.26	0.058
35	0.035	0.25	38.58	2.83	0.0733
40	0.04	0.28	38.59	3.49	0.0904
50	0.05	0.36	38.62	4.75	0.123
60	0.06	0.43	38.65	6.45	0.166
70	0.07	0.50	38.70	7.48	0.193
80	0.08	0.57	38.73	8.50	0.219
90	0.09	0.64	38.76	9.30	0.246
100	0.10	0.71	38.79	10.00	0.258
110	0.11	0.79	38.81	10.48	0.278
120	0.12	0.86	38.84	10.74	0.276
130	0.13	0.93	38.87	10.68	0.275
140	0.14	1	38.87	9.02	0.232
150	0.15	1.07	38.89	6.53	0.167


Variation of Stress (kN/cm²) with respect to strain (%)
Scale:
X axis : 1 small square = 0.02 unit
Y axis : 1 small square = 0.004 unit
Δσd = 0.278
Δσd = 0.244
Δσd = 0.092
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
Axial stress Δσd (kN/cm²)
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Strain (ε %)

Calculation :

For sample 1 :

$\sigma_3 = 100 kPa$

$\Delta\sigma_d = 0.092 \ kN/cm^2 = \frac{0.092}{(10^{-2})^2} = 920 \ kN/m^2$

$\therefore \sigma_1 = 100 + 920 = 1020 \ kN/m^2$

For sample 2 :

$\sigma_3 = 200 kPa$

$\Delta\sigma_d = 0.244 \ kN/cm^2 = 2440 \ kN/m^2$

$\therefore \sigma_1 = 2440 + 200$
$= 2640 \ kN/m^2$

For sample 3 :

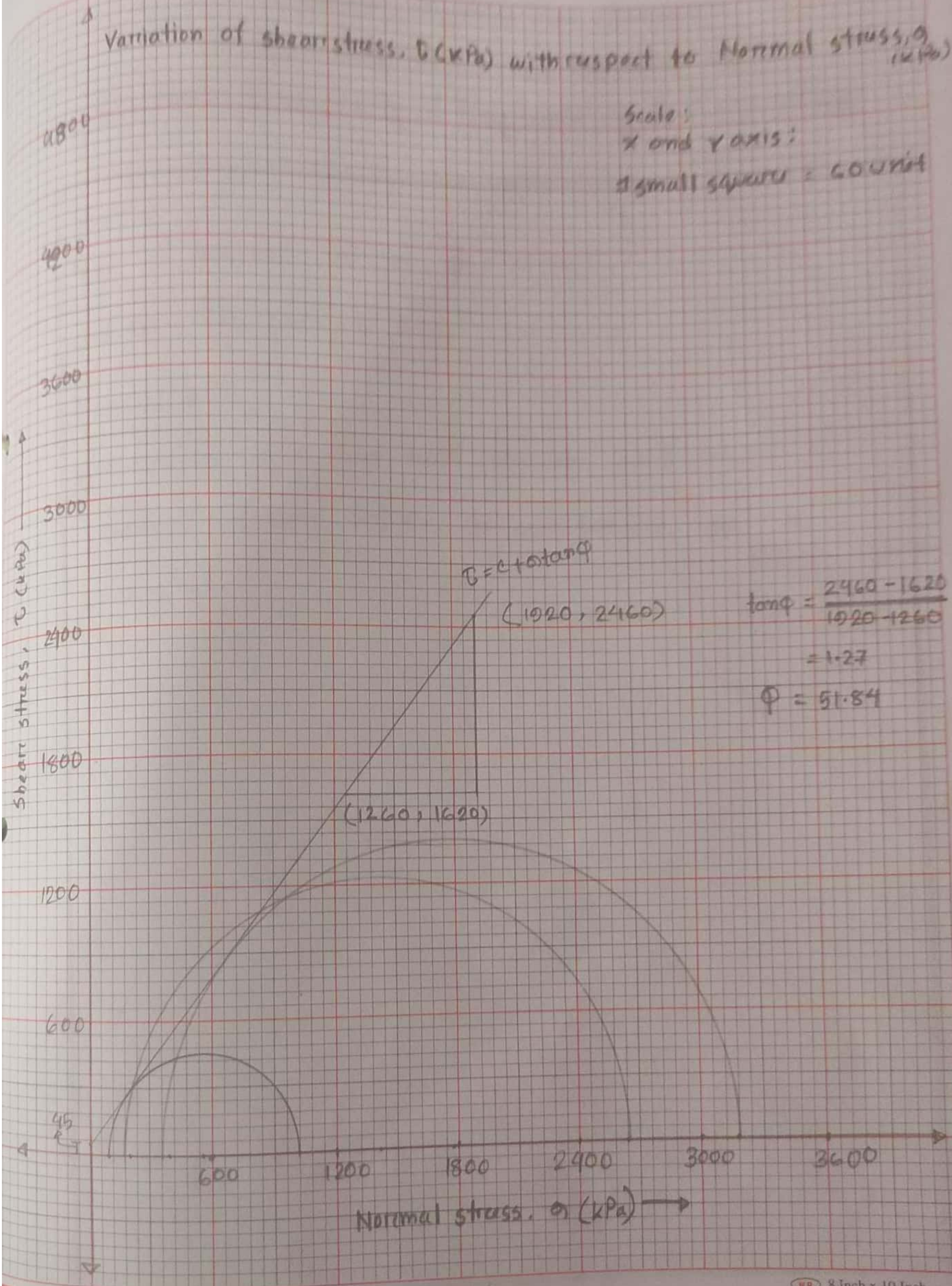
$\sigma_3 = 400 kPa$

$\Delta\sigma_d = 0.278 \ kN/cm^2 = 2780 \ kN/m^2$

$\sigma_1 = \sigma_3 + \Delta\sigma_d = 400 + 2780 = 3180 \ kN/m^2$

Variation of shear stress, τ (kPa) with respect to Normal stress, σ (kPa)

Scale:
X and Y axis:
1 small square = 60 unit



$$\tan\phi = \frac{2460 - 1620}{1920 - 1260}$$

$= 1.27$

$\phi = 51.84$

Result :

Angle of internal friction, $\phi = 51.84^\circ$

cohesion intercept, $c = 45$

Discussion:

Our sample soil has both cohesion and angle of internal friction value. So our sample soil is $c-\phi$ soil.