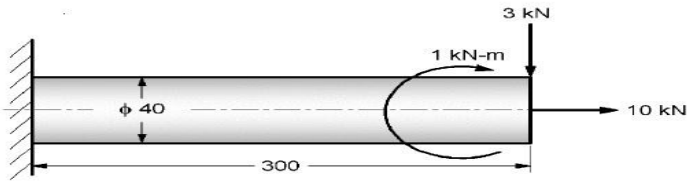
UNIT-1

Problem on Failure Theories

1)A bolt is subjected to an axial pull of 10KN and transverse shear of 5KN.The yield strength of bolt material is 300Mpa considering F.O.S of 2.5.Determine the diameter of bolt using (i) Maximum normal stress theory(ii) Maximum shear stress theory and (iii) Maximum strain theory(iv)octahedran theory Take poison ratio as 0.25.

2)A Steel bar of 40 mm diameter and 300mm length is subjected to a Torque of 1 KN-m and other two loads are shown in fig.if the ultimate tensile strength and yield strength of bar are 450N/mm^2 and 250 N/mm^2 respectively. determine the factor of safety using (i)Maximum principle stress theory (ii)Maximum shear stress theory (iii)Maximum strain energy theory



All Dimension are in mm

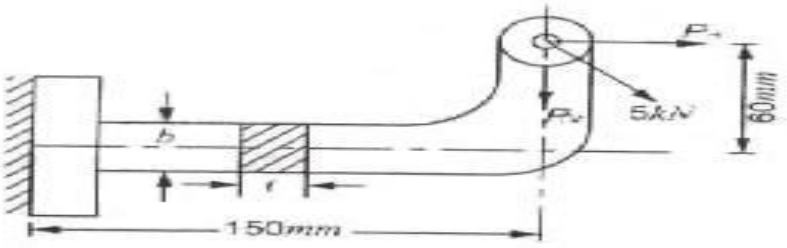
3)

A mild steel shaft of 4 cm diameter is subject to a bending moment of 15×10^4 N-cm and a torque 'T'. If the yield strength of the steel in tension is 3×10^4 N/cm^2, find the maximum value of torque 'T' without causing yielding of the shaft according to :

(i) the maximum principal stress theory ; and

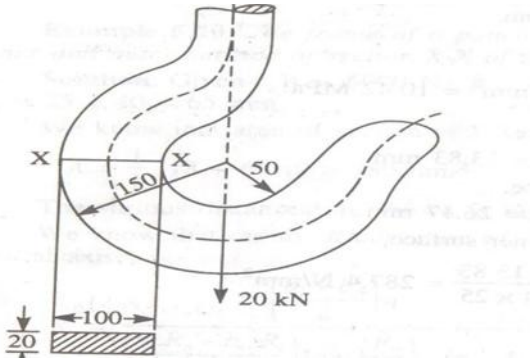
(ii) the maximum shear stress theory.

4.The bracket has a rectangular section whose depth is twice the thickness.Find the cross sectional dimension of bracket if the permissible stress in the material is 50N/mm².

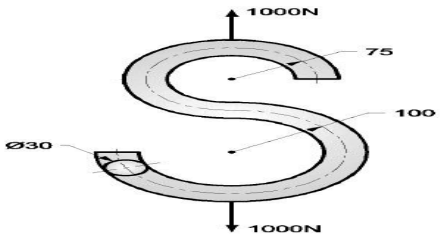


Problem on Curved beam

1)The crane hook carries a load of 20KN,as shown in fig,The section is rectangular whose horizontal side is 100mm.find the stress in the inner and outer fiber at a given section.



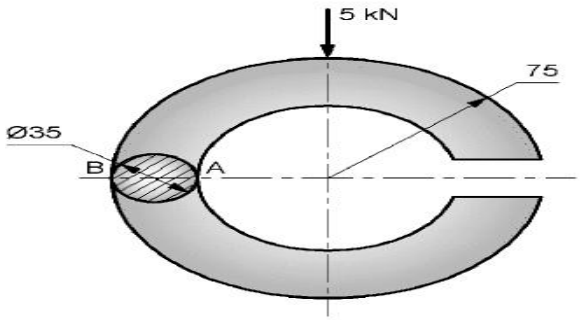
2)A link of S Shape made of diameter 30mm bar shown in figure determine the maximum tensile stress in the link



All Dimension are in mm

3)

Calculate the stress at point A and B for a circular beam as shown in Fig. 2.11.1. The circular beam is subjected to a compressive load of 5 kN.



UNIT-2

Problem on Variable Loading

1)The machine component is subjected to a flexural stress which fluctuate between +300MN/m^2 and 150MN/m^2.Determine the value of minimum ultimate strength according to 1.Gerber relation 2.Modified Goodman relation and 3.Soderberg relation. Take yield strength=0.55 Ultimate strength; Endurance limit=0.5 Ultimate strength and F.O.S=2.

A hot rolled steel shafts is Subjected to a Torsional moment that from 330N-m Clockwise to 110N-m Counter clockwise and an a bending moment at a Critical Section Varies from 440 N-m to -220 N-m shaft is of Uniform Cross section and no keyway is present at the Section. Determine the required shaft diameter.The material has ultimate strength of 550 Mpa and Yield Strength of 410 MPa.Take Endurance Strength as half of Ultimate Strength,factor of Safety is 2.Size Correction factor of 0.85 and Surface finish factor of 0.62.

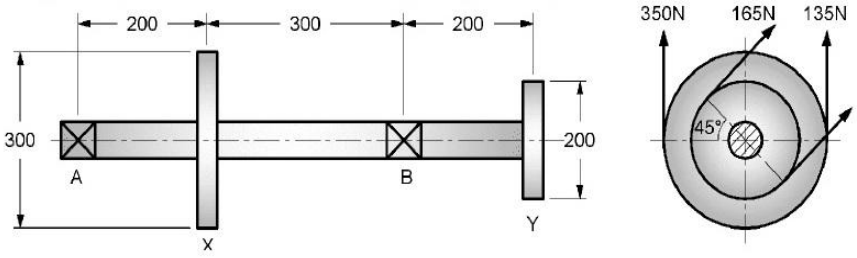
Problem on Knuckle Joints

Design a knuckle joint to carry a load of 140 KN. The design stresses may be taken as 75 MPa in tension; 60 MPa in shear and 90 MPa in crushing.

UNIT-3

Problem on Shaft

1)A Steel shaft made of 40C8 is used to drive a machine The pulley X,Y and Bearings A,B are located as shown in fig.Belt tension are also shown in fig. Allowable shear stress of shaft is 94.5N/mm^2. Assume that the torque on one pulley is equal to that of other pulley, determine the diameter of shaft.



All Dimension are in mm

2)A shaft is to transmit 50kW at 1200rpm. It is also subjected to a bending moment of 275 N-m. Allowable shear stress is 60 N/mm^2. The shaft is not to twist more than 2º in a length of 2m. Design the shaft. Take G = 80 x 10^3 N/mm^2.

3)A shaft is supported by two bearings placed 1m apart. A 600mm diameter pulley is mounted at a distance of 300mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25KN. Another pulley 400mm diameter is placed 200mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180°

and μ=0.24. Determine the suitable diameter for a solid shaft, allowing working stress of 63Mpa in tension and 42Mpa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.

Problem on coupling

1)Its required to design a rigid flange coupling to connect two shafts And transmit 37.5kW Power at 180 r.p.m.The service factors is 1.5.Use the following data (i) Allowable shear stress for shaft and key =104.6N/mm^2 (ii) Allowable shear stress for bolt =90N/mm^2(iii) Allowable shear stress for CI Flange=75N/mm^2(iv)Allowable crushing stress for shaft=133.33N/mm^2(v)Allowable crushing stress for bolt =150N/mm^2

2)Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32kw at 960rpm. The overall torque is 20 percent more than mean torque. The material properties are as follow:

a. The allowable shear and crushing stress for shaft and key material is 40Mpa and 80Mpa respectively.
b. The allowable shear stress for C.I is 15Mpa.
c. The allowable bearing pressure for rubber bush is 0.8N/mm^2.

The material of the pin is same as that of shaft and key.

UNIT-4

Problem on Helical Springs

1)Its required to design a helical compression spring made of oil hardened and tempered carbon steel carrying a maximum static force of 1000N.Maximum deflection of 25mm.The ultimate tensile strength and modulus of rigidity of spring are 420N/mm^2 and 84KN/mm^2 respectively. If Spring index is 5.Determine (i)wire diameter (ii)mean coil diameter (iii)Total no of coils(iv)free length(v)Solid length (vi)pitch. Draw the neat sketch of spring and give the necessary dimension.

2)A Helical compression made of oil tempered carbon steel is subjected to a load which varies from 400N to 1000N.The Spring index is 6 and the design factor of safety is 1.25.if the yield stress is 770 MPa and endurance strength is 350 Mpa.Find(i) Size of wire(ii)Diameter of springs(iii) No of turns of the springs(iv)Free length of the springs. The compression of the springs at the maximum is 30mm.Modulus of Rigidity of the spring materials is may be taken as 80 KN/mm^2

Problem on Leaf Springs

1)A truck spring has an overall length of 1050mm and sustains a load of 5.4KN at its centre.The spring has a 2 extra full length leaves 12graduated leaves with centre band of 80mm wide. all leaves are stressed to 280 N/mm^2 when fully loaded, The ratio of total depth to width is to be approximately 3.if the modulus of elasticity is 2.1*10^{5}N/mm^2 determine (i) width and thickness of the leaves(ii)deflection of the spring(iii)initial space that should be provided between full length and graduated leafs.

2)A locomotive semi-elliptical laminated spring has an overall length of 1 m and sustains a load of 70 KN at its centre. The spring has 3 full length leaves and 15graduated leaves with a central band of 100 mm width. All the leaves are to be stressed to 400 MPa, when fully loaded. The ratio of the total spring depth to that of width is 2. Take young modulus is 210 kN/mm2. Determine (i) the thickness and width of the leaves (ii) the initial gap that should be provided between the full length and graduated leaves before the band load is applied and (iii) the load exerted on the band after the spring is assembled.

Problem on bearings

1. Design a journal bearing for a centrifugal pump with following data:(i)Load on the bearing is 2.2KN (ii)Speed of the journal is 1490r.pm.(iii)Diameter of the journal is 50mm.(iv)working temperature is 60°C.(v)Ambient temperature is 25°C(vi)Radial Clearance is 150Microns.To Find(i)Length of bearing (ii)Dynamic viscosity (iii)Co-efficient of friction (iv)Minimum oil flim(v) Total flow lubricant(vi)Side leakage(vii)Temperature rise.
2. A Single row deep groove ball bearing is subjected to a radial load of 6KN and axial thrust of 2KN.The shaft rotates at 1200 r.pm. The expected life of the bearing is 20000 hours. if the minimum acceptable diameter of the shaft is 75mm.Select Suitable ball bearing for the application.determine suitable tolerance for housing and shaft

UNIT-5

Problem on fly wheel

1) The turning moment Diagram of multicylinder Diesel Engines Scale of (1mm=1 degree) on the abscissa (1mm=250N-m)on the ordinates. The intercepted Area between the torque developed by the engine and the mean resisting torque developed by the engine taken in order -350, 800,-600,+900,-550,+450, and -650.The Engine runing at a mean speed of 750 rpm and the co-efficient of fluctuation to be 0.02.A rimmed flywheel made of grey cast iron (density($\dot{\rho}$)=7100 kg/m^2)is provided. The rim has elliptical cross section and the ratio of width to thickness is 1.5.determine the dimension of rim.

2) A multi cylinder engine is to run at a constant load at a speed of 600 rpm. On drawing the crank effort diagram to scale of 1 mm = 250 N-m and 1 mm = 3°, the areas in square mm above and below the mean torque line were measured and found to be in order +160, –172, +168, –191, +197 and –162. The speed is to be kept with in ±1% of the mean speed of the engine. Determine the moment of inertia of the flywheel. Also determine suitable dimensions for cast ironflywheel with a rim whose breadth is twice its radial thickness. The density of cast iron is 7250 kg/m3, and its working stress in tension is 6 MPa. Assume that the rim contributes 92% of the flywheel effect

Problem on Connecting rod

1)The connecting rod of a petrol engine is to be designed for the following data

(i)Piston diameter 80 mm
(ii)Stroke 120 mm
(iii)Weight of the reciprocating parts 15N
(iv)Length of connecting rod 240 mm
(v)Max speed 2800 rpm.(iv)Explosion pressure corresponding to 10° of crank angle is 3 MPa .If the connecting rod is to be made of mild Steel, find the dimensions.

2)Design a mild steel connecting rod with an I-section for a single cylinder IC engine from the following data. Diameter of the piston is 0.104 m; weight of reciprocating parts is 18.2 N; length of connecting rod-center to center is 0.314 m; stroke length is0.14 m; speed of the engine is 1500 rpm; Maximum explosion pressure is 2.28 MPa. Assume that the maximumthrust takes place at TDC during the explosion stroke. Assume also any missing data