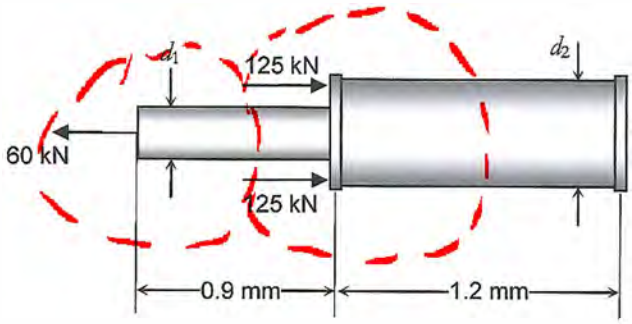
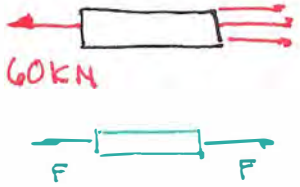
Example

The figure shows two solid cylindrical rods welded together at *B*. The average normal stress in either rod is not to exceed 150 MPa. For the loading shown, find the smallest allowable diameters for the rod.

each



FBD ROD 1



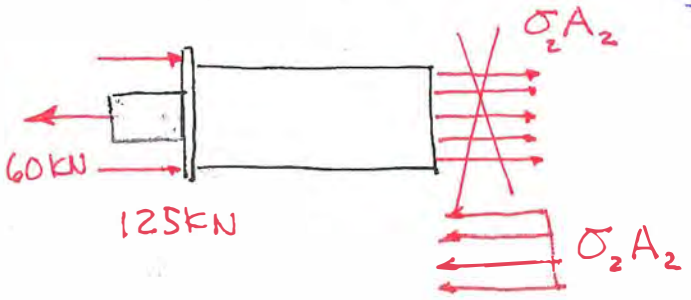
$$\rightarrow \Sigma F_x = 0$$

$$-60\ \text{kN} + \sigma A = 0$$

$$-60\ \text{kN} + (150\ \text{MPa})\left(\pi \frac{d_1^2}{4}\right) = 0$$

$$d_1 = \sqrt{\frac{60\ \text{kN}}{150\ \text{MPa}} \cdot \frac{4}{\pi} \cdot \left\langle \frac{\text{m}^2 \cdot \text{MPa}}{1000\ \text{kN}} \right\rangle} = 22.6\ \text{mm}$$

F.B.D. ROD 2



$$\rightarrow \Sigma F_x = 0$$

$$125 + 125 - 60 + \sigma_2 A_2 = 0$$

$$190\ \text{kN} \oplus (150\ \text{MPa})\frac{\pi d_2^2}{4} = 0$$

$-$!!

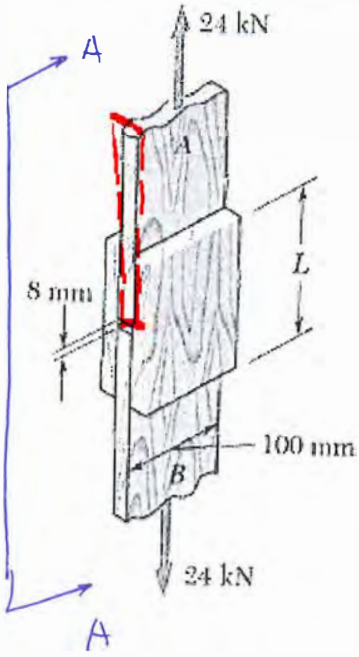
MUST BE IN COMPRESSION.

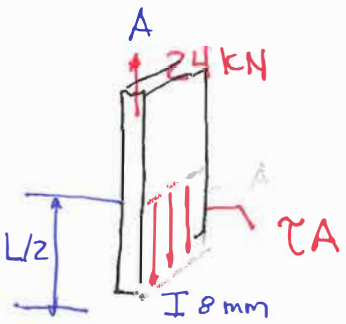
$$d_2 = \sqrt{\frac{190\ \text{kN}}{150\ \text{MPa}} \cdot \frac{4}{\pi} \left\langle \frac{\text{m}^2\ \text{MPa}}{1000\ \text{kN}} \right\rangle}$$

$$= 40.2\ \text{mm}$$

Example

Two pieces of wood are to be joined via gluing splice plates to them as shown in the figure. The clearance between the members is to be 8 mm. If the maximum allowable stress in the glue is not to exceed 800 kPa, what is the smallest allowable length, *L*?





$\uparrow \Sigma F_y = 0$

$24\text{kN} - \tau A - \tau A = 0$

$\tau = \tau_{MAX} = 800\ \text{kPa}$

$A = \left(\frac{L}{2} - \frac{8\text{ mm}}{2}\right)(100\text{ mm})$

SO:

$24\text{kN} - 2\tau A = 0$

$24\text{kN} - 2(800)\left(\frac{L}{2} - \frac{0.008}{2}\right)(0.100\text{ m}) = 0$

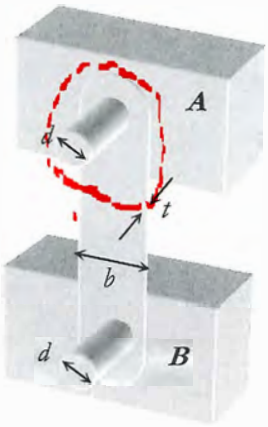
$$L = \frac{24\text{kN}\left\langle\frac{\text{kPa}\cdot\text{m}^2}{\text{kN}\cdot}\right\rangle}{(800\text{ kPa})(0.100\text{ m})} + 0.008\text{m}$$

$= 0.308\text{m} = \boxed{388\text{ mm}}$

Example

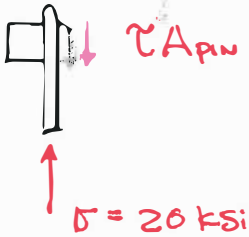
COMPRESSION

Link *AB* is used to support the end of a beam. The dimensions of the link are $b = 2$" and $t = \frac{1}{4}$". The average normal stress in the link is -20 ksi and the average shearing stress in the two pins is 12 ksi. What is the diameter of the two pins?



1 Kip = 1000 lbs.

F.B.D. PIN & LINK @ A



$\uparrow \Sigma F_y = 0$

$-\tau A_{PIN} + \sigma A_{LINK} = 0$

$$-\tau\left(\frac{\pi d^2}{4}\right) + \sigma(b \cdot t) = 0$$

$$-\left(12 \frac{kip}{in^2}\right)\frac{\pi d^2}{4} + 20 \frac{kip}{in^2}\left(2\,in \cdot \frac{1}{4}\,in\right) = 0$$

$$d = \sqrt{\frac{10\,kip \cdot 4}{\pi \cdot 12 \frac{kip}{in}}} = \boxed{1.03\,in}$$

PIN IN SINGLE SHEAR