Crank PreAnalysis

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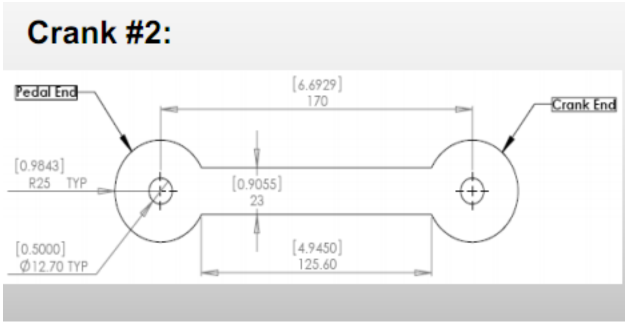

$$\text{Depth} = \frac{3''}{8}$$

Problem: The right side of the crank is held in place by a pin while the left side is pulled downward with a force of 100 lbs. What is the stress at the strain gage center (at (85.72mm -2.39mm) or (3.3748 " , .0941 ") with the orgin at the left hole center)?

1

$$\sigma_{xx}$$

$$M_{gage} = P \times L_y = (100 \text{ lbs}) \times (3.3748'') = 337.48 \text{ lb} \cdot \text{inches}$$

$$I = \frac{1}{12}(\text{thickness})(\text{height}) = \frac{1}{12}(.375)(.9055^3) = 0.02320 \text{ in}^4$$

$$\sigma_x = \frac{M_{gage} \times y}{I} = \frac{337.48 \text{ lbs} \cdot \text{ins} \times .094094 \text{ in}}{.02320 \text{ in}^4} = -1368.65 \text{ psi}$$

2

$$\sigma_{yy}$$

$$\sigma_{yy} = 0$$

3

$$\tau_{xy}$$

$$\tau_{xy} = \frac{VQ}{It}$$

$$V = 100 \text{ lbs} \; ; t = \frac{3}{8} \text{ in} \; ; I = 0.02320 \text{ in}^4$$

$$Q = a \times \bar{y}$$

$$a = \frac{3}{8} \text{ in } \times (\frac{.9055}{2} - .094094) \text{ in} = .1345 \text{ in}$$

$$\bar{y} = \frac{.094094}{2} + \frac{.9055}{4} = .2734 \text{ in}$$

$$Q = a \times \bar{y} = .1345 \text{ in} \times .2734 \text{ in} = .0368 \text{ in}^3$$

$$\tau_{xy} = \frac{VQ}{It} = \frac{100 \text{ lbs} \times .0368 \text{ in}^3}{0.02320 \text{ in}^4 \times \frac{3}{8} \text{ in}} = 422.6309 \text{ psi}$$

4 Hooke's Law

$$\begin{bmatrix} \epsilon_{xx} \\ \epsilon_{yy} \\ \epsilon_{xy} \end{bmatrix} = \frac{1}{E} \begin{bmatrix} 1 & -v & 0 \\ -v & 1 & 0 \\ 0 & 0 & 1+v \end{bmatrix} \begin{bmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \tau_{xy} \end{bmatrix}$$

E = 10,000 ksi

v = .33

$$\begin{bmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \tau_{xy} \end{bmatrix} = \begin{bmatrix} -1368.7 \\ 0 \\ 422.63 \end{bmatrix}$$

$$\frac{1}{E} \begin{bmatrix} 1 & -v & 0 \\ -v & 1 & 0 \\ 0 & 0 & 1+v \end{bmatrix} = 1 \times 10^{-6} \begin{bmatrix} .1 & -.033 & 0 \\ -.033 & .1 & 0 \\ 0 & 0 & .133 \end{bmatrix}$$

$$\begin{bmatrix} \epsilon_{xx} \\ \epsilon_{yy} \\ \epsilon_{xy} \end{bmatrix} = 1 \times 10^{-6} \begin{bmatrix} .1 & -.033 & 0 \\ -.033 & .1 & 0 \\ 0 & 0 & .133 \end{bmatrix} \begin{bmatrix} -1368.7 \\ 0 \\ 422.63 \end{bmatrix} = \begin{bmatrix} -138.1847 \\ 45.1655 \\ 56.2098 \end{bmatrix} \mu\epsilon$$