

CN215 Problem sheet 4 - Stress analysis Solutions

Question 1:

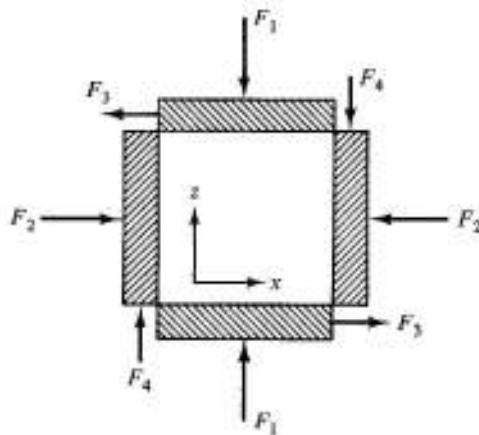


Figure E3-1

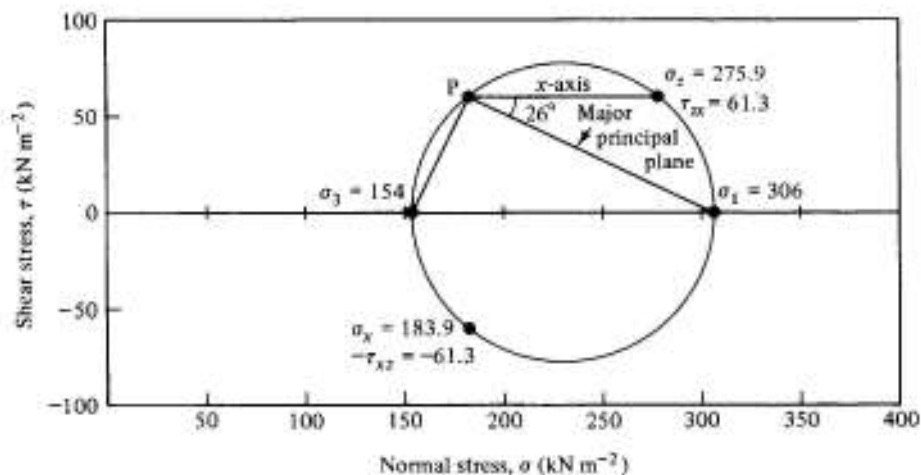
Defining axes (x, z) as shown in Fig. E3-1, and taking account of the directions of the forces, the total stresses are

$$\sigma_x = \frac{F_2 g}{A} = 183.9 \text{ kN m}^{-2},$$

$$\sigma_z = \frac{F_1 g}{A} = 275.9 \text{ kN m}^{-2},$$

$$\tau_{xz} = \tau_{zx} = \frac{F_3 g}{A} = 61.3 \text{ kN m}^{-2}.$$

The Mohr's circle of total stress is shown in Fig. E3-2: for plotting the Mohr's circle the counter-clockwise shear stress τ_{xz} is plotted positively,



while the clockwise shear stress τ_{zx} is plotted negatively. Scaling from the diagram, the principal total stresses are

$$\sigma_1 = 306 \text{ kN m}^{-2} \text{ and } \sigma_3 = 154 \text{ kN m}^{-2}.$$

The pole of the Mohr's circle is located at P and the major principal plane makes an angle of 26° to the x -axis.

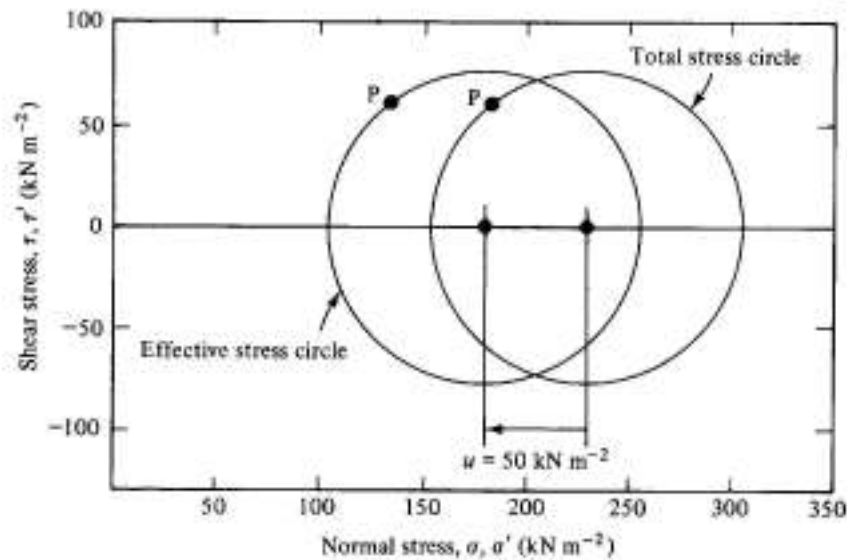
b)

The total stresses on the faces of a cube of soil are the same as those in the previous example (Ex. 3-1) and the pore pressure is $u = 50 \text{ kN m}^{-2}$. Construct the Mohr's circle of effective stress.

Principal effective stresses are given by $\sigma'_1 = \sigma_1 - u$ and $\sigma'_3 = \sigma_3 - u$. Hence,

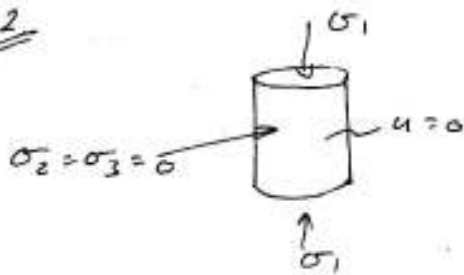
$$\sigma'_1 = 256 \text{ kN m}^{-2} \text{ and } \sigma'_3 = 104 \text{ kN m}^{-2}.$$

The Mohr's circles of total and effective stress are shown in Fig. E3-3.



c) Find from Mohr circle, note as not specified then both clockwise and anti-clockwise plane should be drawn.

Q2

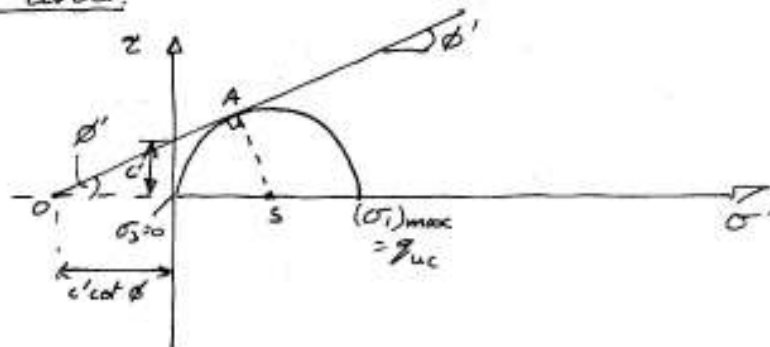


c'
 ϕ'

Unconfined compression
 $\sigma_2 = \sigma_3 = 0$

Find $(\sigma_1)_{max}$ in terms of c' & ϕ'

Draw Mohr circle.



$$AS = \frac{q_{uc}}{2} \quad OS = c' \cot \phi' + \frac{q_{uc}}{2}$$

$$AS = OS \sin \phi' \quad \therefore \frac{q_{uc}}{2} = c' \cot \phi' + \frac{q_{uc}}{2} \sin \phi'$$

$$\therefore q_{uc} = \frac{2c' \cot \phi'}{1 - \sin \phi'} \quad \dots \quad (A)$$

$$\text{If } q_{uc} = 1200 \text{ kPa, } \phi' = 38^\circ \text{ then } c' = 295 \text{ kPa from (A)}$$

Q3: Use Fadum's chart

Q4: Use Newmark's chart (solution done in class)