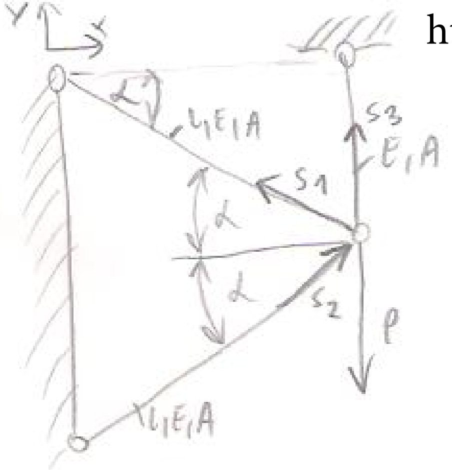
http://mbstudent.com/mechanics-of-materials-stress-in-rods.html



Note:
1st and 3rd rod are stretched
2nd rod is squeezed

$\sin(90-\alpha)=\cos\alpha$

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

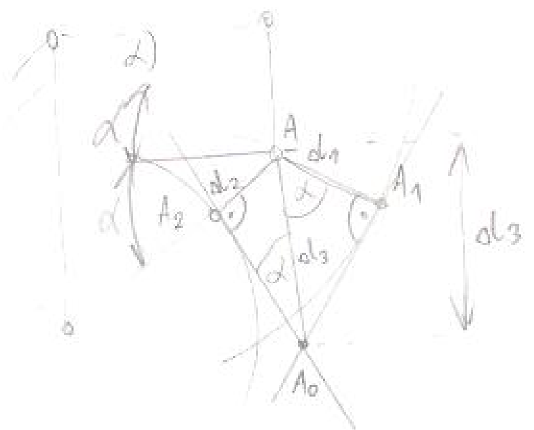
Find:
A = ?
A - rod's section area

$\sum F_{ix}=0 \qquad S_2\cdot\cos\alpha - S_1\cdot\cos\alpha=0$

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

Deformation analysis:

Note:
the1st rod under load was stretched by length Δl_1
the 2nd rod under load was squeezed by length Δl_2



$S_2\cdot\cos\alpha=S_1\cdot\cos\alpha \quad /:\cos\alpha$

$S_2=S_1$

$-P+S_1\cdot\sin\alpha+S_1\cdot\sin\alpha+S_3=0$

$\Delta l_3=\dfrac{S_3\cdot l\cdot\sin\alpha}{E\cdot A}$

$\Delta l_2=\dfrac{S_2\cdot l}{E\cdot A}$

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

$\sin\alpha=\dfrac{\Delta l_1}{\Delta l_3}$

$\sin\alpha=\dfrac{S_1\cdot \cancel{l}}{\cancel{E\cdot A}}\cdot\dfrac{\cancel{E\cdot A}}{S_3\cdot\cancel{l}\cdot\sin\alpha}$

$\sin^2\alpha\cdot S_3=S_1$

$S_3=\dfrac{S_1}{\sin^2\alpha}$

$-P+2S_1\cdot\sin\alpha+\dfrac{S_1}{\sin^2\alpha}=0$

$2\cdot S_1\cdot\sin\alpha+\dfrac{S_1}{\sin^2\alpha}=P$

$S_1\left(2\cdot\sin\alpha+\dfrac{1}{\sin^2\alpha}\right)=P$

$S_1=\dfrac{P}{2\cdot\sin\alpha+\dfrac{1}{\sin^2\alpha}}$

$S_3=\dfrac{P}{\left(2\sin\alpha+\dfrac{1}{\sin^2\alpha}\right)}\cdot\dfrac{1}{\sin^2\alpha}$

$S_3=\dfrac{P}{2\sin^3\alpha+1}$

$\sigma=\dfrac{N}{A}\le k_r \rightarrow A\ge\dfrac{N}{k_r}$

$\underline{A\ge\dfrac{P}{k_r\,(2\cdot\sin^3\alpha+1)}}$

0.4 ✓