Today:

Area moment of Inertia: Steiner theorem

Mass moment of Inertia

Internal forces

Book: Chapter 10.1,10.2,10.4, 7.1-7.3 + hand outs

Steiner theorem:

Allows you to calculate moment of inertia about another axis than through the centroid

$$I_x = \bar{I}_x + Ad_y^2$$

$$I_y = \bar{I}_y + Ad_x^2$$

$$J_0 = \bar{J}_0 + Ad^2$$

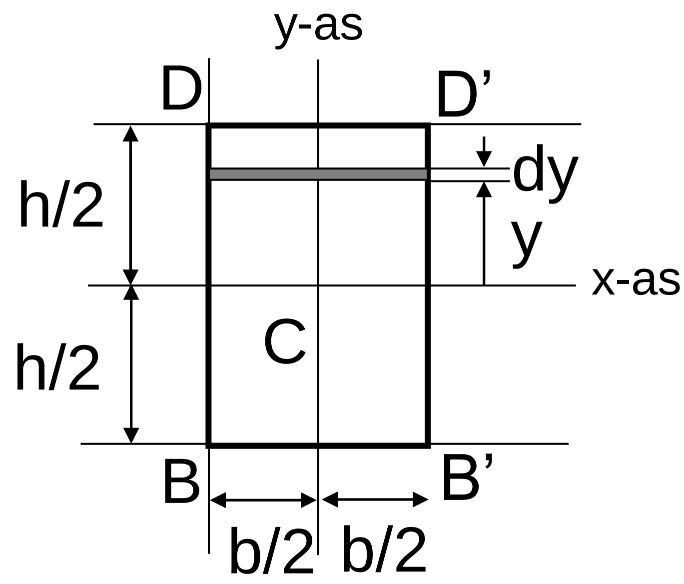
Rectangle

Calculate I_x

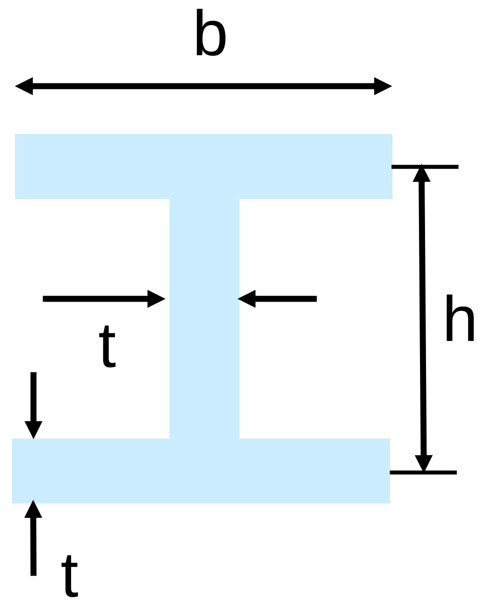
about B-B’ and D-D’

Calculate I_y

about B-D



Example: I-beam



Calculate

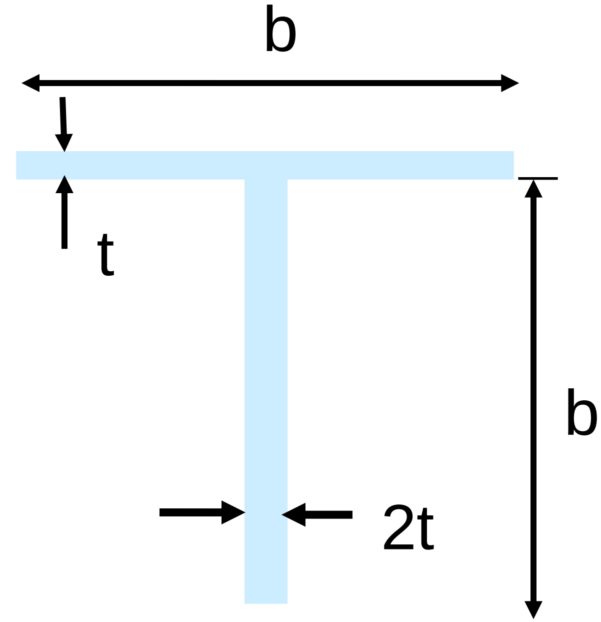
I_x & I_y about C.G.

Thin-walled structures:

- $t << h, b$

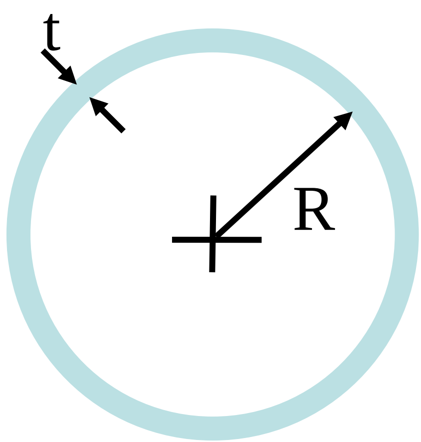
- all higher order terms of t **may be neglected**

Example: T-profile (thin-walled)



Example: Ring (thin-walled)

Calculate J_0

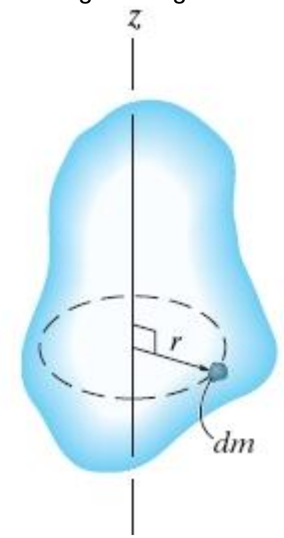


Source: R.C. Hibbeler,
"Engineering Mechanics – Statics"

Mass moment of Inertia

Defined as the integral of the second moment about an axis of infinitesimal elements of mass *dm* composing the body

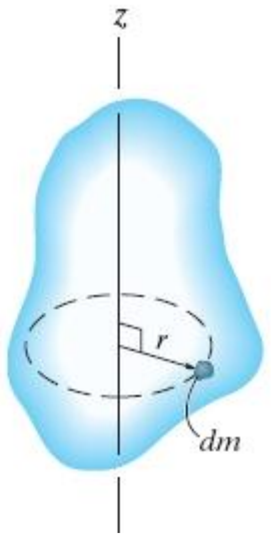
Resistance against *rotational acceleration*



Mass moment of Inertia

Source: R.C. Hibbeler, "Engineering Mechanics – Statics"

Mass moment of inertia about the z-axis is: $I = \int_m r^2 dm$



Unit: [kgm^2]

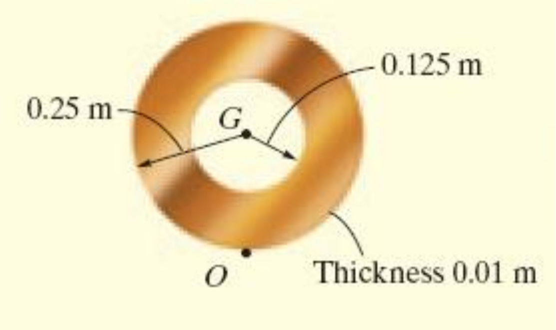
Steiner theorem: $I = I_G + md^2$

Source: R.C. Hibbeler, "Engineering Mechanics – Statics"

Example: Disc

ρ = 8000 kg/m^3
t = 10 mm

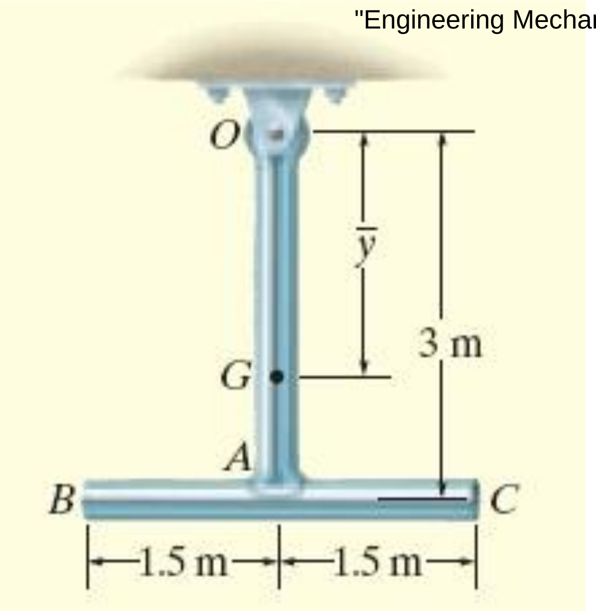
Calculate I_O



(a)

Source: R.C. Hibbeler,
"Engineering Mechanics – Statics"

Example: Pendulum made of two identical bars of 100 kg each.



Note:

At the exam the standard area and mass moments of inertia for circles, cylinders, rings, rectangles and triangles (area only) as well as the location of their centroids are expected to be known.

See last 2 pages of book

Internal forces

Calculate the internal forces in C.