

Announcements

- Cumulative exam continues (through Saturday, April 6)

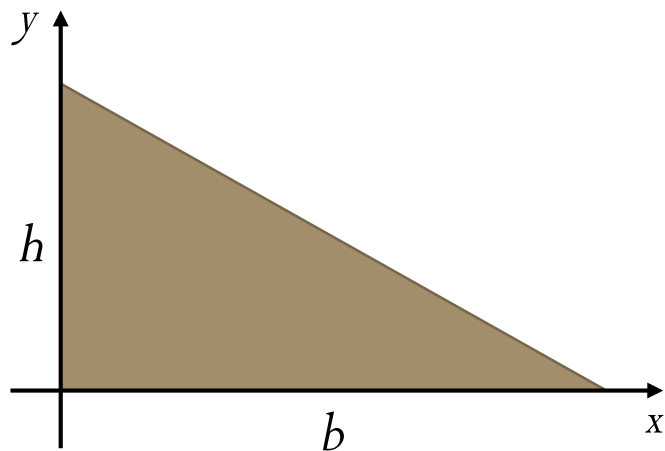
□ Upcoming deadlines:

- Tuesday (4/9): PL HW12

Objectives

- Composite body method for finding centroid.

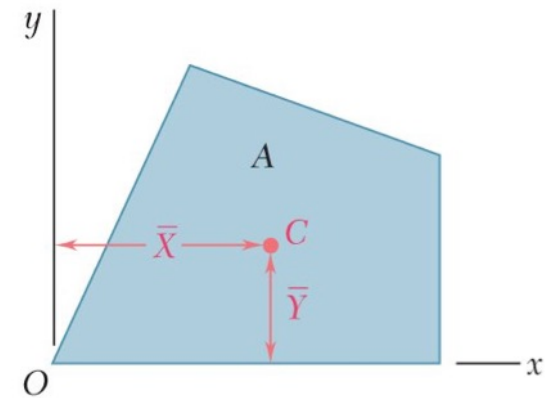
Determine the centroid of a triangle with a base of b and a height of h .



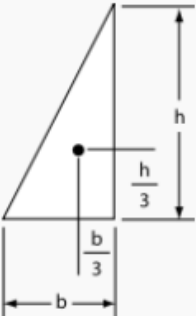
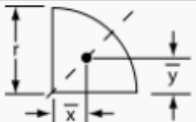

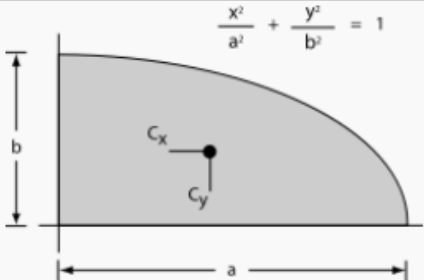
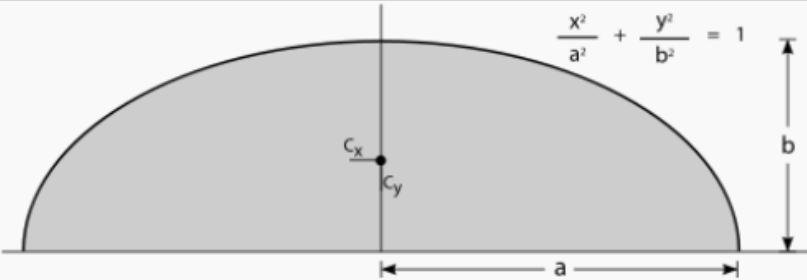
Composite bodies

A composite body consists of a series of connected simpler shaped bodies.

Such body can be sectioned or divided into its composite parts and, provided the weight and location of the center of gravity of each of these parts are known, we can then eliminate the need for integration to determine the center of gravity of the entire body.



Centroid of typical 2D shapes

Shape	Figure	\bar{x}	\bar{y}	Area
Right-triangular area		$\frac{b}{3}$	$\frac{h}{3}$	$\frac{bh}{2}$
Quarter-circular area		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$
Semicircular area		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$
Quarter-elliptical area		$\frac{4a}{3\pi}$	$\frac{4b}{3\pi}$	$\frac{\pi ab}{4}$
Semielliptical area		0	$\frac{4b}{3\pi}$	$\frac{\pi ab}{2}$

Composite bodies – Analysis Procedure

1. Divide the body into finite number of simple shapes
2. Consider “holes” as “negative” parts
3. Establish coordinate axes
4. Determine centroid location by applying the equations

$$\bar{x} = \frac{\sum \tilde{x}W}{\sum W}$$

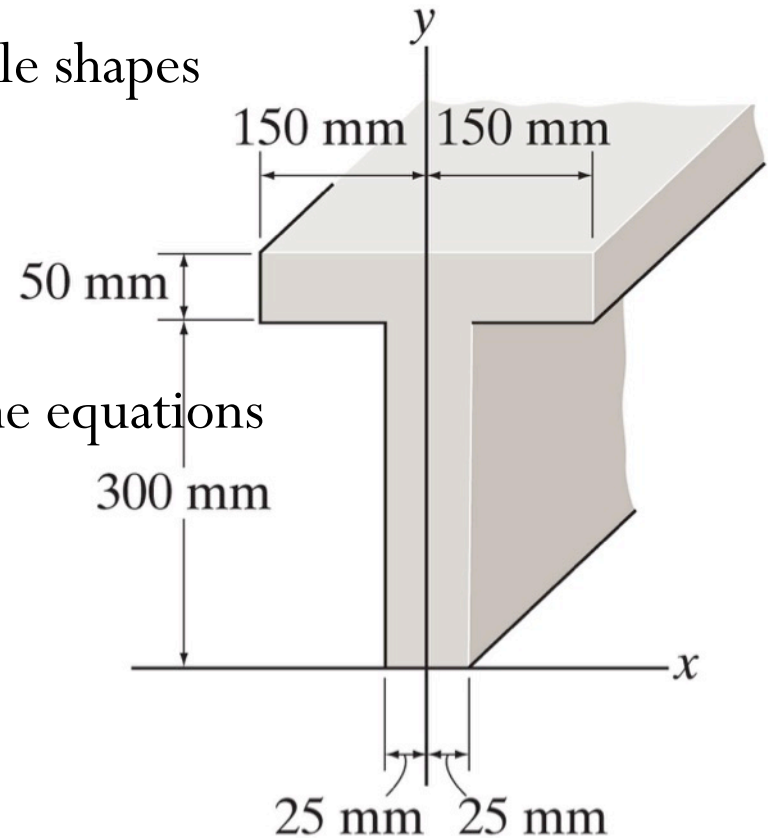
$$\bar{x} = \frac{\sum \tilde{x}A}{\sum A}$$

$$\bar{y} = \frac{\sum \tilde{y}W}{\sum W}$$

$$\bar{y} = \frac{\sum \tilde{y}A}{\sum A}$$

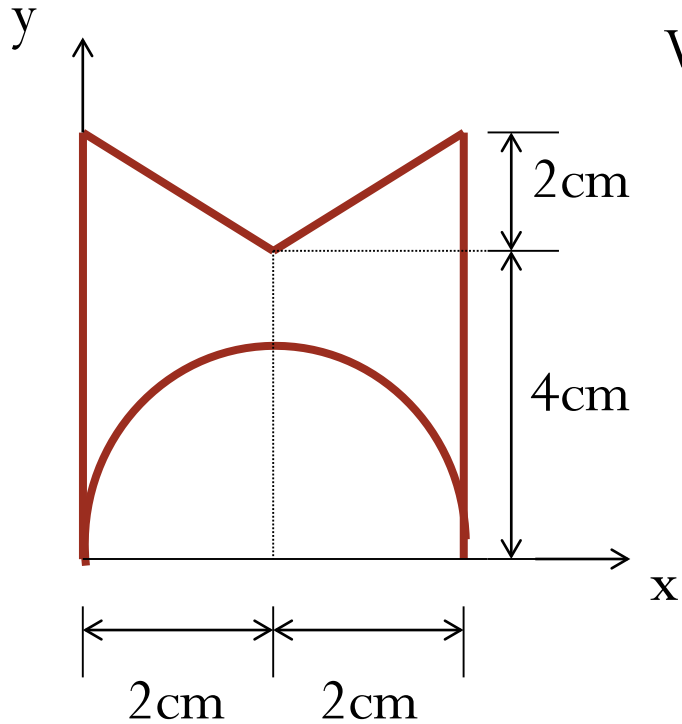
$$\bar{z} = \frac{\sum \tilde{z}W}{\sum W}$$

$$\bar{z} = \frac{\sum \tilde{z}A}{\sum A}$$



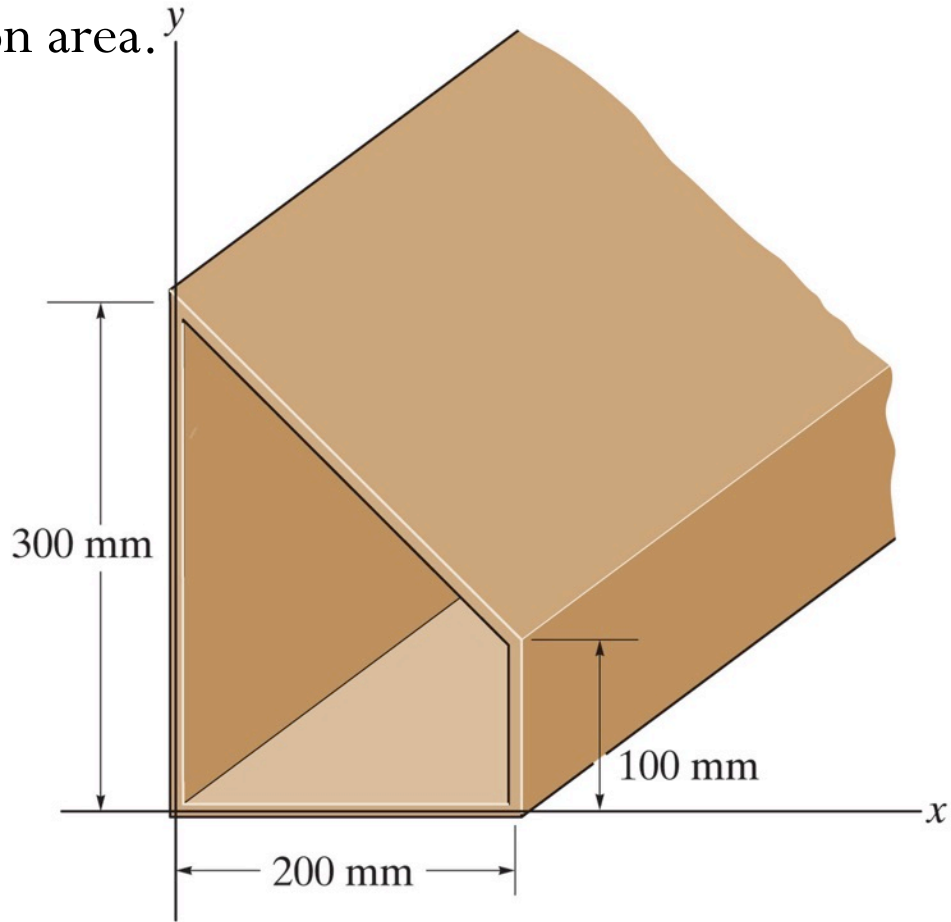
Example

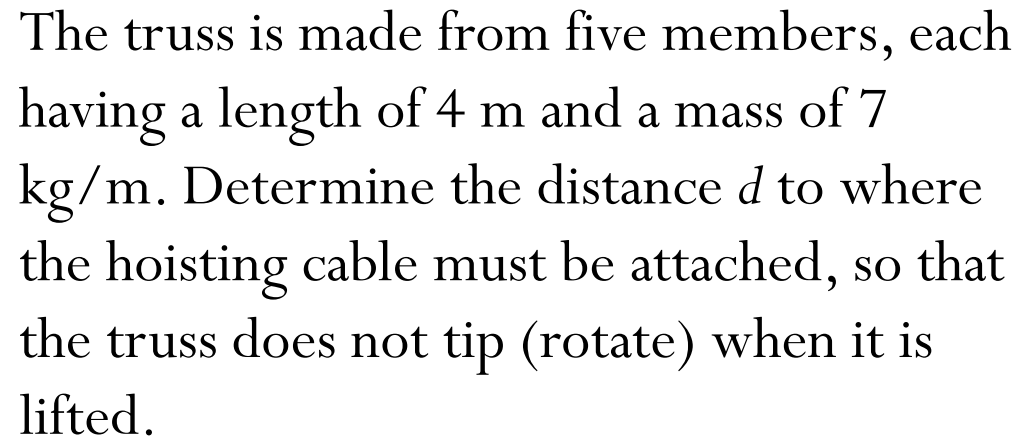
What is the centroid of the resultant area?



Example

Locate the centroid of the cross section area.





The truss is made from five members, each having a length of 4 m and a mass of 7 kg/m. Determine the distance d to where the hoisting cable must be attached, so that the truss does not tip (rotate) when it is lifted.

Determine the location of the center of gravity of the three-wheeler. If the three-wheeler is symmetrical with respect to the x-y plane, determine the normal reaction each of its wheels exerts on the ground.

