Mansoura University

Faculty of Engineering

Department: (Mechanical Power)

Year: 1st year

course: Material strength & Stress analysis

Code: PRE 4121

Time: 3 hours

Date: 1/6/2014

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***Question One:*** ***(20 Marks)***

*A steel tire, 10 mm thick, 80 mm wide, and 1500 mm inside diameter, which shown in Fig. 1 is heated and shrunk onto a steel wheel 1500.5 mm in diameter. If the coefficient of static friction is 0.30, what torque is required to twist the tire relative to the wheel? Neglect the deformation of the wheel. Use E = 200 GPa*

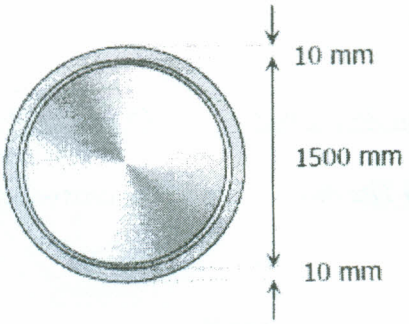


***Fig. 1***

***Question Two:*** ***(25 Marks)***

*A compound shaft consisting of a steel segment and an aluminum segment is acted upon by two torques as shown in Fig. 2. Determine the maximum permissible value of T subject to the following conditions: $\tau_{st} \leq 83$ MPa, $\tau_{al} \leq 55$ MPa, and the angle of rotation of the free end is limited to 6°. For steel, G = 83 GPa and for aluminum, G = 28 GPa.*

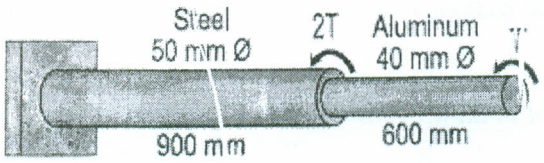


***Fig. 2***

***Question Three:*** ***(25 Marks)***

*A rectangular steel beam, 2 in wide by 3 in deep, is loaded as shown in Fig. 3. Determine the magnitude and the location of the maximum bending stress.*

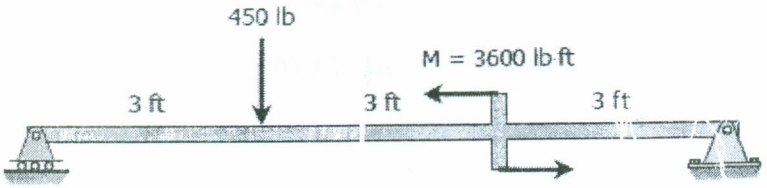


***Fig. 3***

**Question Four:** **(15 Marks)**

*The grain of a wooden member forms an angle of 15° with the vertical. For the state of stress shown in Fig. 4, determine (a) the in-plane shearing stress parallel to the grain, (b) the normal stress perpendicular to the grain. (Use Mohr's Circle)*

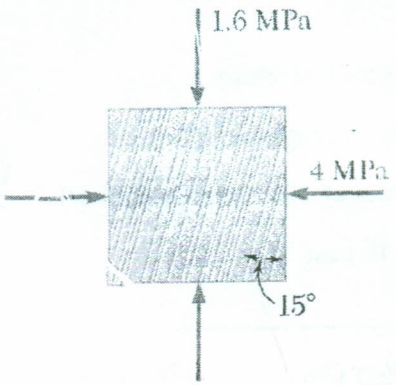


*Fig. 4*

**Question Five:** **(15 Marks)**

*(1) The neutral axis of the cross-section a beam is that axis at which the bending stress is*

*(a) zero* *(b) minimum*

*(c) maximum* *(d) infinity*

*(2) Principle plane is a plane on which the shear stress is*

*(a) zero* *(b) minimum* *(c) maximum*

*(3) The bending moment in the centre of a simply supported beam carrying a uniformly distributed load of w per unit length is*

*(a) Zero* *(b)* $wl^2/2$

*(c)* $wl^2/4$ *(d)* $wl^2/8$

*(4) In a simple bending theory, one of the assumption is that the material of the beam is isotropic. This assumption means that the*

*(a) normal stress remains constant in all directions.*

*(b) normal stress varies linearly in the material.*

*(c) elastic constants are same in all the directions.*

*(d) elastic constants varies linearly in the material.*

*(5) Two shafts 'A' and 'B' are made of same material. The shaft 'A' is solid and has diameter D. The shaft 'B' is hollow with outer diameter D and inner diameter D/2. The strength of hollow shaft in torsion is _____ as that of solid shaft.*

*(a) 1/16* *(b) 1/8*

*(c) 1/4* *(d) 15/16*