

1.

$$c' = 0. \Rightarrow \sigma'_1 = \sigma'_3 \tan^2(45^\circ + \frac{\phi'}{2})$$

$$a. \quad 250 + 275 = 250 \tan^2(45^\circ + \phi'/2) \Rightarrow \phi' \approx 20.8^\circ$$

$$b. \quad \theta = 45^\circ + \frac{\phi'}{2} \Rightarrow \theta = 55.4^\circ$$

$$c. \quad \sigma' = 338.7 \text{ kPa} \quad \sigma \quad \tau = 128.7 \text{ kPa}$$

2.

$$c = 0. \Rightarrow \sigma_1 = \sigma_3 \tan^2(45 + \frac{\phi}{2})$$

$$15 + 11 = 15 \tan^2(45 + \frac{\phi}{2}) \Rightarrow \phi = 15.6^\circ$$

$$c' = 0. \Rightarrow \sigma'_1 = \sigma'_3 \tan^2(45^\circ + \frac{\phi'}{2})$$

$$15 + 11 - 7.2 = (15 - 7.2) \tan^2(45^\circ + \frac{\phi'}{2}) \Rightarrow \phi' = 24.4^\circ$$

3.

$$c' = 0. \Rightarrow \sigma'_1 = \sigma'_3 \tan^2(45^\circ + \frac{\phi'}{2})$$

$$100 - \Delta u_{df} = (0. - \Delta u_{df}) \tan^2(45^\circ + \frac{25^\circ}{2})$$

$$\Delta u_{df} = -68.5 \text{ kPa}$$