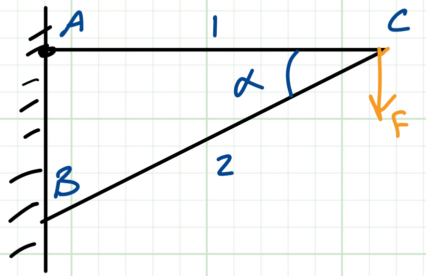
Luke Verlongieri | AA 331 | HW 2

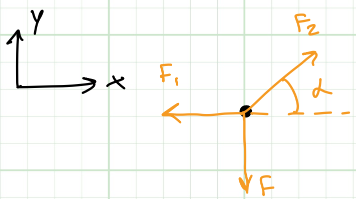
1) Stress

Schematic



Assuming Static

a) Draw FBD of point C



b) Find the axial forces on $\text{bar}_{1,2}$

$\Sigma F_y = 0 = F_2 \sin\alpha - F$

$\Sigma F_x = 0 = F_2 \cos\alpha - F_1$

$\rightarrow \boxed{F_1 = \frac{F}{\sin\alpha}}$

$\rightarrow \boxed{F_2 = F\cot\alpha}$

c) Find the avarage stresses in the bars

$$\boxed{\sigma_1 = \frac{F_1}{A_1} = \frac{F}{A_1 \sin\alpha}} \qquad \boxed{\sigma_2 = \frac{F_2}{A_2} = \frac{F\cot\alpha}{A_2}}$$

D) Determine the Cross Sectional Areas A_1, A_2

$$A_1 = F_1/\sigma_1 = \frac{F}{\sigma_1 \sin\alpha}$$

$$A_2 = F_2/\sigma_2 = \frac{F\cot\alpha}{\sigma_2}$$

e) Determine what bars are in tension and Compression.

For static Stability, Bar 2 must apply an upward force to balance force F So it is in Compression.

Because F_2 has an x Component for stability F_1 must oppose that force. Because F_1 points toward Bar_1 This bar is in tension

F) given $A_1 = A_2 = 3 \text{ in}^2$

$F = 5 \text{ lbs} \quad \alpha = 30°$

$$\sigma_1 = \frac{F}{A_1 \sin\alpha} = \frac{(5 \text{ lbs})}{(3\text{in}^2)\sin(30°)}$$

$\rightarrow \boxed{10/3 \text{ psi}}$

$$\sigma_2 = \frac{F\cot\alpha}{A_2} = \frac{(5 \text{ lbs})\cot 30°}{3 \text{ in}^2}$$

$\rightarrow \boxed{2.89 \text{ psi}}$

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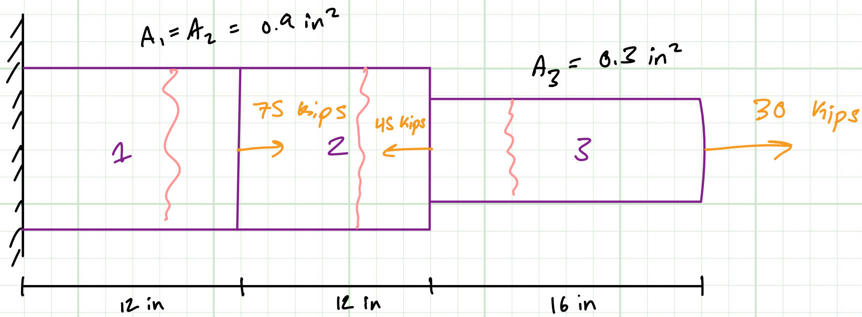
2) Deflection

Note : $E_{steel} = 29 \cdot 10^6$ psi

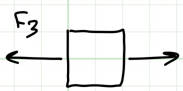
Deformation (δ)

$$\delta = \sum_i \frac{P_i L_i}{A_i E_i}$$

<u>Schematic</u>

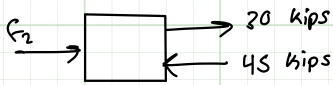


Determine the horizontal deformation



$F_2 = 30$ kips $\sigma_3 = \dfrac{F_3}{A_3} = \dfrac{30\text{ kips}}{0.3\ in^2}$

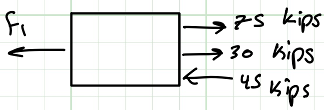
$\rightarrow 100$ ksi



$-F_2 = (30 - 45)$ kips

$\rightarrow F_2 = 15$ kips $\sigma_2 = \dfrac{F_2}{A_2} = \dfrac{15\text{ kips}}{0.9\ in^2}$

$\rightarrow 16.67$ ksi



$F_3 = (75 + 30 - 45)$ kips

$\rightarrow F_3 = 60$ kips $\sigma_1 = \dfrac{F_3}{A_3} = \dfrac{60\text{ kips}}{0.9\ in^2}$

$\rightarrow 66.67$ ksi

Stages 1 and 3 are in Tension, since the restoring force points toward the Beam. Stage 2 points away from the beam indicating that it is in Compression

$$\delta_T = \sum \delta = \frac{1}{E}\left(L_1\sigma_1 - L_2\sigma_2 + L_3\sigma_3\right) = \frac{1}{29 \cdot 10^6\text{ psi}}\left((12\text{ in})(66.67\text{ ksi} - 16.67\text{ ksi}) + (16\text{ in})(100\text{ ksi})\right)$$

$$\boxed{\delta_T = 0.076\text{ in}}$$

Or just use the formula

$E\varepsilon = \sigma$

$\delta = L\varepsilon$

$= \dfrac{L\sigma}{E} = \dfrac{PL}{AE}$

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3) Material properties

All values @ room temperature

	Aluminum 2024 – T6 (metric)	Aluminum 2024 – T6 (imperial)	Aluminum 6061 – T6 (metric)	Aluminum 6061 – T6 (imperial)	Aluminum 7075 – T6 (metric)	Aluminum 7075 – T6 (imperial)
Modulus of Elasticity (E)	72.4 GPa	10500 ksi	68.9 GPa	10000 ksi	71.7 GPa	10400 ksi
Poisson's Ratio (ν)	0.33		0.33		0.33	
Ultimate Stress (σ)	476 MPa	69 ksi	310 MPa	45 ksi	572 Mpa	83 ksi
Yield Strength (σ)	393 MPa	57 ksi	276 MPa	40 ksi	503 mpa	73 ksi
Density (ρ)	2.78 g/cm^3	0.100 $\frac{lb}{in^3}$	2.70 g/cm^3	0.0975 $\frac{lb}{in^3}$	2.81 $\frac{g}{cm^3}$	.102 $\frac{lb}{in^3}$

of these materials 7075 is the strongest, however 2024 has the highest strain to stress ratio (E) which I find interesting

4) This took me about 2 hours to complete.