Problem of Practices
on
Mechanical Engineering Design
Chapter-18 Design of IC Engine Components

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1. An automobile engine has a bore of 150 mm and stroke of 150 mm. It is expected that the engine would develop a maximum pressure of 32.0 kg/cm^2 and the engine would run at a speed of 1100 r.p.m. The connecting rod length to crank radius ratio is 5.0. Find the dimensions of the I-section connecting rod to be used for a safety factor of 8 and made of medium carbon steel. The I-section cross-section be taken as $6t \times 4t$, where t = flange and wed thickness. Assume that the yield strength of steel is 3500 kg/cm^2 and $E = 2.0 \times 10^6$ kg/cm^2.
Weight of the reciprocating parts of the engine = 0.03 kg/cm^2 of piston area. Any data not given-can be assumed suitably.

2. Design a flywheel for a single cylinder four-stroke diesel engine, made of cast iron, whose allowable strength is 20 MN/m^2, The engine is running at a speed of 1400 r.p.m. and producing 5 kW of power. Maximum peripheral speed of the flywheel may be up to 24 m/sec. Coefficient of fluctuation of energy may be taken as 2.2 and coefficient of speed fluctuation as 0.015. Density of cast iron may be taken as 7000 kg/m^3.

(The effect of overhang of the flywheel on the end may be neglected.)

3. An equal angle section 100 mm × 100 mm × 8 mm is welded to a gusset plate to serve as a tension member. Calculate the minimum amount of overlapping by the angle section on the gusset plate with a view to limit the induced stress to 100 mega pascal in the angle section when only the side welds are used. The effective area of angle may be taken as the area of the connected leg plus half the area of the unconnected leg. The safe stress in the weld is 90 mega pascal and the shock factor is 1.5.

4. Data given below refer to a single cylinder 4-stroke I.C. engine.
Find the suitable dimensions of cross-section of the connecting rod under gas load and check the design under inertia load due to the self-weight of the connecting rod OR find the suitable dimensions of crank web of a centre crank for the engine.
Cylinder diameter = 110 mm, Stroke = 160 mm, Power = 10 kW at 800 rpm, Max. explosion pressure = 2.2 MPa (22 kgf/cm^2) at TDC, Length of connecting rod = 360 mm, At max. torque position gas pressure = 1.2 MPa (12 kgf/cm^2) at θ = 40°, Mass of reciprocating parts = 2 kg, Density of connecting rod material = 7.2 kg per 1000 cm^3.
Draw neat sketch, wherever necessary.

5. A connecting rod is required to be designed for a high speed, four stroke I.C. engine. The following data are available.
Diameter of piston = 88 mm.
Mass of reciprocating parts = 1.6 kg
Length of connecting rod (centre to centre) = 300mm
Stroke = 125 mm
R.P.M. = 2200 (when developing 50kw)
Compressing ratio = 6.8:1 (approximately)
Probable maximum explosion pressure (assumed shortly after dead centre, say at about 3°) = 3.5 N/mm^2.

6. Determine the thickness of a cast iron cylinder wall and the stresses for a 250 mm petrol engine with a maximum gas pressure of 3.0 N/mm^2. Take the reboring factor for the cylinder wall as 7.5 mm and Poisson ratio as 0.25 for cylinder material. Take maximum hoop stress as 45 MPa for the material.

7. The cylinder of a slow speed steam engine is 250 mm diameter and the steam pressure 1 N/mm^2. The piston rod length is 1000 mm and the connecting rod is 1.2 m long. The engine stroke is 550 mm. Determine the dimensions of the cross section of the connecting rod assuming the depth to be twice as thickness and a suitable diameter for the piston rod.

8. Design a cast iron piston for a single acting four stroke engine for the following data:
Cylinder bore = 100 mm; Stroke = 125 mm; Maximum gas pressure = 5 N/mm^2; Indicated mean effective pressure = 0.75 N/mm^2; Mechanical efficiency = 80%; Fuel consumption = 0.15 kg per brake power per hour; Higher calorific value of fuel = 42 × 10^3 kJ/kg; Speed = 2000 r.p.m. Any other data required for the design may be assumed.

9. The bore of a cylinder of the four stroke diesel engine is 150 mm. The maximum gas pressure inside the cylinder is limited to 3.5 Mpa. The cylinder head is made of grey cast iron FG 200 (σ_{ut} = 200 N/mm^2) and the FOS is 5. Determine the

thickness of the cylinder head. Studs is made of steel FeE 250 (σ_{yt} = 250 N/mm^2) and the FOS is 5. Calculate:

(i) Number of studs.
(ii) Nominal diameter of studs.
(iii) Pitch of studs