Problem of Practices
on
Mechanical Engineering Design
Chapter-15 Power Screws

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1. An electronic motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 30 cm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm Coefficient of friction at screw threads is 0.10. Estimate power of the motor.

2. A single start square thread screw clamp is to be designed for a compressive load of 20 kN. The pad offers a friction torque of 30 Nm Calculate
    (i)   the pitch and diameter of the screw;
    (ii)   height of the nut; and
    (iii)   dimensions of the tommy bar operating the screw.
    Assume Maximum force at the end of the tommy bar = 250 N.
    Safe compressive stress for the screw = 100 MPa.
    Safe bearing pressure for the screw and nut = 8 MPa.
    Safe bending stress in the handle = 95 MPa.
    Coefficient of screw thread friction = 0.15.

3. The screw of a car lift has 150 mm dia. with square threads of 50 mm pitch and lead of 100 mm. Assume 1000 N is required for lifting of the car and thread friction coefficient is 0.20.

      (i)   Compute the torques required to rotate the screw to raise the car and lower the car. Also compute the overall efficiency of the screw.

      (ii)   What is the flaw in the above design?

4.   Two railway coaches are coupled with the help of two tie rods of a turn buckle with right and left handed threads having single-start square threads. Pitch and mean diameter of the threads are 8 mm and 30 mm respectively. How much energy will be spent in bringing two coaches closer through a distance of 320 mm against a steady load of 5.0 kN. Use coefficient of friction in screw thread and coupler nut as 0.12. Determine shear stress on the tie rod due to above torque.

5.   The following particulars refer to a screw jack:

Vertical load on the screw $W = 20,000$ N,

Force applied at the lever end whose length $l = 80$ cm,

Mean radius of the screw $r = 2.5$ cm,

Pitch of the screw $p = 1$ cm,

Mean radius of contact surface between swivel & head $r_m = 4$ cm,

Coefficient of friction between screw thread and bearing $\mu' = 0.15$,

Coefficient of friction between the swivel head and bearing $\mu = 0.1$.

Determine:

(i)   The force on the lever end required while raising and lowering the load.

(ii) The efficiency of the screw jack in both cases.
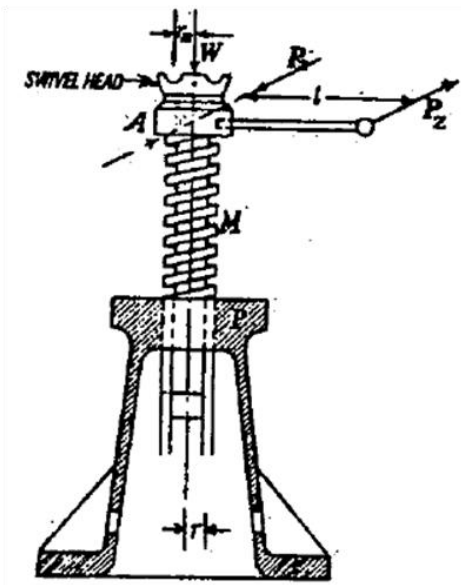
6.   A power screw is made with ACME threads 34 mm-6 mm, single start to lift and lower a load of 10 kN. The screw and nut are well lubricated. Sliding friction is 0.15 and rolling friction is 0.02. Take semi thread angle as 14.5°. Determine:

      (i)   Raising torque.

      (ii)   Lowering torque.

      (iii)   Efficiency of the power screw.

7.   It is required to design a flypress, as shown in the figure, that is capable of punching 50 mm diameter circles from a 1.5 mm thick mild steel sheet. The ultimate shear strength of the sheet metal is 375 N/mm² and it can be assumed that shearing will be complete when the punch penetrates through half the thickness of the sheet. The screw, with square threads, is made of bronze. The factor of safety is 3. The total working stroke consists of a one quarter revolution, 45° in

front of the press and 45° behind the press. During the return stroke, the punch is raised by 5 mm to provide clearance to insert the sheet. The forward or working stroke is completed in 1 sec. The balls are made of cast iron, with a mass density of 7280 kg/m³ and the radius R_m is 500 mm.

Neglecting collar friction, calculate:
(i)   The dimensions of the screw,
(ii)   The length of the nut and
(iii)   The size of the balls.