7.3

Given:

Loose sandy soil $\tau_f = \sigma' \tan 30°$

Drained triaxial test

Confining pressure =70 KN/m$^2$=$\sigma_3$

Determine:

Deviator stress at failure

SOL.

$$\sigma_1 = \sigma_3 \tan^2\left(45 + \frac{\emptyset}{2}\right) + 2c \tan\left(45 + \frac{\emptyset}{2}\right)$$

$\emptyset = 30°$ , c= 0 (Given)

$$\Longrightarrow \quad \sigma_1 = 70 \tan^2\left(45 + \frac{30}{2}\right) = 210 \frac{KN}{m^2}$$

$$\Delta\sigma_d = \sigma_1 - \sigma_3 = 210 - 70 = 140 \frac{KN}{m^2}$$

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7.4

For problem 7.3

a) Estimate the angle that the failure plane makes with the major principal plane.
b) Determine $\tau_n, \sigma_n$ if $\theta = 30°$

SOL.

a) $\theta = 45 + \frac{\emptyset}{2} = 45 + \frac{30}{2} = 60°$
b) $\sigma = \frac{\sigma_1 + \sigma_3}{2} + \frac{\sigma_1 - \sigma_3}{2} \cos 2\theta$

$$\sigma = \frac{210 + 70}{2} + \frac{210 - 70}{2} \cos 2 \times 30 = 175 \frac{KN}{m^2}$$

$$\tau_n = \frac{\sigma_1 - \sigma_3}{2} \sin 2\theta$$

$$\tau_n = \frac{210 - 70}{2} \sin 2 \times 30 = 60.62 \frac{KN}{m^2}$$

For failure $\tau_f = \sigma \tan \emptyset = 175 \tan 30 = 101 \frac{KN}{m^2}$

Since the actual $\tau = 60.62 \frac{KN}{m^2} < 101 \frac{KN}{m^2}$ , the sample did not fail along this line.

## Problem 7.6

specimen I : $\sigma_3 = 69\ kN/m^2$, $\sigma_1 = 282\ kN/m^2$

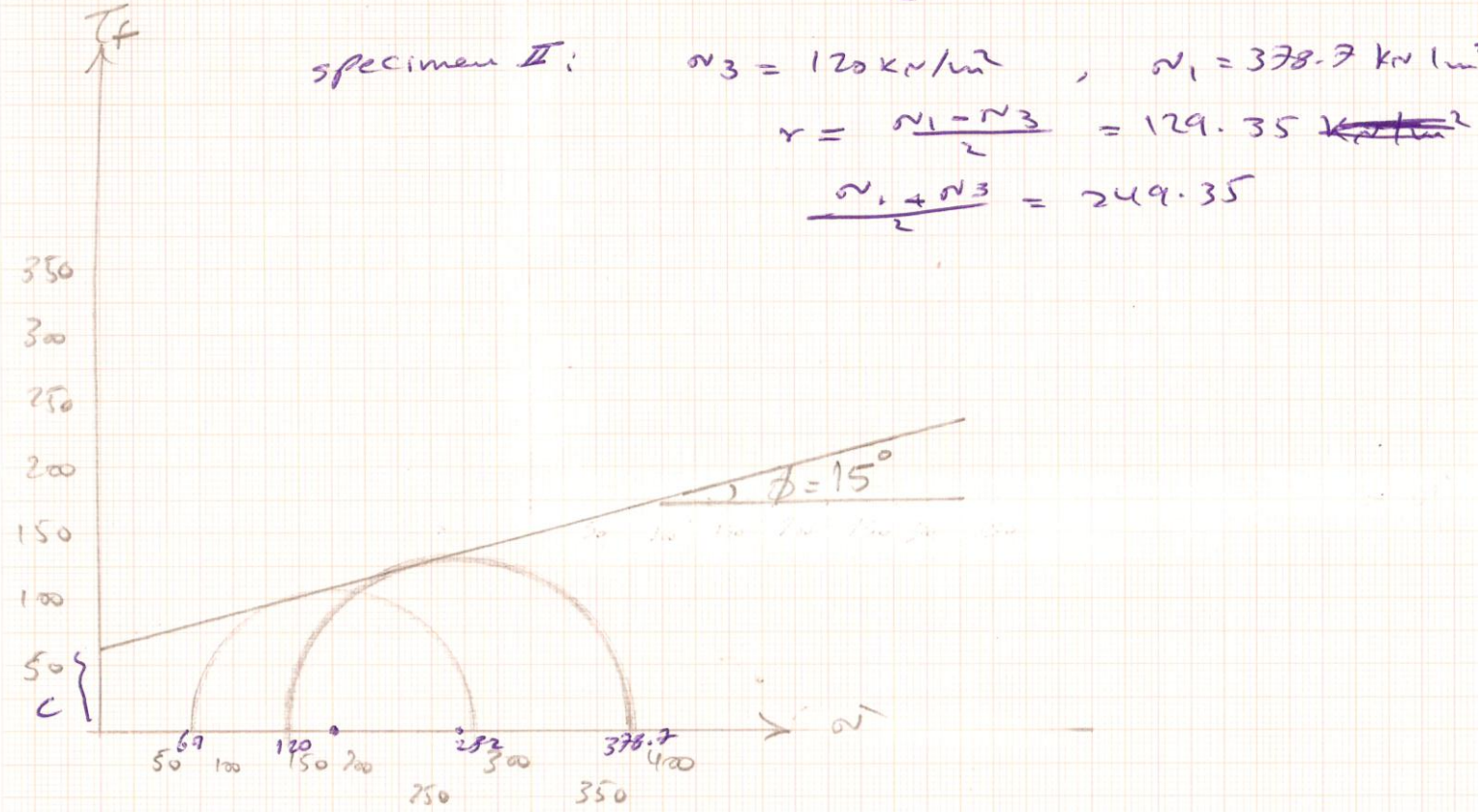
radius $= \frac{\sigma_1 - \sigma_3}{2} = 106$

$\frac{\sigma_1 + \sigma_3}{2} = 175$

specimen II : $\sigma_3 = 120\ kN/m^2$ , $\sigma_1 = 378.7\ kN/m^2$

$r = \frac{\sigma_1 - \sigma_3}{2} = 129.35$

$\frac{\sigma_1 + \sigma_3}{2} = 249.35$




$\phi = 15°$ , $C = 58\ kN/m^2$

7.10

Given:

CU test on NCC, that yielded the following results:

- $\sigma_3 = 84\ \frac{KN}{m^2}$
- $(\Delta\sigma_d)_f = 64\frac{KN}{m^2}$
- $(\Delta u_d)_f = 48\frac{KN}{m^2}$

Calculate the CU friction angle($\emptyset$) and the drained friction angle($\emptyset'$) .

SOL.

$$\sigma_1 = 64 + 84 = 148\ \frac{KN}{m^2}$$

$$\sigma'_1 = 148 - 48 = 100\ \frac{KN}{m^2}$$

$$\sigma'_3 = 84 - 48 = 36\ \frac{KN}{m^2}$$

C=0 (NCC)

The CU friction angle($\emptyset$)

$$\sigma_1 = \sigma_3 \tan^2\left(45 + \frac{\emptyset}{2}\right) + 2c\tan\left(45 + \frac{\emptyset}{2}\right)$$

$$148 = 84\tan^2\left(45 + \frac{\emptyset}{2}\right)$$

$$\tan^2\left(45 + \frac{\emptyset}{2}\right) = 1.76$$

$$\tan\left(45 + \frac{\emptyset}{2}\right) = 1.33$$

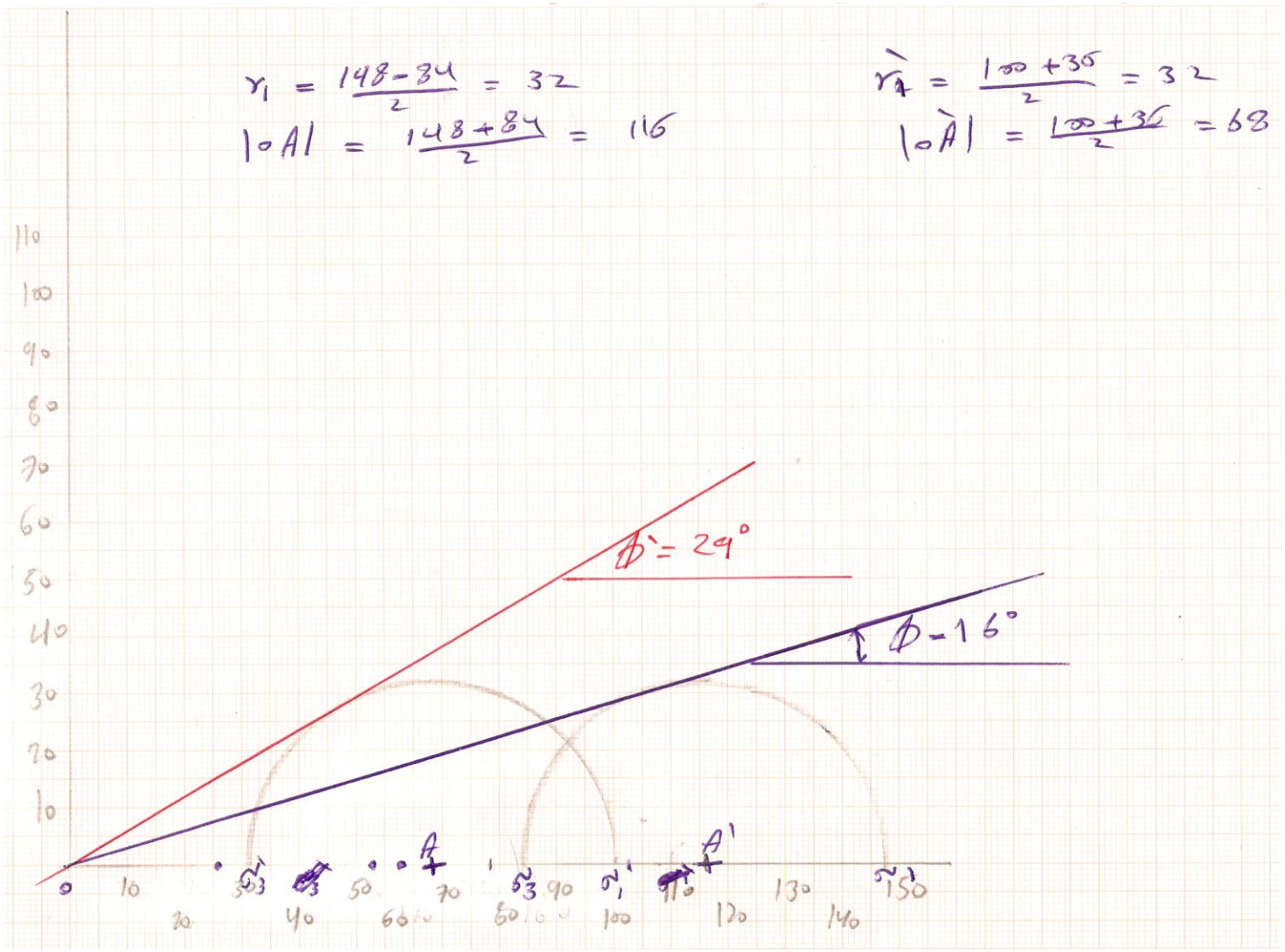
$$\emptyset = 16°$$

The drained friction angle($\emptyset'$)

$$\sigma'_1 = \sigma'_3 \tan^2\left(45 + \frac{\emptyset'}{2}\right) + 2c'\tan\left(45 + \frac{\emptyset'}{2}\right)$$

$$100 = 36\tan^2\left(45 + \frac{\emptyset'}{2}\right)$$

$$\tan^2\left(45 + \frac{\emptyset'}{2}\right) = 2.77 \quad \Longrightarrow \quad \emptyset' = 28°$$


r1 = 148-84/2 = 32
|oA| = 148+84/2 = 116
r2 = 100+35/2 = 32
|oA'| = 100+35/2 = 68
Φ' = 29°
Φ = 16°
A
A'