MACHINE DESIGN & INDUSTRIAL DRAFTING
SUBJECT CODE :- 2141907

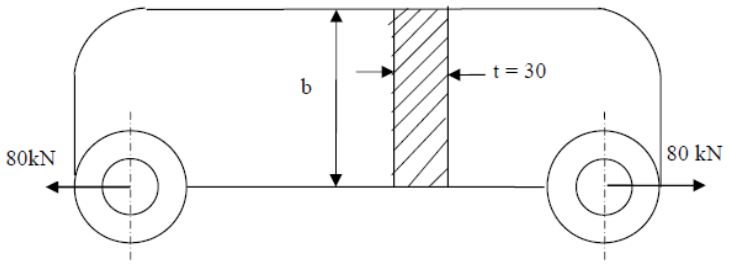
TUTORIAL -01
Introduction of Machine Design & Industrial Drafting.

Section-A Descriptive type Questions

1. Name the different theories of failures of mechanical components made of ductile material. Explain the maximum shear stress theory giving conservative zone
2. Describe Hertz contact stress theory giving suitable examples
   Define factor of safety and state the important factors affecting the factor of safety.
3. Differentiate between (1) Tortional Shear Stress & Transverse Shear Stress
   (2) Compressive Stress & Crushing Stress
4. Explain design procedure for the machine component under eccentric loading.
5. Explain in brief Coulomb Mohr Theory of failure of the mechanical components

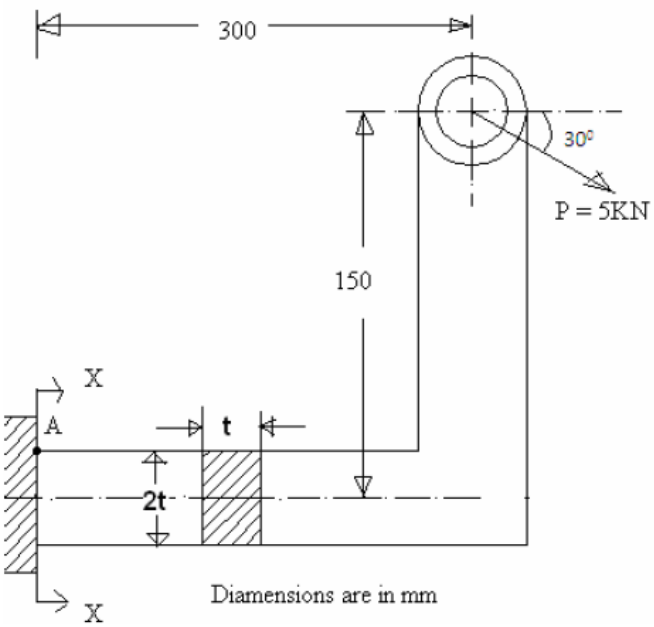
Section-B Numerical type Questions

1. Determine the principals Stresses for 35mm rod diameter supported at end act as cantilever beam which is subjected to an axial compressive load of 15KN & twisting moment of 250Nm.
2. Determine the thickness of a 120 mm wide uniform plate for safe continuous operation of the plate is to be subjected to tensile load that has maximum value of 250 KN and minimum value of 100 KN. The properties of the plate material are as follows:
   Endurance limit=225 N/mm^2,
   Yield point stress=300 N/mm^2,
   Factor of safety=1.5
3. A 'C' Frame of the press takes a load of 100 kN at an eccentricity of 250 mm. Frame has 'I' Cross section with 't' as a thickness, '6t' depth and '3t' as width. Permissible tensile stress for frame material is 100 MPa. Determine the cross-sectional dimensions of the frame.
4. A mild steel link is as shown in Fig., which is subjected to a tensile load
   of 80 kN. Find the b. The permissible tensile stress is 70 MPa.



5. A wall bracket with rectangular cross section is shown in Fig. The depth of the cross-section is

twice of the width. The force P acting on the bracket at 300 to the horizontal is 5 KN. The bracket is made gray cast iron FG 200 (S_{ut} = 200 N/mm^2) and factor of safety = 3.5 Determine the dimensions of the cross section of the bracket.

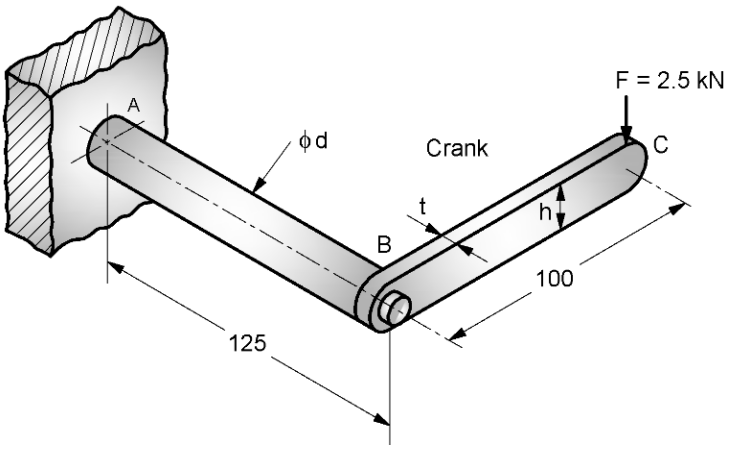


6. Fig. shows a bracket subjected to a force of 2.5 kN. A circular rod AB of bracket is fixed to a plate at A and rectangular lever BC is Ficed to the rod at B. The bracket as well as rod are made of plain carbon steel. Design the diameter 'd' of the rod and the rectangular cross-section of lever BC, using follwing data:

i.) b/t =5,

ii.) Permissible tensile stress for bracket material = 80 N/mm^2.

iii) Permissible shear stress for bracket material = 55 N/mm^2



MACHINE DESIGN & INDUSTRIAL DRAFTING
SUBJECT CODE :- 2141907

TUTORIAL -02
Application Problems

Section-A Descriptive type Questions

1. Explain procedure to design cotter joint
2. State the different applications of the Knuckle joint.
3. Distinguish between cotter joint and knuckle joint.
4. Explain the basic types of levers with the help of neat sketches & examples.
5. Define following :
   (1) Arm of lever,
   (2) Leverage,
   (3) Displacement ratio
   Differentiate between simple and compound lever.
6. What is lever? Why they are usually made tapered?

Section-B Numerical type Questions

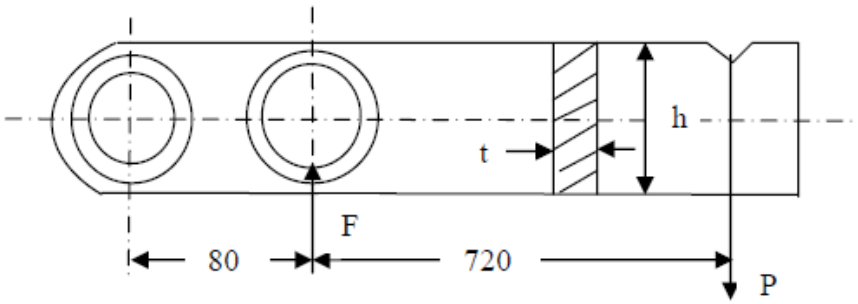
1. Design and draw a neat sketch of spigot rod for the cotter joint using the following data..
   Axial load 30 KN Tensile stress = 50 N/mm^2 Crushing Stress = 90 N/mm^2 And Shear Stress = 35 N/mm^2
2. Two rods of 50 mm diameter are to be joined by a cottered joint ,with thickness of cotter as 12.5mm. If the joint is withstand an axial pull of 6000 KN find the various dimensions required. The permissible stresses are 300 N/mm^2 in tension,200 N/mm^2 in shear and450 N/mm^2 crushing.
3. Design a knuckle joint to connect two mild steel bars under a tensile load of 25 kN. The allowable stresses are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing. Standard diameter of solid bars are 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40 mm. Check failure of knuckle pin in shear, failure of rod end & forked end in tension, shearing and crushing.
4. Design a knuckle joint for a tie rod of a circular section to sustain a max. pull of 70kN. The ultimate strength of the material of the rod against tearing is 420N/mm2. The ultimate tensile and shearing strength of the pin material are 510 N/mm^2 and 396 N/mm^2 respectively. Determine the tie rod section and pin section . Take F.S.=6
5. A lever loaded safety valve is 70 mm in diameter and is to be designed for a boiler to blow-off at pressure of 1 N/mm2 gauge. Design a suitable mild steel lever of rectangular cross-section. The permissible stresses are: Tensile stress = 70 MPa; Shear stress = 50 MPa; Bearing pressure intensity = 25 MPa. The pin is also made of mild steel. The distance from fulcrum to weight of lever is 880 mm and distance between fulcrum and pin connecting valve spindle links to lever is 80 mm.

MACHINE DESIGN & INDUSTRIAL DRAFTING
SUBJECT CODE :- 2141907

6. Bell crank lever is to be designed to raise a load of 5KN at the short arm end. The arm lengths are 150 mm and 500 mm. The permissible stresses for lever and pin materials in shear and tension are 60 MPa and 90 MPa respectively. The bearing pressure on the pin is to be limited to 12 MPa. Assume the lever cross

section as t x 4t and fulcrum pin length as 1.25 times pin diameter

7. The lever of a lever loaded safety valve shown in Fig. The diameter of the valve is 80 mm and valve has to blow off at a pressure of 1.25 MPa. The permissible stress in tension, shear and crushing are 70 MPa, 20 MPa and 50 MPa respectively. The permissible bearing pressure for the pin may be taken as 20 MPa. Design the pins and the lever; assume rectangular cross section of the lever with height equal to three times the thickness.



MACHINE DESIGN & INDUSTRIAL DRAFTING
SUBJECT CODE :- 2141907

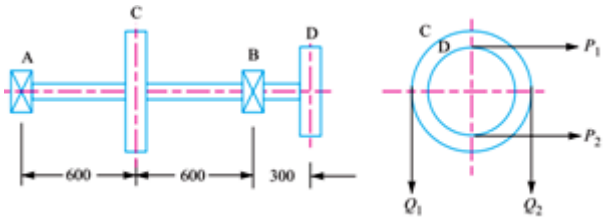
TUTORIAL -03
Shafts, Keys and Couplings

Section-A Descriptive type Questions

1. Explain functions and classification of shaft.
2. Compare the weight, strength and rigidity of a hollow shaft of same external diameter as that of solid shaft, Both the shaft are made of same material. Assume that the diameter ratio for the hollow shaft as 0.6.
3. What do you understand by tensional rigidity and lateral rigidity?
4. What are the basic functions of the key? What is splined shaft?
5. State the difference between shaft, axle and spindle.
6. What are the different types of sunk key? Explain each with application.
7. Differentiate between flexible coupling and rigid coupling? State the different applications of coupling?

Section-B Numerical type Questions

1. Find the diameter of a solid shaft to transmit 30 kw at 230 rpm.The shear stress is 50 MPa. If a hollow shaft is to be used in place of solid shaft , find the inside and outside diameter when the ratio of inside to outside diameter is 6:8.
2. A 45mm diameter shaft is made of steel with a yield strength of 400 N/mm^2. A parallel key of size 14 mm wide and 9 mm thick made of steel with a yield strength of 340 N/mm^2 is to be used. Find the required length of key, if the shaft is loaded to transmit the max. permissible torque. Use max. shear stress theory and assume F.O.S. = 2
3. A 600 mm diameter pulley transmits 16 kW power at a speed of 400 rpm. Pulley is cantilever at a distance of 200 mm from the nearest bearing. The weight of the pulley is 1500 N. It is driven by a horizontal belt drive. The co-efficient of friction between belt and pulley is 0.3 and the angle of lap 180^0. Take the fatigue and shock factors as Kb = 2.0 and Ks = 1.5. Determine the shaft diameter.
4. A horizontal shaft AD supported in bearings at A and B and carrying pulleys at C and D is to transmit 75 kW at 500 r.p.m. from drive pulley D to off-take pulley C, as shown in Fig. Calculate the diameter of shaft. The data given is : P1 = 2 P2 (both horizontal), Q1 = 2 Q2 (both vertical), radius of pulley C = 220 mm, radius of pulley D = 160 mm, allowable shear stress = 45 MPa.



5. The shaft and the flange of a marine engine are to be designed for flange coupling in which the

flange is larger at the end of the shaft.

Power of the engine = 3mw

Speed of the engine = 100r.p.m.

Permissible shear stress in bolts and shafts = 60 N/mm^2

No. of bolts used = 8

Pitch circle dia. of bolts = 1.6* dia. Of shaft

Find (1) Dia. Of shaft

(2) Dia. Of bolt

(3) Thickness and dia. Of flange.

6. Design and draw a rigid type cast iron flange coupling for a steel shaft transmitting 15 KW at 200 rpm and having an allowable shear stress of 40 KN/mm^2. The maximum torque is 25% greater than the full load torque. The working stress in the bolt should not exceed 30 KN/mm^2. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The shear stress for cast iron is 14 KN/mm^2.

7. Design a split muff coupling to transmit 30 KW power at100 rpm, using the following data.
Number of bolts = 4, allowable shear stress for shaft and key = 40 N/mm^2, allowable tensile stress for the blots = 70 N/mm^2. Take co-efficient of friction = 0.3.

MACHINE DESIGN & INDUSTRIAL DRAFTING
SUBJECT CODE :- 2141907

TUTORIAL -04
Beams and Columns

Section-A Descriptive type Questions

1. Distinguish between beams, columns and strut giving suitable examples.
2. What is slenderness ratio of column? How crippling stress is decided by using Euler's equations? Give the validity of the equation.
3. Explain Rankine's and Johnson's formula for designing columns.

Section-B Numerical type Questions

1. An I section 500 mm x 250 mm x 10 mm and 8 m long is used as a column. Both the ends of column are fixed. Take young's modulus E = 200 x 10^3. Find Eule's critical load.
2. A connecting rod of uniform rectangular cross-section having b/d ratio of 1.5 and length 100 mm is used for supporting an axial compressive load of 20 kN. It is hinged at both ends and made of alloy steel with ultimate compressive strength of 700 MPa and modulus of elasticity of 210 GPa. Considering factor of safety 4, determine cross-sectional dimensions using appropriate of Euler's and Johnson's formulae.
3. A 300 mm long alloy steel rod is used to support an axial compressive load of 65 kN. One end of rod is fixed and the other end is free to support load. Assuming compressive yield strength 550 N/mm2 and modulus of elasticity 210 GPa, determine diameter of rod by buckling consideration. Use Rankine's formula with Rankine constant $\alpha = 1/7500$. Take factor of safety 3.5.

MACHINE DESIGN & INDUSTRIAL DRAFTING
SUBJECT CODE :- 2141907

TUTORIAL -05
Power Screws and Threaded Joints

Section-A Descriptive type Questions

1. Define Pitch, Lead, Nominal diameter and Core diameter for power screw.

2. What is self-locking and over-hauling of power screw? Why the efficiency of self-locking square threaded screw is less than 50%?

3. Draw a neat sketch of turn buckle used for tie rods, giving design procedure.

Section-B Numerical type Questions

1. Calculate required height of the nut for simple screw jack from the following data.
(1)The load to be lifted W is 150KN.
(2)Compressive stress $\sigma c=125/mm^2$
(3)Bearing pressure $18N/mm^2$ for nut.

2. Determine the ratio of torque required to raise and lower the load from the following data.
Load=20KN,
Pitch=8mm,
Dia. Of screw=40mm,
coefficient of friction=0.1

3. The nominal diameter of a triple threaded square screw is 50 mm, while pitch is 8 mm. It is used with a collar having outer diameter of 100 mm and inner diameter of 65 mm. The coefficient of friction at thread surface as well as at collar surface can be taken as 0.15. The screw is used to raise a load of 15 kN. Using uniform wear theory for collar friction, calculate:
(i) Torque required to raise load,
(ii) Torque required to lower load and
(iii) Force required to raise load, if applied at a radius of 500 mm.

4. A bracket is bolted to column by 6 bolts arrange in two column. The distance between bolts along the row is 75mm and along the column 50mm. The joint is subjected to maximum eccentric force of 50KN acting at 150mm away from the centre of column. Taking allowable stress in the bolt as $150N/mm^2$, Determine the size of each bolt.

5. Design and draw a turnbuckle for a capacity of 40 kN, which is used for adjusting tension in a v-belt drive of a machine tool. The permissible stresses for rods and nut are 80 MPa in tension, 50 MPa in shear and 80 MPa in crushing.

6. The lead screw of a lathe machine has single start trapezoidal threads of 52 mm nominal diameter and 8 mm pitch. The screw is required to exert an axial force of 2 kN in order to drive the tool carriage, during turning operation. The thrust is carried on a collar of 100 mm outer diameter and 60 mm inner diameter. The values of co-efficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 rpm. Calculate
(i) The power required to drive the lead screw.
(ii) The efficiency of the screw.

MACHINE DESIGN & INDUSTRIAL DRAFTING
SUBJECT CODE :- 2141907

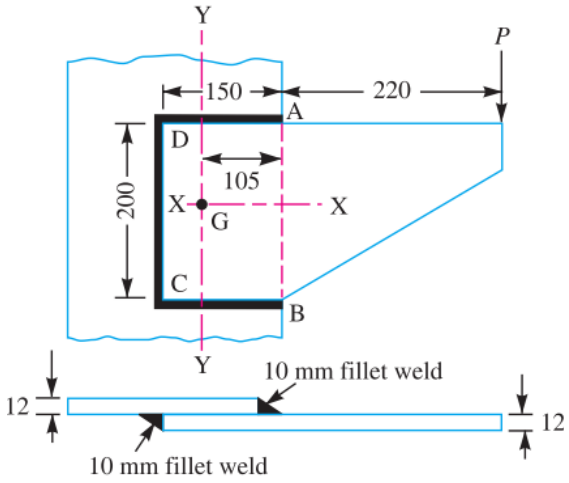
TUTORIAL -06
Welded & Riveted joints

Section-A Descriptive type Questions

1. Explain the following terms related to riveted joints:
   (i) pitch (ii) diagonal pitch (iii) margin (iv) back pitch
2. Explain caulking and fullering in riveted joint.
3. Which kinds of stresses are induced in welded butt joint?
4. Deduce the design equation for circular fillet weld subjected to torsion.
5. What do you mean by eccentric loaded welded joint? Write the detail design procedure for designing such a joint.
6. Draw neat sketch of Double riveted zig-zag butt joint with all terminology.

Section-B Numerical type Questions

1. A solid rectangular bar of 100 mm width and 150 mm depth is welded to vertical column by means of fillet weld all around. The joint is subjected to 25KN at distance of 500mm from the plane of weld . Determine throat thickness using allowable stress of weld is 75N/mm^2.
2. A bracket is welded to the side of a column and carries a vertical load P, as shown in Fig.
   Evaluate P so that the maximum shear stress in the 10 mm fillet welds is 80 MPa.



3. A circular shaft, 75 mm in diameter, is welded to the support by means of a circumferential fillet weld. It is subjected to a torsional moment of 3000 N-m. Determine the size of weld, if the maximum shear stress in the weld is not to exceed 70 N/mm^2.
4. Explain the important terminology of riveted joints and find the efficiency of the double riveted lap joints with zig-zag riveting is to be designed for 13 mm thick plates. Assume 80 MPa, 60 MPa and 120 MPa in tension, Shear and crushing respectively. Also calculate pitch of rivets.
5. Two steel plates, 120 mm wide and 12.5 mm thick, are joined together by means of double

transverse fillet welds. The maximum tensile stress for plates and welding materials should not exceed 110 N/mm^2. Find required length of weld, if strength of weld is equal to strength of plates.

6. Design a double riveted zigzag lap joint for 13 mm thick plates. The allowable stresses are: σt = 80 MPa, τ = 60 MPa and σc = 120 MPa. State how the joint will fail and find efficiency of joint.

7. A double riveted double cover butt joint in plates 20mm thick is made with 25mm dia. Rivets at 100mm pitch. The permissible stress are ft=120 N/mm^2, Shear stress= 100 N/mm^2,fc= 150 N/mm^2. Find the Efficiency of joint, taking the strength of the rivets in double shear as twice than that of single shear.

8. A bracket is subjected to a load of 32 kN which is joined to a structure by means of 8 numbers of rivets as shown in Fig. Find the size of the rivets if the permissible shear stress is 80 MPa.