Course Code: ESC106A
Course Title: Construction Materials and Engineering Mechanics

Lecture No. 41:
Determination of Moment of Inertia

Delivered By: Nimmy Mariam Abraham

Lecture Intended Learning Outcomes

At the end of this lecture, students will be able to:

- Determine the Moment of Inertia for different sections by integration method
- Apply parallel axis theorem for determination of MI

Contents

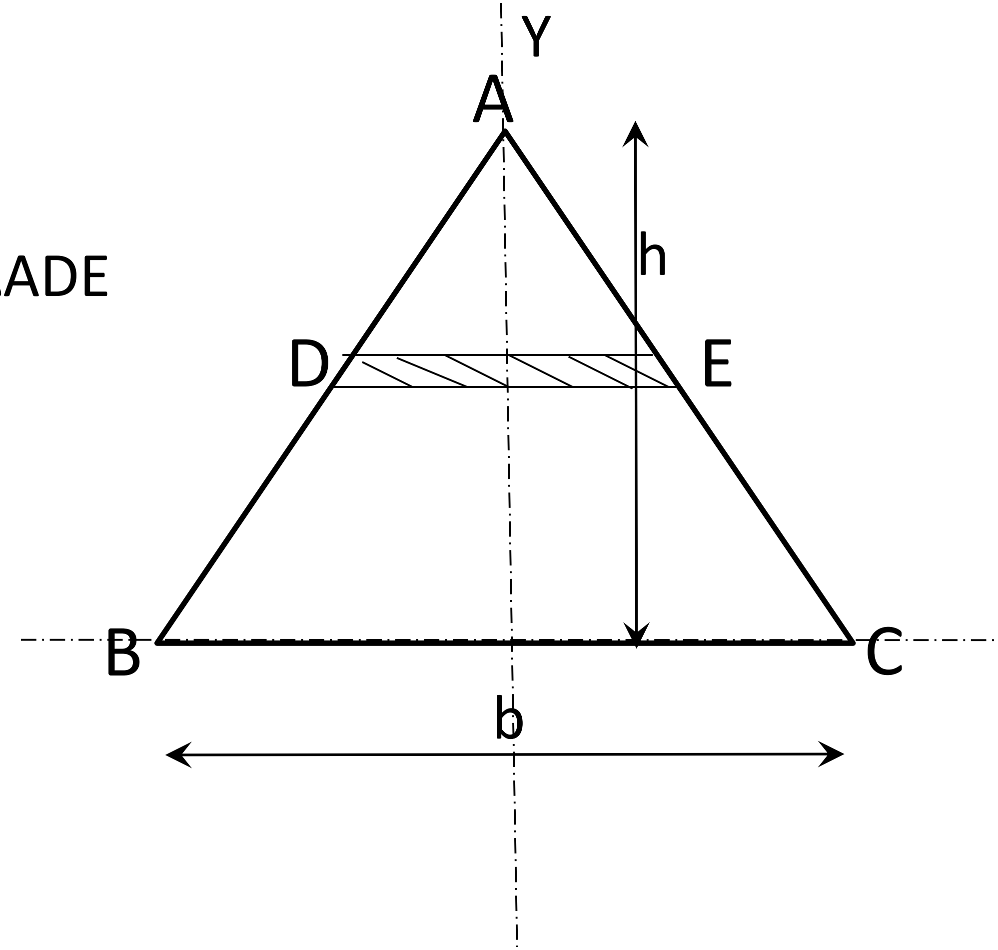
Moment of inertia of triangular section and uniform thin rod

Moment of Inertia of triangular section

Case 1: MI about the base

$$dA = DE.dy$$

Distance DE is obtained from ΔABC & ΔADE



$$\frac{DE}{BC} = \frac{y}{h}$$

$$DE = \frac{by}{h}$$

$$dA = \frac{by}{h}dy$$

Moment of Inertia of triangular section

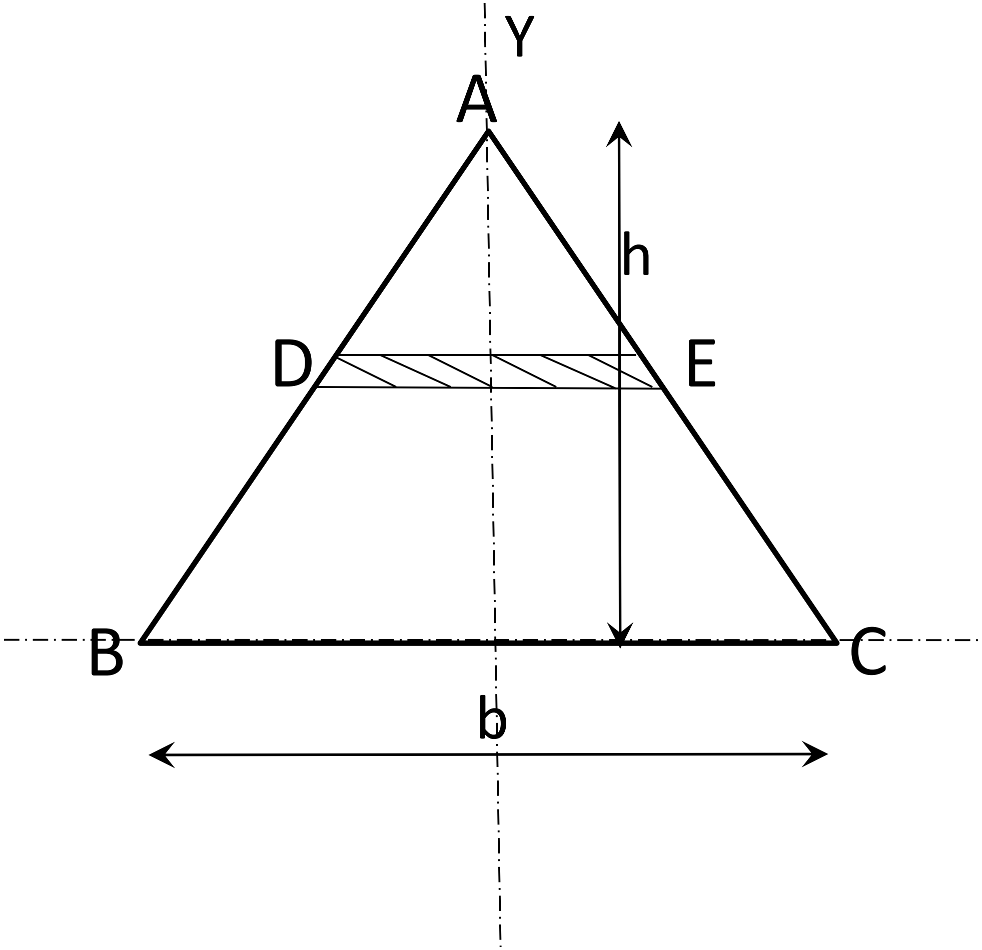
MI of the strip about the base

$$(I_{BC})_{DE} = \frac{by}{h} dy.(h-y)^2$$

$$I_{BC} = \int_0^h \frac{by}{h}[h-y]^2.dy$$

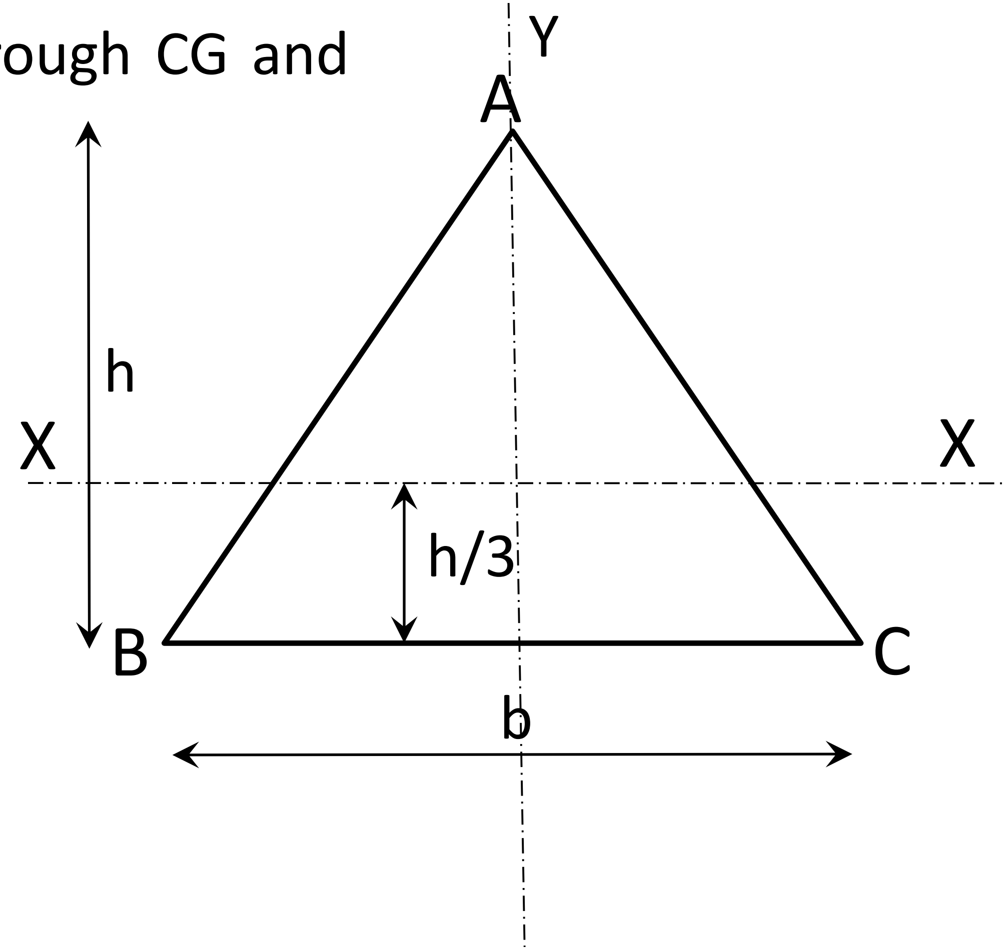
$$I_{BC} = \frac{b}{h}\int_0^h y\left[h^2 - 2hy + y^2\right]dy$$

$$I_{BC} = \frac{b}{h}.h^4\left[\frac{6+3-8}{12}\right] = \frac{bh^3}{12}$$



Moment of Inertia of triangular section

Case 2: MI about an axis passing through CG and parallel to base.



From parallel axis theorem,

$$I_{BC} = I_G + A\left(\frac{h}{3}\right)^2$$

$$I_G = I_{BC} - A\left(\frac{h}{3}\right)^2$$

$$I_G = \frac{bh^3}{12} - \frac{1}{2}bh\left(\frac{h}{3}\right)^2$$

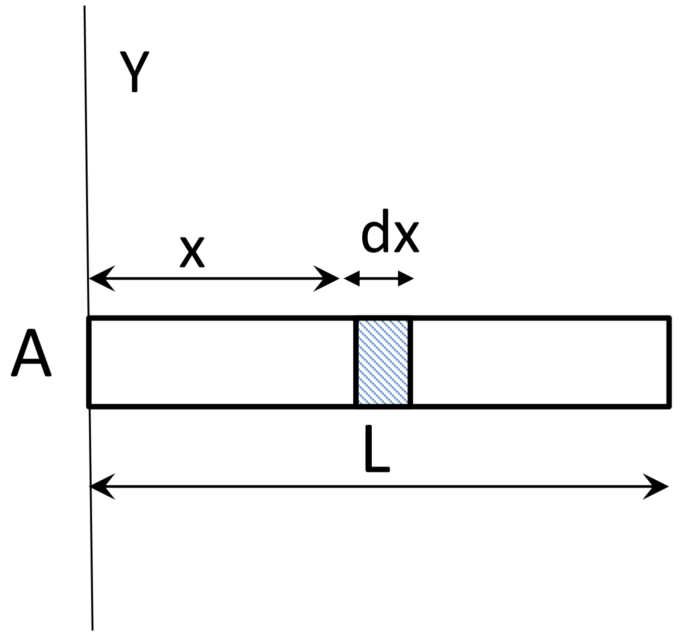
$$I_G = \frac{bh^3}{36}$$

Moment of Inertia of uniform thin rod

- Consider a uniform thin rod AB of length L.

If m is the mass per unit length of the rod,

- Total mass of the rod M = *m.L*



$$M_{strip} = m.dx$$

$$(I_{YY})_{strip} = mdx.x^2 = mx^2dx$$

$$I_{YY} = \int_0^L mx^2dx = \left[m\frac{x^3}{3}\right]_0^L = \frac{mL^3}{3}$$

$$I_{YY} = \frac{ML^2}{3}$$

Summary

- Moment of inertia of area (mass) of various sections about the considered reference axis is obtained by integration method.

- Parallel axis theorem is applied for finding out the moment of inertia of various sections.