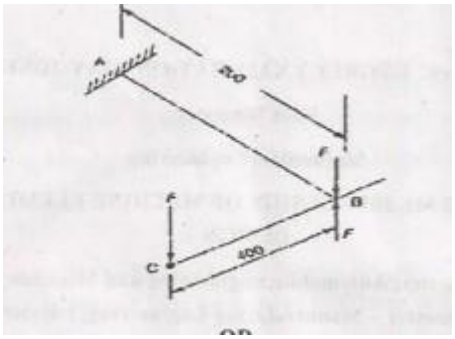
Design of Machine Elements

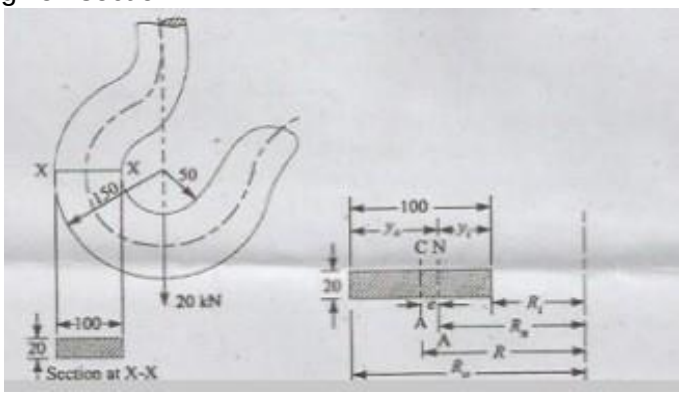
Important 13mark questions

Unit I

1. The shaft of an overhang crank is subjected to a force F of 2 kN as shown fig. below. The shaft is made of 30 Mn^2 steel having a allowable shear strength equal to 100 N/mm^2. Determine the diameter of the shaft.



2. The crane hook carries a load of 20 kN as shown in Fig. 1. The section at X-X is rectangular whose horizontal side is 100 mm. Find the stresses in the inner and outer fibres at the given section.



Unit II

1. Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r. p. m. The overall torque is 20 percent more than mean torque. The material properties are as follows:
   (i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively
   (ii) The allowable shear stress for cast iron is 15 MPa;
   (iii) The allowable bearing pressure for rubber bush is 0.8 N/mm^2
   (iv) The material of the pin is same as that of shaft and key.

   Draw neat sketch of the coupling.

2. A rigid coupling is used to transmit 50 kW power at 300 rpm. There are six bolts the outer diameter of the flanges is 220 mm, while the recess diameter is 150 mm. The coefficient of friction between the flanges is 0.15 mm. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes.

Unit III

1. A rectangular steel plate 100 mm wide is welded to a vertical plate to form a cantilever with an overlap of 50 mm and an overhang of 150 mm. It carries a vertical downward load of 60 kN at free end. Fillet weld is done three sides of the plate for a permissible stress of 140 N/mm^2. Determine the size of the weld.
2. A bracket as shown in figure 2. Supports a load of 30 kN. Determine the size of bolts, if the maximum allowable tensile stress in the bolt material is 60 MPa. Four bolts are used. The distances are: L_1 = 85 mm, L_2 = 250 mm and L = 500 mm.

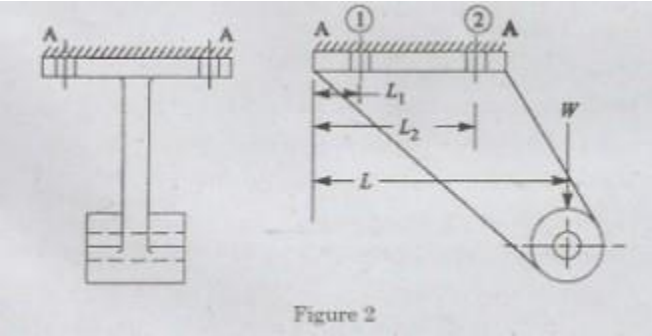


Figure 2

Unit IV

1. A single cylinder double acting stream engine delivers 185 kW at 100 r. p. m. The maximum fluctuation of energy per revolution is 15 percent of the energy developed per revolution. The speed variation is limited to 1 percent either way from the mean. The mean diameter of the rim are 2.4 m. Design and draw two views of the flywheel.
2. Design a helical spring for a spring-loaded safety value for the following conditions:
   Diameter of value seat = 65 mm; Operating pressure = 0.7 N/mm^2,
   Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm^2 = 3.5 mm
   Maximum pressure when the valve blows off freely = 0.75 N/mm^2 ,
   Maximum allowable stress = 550 MPa;
   Modulate of rigidity = 84 k N/mm^2, Spring index = 6;
   Draw a neat sketch of the free spring showing the main dimensions.

Unit V

1. Select a suitable deep groove ball bearing for supporting a radial load of 10 kN and an axial load of 3 kN for a life of 4000 hours at 800 rpm. Select from series 63. Calculate the expected life of the selected bearing.
2. Determine the dimensions of an I-section connecting rod for a petrol engine from the following data:
   Diameter of the piston = 120 mm;
   Mass of the reciprocating parts = 3kg;
   Length of the connecting rod from centre to centre = 450 mm;
   Stroke length = 170 mm; Speed = 1500 r. p. m;
   Maximum pressure = 2.5 N/mm^2.