(Mechanics of Materials)

Problem Sheet (Torsion)

Pb.2.1 Determine the torque T that causes a maximum shearing stress of 70MPa in the Steel cylindrical shaft shown.

Pb.2.2 Determined the maximum shearing stress caused by a torque of magnitude T= 800Nm.

Pb.2.3 Knowing that the internal diameter of the hollow shaft shown is d = 0.9in. Determine the maximum shearing stress caused by a torque of magnitude T = 9 kip in.

Pb.2.4 Knowing that d = 1.2in. Determine the torque T that causes a maximum shearing Stress of 7.5ksi in the hollow shaft shown.

Pb.2.5 (a) For the hollow shaft and loading shown, determine the maximum shearing stress.(b) Determine the diameter of a solid shaft for which the maximum shearing stress under the loading shown is the same as in part a.

Pb.2.6 (a) Determine the torque that may be applied to a solid shaft of 90mm outer the diameter without exceeding an allowable shearing stress of 75Mpa. (b) Solve part a, assuming that the solid shaft is replaced by hole low shaft of the same mass and of 90mm inner diameter.

Pb.2.7 (a) For the 3-in. diameter solid cylinder and loading shown, determine the maximum shearing stress. (b) Determine the inner diameter of the hollow cylinder, of 4-in.outer diameter, for which the maximum stress is the same in part a.

Pb.2.8 (a) Determine the torque that may be applied to a solid shaft of 0.75-in diameter without exceeding an allowable shearing stress of 10Ksi. (b) Solve part a, assuming that the solid shaft has been replaced by a hollow shaft of the same cross-sectional area with an inner diameter equal to half its own outer diameter.

Pb.2.9 Knowing that each of the shafts AB, BC, and CD consists of a solid circular rod, determine (a) the shafts in which the maximum shearing stress occurs, (b) the magnitude of that stress.

Pb.2.10. Knowing that a 0.30-in. diameter hole has drilled through each of the shafts AB, BC, and CD, determine (a) the shafts in which the maximum shearing stress occurs, (b) the magnitude of that stress.

Pb.2.11 The allowable stress is 15ksi in the 1.5-in. diameter steel rod AB and 8ksi in the 1.8-in. diameter brass rod BC. Neglecting the effect of stress concentrations, determine the largest torque the may be applied at A.

Pb.2.12 The allowable stress is 15ksi in the steel rod AB and 8ksi in the brass rod BC. Knowing that a torque of magnitude T= 10kip in. is applied at A, determine the required diameter of (a) rod AB, (b) rod BC.

Pb.2.13 The solid rod AB has a diameter d = 60mm. The pipe CD has an outer diameter of 90mm and a wall thickness of 6mm. knowing that both the rod and the pipe are made of steel for which the allowable shear stress is 75Mpa; determine the largest torque T that may be applied at A.

Pb.2.14 The solid rod AB has a diameter d = 60mm. and is made of steel for which the allowable shearing stress is 85MPa. The pipe CD has an outer diameter of 90mm and a wall thickness of 6mm is made of aluminum for which the allowable shear stress is 54Mpa, determine the largest torque T that may be applied at A.

Pb.2.15 The allowable stress is 50MPa in the brass rod AB and 25MPa in the aluminum rod BC. Knowing that a torque of magnitude T= 1250Nm is applied at A, determine the required diameter of (a) rod AB, (b) BC.

Pb.2.16 The solid rod BC has a diameter of 30mm and is made of aluminum for which the allowable shearing stress is 25MPa. The rod AB is hollow and has an outer diameter of 25mm, it is made a brass for which the allowable shearing stress is 50MPa. Determine (a) the largest inner diameter of rod AB for which the factor of safety is same for each rod, (b) the largest torque that may be applied at A.

PB.2.17 A torque of magnitude T= 1000Nm is applied at Das shown Knowing that the diameter of the shaft AB is 56mm and the diameter of the shaft CD is 42mm, determine the maximum shearing stress in (a) shaft AB, (b) shaft CD.

Pb.2.18 A torque of magnitude T = 1000Nm is applied at D as shown. Knowing that the allowable shearing stress is 60MPa in each shaft, determine the required diameter of (a) shaft AB (b) Shaft CD.

Pb.2.19 Under normal operating conditions a motor exerts a torque of magnitude TF = 1200lb.in. at F. Knowing that the allowable shearing stress is 10.5ksi in each shaft, determine for the given data the required diameter of (a) shaft CDE, (b) shaft FGH.

r_D =8in. r_G = 3in.

r_D =3in, r_G = 8in

Pb.2.20 Under normal operating conditions a motor exerts a torque of magnitude T_F at F. The shafts are made of steel for which the allowable shearing stress is 12ksi and have diameters d_{CDE} = 0.900in. and d_{FGH} = 0.800in. Knowing that r_D = 6.5in. and r_G =4.5in, determine the largest allowable value of T_F**.**

Pb.2.22 Determine the largest allowable diameter of a 3m long steel rod (G = 77GPa), determine the angle of twist between (a) A and B, (b) A and C.

Pb.2.23 The torques shown are exerted on pulleys A and B. knowing that the shafts are solid and made of aluminum (G = 77GPa), determine the angle of twist between (a) A and B, (b) A and C.

Pb.2.25 The solid brass rod AB (G = 39GPa) is bounded to the solid aluminum rod BC (G= 27GPa).Determine the angle of twist (a) at B (b) at A.

Pb.2.26 The design specifications of a 4-ft long solid circular transmission shaft require that the angle of twist of the shaft not exceed 4^o when a torque of 6kip in. is applied. Determine the required diameter of the shaft, knowing that the shaft is made of (a) a steel with an allowable shearing stress of 12ksi and a modulus of rigidity of 77GPa, (b) a bronze with an allowable shearing stress of 12ksi and a modulus of rigidity of $11.2x10^6$psi.

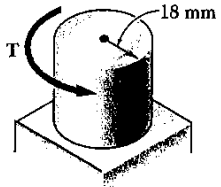
Pb.2.27 Using an allowable stress of 55MPa, design a solid steel shaft to transmit 10KW at a frequency of 15Hz.

Pb.2.28 Using an allowable stress of 5ksi, design a solid steel shaft to transmit ½ hp at a speed of 1725rpm.

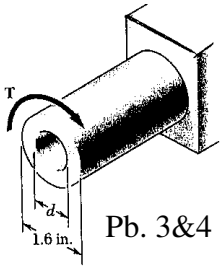
Pb.2.29 Design a solid steel shaft to transmit 100hp at a speed of 1200 rpm, if the maximum shearing stress is not to exceed 7500psi.

Pb.2.30 Design a solid steel shaft to transmit 0.375hp at a frequency of 29Hz, if the shearing stress is not to exceed 35MPa.

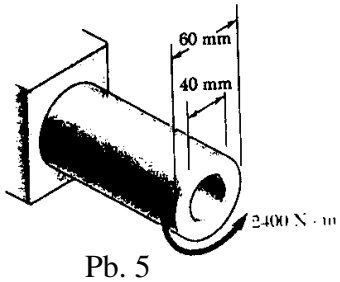
Pb.2.31 A hollow shaft is to transmit 250kW at a frequency of 30Hz. Knowing that the shearing stress must not exceed 50MPa, design a shaft for which the ratio of inner diameter to outer diameter is 0.75.



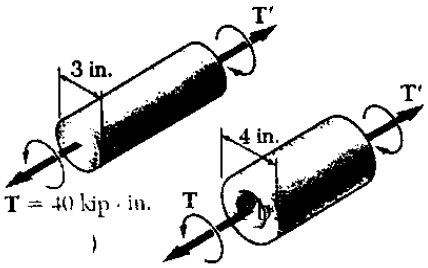
Pb. 1&2

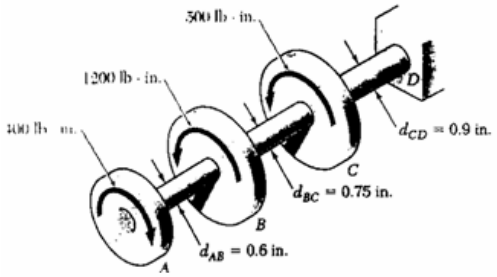


Pb. 3&4

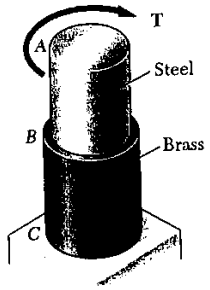


Pb. 5

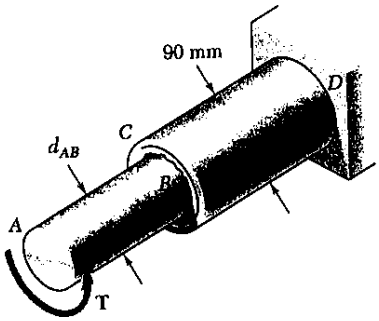




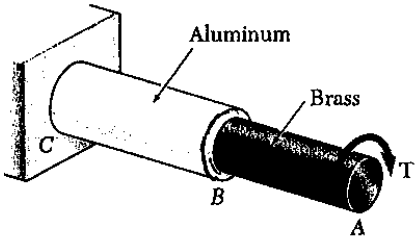
Pb. 9&10



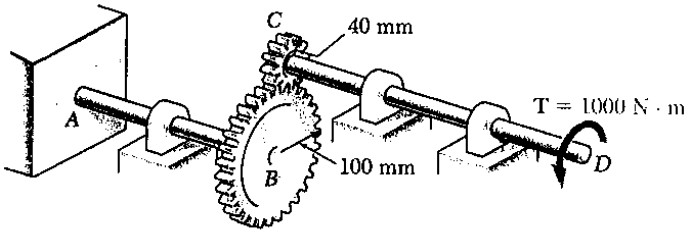
Pb. 11&12



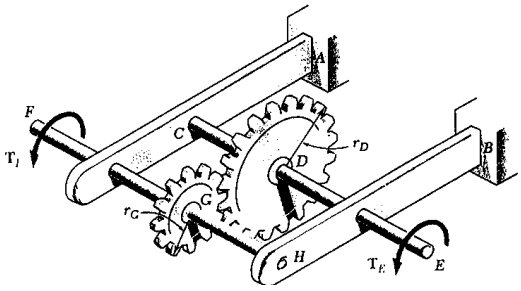
Pb. 13&14



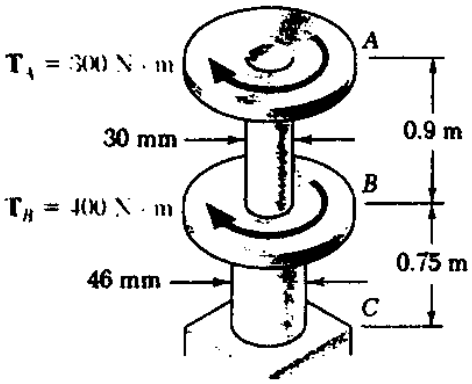
Pb. 15&16



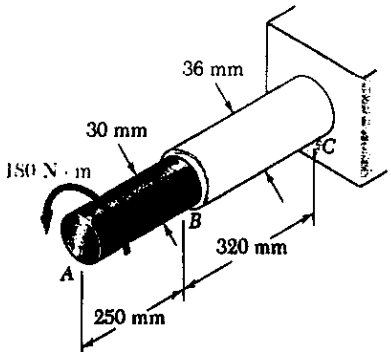
Pb. 17&18



Pb. 19&20


A
T_A = 300 N · m
30 mm
0.9 m
B
T_B = 400 N · m
46 mm
0.75 m
C

Pb.23


36 mm
30 mm
150 N · m
C
B
320 mm
A
250 mm

Pb.25