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Code No: R31035 **R10** **Set No: 1**

III B.Tech. I Semester Regular Examinations, November/December - 2012

DESIGN OF MACHINE MEMBERS - I

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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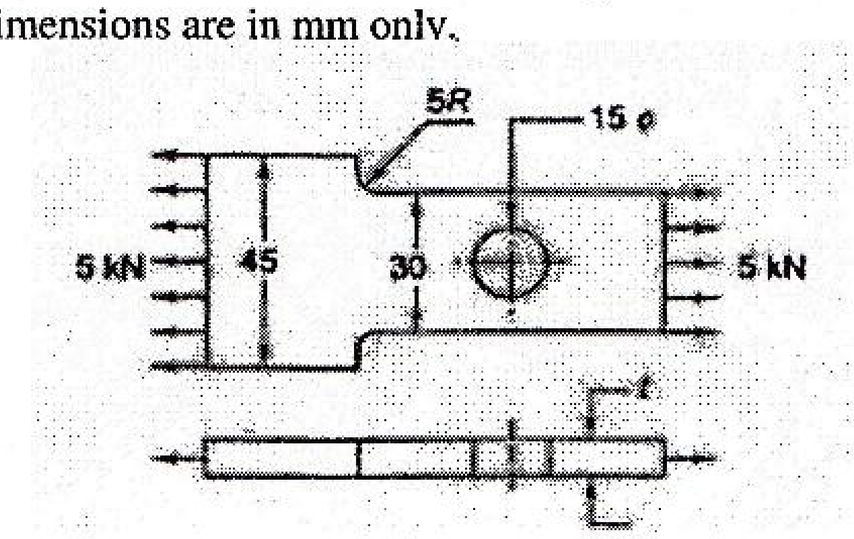
1. (a) Compare the Distortion energy theory and maximum shear stress theory.
   (b) A 50 mm diameter non rotating shaft of steel with yield strength of 400 MPa is subjected to a steady torque of 1500 Nm. Find the permissible steady bending moment that can be superimposed on it if the factor of safety is 5. Use Von-Mises theory. Locate the loading point in the Von-Mises ellipse.

2. (a) What is stress concentration? What are the different methods to reduce stress concentration?
   (b) A flat plate is subjected to a tensile force of 5 kN as shown in figure 1. The plate material is grey cast iron FG 200 and the factor of safety is 2.5. Determine the thickness of the plate. All the dimensions are in mm only.

Figure 1



3. (a) Define the efficiency of the riveted joint. According to Indian Boiler Regulations, what is the highest efficiency required of a riveted joint?
   (b) A double riveted lap joint with chain riveting is to be made for joining two plates 10 mm thick. The allowable stresses are 60 MPa in tension, 50 MPa in shear and 80 MPa in crushing. Find the rivet diameter, pitch of rivets and distance between rows of rivets. Also find the efficiency of the joint.

4. A cast iron bracket, supporting the transmission shaft and the belt pulley, is fixed to the steel structure by means of four bolts as shown in Figure 2. There are two bolts at A and two bolts at B. The tensions in slack and tight sides of the belt are 5 kN and 10 kN respectively. The belt tensions act in a vertically downward direction. The distances are l_1 = 50 mm, l_2 = 150 mm and l = 200 mm. The maximum permissible tensile stress in the bolt is 60 N/mm^2. Specify a suitable bolt size.

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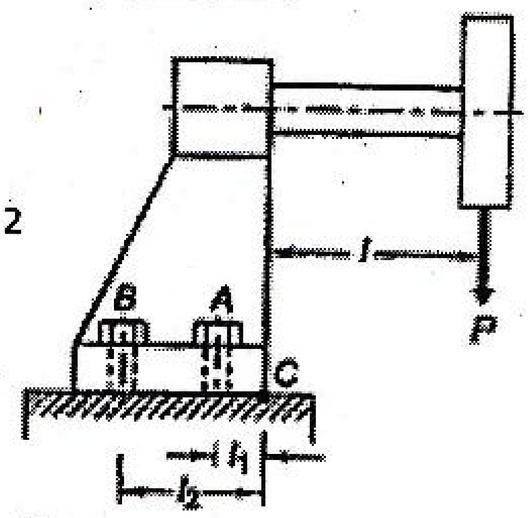
Figure 2



5. (a) Where do you use cotter joint? Give practical examples.
   (b) Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress = compressive stress = 50 MPa; shear stress = 35 MPa and crushing stress = 90 MPa.

6. A shaft is supported by two bearings 400 mm apart and carries a bevel gear of 200 mm pitch diameter at one end that is overhanging beyond the nearer bearing by 150 mm. The gear produces a radial load of 9.8 kN and a thrust load of 2.94 kN when the speed is 600 rpm. Determine the shaft diameter if the shaft is made of steel with allowable shear stress of 40 MPa. Also determine the angle of twist and deflection at the bevel gear location if the modulus of rigidity is 80 GPa and the modulus of elasticity is 210 GPa.

7. (a) What is the difference between rigid and flexible coupling?
   (b) Design a cast iron flange coupling for joining two mild steel shafts transmitting 100 kW at 250 rpm. The angle of twist should not exceed 1^0 in a length of 25 diameters. Take yield strength in shear for the shaft is 40 MPa and for bolts is 28MPa.

8. (a) What is surge in spring? What are the methods to avoid the surge in spring?
   (b) Design a closed coil helical spring for a boiler safety valve which is required to blow off steam at pressure of 1.5 MPa. The diameter of the valve is 50 mm. The initial compression of the spring is 40 mm and the lift is limited to 20 mm.

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Code No: V3113 **R07** **Set No: 2**

III B.Tech. I Semester Supplementary Examinations, November/December - 2012

DESIGN OF MACHINE MEMBERS - I

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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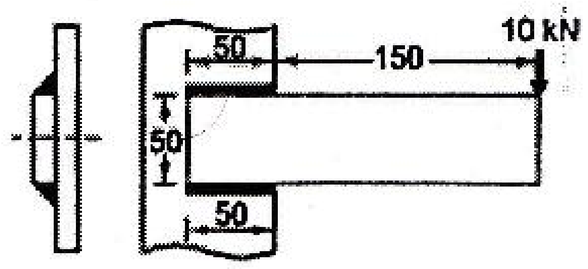
1. (a) Derive the relationship between the yield strength in shear and the yield strength in tension using the Distortion energy theory.
   (b) A machine element is subjected to principal stresses of 120 MPa, 0 MPa and -90 MPa. The material used is 30C8. Calculate the factor of safety by (a) the maximum normal stress theory, (b) the maximum shear stress theory and (c) the Distortion energy theory

2. (a) What is fatigue stress concentration factor? In what way, it is different from the theoretical stress concentration factor.
   (b) A machine part is made of forged steel with ultimate strength of 630 MPa and endurance strength is 0.22 times ultimate strength. The life of the part is 250000 cycles. The loading for the 50% of the time is ± 225 MPa and for 30% of the time is ± 145 MPa. Calculate the loading during the remaining time.

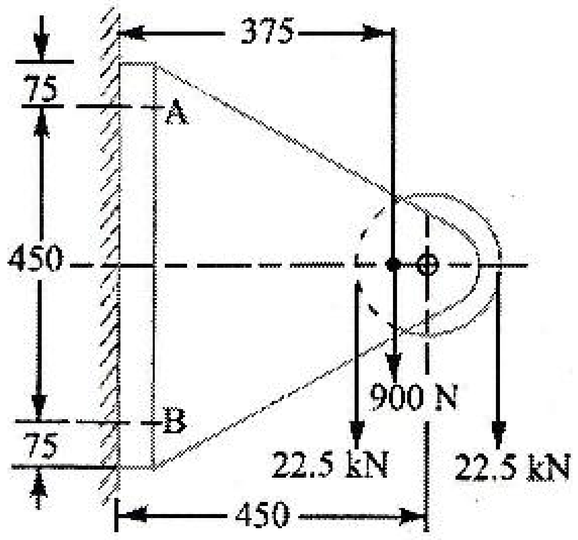
3. (a) What are primary and secondary shear stresses in eccentrically loaded welded joints? What are the assumptions made in evaluating them?
   (b) A welded connection of steel plates, as shown in Figure 1, is subjected to an eccentric force of 10 kN. Determine the throat dimension of the welds, if the permissible shear stress is limited to 95 MPa

Figure 1



4. A pulley bracket, as shown in Figure 2, is supported by 4 bolts, two at *A-A* and two at *B-B*. Determine the size of bolts using an allowable shear stress of 25 MPa for the material of the bolts. List the assumptions made in the analysis.

Figure 2



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5. (a) What is knuckle joint? Give practical examples.
(b) Design a knuckle joint to connect two circular rods subjected to an axial tensile force of 50 kN. The material for the two rods and pin is selected as plain carbon steel of Grade 30C8 with yield strength 400 MPa. Assume factor of safety of 5. Specify the dimensions of the knuckle joint with a neat sketch.

6. (a) Which theory is commonly used for the design of the shafts? Explain why?
(b) An electric motor drives a machine through a pair of spur gears. The pinion is mounted on motor shaft and over hangs by 200 mm from the nearest bearing. The pinion has 20 teeth of 10 mm module and 200 involute profile. Design the motor shaft to transmit 15 kW at 1200 rpm. Use safe shear stress value of 40 MPa. Take the shock and fatigue correction factors as 1.2 and 1 respectively.

7. (a) What is the difference between protected and unprotected rigid flange coupling?
(b) A driving shaft is joined with coaxial driven shaft through a muff coupling. The shaft transmits 60 kW of power at 150 rpm. Design the shaft, key and muff. Assume a factor of safety of 5 with following ultimate strength values.
Ultimate shear strength for shaft = 300 N/mm^2
Ultimate shear strength for key = 200 N/mm^2
Ultimate shear strength for muff = 50 N/mm^2
Ultimate compressive strength for key = 500 N/mm^2

8. (a) What are the different types of stresses induced in the wire of helical springs? Sketch its distribution.
(b) From a toy gun, a bullet of 1 N is fired. The bullet travels a distance of 10 m. the compression of the spring when the gun is loaded is 100 mm and the bore of the barrel is 20 mm. Design a suitable spring.

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Code No: R31035 **R10** **Set No: 3**

III B.Tech. I Semester Regular Examinations, November/December - 2012

DESIGN OF MACHINE MEMBERS - I

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Derive the Von Mises effective stress equation using the principal stresses.
   (b) A 100 mm diameter off-set link is transmitting an axial pull of 30 KN as shown in the figure 1. Find the stresses at points A and B.

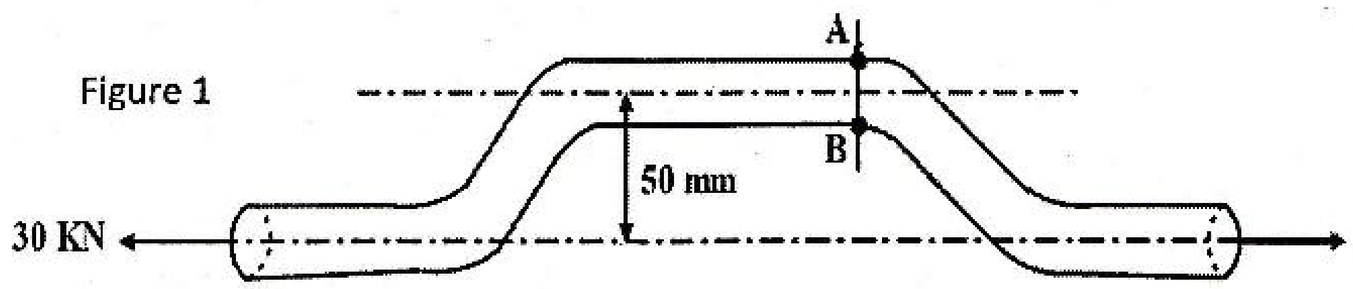

Figure 1

2. (a) Compare the Soderberg, Goodman and Gerber diagrams for the zero variable stresses.
   (b) A machine component is subjected to fluctuating stress that varies from 40 to 100 N/mm^2. The corrected endurance limit stress for machine component is 270 N/mm^2. The ultimate and tensile strength of the material are 600 and 450 N/mm^2 respectively. Find the factor of safety using (i) Soderberg line, (ii) Goodman line and (iii) Gerber theory. Also, find the factor of safety against static loading.

3. (a) How is a rivet joint of uniform strength designed?
   (b)Two lengths of mild steel tie rod having width 200 mm are to be connected by means of Lozenge joint with two cover plates to withstand a tensile load of 180 kN. Completely design the joint, if the permissible stresses are 80 MPa in tension; 65 MPa in shear and 160 MPa in crushing. Draw a neat sketch of the joint.

4. A bearing shown in Figure 2 is fastened to a frame by 6 bolts spaced equally on a 250 mm bolt circle, of which 2 bolts are positioned on the horizontal line. The bearing flange diameter is 300 mm and a load of 50 kN is applied at 275 mm from the frame. Determine the size of the bolts. What are conditions required for the arrangement of the bolts to have the maximum strength. Assume that the bolt is made of C20 steel having yield strength of 245 MPa and Factor of safety 3.

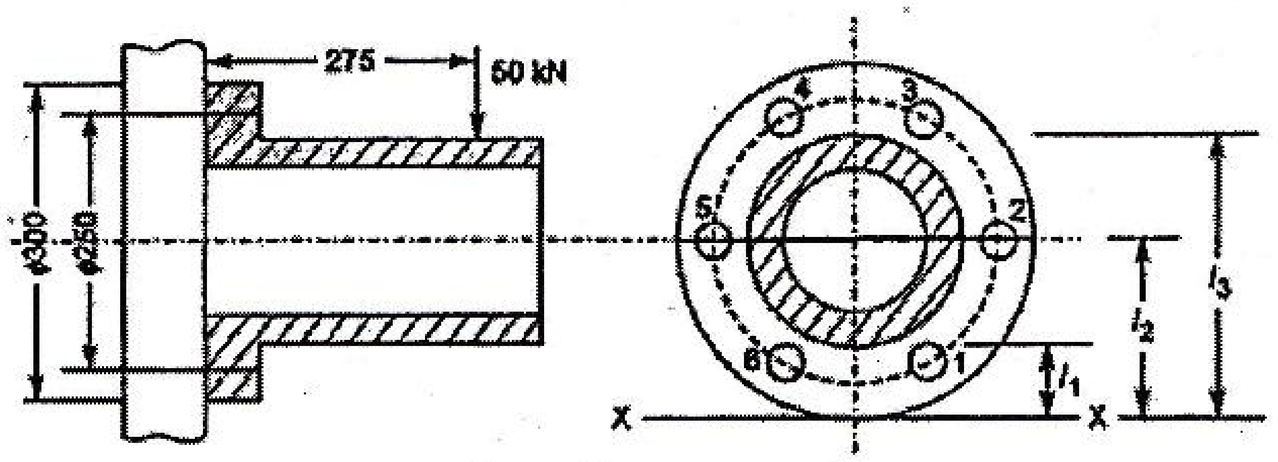

Figure 2

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5. (a) Differentiate between a cotter and knuckle joint.
(b) Design a spigot and socket joint to connect two rods of 30C8 steel to carry an axial tensile and compressive load of 10 kN. Explain the construction of the joint with a neat sketch

6. A steel shaft 800 mm long transmitting 15 kW at 400 r.p.m. is supported at two bearings at the two ends. A gear wheel having 80 teeth and 500 mm pitch circle diameter is mounted at 200 mm from the left hand side bearing and receives power from a pinion meshing with it. The axis of pinion and gear lie in the horizontal plane. A pulley of 300 mm diameter is mounted at 200 mm from right hand side bearing and is used for transmitting power by a belt. The belt drive is inclined at 30° to the vertical in the forward direction. The belt lap angle is 180 degrees. The coefficient of friction between belt and pulley is 0.3. Design and sketch the arrangement of the shaft assuming the values of safe stresses as: $\tau = 55$ MPa; $\sigma_t = 80$ MPa. Take torsion and bending factor 1.5 and 2 respectively .

7. (a) Sketch a muff coupling and identify its advantages and disadvantages.
(b) A shaft transmitting 150 kW is to be connected to a coaxial shaft through cast iron flange coupling. The shaft runs at 120 rpm. The key and shaft are to be made of same material for which permissible shearing stress is 60 N/mm^2 and compressive strength is 120 N/mm^2. The steel bolts may be subjected to maximum shearing stress of 26 N/mm^2. Design protected type flange coupling.

8. (a) Derive the expression for the strain energy stored in helical spring in terms of wire diameter, mean coil diameter and number of turns.
(b) A railway wagon of mass 250 kN moving with a velocity of 2.5 m/s is brought to rest by springs of mean each diameter 350 mm. the maximum deflection of the spring is 210 mm. Find the wire diameter and number of turns. Take modulus of rigidity is 80 GPa and allowable shear stress 600 MPa.

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Code No: R31035 **R10** **Set No: 4**

III B.Tech. I Semester Regular Examinations, November/December - 2012

DESIGN OF MACHINE MEMBERS - I

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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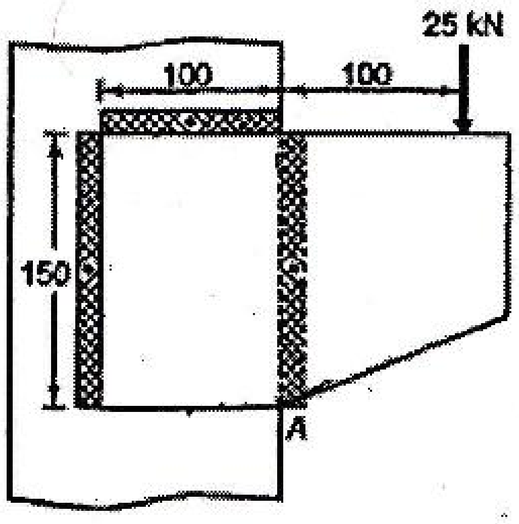
1. (a) Differentiate between (i) Elastic Deformation and Plastic Deformation (ii) Ductility and Brittleness.
   (b)A mass of 50 kg drops through 25 mm at the center of a 250 mm long simply supported beam. The beam has square cross section. It is made of steel 30C8 and the factor of safety is 2. The modulus of elasticity is ,207 000 N/mm^2. Determine the dimensions of the cross-section of the beam.

2. A cast iron shaft, with an ultimate tensile strength of 175 MPa, is subjected to a torsional load which is completely reversed. The load is to be applied an indefinite number of cycles. The shaft is 50 mm diameter and is joined to a 75 mm diameter shaft with 12.5 mm radius fillet. The factor of safety is to be 2. What is the maximum torque that can be applied to the shaft? Solve by two methods: (i) using Soderberg Equation (ii) Torsion Equation.

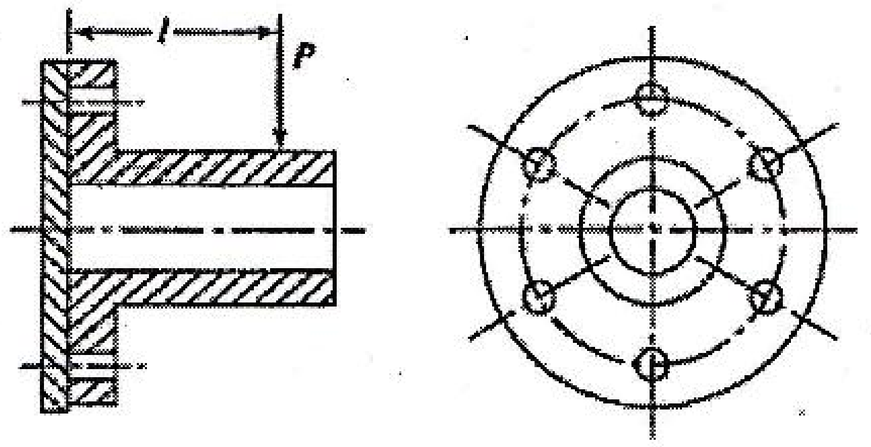
3. An eccentrically loaded bracket is welded to the support as shown in Figure 1. The permissible shear stress for the weld material is 55 N/mm^2 and the load is static. Determine the throat and leg dimensions for the welds. Explain the nature of the stresses induced in the welds.

Figure 1



4. For the circular flange shown in Figure 2, P = 20 kN and l = 100 mm. It is supported by 6 bolts of 30C8 steel at 150 mm pitch circle diameter. Find the diameter of the bolts if the outer diameter of the bracket is 200 mm. Consider Factor of safety = 6. List the assumptions made. Discuss the nature of the force developed in bolts.

Figure 2



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5. (a) A heat treated steel shaft of tensile yield strength of 350 MPa has a diameter of 50 mm. The shaft rotates at 1000 rpm and transmits 100 kW through a gear. Select an appropriate rectangular key for the gear.
(b) Draw a neat sketch of a cotter joint and write the equations of failure for the different sections.

6. A transmission shaft supporting a spur gear B and pulley D is shown in figure 3. The shaft is mounted on two bearings A and C. the diameter of the pulley and the pitch circle diameter of the gear are 450 and 300 mm respectively. The pulley transmits 20 kW power at 500 rpm to the gear. The belt tension ratio is 3. The material of the shaft is steel with ultimate strength 700 MPa and yield strength 460 MPa. Take the shock and fatigue correction factors are 1.5 each. The gear and pulley are keyed to the shaft. Determine the diameter of the shaft.

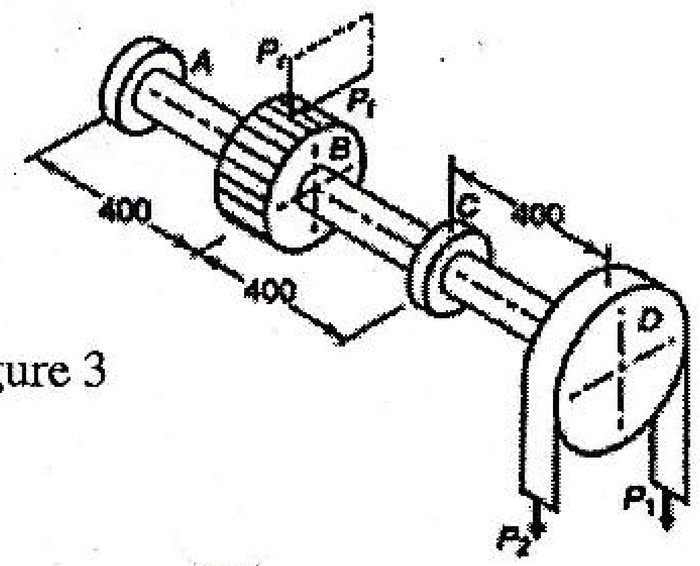

Figure 3

7. (a) What is the difference between a clutch and coupling?
(b) Design a bush type flexible coupling to transmit 50 kW at 300 rpm to a compressor. Select your own material and factor of safety.

8. (a) What are the different styles of ends for the helical compression springs? State the relation between active and inactive coils for each type.
(b) Design a helical valve spring for an operating load range of 100 N to 150 N. The deflection of the spring is 7.5 mm for this range. Take yield strength in shear is 700 MPa, factor of safety is 1.5 and modulus of rigidity is 80 GPa.

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