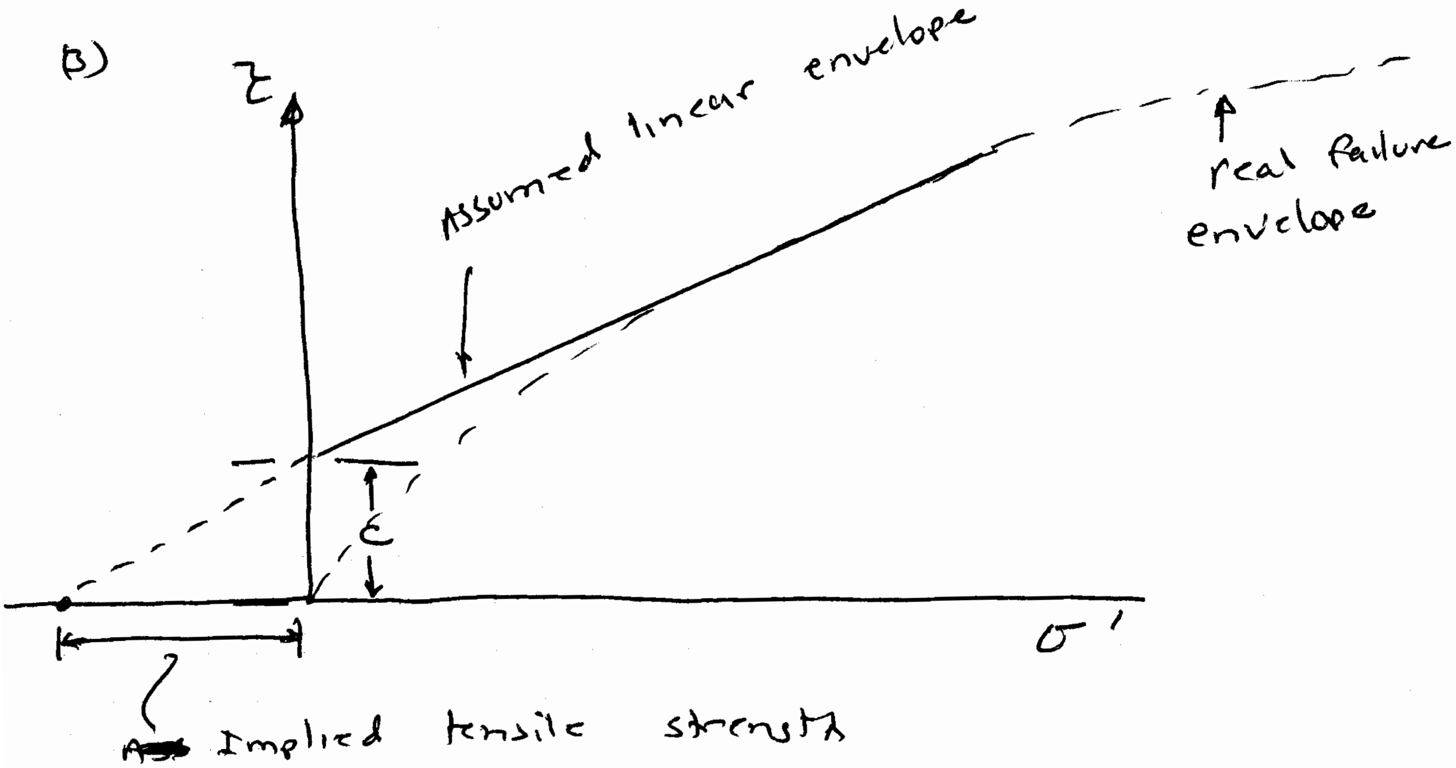
Assignment 8

(1) See Assignment 7 solution

(2) See Assignment 7 solution

(3)



Soil failure envelope is assumed to be linear. This is true over a given stress range.

If soil has cohesion it mean soil can take tension → This is not true.

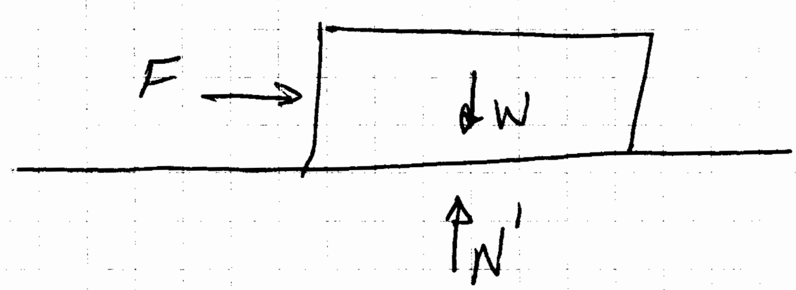
∴ soil cohesion is apparent as it may not be real, over all stress ranges

note for low stress get ~~has~~ low c' high ϕ'

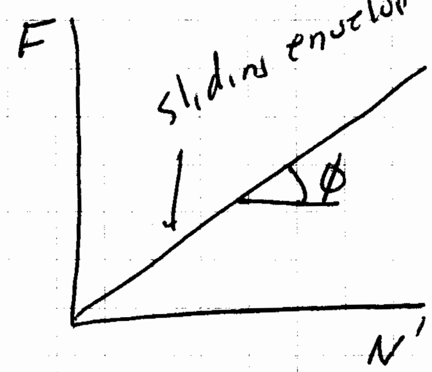
medium stress problems medium c' medium ϕ'

high stress problems high c' low ϕ'

(b) Friction sliding block mode



$\mu = \frac{F}{N} = \tan\phi$



$F = \mu N$

μ = coef. of friction

N' = normal force on Bottom of block

$F = \tan\phi \; N$

if glue

$F = c_1' + \tan\phi N$

c = force to break glue

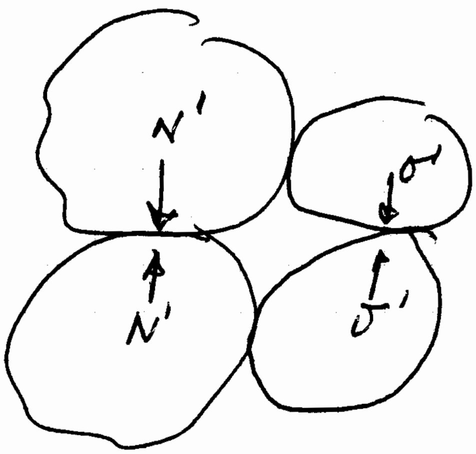
In stress term $\tau = \frac{F}{A}$ $c = \frac{c_1'}{A}$ $\sigma = \frac{N}{A}$

$\tau = c + \sigma_n \tan\phi'$

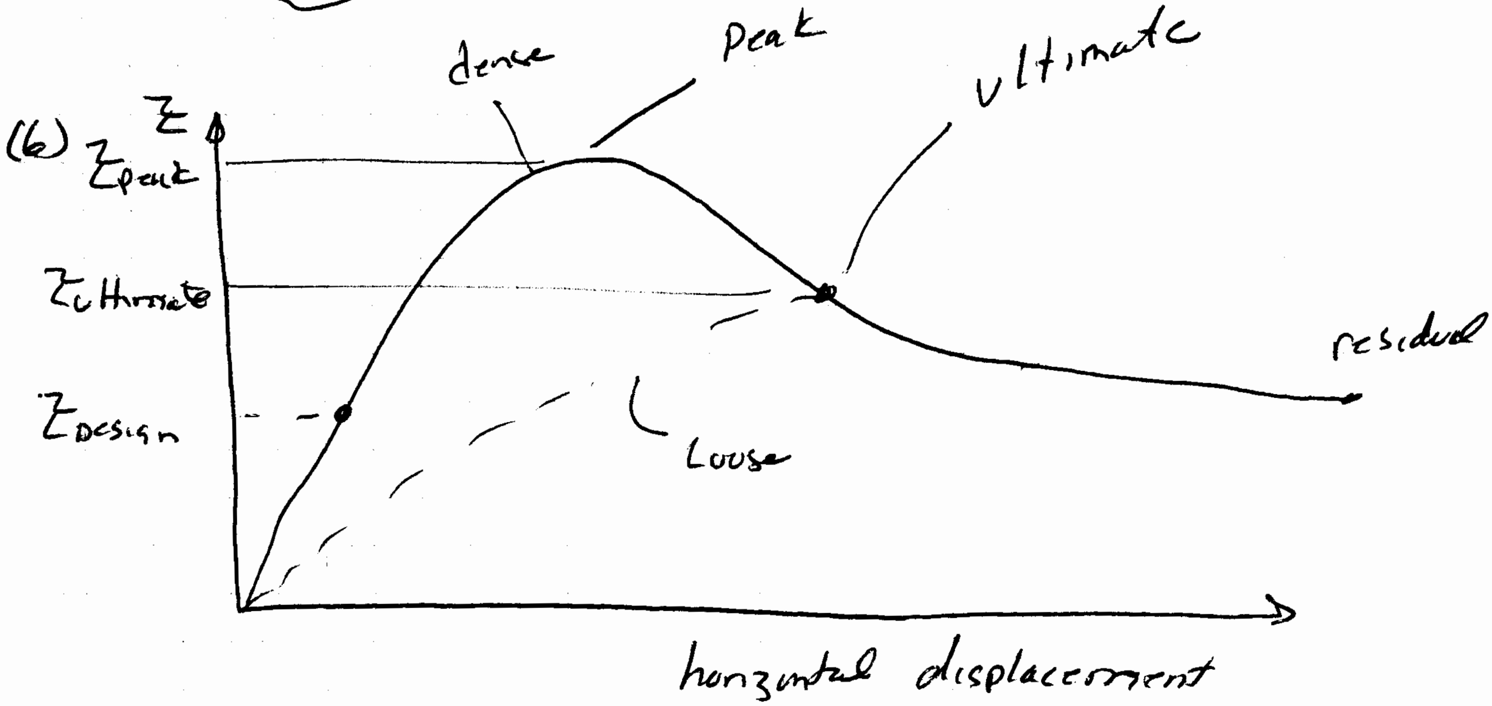
(5) need to know contact stress between soil particles

$\Rightarrow$ this is effective <u>stress</u>.

if contact stress $= 0$ $\therefore \tau = 0$



(6)



$$\tau_{design} = \frac{\tau_{peak}}{F} \text{ or } \frac{\tau_{ultimate}}{F}$$

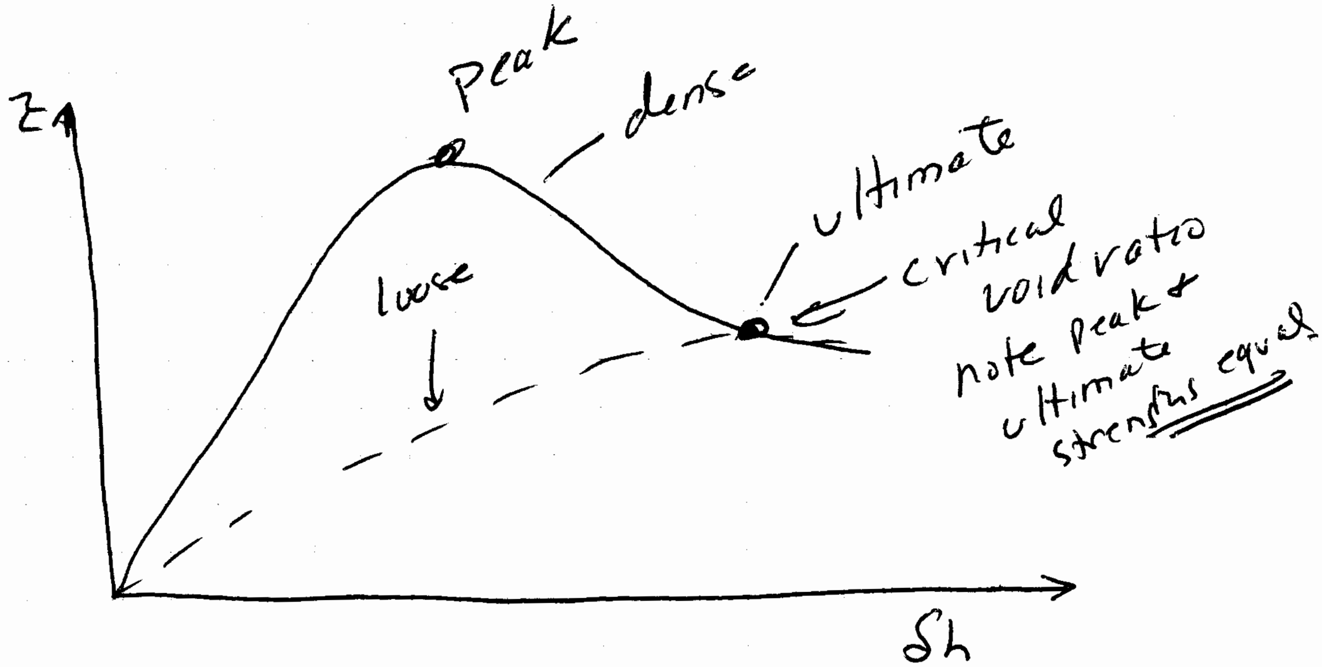
F typically 1.5 to 2.0 $\therefore F = \dfrac{\tau_{peak}}{\tau_{design}}$ or $\dfrac{\tau_{ult}}{\tau_{design}}$

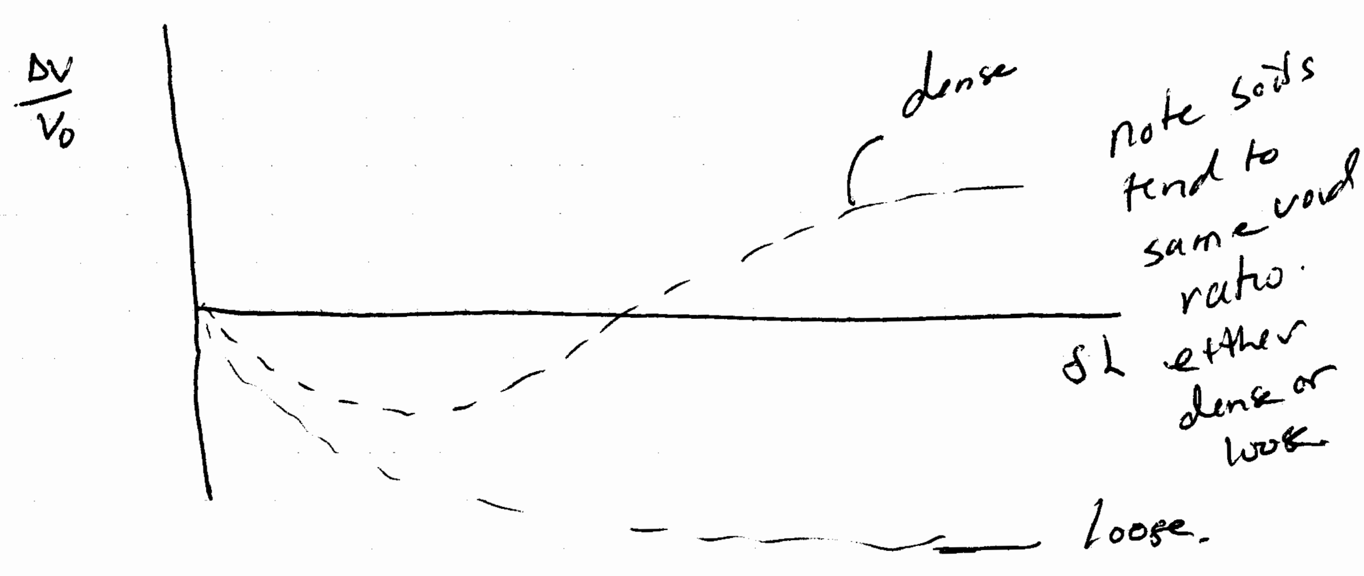
(7) - Soil sample insitu stress so can test soil in expected stress range in the field

- soil hydraulic conductivity to see if direct shear or triaxial

- drained or undrained test.

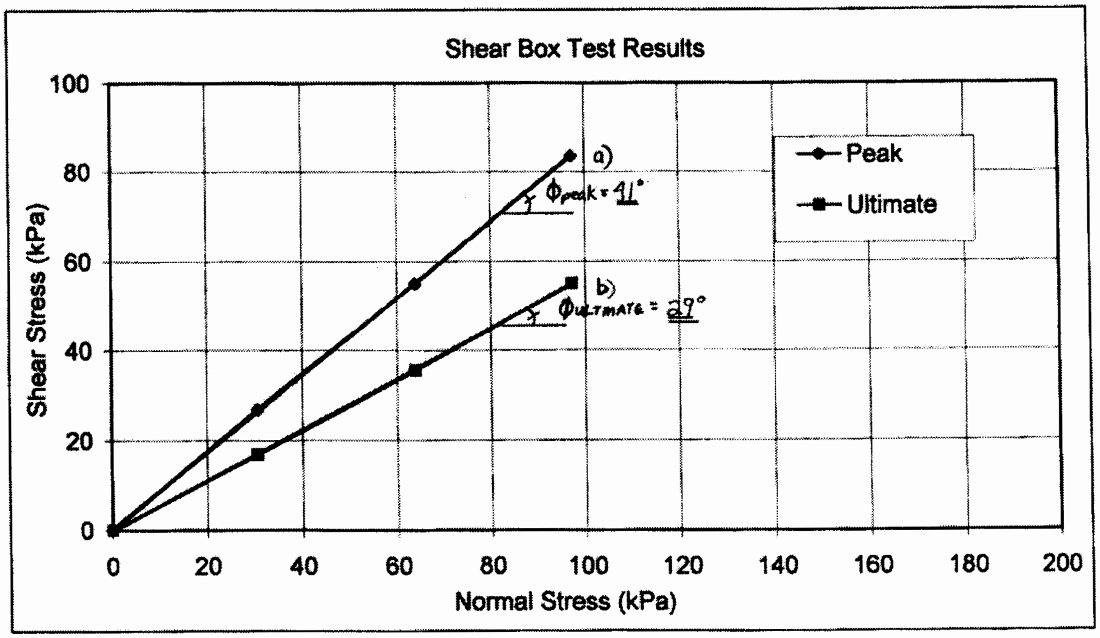
(8)





Q 9

Normal Load (N)	Normal Stress (kPa)	Shear Load (N) Peak	Shear Load (N) Ultimate	Shear Stress (kPa) Peak	Shear Stress (kPa) Ultimate
0	0	0	0	0	0
110	30.6	97	61	26.9	16.9
230	63.9	198	128	55.0	35.6
350	97.2	301	198	83.6	55.0



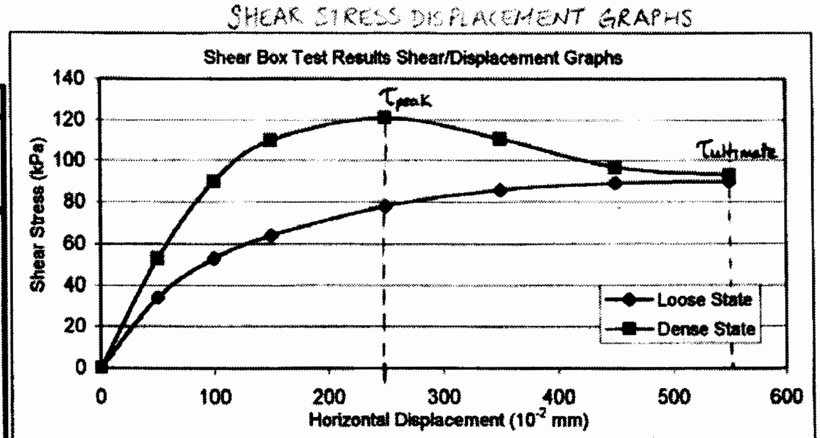
Q10

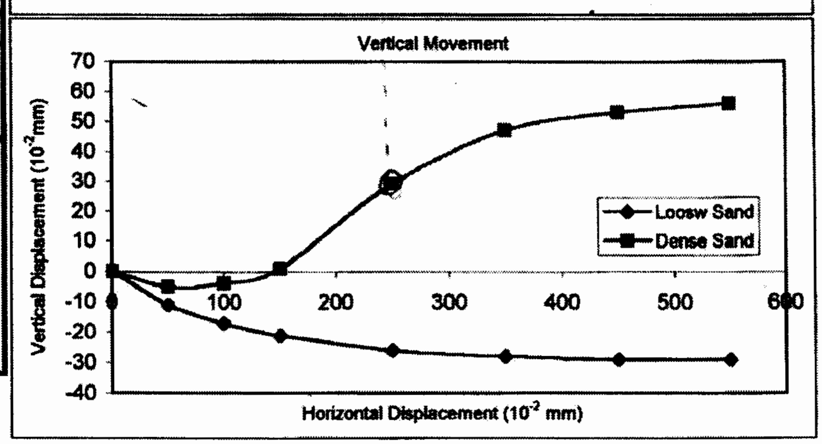
$\sigma_n = 160\ kN/m^2$

TEST 1 - Loose state		
Horizontal Displacement (10^{-2} mm)	Vertical Displacement (10^{-2} mm)	Shear Stress (kPa)
0	0	0
50	-11	34
100	-17	53
150	-21	64
250	-26	78
350	-28	86
450	-29	89
550	-29	90

TEST 2 - Dense state		
Horizontal Displacement (10^{-2} mm)	Vertical Displacement (10^{-2} mm)	Shear Stress (kPa)
0	0	0
50	-5	53
100	-4	90
150	1	110
250	29	peak 121
350	47	111
450	53	97
550	56	ultimate 93

SHEAR STRESS DISPLACEMENT GRAPHS





$\boxed{\tau = \sigma_n \tan\phi}$ $\therefore \phi = \tan^{-1}\left(\frac{\tau}{\sigma_n}\right)$

$\phi_{peak} = \tan^{-1}\left(\frac{121}{160}\right) = \underline{37°}$ $\phi_{ult} = \tan^{-1}\left(\frac{92}{160}\right) = \underline{30°}$

PAG

3. UNCONSOLIDATED-UNDRAINED (UU) TRIAXIAL TEST
(ON FULLY SAT. ($S_r=1$) CLAY)

Q 11

RESULTS:

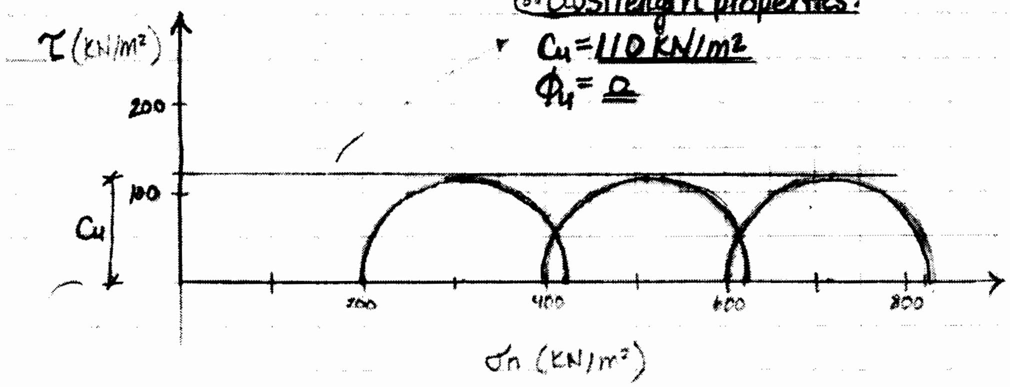
ALL ROUND PRESSURE (kN/m^2)	200	400	600
PRINCIPAL STRESS DIF (kN/m^2) (i.e. $\sigma_1-\sigma_3$)	222	218	220

(u) σ_3 = ALL ROUND	$\sigma_1-\sigma_3$	σ_1	$R=(\sigma_1+\sigma_3)/2$
200	222	422	311
400	218	618	509
600	220	820	710

Undrained (3. CU) strength properties:

$C_u = \underline{110\ kN/m^2}$

$\phi_u = \underline{0}$



4. CONSOLIDATED-UNDRAINED (CU) TRIAXIAL TEST
(ON FULLY SAT ($S_r=1$) CLAY)

Q 12

a)

σ_3 (kN/m^2)	$\sigma_1-\sigma_3$ (kN/m^2)	u (kN/m^2)	σ_1	$\sigma_1'=\sigma_1-u$	$\sigma_3'=\sigma_3-u$
150	103	82	253	171	68
300	202	169	469	300	98
450	305	252	802	550	198
600	410	331	1010	679	269
↑ TOTAL PLOT			↑ TOTAL PLOT	↑ EFFECTIVE PLOT	↑ EFFECTIVE PLOT

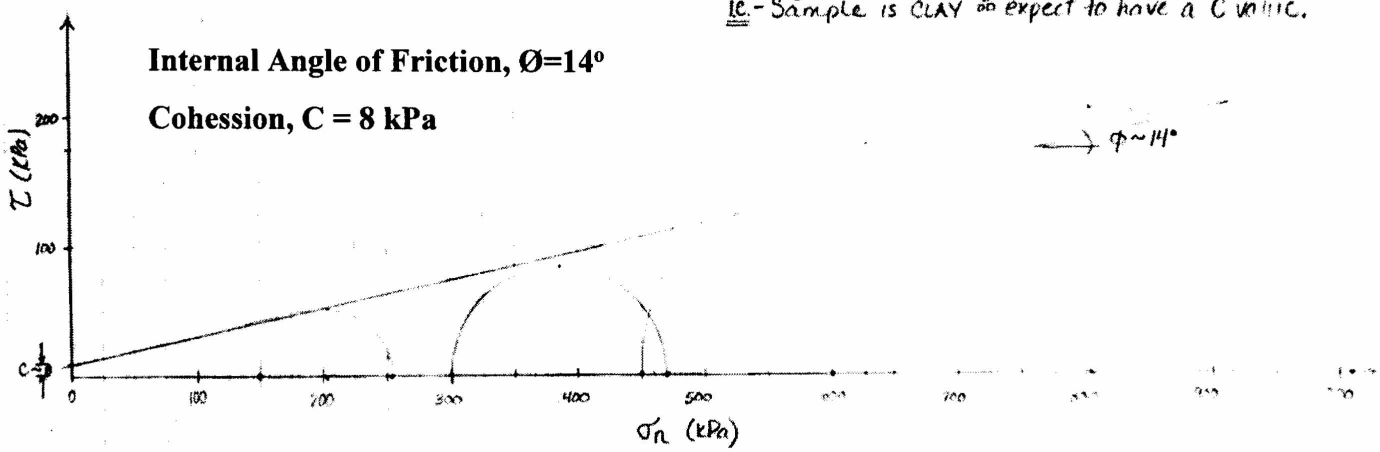
b)

$p=(\sigma_1-\sigma_3)/2$	$q=(\sigma_1'+\sigma_3')/2$
51.5	119.5
101	199
152.5	374
205	474

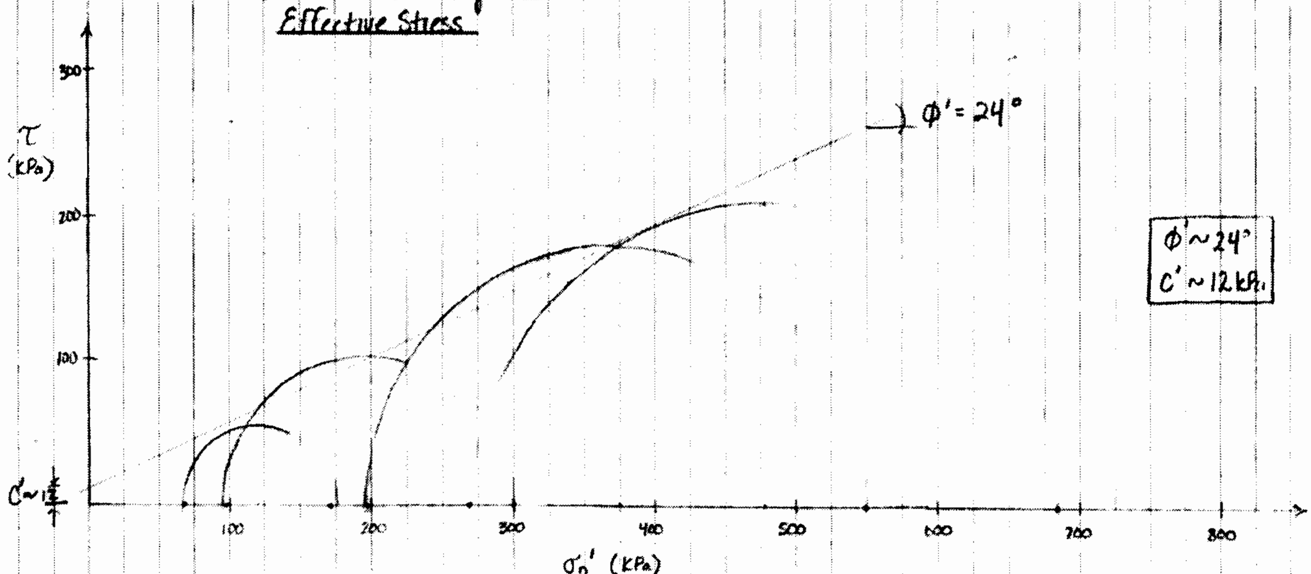
* Use a compass!!! Accuracy!!!
* These plots are subjective – use the p vs q plot to check your results from part a.
* Allways look @ your values for ϕ & c & think if they make sense.
  ie. – Sample is CLAY ∴ expect to have a C value.

Q12

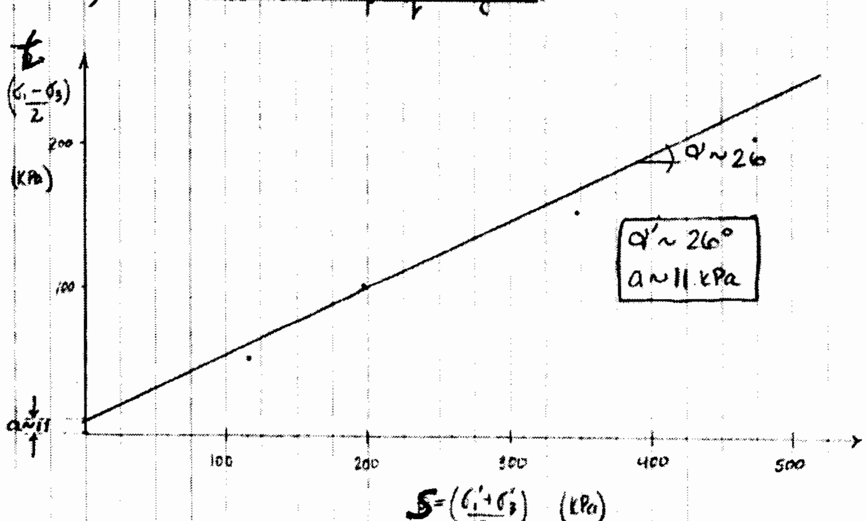
7a) τ vs σ_n Diagram
Total Stress:



7a) Plot τ vs σ_n Diagram
Effective Stress



7b) Plot test results on a p vs q diagram



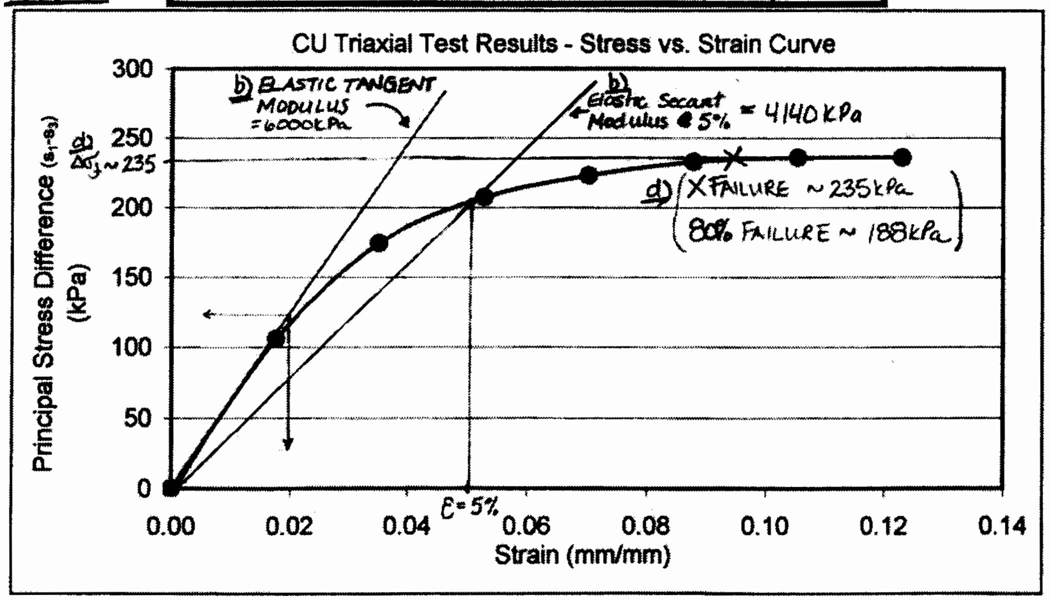
c) $\phi' = \sin^{-1}(\tan \alpha')$
$= \sin^{-1}(\tan 26)$
$\therefore \phi' = \underline{21.3°}$

$c' = \dfrac{a}{\cos \alpha'}$
$= \dfrac{11}{\cos(26)}$
$\therefore c' = \underline{12 \text{ KPa}}$

Q13

Vert Dial Rdg (mm)	$\sigma_1-\sigma_3$ (kPa)	σ_1 (kPa)	u (kPa)	ε (Strain)
0	0	138	15	0.00
2.5	106	244	22	0.02
5	174] 188	312	34] $u_{e\,80\%}$	0.04
7.5	207	345	41	0.05
10	223	361	43	0.07
12.5	233	371	43	0.09
15	236	374	42	0.11
17.5	236	374	41	0.12

a) PLOT:



b) Elastic Tangent Modulus:

$= \frac{RISE}{RUN} = \frac{\Delta(\sigma_1-\sigma_3)}{\Delta\varepsilon}$

$= \frac{120-0}{0.02-0}$

$= 6000\ kPa$

$= 6.0\ GPa$

Elastic Secant Modulus:

$= \frac{207-0}{0.05-0}$

$= 3760\ kPa$

$= 4140\ kPa$

$= 41.4\ GPa$

d) Skempton's Pore water Pressure Parameter:

$\boxed{\bar{A} = \frac{\Delta u_d}{\Delta \sigma_d}}$ → Solve for $(\Delta u_d)_{80\%}$:

$\frac{207-188}{41-u_{80\%}} = \frac{188-174}{u_{80\%}-34}$

$19u_{80\%} - 646 = 574 - 14u_1$

$33u_{80\%} = 1220$

$\therefore u_{80\%} = 37\ kPa$

$\bar{A}_{(80\%)} = \frac{\Delta u_{(80\%)}}{\Delta\sigma_{(80\%)}}$

$= \frac{u_{80\%} - 15}{\sigma_{80\%} - 0}$

$= \frac{37-15}{188-0}$

$\bar{A}_{(80\%)} = 0.12$

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