Problem Sheet #1

Pb.1 The rigid bar BDE is supported by two links AB and CD. Link AB is made of aluminum (E = 70 GPa) and has a cross-sectional area of 500 mm^2. Link CD is made of steel (E = 200 GPa) and has a cross-sectional area of (600 mm^2). For the 30-kN force shown, determine the deflection a) of B, b) of D, and c) of E.

Pb.2 A rectangular base plate is fixed at each of its four corners by a 20 mm diameter bolt & nut. The plate is rests on washers of 22 mm internal diameter & 50 mm external diameter. Upper washers which are placed b/w the nut & the plate are of 22 mm internal diameter & 44 mm external diameter.
If the base plate carries a load of 120 KN (including self weight, which is equally distributed on four corners), Calculate the stress on lower washers before the nuts are tightened.
What could be the stress in the upper & lower washers when the nuts are tightened so as to produce a tension of 5 KN on each bolt? (18.95 MPa, 4.38 MPa, 22.11 MPa).

Pb. 3 with a punch for which the maximum crushing stress is 4 times the shearing stress of the plate. Show that the biggest hole that can be punched in the plate is of diameter equal to the plate thickness.

Pb. 4 The piston rod of a steam engine is 50mm in diameter & 600mm long. The dia of the piston is 400mm & the max. steam pressure is 0.9KN/mm^2 . Find the compression of the piston rod. E= 210 KN/mm^2 (0.165 mm)

Pb.5 Two wooden planks, each 7/8″ thick & 6″ wide, are joined by the glued mortise joint shown. Knowing that the joint will fail when the average shearing stress in glue reaches 120 Psi, Determine the smallest allowable length ‘d’ of the cuts if the joint is to withstand axial load of magnitude P=1200 lb.

Pb.6 A couple ‘M’ of magnitude 1500 N.m is applied to the crank of an engine. For the position shown, determine (a) the force ‘P’ required to hold the engine system in equilibrium, (b) the average normal stress in the connecting rod BC, which has a 450 mm^2 uniform cross section.

Pb.7 Three ¾ ″ diameter steel bolts are to be used to attach the steel plate shown to wooden beam. Knowing that the plate will support a 24 Kpi load & the ultimate shearing stress for the steel used is 52 Ksi, determine the F.O.S for this design.

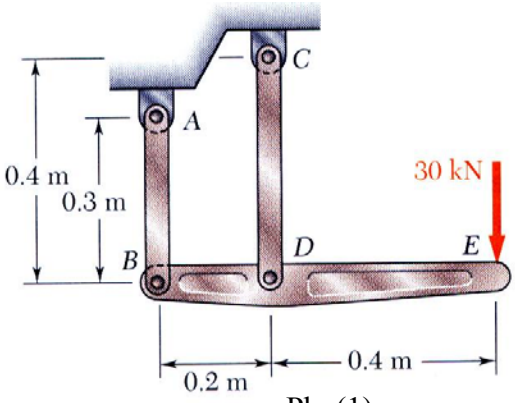
Pb.8 Each of the steel links AB & CD is connected to a support & to member BCE by ½ ″ diameter steel pins acting in single shear. Knowing that the ultimate shearing stress is 24 Ksi for steel used in pins & that the ultimate normal stress is 60 Ksi for the steel used in links. Determine the allowable load ‘P’ if an overall F.O.S of 3.2 is desired. (Note that the links are not reinforced around the pin holes).

Pb.9 A solid aluminum shaft of 80 mm diameter fits concentrically in a hollow steel tube. Compute the minimum internal diameter of the steel tube so that no contact pressure exists when the aluminum shaft carries axial compressive load of 400 KN. Assume v=1/3 & Eal=70 Gpa. (d=80.0303 mm)

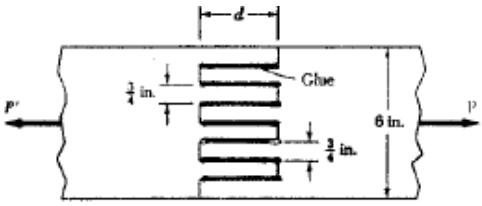
Pb.10 A steel rod having x-sectional area of 300mm^2 & a length of 150 m is suspended vertically from one end. It supports a tensile load of 20 KN at the lower end. If the unit mass of steel is 7850 Kg/m^3 & E= 200* 10^3 MN/m^2, find the total elongation of the rod. (δ= 54.3 mm)

Pb.11 A steel wire 30 ft long, hanging vertically, supports a load 0f 500 Ib. Neglecting the weight of the wire, determine the required diameter if the stress is not exceed 20 Ksi & the total elongation is not exceed 0.20 ″. E= 29*10^6 Psi. (1.878 mm)

Pb.12 A mild steel rod of 12mm diameter was tested for tensile strength with the gauge length of 60mm. Following observations were recorded:
Final length =80mm; Final diameter = 7mm; Yield load =3.4 KN & Ultimate load = 6.1 KN. Calculate a) Yield stress b) Ultimate tensile stress. C) %age reduction in area d) %age elongation. (30.1 MPa, 54 MPa, 0.66 or 66%, 0.25 or 25%).



Pb. (1)



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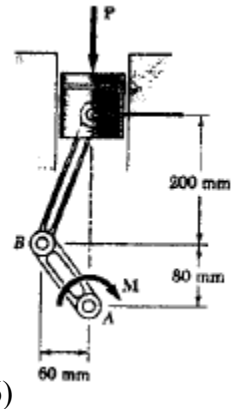

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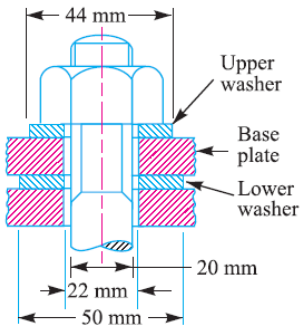

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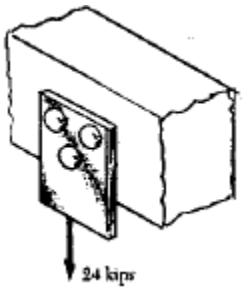

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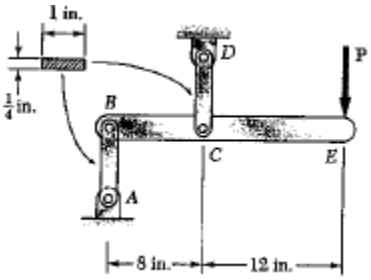

Pb. (8)

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