MECH 5312 - Solid Mechanics II

Calvin M. Stewart

Mock Exam 1

Problem 1

Problem 2

$$\sigma := \begin{pmatrix} 2 & 4 \\ 4 & 2 \end{pmatrix} \qquad I := \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\left|\sigma - \sigma_n \cdot I\right| \rightarrow \sigma_n^{\ 2} - 4\cdot\sigma_n - 12$$

$$\left|\sigma - \sigma_n \cdot I\right| \text{ solve}, \sigma_n \rightarrow \begin{pmatrix} -2 \\ 6 \end{pmatrix}$$

$$\sigma_1 := 6 \qquad \sigma_2 := -2$$

$$\left(\sigma - \sigma_1 \cdot I\right)\cdot\begin{pmatrix} n_1 \\ n_2 \end{pmatrix} \rightarrow \begin{pmatrix} 4\cdot n_2 - 4\cdot n_1 \\ 4\cdot n_1 - 4\cdot n_2 \end{pmatrix}$$

$$n_1 := 1 \qquad n_2 := 1$$

Given

$$4\cdot n_2 - 4\cdot n_1 = 0$$

$$4\cdot n_1 - 4\cdot n_2 = 0$$

$$\sqrt{n_1^{\ 2} + n_2^{\ 2}} = 1$$

$$\text{Find}\left(n_1, n_2\right) = \begin{pmatrix} 0.707 \\ 0.707 \end{pmatrix}$$

$$n_1 := n_1 \qquad n_2 := n_2$$

$$\left(\sigma - \sigma_2 \cdot I\right)\cdot\begin{pmatrix} n_1 \\ n_2 \end{pmatrix} \rightarrow \begin{pmatrix} 4\cdot n_1 + 4\cdot n_2 \\ 4\cdot n_1 + 4\cdot n_2 \end{pmatrix}$$

$$n_1 := 1 \qquad n_2 := 1$$

Given

$$4 \cdot n_1 + 4 \cdot n_2 = 0$$

$$4 \cdot n_1 + 4 \cdot n_2 = 0$$

$$\sqrt{{n_1}^2 + {n_2}^2} = 1$$

$$\mathrm{Find}(n_1, n_2) = \begin{pmatrix} -0.707 \\ 0.707 \end{pmatrix}$$

Problem 3

Displacement Problem

$x := 1.5mm$ $\qquad x_p := 1.51mm$

$y := 1.5mm$ $\qquad y_p := 1.503mm$

$$u := x_p - x = 0.01 \cdot mm$$

$$v := y_p - y = 0.003 \cdot mm$$

$$C_1 := \frac{u}{x \cdot y} = 4.444 \times 10^{-3} \cdot \frac{1}{mm}$$

$$C_2 := \frac{v}{x \cdot y} = 1.333 \times 10^{-3} \cdot \frac{1}{mm}$$

$x := x$ $\qquad y := y$

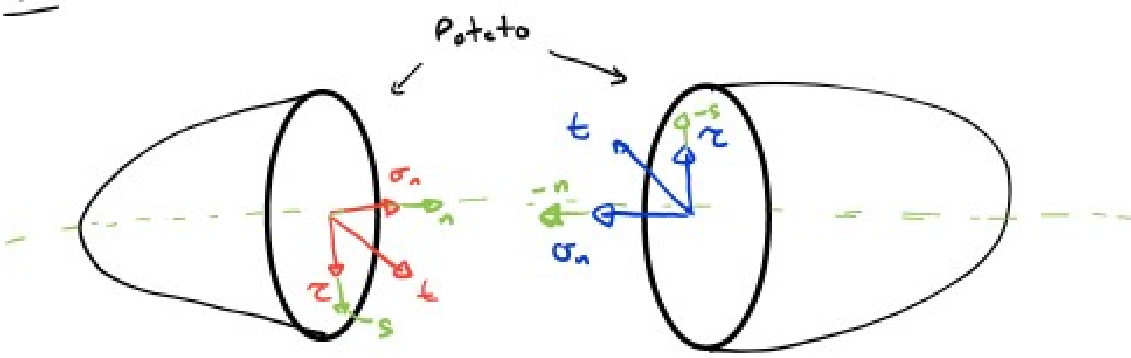
$$\varepsilon_{xx} := \frac{d}{dx}(C_1 \cdot x \cdot y) = 6.667 \times 10^{-3}$$

$$\varepsilon_{yy} := \frac{d}{dy}(C_2 \cdot x \cdot y) = 2 \times 10^{-3}$$

$$\gamma_{xy} := \frac{d}{dx}(C_2 \cdot x \cdot y) + \frac{d}{dy}(C_1 \cdot x \cdot y) = 8.667 \times 10^{-3}$$

Mock Exam 1

P1



static equilibrium

$$\Sigma \vec{F} = 0 \qquad \Sigma \vec{M} = 0 \qquad \text{2 vector Eqns}$$

$$\Sigma F_x = 0 \qquad \Sigma M_x = 0 \qquad \text{6 Equil Eqns}$$

$$\Sigma F_y = 0 \qquad \Sigma M_y = 0$$

$$\Sigma F_z = 0 \qquad \Sigma M_z = 0$$

Eqn of Equil.

ΣM

ΣF

$$t = \frac{\Delta F}{\Delta A} = \frac{dF}{dA}$$

$$\Delta F = t \cdot \Delta A$$

$$\begin{cases} \underline{t}^{(n)} = \sigma_n \underline{n} + \tau \underline{s} \\ \underline{t}^{(-n)} = -(\sigma_n \cdot \underline{n} + \tau \underline{s}) \end{cases}$$

$$\Sigma \vec{F} = (\sigma_n \underline{n} + \tau \underline{s})\Delta A - (\sigma_n \underline{n} + \tau \underline{s})\Delta A = 0$$

$$\Sigma F_n : (\sigma_n - \sigma_n)\Delta A = 0$$

$$\Sigma F_s : (\tau - \tau)\Delta A = 0$$

c) stress on the surfaces must be equal (of equal mag) & opposite (opposite direction)