Mansoura University
Faculty of Engineering
Prod. Eng. & Mech. Design Dept.

Level 100 – Biomedical Eng. Dept.
PDE181 – Strength of Materials
20 Marks – 1 Hour

Mid Term Exam

Question [1]: (5 Marks)

Choose the correct answer for the following sentences from the bracket: (0.5 each)

[Stress Concentration – Stress – Strain – Normal – Shear – Safety Factor – Material – No – Force – Elasticity Modulus – Poisson Ratio – Statically Indeterminate – Equilibrium – Area]

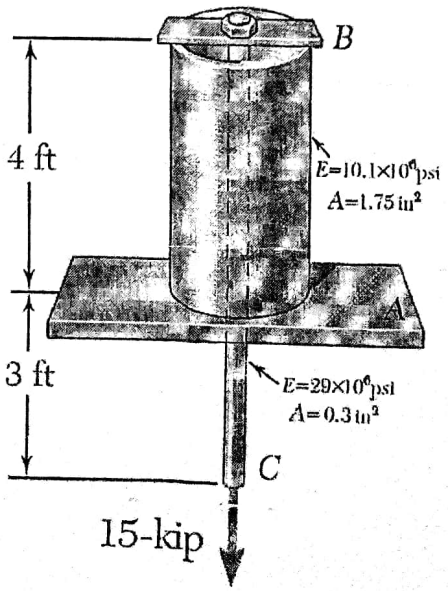
- If a bar, fixed from one end only, is subjected to a temperature rise of 50°, then it is subjected to No stress.
- The difference between stress analysis and design is that stress analysis is used to determine stress, while design is used to determine either Force, Area or Material.
- Poisson ratio is defined as the ratio of the lateral strain to the axial strain.
- For a structure, if fundamental equations of statics are not sufficient to determine all the reactive forces at the supports, the structure is said to be statically Indeterminate
- Bearing stress is a type of Normal stresses.
- The presence of holes or fillets in loaded parts leads to stress concentration near the holes or fillets.
- The ratio of material strength to the allowable stress is known as Safety Factor

Question [2]: (5 Marks)

(0.5 each)

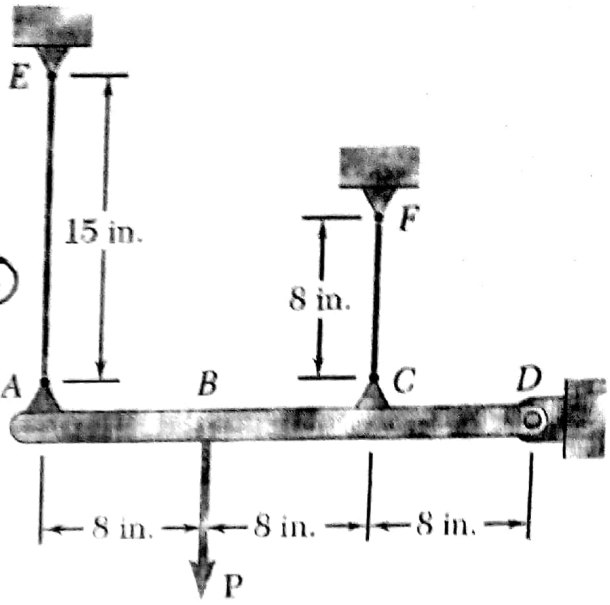
Complete the following sentences with respect to the figure shown:

- Rod BC is subjected to tensile stress of value 50,000 psi MPa which is accompanied by increase (increase/decrease) of its length with a magnitude of 0.145 in.
- Pipe AB is subjected to compressive stress of value 8,571.43 psi MPa which is accompanied by decrease (increase/decrease) of its length with a magnitude of 0.041 in.
- The resulting deflection of point C is going to be downward (upward/downward) with a value of 0.186 in.



Question [3]: **(10 Marks)**

The rigid bar AD is supported by two steel wires of 1/16in diameter (E=29X10^{6}psi) and a pin and bracket at D. Knowing that the wires were initially taut, determine (a) the additional tension in each wire when a 120lb load P is applied at B, (b) the corresponding deflection of point B.



• Given: $d_{wire} = \frac{1}{16}$ in $E_{st} = 29*10^6$ psi

$P = 120$ lb

• Req.: F_{AE}, F_{CF}, δ_B

• Sol.:

$\rightarrow \Sigma M_D = 0$: $120 * 16 = F_{AE} * 24 + F_{CF} * 8$ → (1)

$\rightarrow \Sigma F_y = 0$: $120 = F_{AE} + F_{CF} + D_y$ (2)

$\rightarrow \Sigma M_x = 0$: $D_x = 0$

∵ we have 2 eqns & 3 unknowns

∴ problem is statically indeterminate (1)

$\rightarrow \frac{\delta_{AE}}{24} = \frac{\delta_B}{16} = \frac{\delta_{CF}}{8}$ (1)

@ $\frac{\delta_{AE}}{24} = \frac{\delta_{CF}}{8} \Rightarrow \frac{F_{AE} L_{AE}}{A_{wire} \cdot E_{st}} = \frac{24}{8} * \frac{F_{CF} * L_{CF}}{A_{wire} * E_{st}}$

$\therefore F_{AE} * 15 = \frac{24}{8} * F_{CF} * 8$

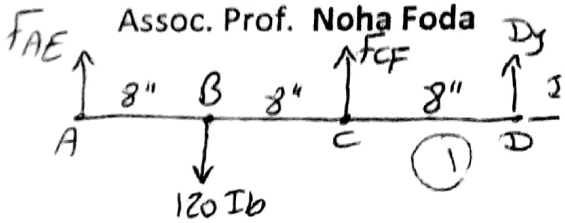
$\therefore F_{AE} = 1.6 F_{CF}$ → (2) (1)

Solving (1) & (2)

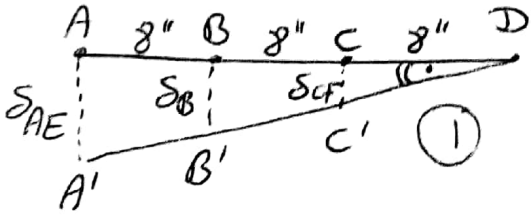
$\therefore$ **$F_{AE} = 66.2$ lb** **$F_{CF} = 41.38$ lb** (1)

Best Wishes

Assoc. Prof. **Noha Foda**



(1)



(1)

@ $\frac{\delta_{AE}}{24} = \frac{\delta_B}{16} \Rightarrow \delta_B = \frac{16}{24} * \frac{F_{AE} \cdot L_{AE}}{A_{wire} \cdot E_{st}}$

$\therefore \delta_B = \frac{16}{24} * \left(\frac{66.2 * 15}{\frac{\pi}{4} * (\frac{1}{16})^2 * 29*10^6} \right) \Rightarrow$ **$\delta_B = 7.44*10^{-3}$ in ↓** (2)