Alexandria University	**جامعة الاسكندرية**
Faculty of Engineering	**كلية الهندسة**
Electrical Engineering Department - Communication	**قسم الهندسة الكهربية- اتصالات**
May 2016	**مايو 2017**
Mechanical Engineering (Design)	**الهندسة الميكانيكية (تصميم)**
Second Year	**السنة الثانية**
Time Allowed: 45 Minutes	**الزمن: 45 دقيقة**

Answer the following two questions at the same paper:

QUESTION ONE (10 points):

The wire DE has a diameter of 5 mm and is made from A-36 steel with allowable stress of 180 MPa and 200 GPa modulus of elasticity, E. If a 80-kg man is sitting on seat C, determine the elongation and stress of wire DE. Can the wire DE sustain the load?

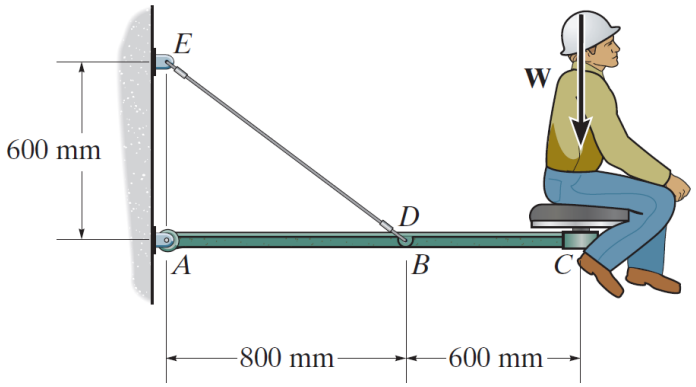


Figure 1.

Solution

Equations of Equilibrium:

The force developed in wire DE can be determined by writing the moment equation of equilibrium about A with reference to the free body diagram shown in Fig.

$$\zeta + \Sigma M_A = 0; \qquad F_{DE}\left(\frac{3}{5}\right)(0.8) - 80(9.81)(1.4) = 0$$

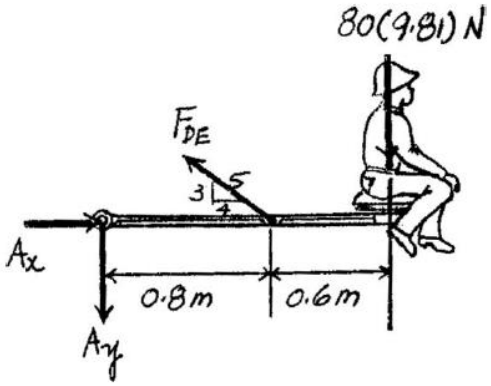
$$F_{DE} = 2289 \text{ N}$$

Normal Stress and Strain:

$$\sigma_{DE} = \frac{F_{DE}}{A_{DE}} = \frac{2289}{\frac{\pi}{4}(5)^2} = 116.58 \text{ MPa}$$

Since $\sigma_{DE} < \sigma_{allow} = 180\ MPa$, **The cable can sustain the load.** The Hooke's Law can be applied

$$\sigma_{DE} = E\epsilon_{DE}$$
$$116.58 = 200\times10^3\ \epsilon_{DE}$$
$$\epsilon_{DE} = 0.583\times10^{-3}$$



The unstretched length of wire *DE* is

$$L_{DE} = \sqrt{600^2 + 800^2} = 1000\ mm$$

Thus, the elongation of this wire is given by

$$\delta_{DE} = \epsilon_{DE}\, L_{DE} = 0.583\times10^{-3}\times1000$$

$$\delta_{DE} = 0.583\ mm$$

QUESTION TWO (10 points):

The Determine the maximum axial force that can be applied to the bar. The bar is made of steel with an allowable stress of 60 Mpa.

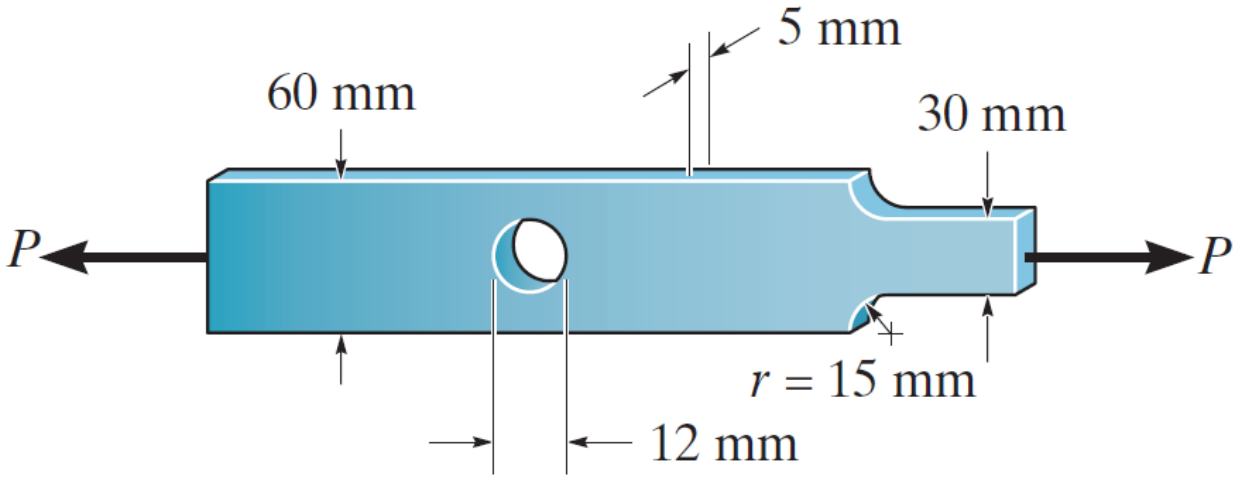


Figure 2.

Solution

For the right small section of the bar

$$\sigma = \frac{P}{A} = \frac{P}{30 * 5} \leq \sigma_{allow}$$

$$\frac{P}{150} \leq 60$$

$$P \leq 9000\ N$$

For the right left section at the whole

$$\sigma = \frac{P}{A} = \frac{P}{(60 - 12) * 5} \leq \sigma_{allow}$$

$$\frac{P}{240} \leq 60$$

$$P \leq 14400\ KN$$

So the maximum axial force that can be applied to the bar is 9000 N.