12-331 Solid Mechanics

HW #4 Due: 9/26/2000

3-7 • Modulus of Elasticity:

$\sigma = 40$ ksi, $\varepsilon = 0.001$ (in/in)

$$E = \frac{40-0}{0.001-0} = \underline{40.0\times10^3 \text{ ksi}}$$

• Yield load; $\sigma_y = 40$ ksi

$$P_y = \sigma_y \cdot A = 40.0\left(\frac{\pi}{4}(0.5)^2\right) = \underline{1.85 \text{ kip}}$$

• Ultimate Load; $\sigma_u = 76$ ksi

$$P_u = \sigma_u \cdot A = 76\left(\frac{\pi}{4}0.5^2\right) = \underline{14.9 \text{ kip}}$$

3-8 • Modulus of Elasticity

$$E = \frac{40-0}{0.001-0} = 40.0\times10^3 \text{ (ksi)}$$

• Elastic Recovery;

$$E.R = \frac{\sigma}{E} = \frac{70}{40(10^3)} = 0.00175 \text{ (in/in)}$$

The amount of E.R $= (2)\times0.00175$

$= \underline{0.0035 \text{ (in)}}$

• Permanent Set;

Permanent Set $= 0.08 - 0.00175$

$= 0.07825$ (in/in)

Permanent Elongation

$= (2)(0.08-0.00175)$

$= \underline{0.1565 \text{ (in)}}$

3-12 • Modulus of Elasticity;

$$E = \frac{2-0}{0.004-0} = 0.5\times10^3 \text{ ksi}$$

• Elastic Recovery;

From the stress-strain diagram

when $\varepsilon = 0.024 \rightarrow \sigma = 3.70$ ksi

So, $E.R = \frac{\sigma}{E} = \frac{3.70}{0.5\times10^3} = 0.0074$ (in)

• permanent Set;

Permanent Set $= 0.024 - 0.0074$

$= 0.0166$ (in/in)

Permanent Elongation $= 0.0166(10)$

$= 0.166$ (in)

Approx. length of specimen

$= 10 + 0.166 = \underline{10.166 \text{ (in)}}$

3-22 • Modulus of Elasticity;

$$E = \frac{11-0}{2-0} = \underline{5.50 \text{ psi}}$$

• Modulus of Toughness;

$U_t \equiv$ The total Area under the $\sigma-\varepsilon$ diagram

$= \frac{1}{2}(2)(11) + \frac{1}{2}(11+55)(0.25)$

$= \underline{19.25 \left(\frac{\text{in}\cdot\text{lb}}{\text{in}^3}\right)}$

• Modulus of Resilience;

$U_r \equiv$ The Area under the linea portio of $\sigma-\varepsilon$ diagram

$= \frac{1}{2}(11)(2) = 11.0 \left(\frac{\text{in}\cdot\text{lb}}{\text{in}^3}\right)$