	15

College of Engineering & Technology

Department: Mechanical Engineering Marks: 15
Lecturer: Dr. Rola Afify Time: 3.00 - 4.00
Course Code: ME356 Date: 25/11/2015

Name: Model Answer R.N.:

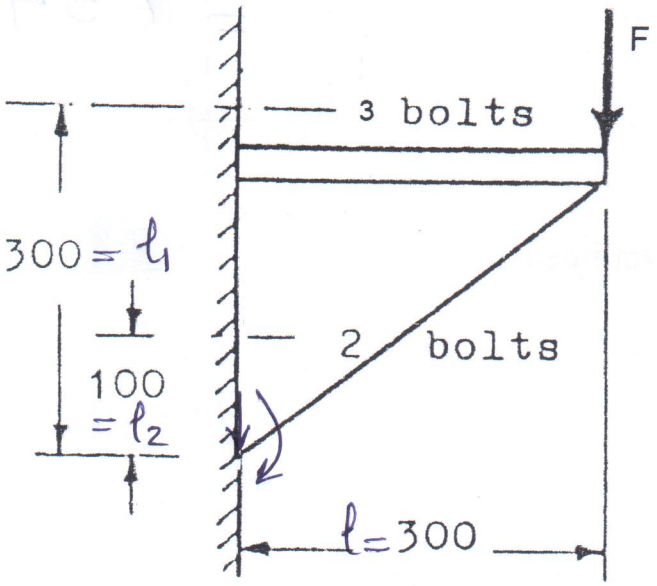
Answer the following questions: (*one mark for good drawings*)

Question one (7 marks)

5M15 are used to secure the bracket, shown in figure, to the wall. If the bolts are made of steel having allowable stress 210 MPa, determine the maximum safe force that can be applied to the bracket.

5 bolts $\sigma_{all} = 210$ MPa

F = ?? d = 15 mm



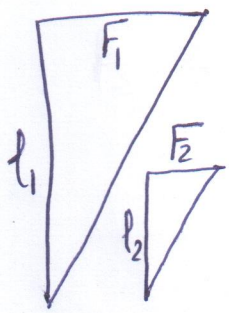
Dim. in mm.

Soln

$$F * l = 3F_1 l_1 + 2F_2 l_2$$

$$F * 300 = 3F_1 * 300 + 2F_2 * 100$$

$$3F = 9F_1 + 2F_2 \longrightarrow (1)$$



$$\frac{F_1}{l_1} = \frac{F_2}{l_2}$$

$$F_2 = F_1 * \frac{l_2}{l_1} = \frac{100}{300} F_1 = \frac{F_1}{3} \longrightarrow (2)$$

sub. in (1)

$$3F = 9F_1 + \frac{2}{3} F_1 = 9.667 F_1$$

$$F = \frac{9.667}{3} F_1 \quad \therefore \quad \boxed{F_1 = 0.31F} \longrightarrow (3)$$

$$\sigma_t = \frac{F_1}{A} = \frac{0.31F}{\frac{\pi}{4}(0.85 * 15)^2} = 2.43 * 10^{-3} F = \frac{F}{411.52}$$

$$\tau = \frac{F}{nA} = \frac{F}{5 * \frac{\pi}{4}(0.85 * 15)^2} = 1.566 * 10^{-3} F = \frac{F}{638.38}$$

$$\sigma_{max} = \frac{\sigma_t}{2} + \sqrt{\left(\frac{\sigma_t}{2}\right)^2 + \tau^2} \leq \sigma_{all}$$

$$= \frac{F}{2 * 411.52} + \sqrt{\left(\frac{F}{2 * 411.52}\right)^2 + \left(\frac{F}{638.38}\right)^2}$$

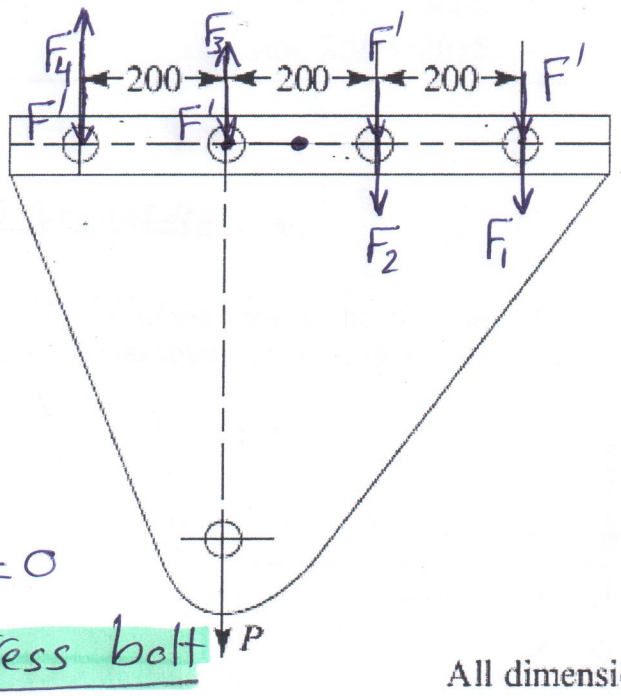
$$= \frac{F}{311.76} = 210$$

$$F = 210 * 311.76$$

$$= 65470 \text{ Newton}$$

Question two (7 marks)

Find the value of P for the joint shown in Figure based on a working shear stress of 100 MPa for the rivets. The four rivets are equal, each of 20 mm diameter.



All dimensions in mm

$P = ??$ $\quad \tau = 100$ MPa

4 rivets $\quad d = 20$ mm

Soln

$$F' = \frac{P}{4} = 0.25P$$

$r_4 = r_1 = 300$ mm

$r_3 = r_2 = 100$ mm

$\theta_1 = \theta_2 = 180^\circ \quad \theta_3 = \theta_4 = 0$

bolt ① is the max. stress bolt

$$F_1 = \frac{T r_1}{2r_1^2 + 2r_2^2} = \frac{P * 100 \text{ A } 300}{2*(300)^2 + 2*(100)^2}$$

$$= 0.15P$$

$$F_s = F' + F_1 = 0.25P + 0.15P = 0.4P$$

$$\tau = \frac{F_s}{A}$$

$$100 = \frac{0.4P}{\frac{\pi}{4}*(20)^2}$$

$$P = 78539.8 \text{ Newton}$$