TUTORIAL-BEAMS & COLUMNS.

Compare the ratio of strength of a solid steel column to that of a hollow column of internal diameter equal to 3/4th of its external diameter. Both the columns have the same cross-sectional areas, lengths and end conditions. **[Ans. 25/7]**

Determine the diameter of the pistion rod of the hydraulic cylinder of 100 mm bore when the maximum hydraulic pressure in the cylinder is limited to 14 N/mm^2. The length of the piston rod is 1.2 m. The factor of safety may be taken as 5 and the end fixity coefficient as 2. **[Ans. 45 mm]**

Determine the dimensions of an *I*-section connecting rod for an internal combustion engine having the following specifications :

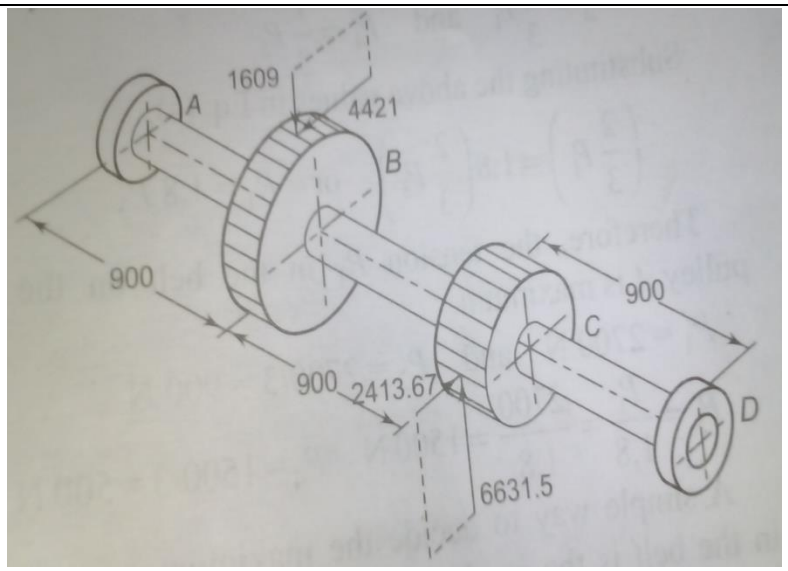
Diameter of the piston	= 120 mm
Mass of reciprocating parts piston	= 350 kg/m^2 of area
Length of connecting rod	= 350 mm
Engine revolutions per minute	= 1800
Maximum explosion pressure	= 3 N/mm^2
Stroke length	= 180 mm

The flange width and the depth of the *I*-section rod are in the ratio of 4 *t* : 6 *t* where *t* is the thickness of the flange and web. Assume yield stress in compression for the material as 330 MPa and a factor of safety as 6. **[Ans. *t* = 7.5 mm]**

It is required to design the piston rod of a steam engine on the basis of buckling strength. The internal diameter of the cylinder is 200 mm, while the operating steam pressure is limited to 1 N/mm^2. The length of the piston rod is 1 m. One end of the piston rod is fixed in the piston, while the other can be considered as hinged. The piston rod is made of steel 40C8 (S_{yt} = 380 N/mm^2 and E = 207 000 N/mm^2). The factor of safety is 5. Neglecting inertia forces, determine the diameter of the piston rod.

[29.97 mm]

Consider the forces acting on the intermediate shaft of a gear box as shown in figure. The maximum permissible radial deflection at any gear is limited to 1 mm. take E= 207 GPa. Find the diameter of the shaft on the basis of strength and lateral rigidity.



In a screw jack, one end of the screw is fixed in the nut and the other end supports a load of 10 kN. The length of the screw between the nut and the free end is 500 mm, when the load is completely raised. The screw is made of steel 40C8 ($S_{yt} = 380$ N/mm^2 and $E =$ 207 000 N/mm^2). The nominal diameter and the pitch of the screw are 30 mm and 6 mm respectively. The screw has square threads. Determine the factor of safety from buckling considerations.

[3.33]

The link of a mechanism is subjected to an axial compressive force. It has solid circular cross-section with diameter of 6 mm and length of 300 mm. The two ends of the link are hinged. It is made of steel 30C8 ($S_{yt} = 400$ N/mm^2 and $E = 207\,000$ N/mm^2). Assuming a factor of safety of 3.5, determine the safe axial force that the link can carry without buckling.

[412.6 N]

Example 9.27 *A transmission shaft with a uniformly distributed load of 10 N/mm is shown in Fig. 9.48(a). The maximum permissible deflection of the shaft is (0.003L), where L is the span length. The modulus of elasticity of the shaft material is 207 000 N/mm^2. Determine the shaft diameter by Castigliano's theorem.*