Mansoura University

Faculty of Engineering
Dept. of production & Mechanical Design

Final Exam June 2010
Date: 29-6-2010
Time: 3 hours
Full mark: (90 mark)

Exam of Strength of Material
For Production & Mechanical Design Dept. Grad 1 students

Question One:

(a) Two solid cylindrical rods AB and BC are welded together at B and loaded as shown in *Fig.1.* Knowing that the average normal stress must not exceed 150MPa in either rod. Determine the smallest allowable values of diameters d1 and d2.

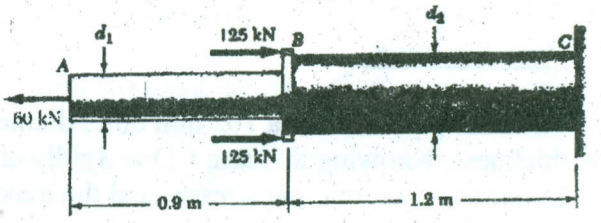

Fig. 1

(b) Two wooden planks, each (7/8) in. thick and 6 in. wide, are joined by the glued mortise joint shown in *Fig. 2* knowing that the joint will fail when the average shearing stress in the glue reaches 120 psi. Determine the smallest allowable length d of the cuts if the joint is to withstand an axial load of magnitude P=1200 lb.

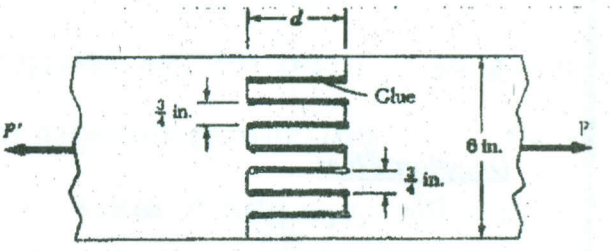

Fig. 2

Question Two:

Shaft *BC* is hollow with inner and outer diameters of 90 mm and 120 mm, respectively. Shafts *AB* and *CD* are solid of diameter *d*. For the loading shown in *Fig. 3*,

Determine:

(a) The minimum and maximum shearing stress in shaft *BC*,

(b) The required diameter *d* of shafts *AB* and *CD* if the allowable shearing stress in these shafts is 65 MPa.

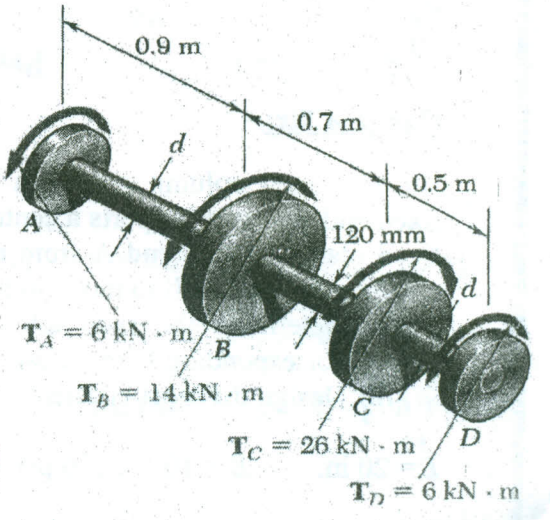

Fig. 3

Question Three:

Determine the largest permissible uniformly distributed load w for the beam shown in *Fig. 4*, knowing that the allowable normal stress is +12 ksi in tension and -19.5 ksi in compression.

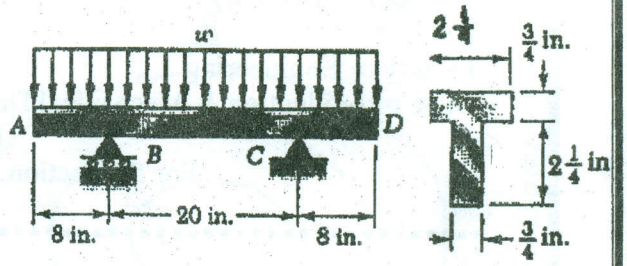

Fig. 4

Question Four:

The steel pipe AB has a 102 mm outer diameter and 6 mm wall thickness. Knowing that arm CD is rigidly attached to the pipe. Determine the principal stresses and the maximum shearing stress at point ***H*** and ***K***.

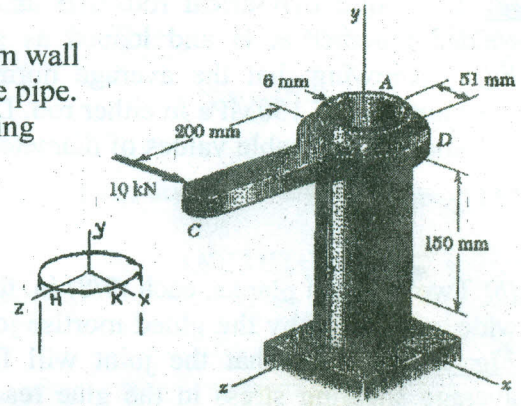

Fig. 5

Question Five:

The pressure tank shown in *Fig. 6* has a (3/8) in. wall thickness and butt-welded seams forming an angle $\beta = 20^\circ$ with a transverse plane. For a gage pressure of 85 psi, determine:

(a) The normal stress perpendicular to the weld.

(b) The shearing stress parallel to the weld.

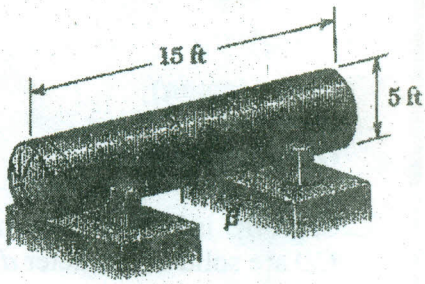

Fig. 6

Question Six:

An aluminum column of length L and rectangular cross-section has a fixed end at B and supports a centric load at A. Two smooth and rounded fixed plates restrain end A from moving in one of the vertical planes of symmetry but allow it to move in the other plane as shown in *Fig. 7*.

(a) Determine the ratio a/b of the two sides of the cross-section corresponding to the most efficient design against buckling.

(b) Design the most efficient cross-section for the column

$L = 20$ in. $E = 10.1 \times 106$ psi $P = 5$ kips $FS = 2.5$

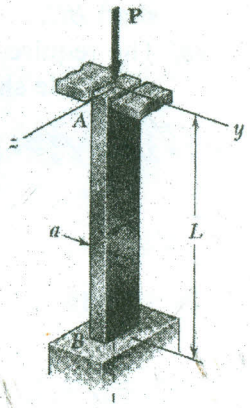

Fig. 7

Best Wishes
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