Answers for Assignment 3:

If you find mistakes in these answers, please contact us and thank you for your correction.

Due to the calculation accuracy, some answers will be slightly different from your answers after the decimal point.

1. Refer to slide 03 P11-12.

2.

$\sigma_{\max} = 19.29MPa$, $\sigma_{\min} = 4.71MPa$, $\alpha_p = 35.38°$

$\tau_{\max} = \pm 7.29MPa$, $\alpha_{\max s} = -9.62°$

A method: select a direction as original x plain, use (1) to find ε_x, ε_y and γ_{xy} (note $\gamma_{xy} = 2\varepsilon_{xy}$), then use (2) find σ_x, σ_y and τ_{xy} on this plane, finally, calculate the principle stress and maximum shear stress.

$$\varepsilon_{x'} = \frac{\varepsilon_x + \varepsilon_y}{2} + \frac{\varepsilon_x - \varepsilon_y}{2}\cos 2\alpha + \frac{\gamma_{xy}}{2}\sin 2\alpha \tag{1}$$

$$\begin{cases} \varepsilon_x = \dfrac{1}{E}(\sigma_x - \nu\sigma_y) \\ \varepsilon_y = \dfrac{1}{E}(\sigma_y - \nu\sigma_x) \\ \gamma_{xy} = \dfrac{2(1+\nu)}{E}\tau_{xy} \end{cases} \tag{2}$$

3. $\Delta L_{AB} = \varepsilon_{45} L_{AB} = 0.003 L_{AB}$

A method: find $\sigma_{x'}$ and $\sigma_{y'}$ in the plane with $\alpha = 45°$, then calculate ε_{45}.

4. We have already know that:

$$K = \frac{E}{3(1-2\nu)} \tag{3}$$

$$\lambda = \frac{\nu E}{(1+\nu)(1-2\nu)} \tag{4}$$

$$G = \frac{E}{2(1+\nu)} \tag{5}$$

From (3) we can deduce the first formula in the problem:

$$\nu = \frac{3K - E}{6K} \tag{6}$$

Substitute (6) into (4), we can get:

$$E = \frac{9KG}{3K + G} \tag{7}$$

From (3) and (5), we can know $1 - 2\nu = \frac{E}{3K}$ and $1 + \nu = \frac{E}{2G}$, substitute them into (4), then, replace E by formula (7), we can get the second formula in the problem:

$$\lambda = \frac{3K - 2G}{3} \tag{8}$$

Substitute (8) into (7), we can get the third formula in the problem:

$$E = \frac{9K(K - \lambda)}{3K - \lambda} \tag{9}$$

Substitute (6) into (5), we can get the fourth formula in the problem:

$$G = \frac{3KE}{9K - E} \tag{10}$$

From (5), $1 + \nu = \frac{E}{2G}$, so $\nu = \frac{E}{2G} - 1$, substitute it into (3), the last formula in the problem is:

$$K = \frac{EG}{3(3G - E)} \tag{11}$$