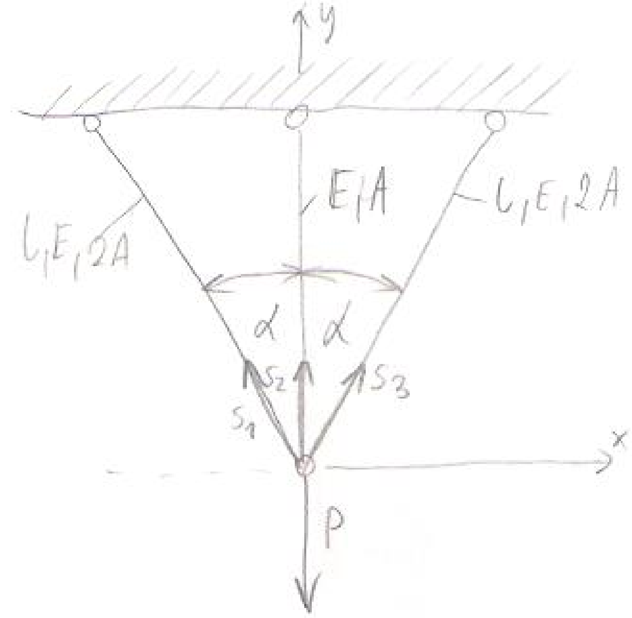


Known:
P - force
l - length
E - Young's modulus
k_r - maximum stress
α = 30 degrees

$\sin 30° = \frac{1}{2}$

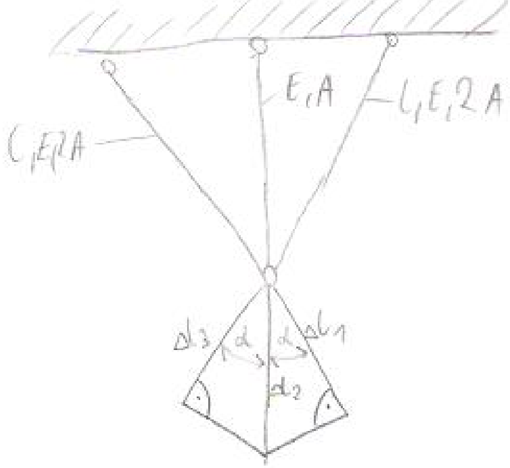
$\cos 30° = \frac{\sqrt{3}}{2}$

Find:
A = ?
A - rod's section area

$$\Sigma F_{ix} = 0 \qquad -S_1 \cdot \sin\alpha + S_3 \cdot \sin\alpha = 0 \rightarrow \boxed{S_1 = S_3}$$

$$\Sigma F_{iy} = 0 \qquad S_1 \cdot \cos\alpha + S_2 + S_3 \cdot \cos\alpha - P = 0$$

Deformation analysis:



$$\frac{\Delta l_3}{\Delta l_2} = \frac{l \cdot \cos\alpha}{l}$$

$$\frac{S_3 \cdot l}{E \cdot 2A} \cdot \frac{E \cdot A}{S_2 \cdot l \cdot \cos\alpha} = \frac{l \cdot \cos\alpha}{l}$$

$$\frac{S_3}{2 \cdot S_2 \cdot \cos\alpha} = \cos\alpha \quad / \cdot \cos\alpha$$

$$\frac{S_3}{2 \cdot S_2} = \cos^2\alpha \quad / \cdot S_2$$

$$\frac{1}{2} S_3 = S_2 \cdot \cos^2\alpha$$

$$S_2 = \frac{S_3}{2 \cdot \cos^2\alpha}$$

$$\Delta l_1 = \frac{S_1 \cdot l}{E \cdot 2A}$$

$$\Delta l_2 = \frac{S_2 \cdot l \cdot \cos\alpha}{E \cdot A}$$

$$\Delta l_3 = \frac{S_3 \cdot l}{E \cdot 2A}$$

$$S_3 \cdot \cos\alpha + S_3 \cdot \frac{1}{2 \cdot \cos^2\alpha} + S_3 \cdot \cos\alpha - P = 0$$

$$S_3 \left(\cos\alpha + \frac{1}{2\cos^2\alpha} + \cos\alpha \right) = P$$

$$\underbrace{S_3 = \frac{P}{\left(2\cos\alpha + \frac{1}{2\cos^2\alpha} \right)}}$$

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$$S_2 = \frac{S_3}{2 \cdot \cos^2 \alpha}$$

$$S_2 = S_3 \cdot \frac{1}{2 \cdot \left(\frac{\sqrt{3}}{2}\right)^2}$$

$$S_2 = S_3 \cdot \frac{1}{2 \cdot \frac{3}{4}}$$

$$S_2 = S_3 \cdot 1 \cdot \frac{4}{6}$$

$$S_2 = \frac{4}{6} S_3$$

$$S_2 = P \cdot \frac{4}{6} \cdot \frac{1}{\sqrt{3} + \frac{4}{6}}$$

$$\sigma = \frac{P}{A} \leq k_r$$

$$\frac{S_2}{A} \leq k_r$$

$$A \geqslant \frac{S_2}{k_r}$$

$$A \geqslant P \cdot \frac{4}{6} \cdot \frac{1}{\sqrt{3} + \frac{4}{6}} \cdot \frac{1}{k_r}$$

$$S_3 = P \cdot \frac{1}{2 \cdot \cos \alpha + \frac{1}{2 \cdot \cos^2 \alpha}}$$

$$S_3 = P \cdot \frac{1}{2 \cdot \frac{\sqrt{3}}{2} + \frac{1}{2 \cdot \left(\frac{\sqrt{3}}{2}\right)^2}}$$

$$S_3 = P \cdot \frac{1}{\sqrt{3} + \frac{4}{6}}$$