

演習問題 4 解答

問題 4.1

(1)

$$\sigma_x = 0, \quad \sigma_y = 0, \quad \sigma_z = 0, \quad \tau_{xy} = \frac{E\varepsilon_0}{2(1+\nu)}, \quad \gamma_{yz} = 0, \quad \gamma_{zx} = 0$$

$$\sigma_1 = \frac{E\varepsilon_0}{2(1+\nu)}, \quad \sigma_2 = -\frac{E\varepsilon_0}{2(1+\nu)}, \quad \sigma_3 = 0$$

(2)

$$\sigma_x = \frac{E\varepsilon_0}{1+\nu} \left\{ -\nu + \frac{\nu}{1-2\nu}(1-2\nu) \right\} = 0, \quad \sigma_y = \frac{E\varepsilon_0}{1+\nu} \left\{ 1 + \frac{\nu}{1-2\nu}(1-2\nu) \right\} = E\varepsilon_0,$$

$$\sigma_z = \frac{E\varepsilon_0}{1+\nu} \left\{ -\nu + \frac{\nu}{1-2\nu}(1-2\nu) \right\} = 0$$

$$\tau_{xy} = 0, \quad \gamma_{yz} = 0, \quad \gamma_{zx} = 0$$

$$\sigma_1 = E\varepsilon_0, \quad \sigma_2 = \sigma_3 = 0$$

(3)

$$\sigma_x = \frac{E\varepsilon_0}{1+\nu} \left\{ -1 + \frac{\nu}{1-2\nu} \left(-1 + \frac{\nu}{1-\nu} \right) \right\} = -\frac{E\varepsilon_0}{(1+\nu)(1-\nu)}$$

$$\sigma_y = \frac{E\varepsilon_0}{1+\nu} \left\{ \frac{\nu}{1-2\nu} \left(-1 + \frac{\nu}{1-\nu} \right) \right\} = -\frac{\nu E\varepsilon_0}{(1+\nu)(1-\nu)}$$

$$\sigma_z = \frac{E\varepsilon_0}{1+\nu} \left\{ \frac{\nu}{1-\nu} + \frac{\nu}{1-2\nu} \left(-1 + \frac{\nu}{1-\nu} \right) \right\} = 0$$

$$\tau_{xy} = \frac{E\varepsilon_0}{2(1+\nu)}, \quad \gamma_{yz} = 0, \quad \gamma_{zx} = 0$$

$$\sigma_{1,2} = \frac{E\varepsilon_0}{(1+\nu)(1-\nu)} \left\{ \frac{-1-\nu}{2} \pm \sqrt{\left(\frac{1-\nu}{2} \right)^2 + \left(\frac{-1+\nu}{2} \right)^2} \right\} = \frac{E\varepsilon_0}{2(1-\nu)} (-1 \pm \sqrt{2})$$

問題 4.2

$$(1) \quad \sigma_x = \frac{2\sqrt{3}F}{ha}, \quad \sigma_y = 0, \quad \tau_{xy} = \frac{F}{ha}$$

$$(2) \quad \sigma_1 = \frac{(\sqrt{3}+2)F}{ha}, \quad \sigma_2 = \frac{(\sqrt{3}-2)F}{ha}$$

$$(3) \quad \sigma_x = \sigma_y = \frac{\sqrt{3}F}{ha}, \quad \tau_{xy} = -\frac{2F}{ha}$$

$$(4) \quad \varepsilon_x = \frac{(1-\nu)\sqrt{3}F}{Eha}$$