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DESIGN OF MACHINE MEMBERS UNDER SIMPLE STRESS

Bending moment

A **bending moment** is the reaction induced in a structural element when an external force or moment is applied to the element causing the element to bend. The most common or simplest structural element subjected to bending moments is the beam.

For bending moment (one force applicable)

$$\text{Stress, S} = \frac{Mc}{I}$$

Here,

M = Bending moment

C = Distance from the neutral plane to a point on the tensile side =

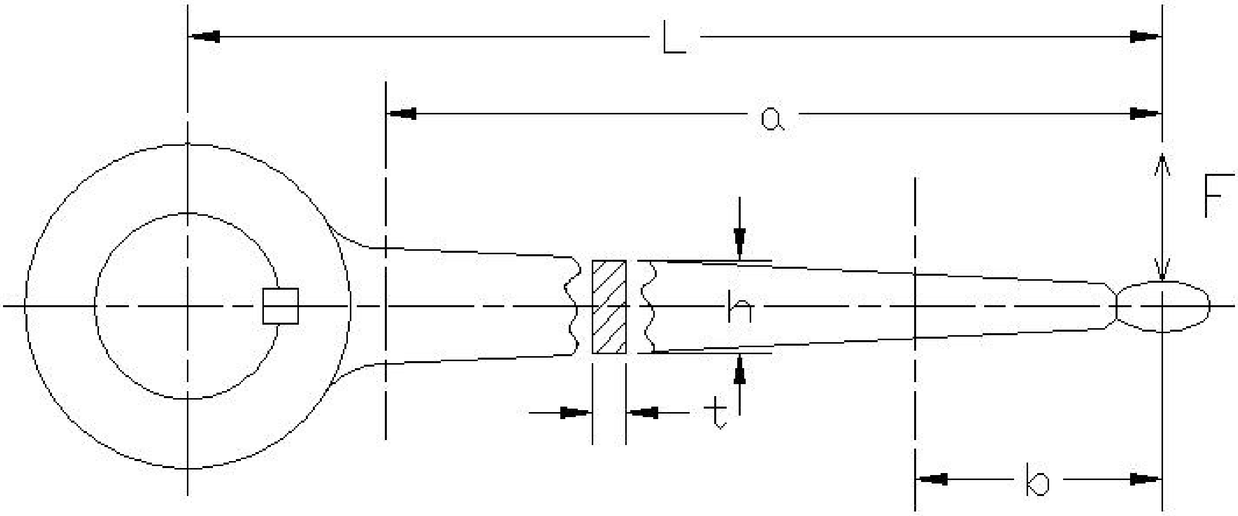
I = Moment of inertia

Moment of inertia

- The moment of inertia, otherwise known as the angular mass or rotational inertia, of a rigid body is a tensor that determines the torque needed for a desired angular acceleration about a rotational axis.

- Torque, moment, or moment of force is rotational force.

Problem: A lever keyed to a shaft is *L =15 in long and has a rectangular cross section of h = 3t . A 2000-lb load is gradually applied and reversed at the end as shown; the* material is AISI C1020, as rolled. Design for both ultimate and yield strengths. (a) What should be the dimensions of a section at *a =13 in? (b) at b = 4 in ?*



Solution:

For AISI C1020, as rolled, Table AT 7

$s_u = 65\ ksi$

$s_y = 49\ ksi$

Design factors for gradually applied and reversed load

$N_u = 8$

$N_y = 4$

$I = \frac{th^3}{12}$, moment of inertial

but $h = 3t$

$I = \frac{h^4}{36}$

Based on ultimate strength

$$s = \frac{s_u}{N_u}$$

(a) $s = \frac{Mc}{I} = \frac{Fac}{I}$

$$c = \frac{h}{2}$$

$$F = 2000\ lbs = 2\ kips$$

$$s = \frac{65}{8} = \frac{(2)(13)\left(\frac{h}{2}\right)}{\left(\frac{h^4}{36}\right)}$$

$$h = 3.86\ in$$

$$t = \frac{h}{3} = \frac{3.86}{3} = 1.29\ in$$

say

$$h = 4.5\ in = 4\frac{1}{2}\ in$$

$$t = 1.5\ in = 1\frac{1}{2}\ in$$

(b) $s = \frac{Mc}{I} = \frac{Fbc}{I}$

$$c = \frac{h}{2}$$

$$F = 2000\ lbs = 2\ kips$$

$$s = \frac{65}{8} = \frac{(2)(4)\left(\frac{h}{2}\right)}{\left(\frac{h^4}{36}\right)}$$

$$h = 2.61\ in$$

$$t = \frac{h}{3} = \frac{2.61}{3} = 0.87\ in$$

say

$$h = 3\ in$$

$$t = 1\ in$$

Based on Yield Strength:

Assignment.