ENSC 2113
Engineering Mechanics: Statics

Chapter 9:

Composite Bodies

(Section 9.2)

COLLEGE OF
ENGINEERING, ARCHITECTURE
AND TECHNOLOGY

Chapter 9 Outline:

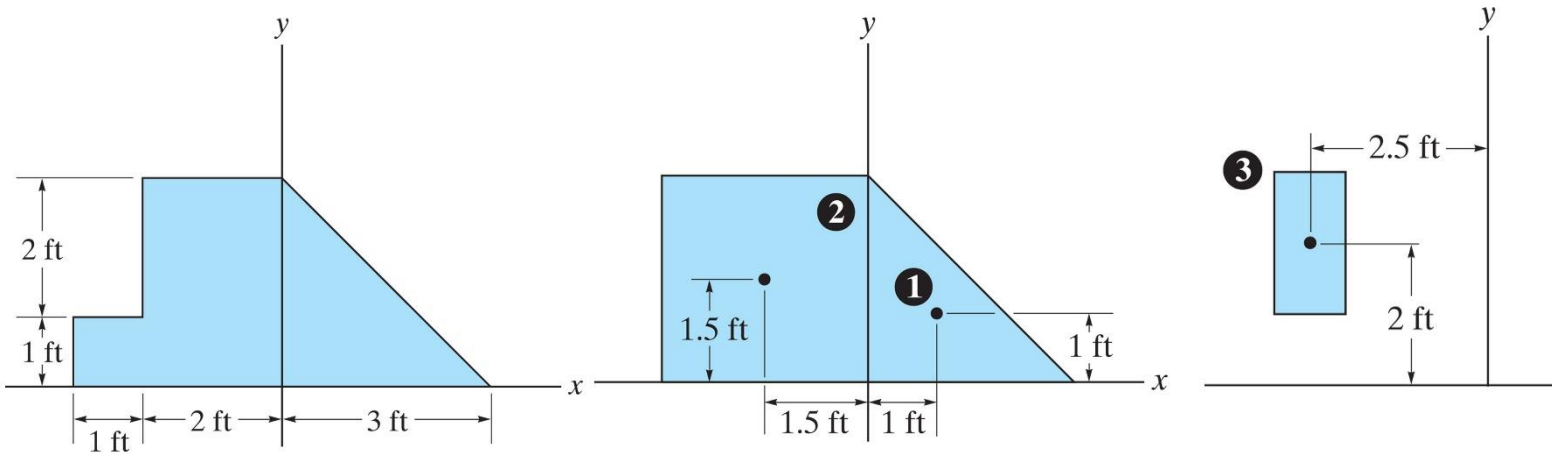
9.1 Center of Gravity, Center of Mass, and the Centroid of a Body

9.2 Composite Bodies

9.3 Theorems of Pappus and Guldinus

9.4 Resultant of a General Distributed Loading

9.5 Fluid Pressure

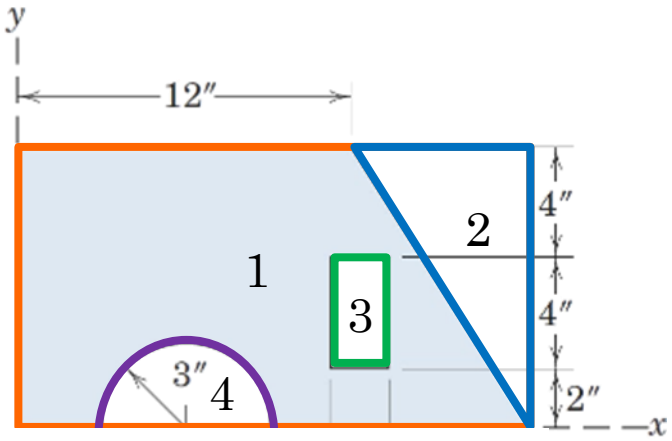


Chapter 9 Objectives:

- To discuss the concept of the center of gravity, center of mass, and the centroid.
- To show how to determine the location of the center of gravity and centroid for a body of arbitrary shape and one composed of composite parts.
- To use the theorems of Pappus and Guldinus for finding the surface area and volume for a body having axial symmetry.
- To present a method for finding the resultant of a general distributed loading to show how it applies to finding the resultant force of a pressure loading caused by a fluid.

9.2 Composite Bodies:

- Identify the composite pieces, treating voids as negative quantities.

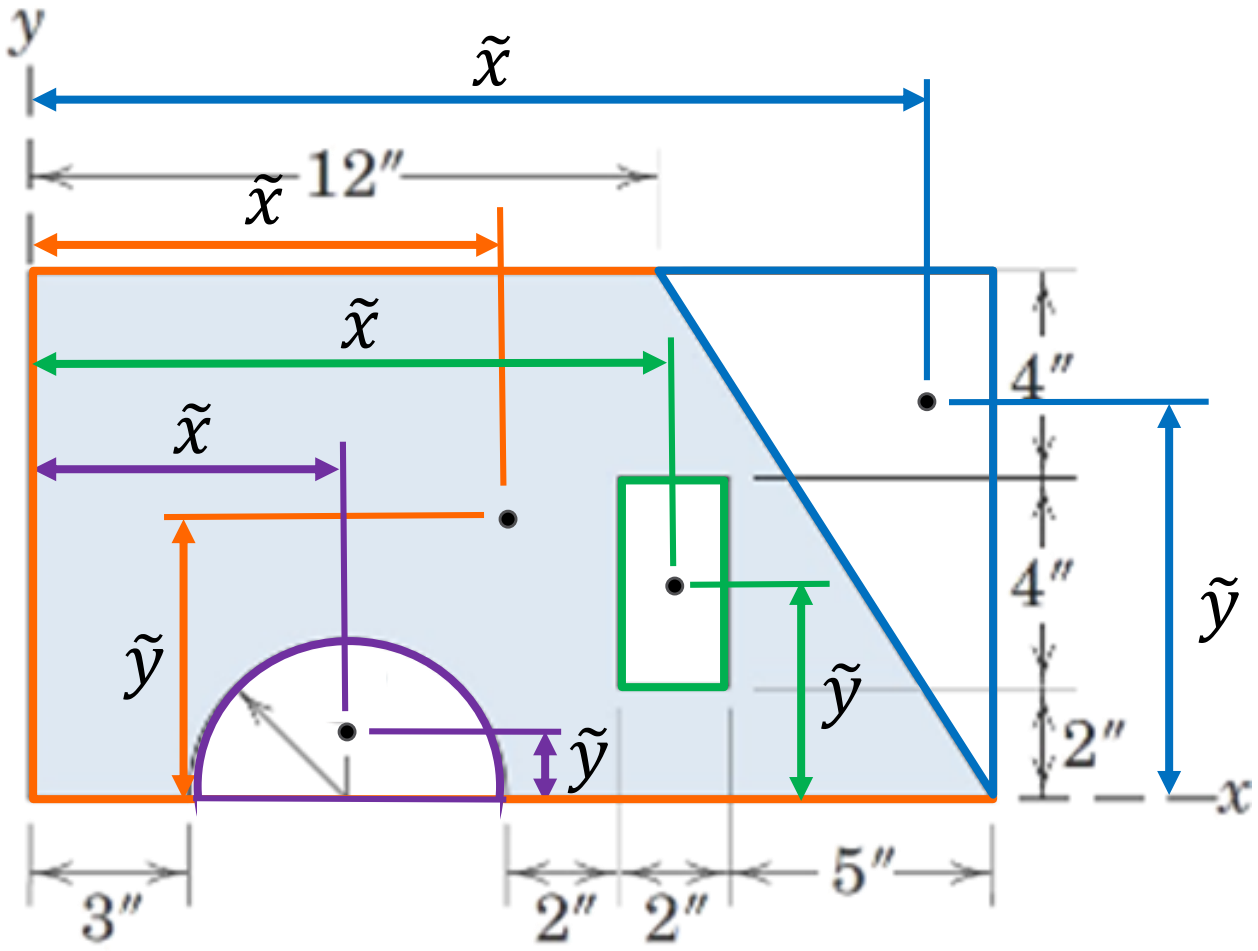


9.2 Composite Bodies:

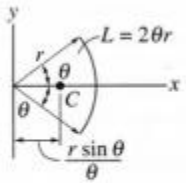
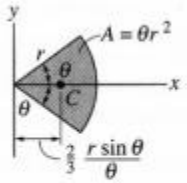
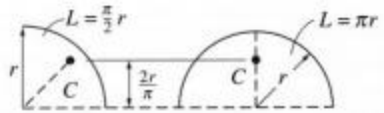
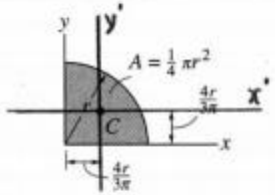
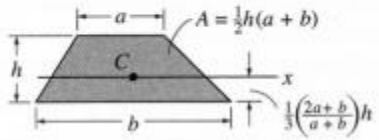
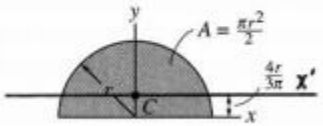
- Measure the centroidal coordinate for every piece from the origin

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

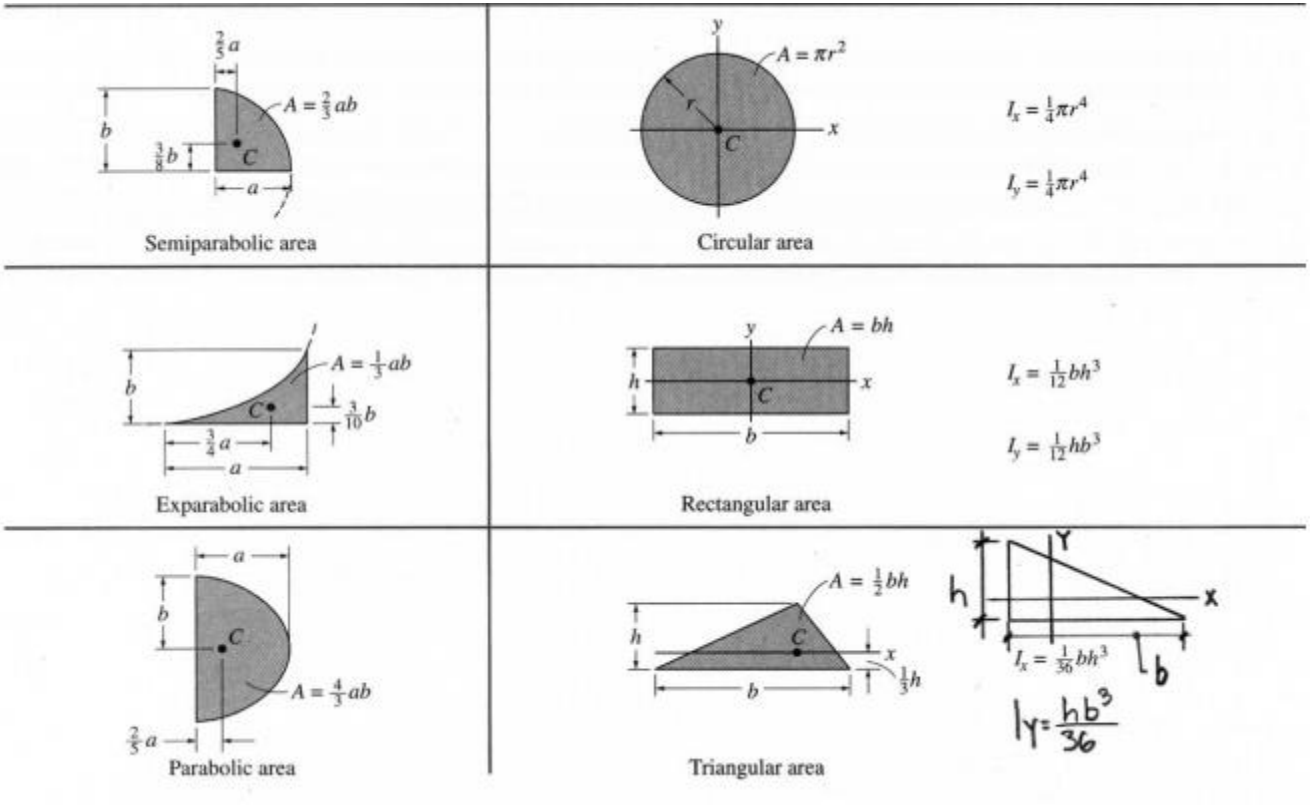
$$\bar{y} = \frac{\sum \tilde{y} A}{\sum A}$$



9.2 Composite Bodies:

Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4}r^4(\theta - \frac{1}{2}\sin 2\theta)$ $I_x = \frac{1}{4}r^4(\theta + \frac{1}{2}\sin 2\theta)$
 Quarter and semicircle arcs	 Quarter circle area	$I_{x'} = I_{y'} = .0548r^4$ $I_x = \frac{1}{16}\pi r^4$ $I_y = \frac{1}{16}\pi r^4$
 Trapezoidal area	 Semicircular area	$I_{x'} = .1098r^4$ $I_x = \frac{1}{8}\pi r^4$ $I_y = \frac{1}{8}\pi r^4$

9.2 Composite Bodies:



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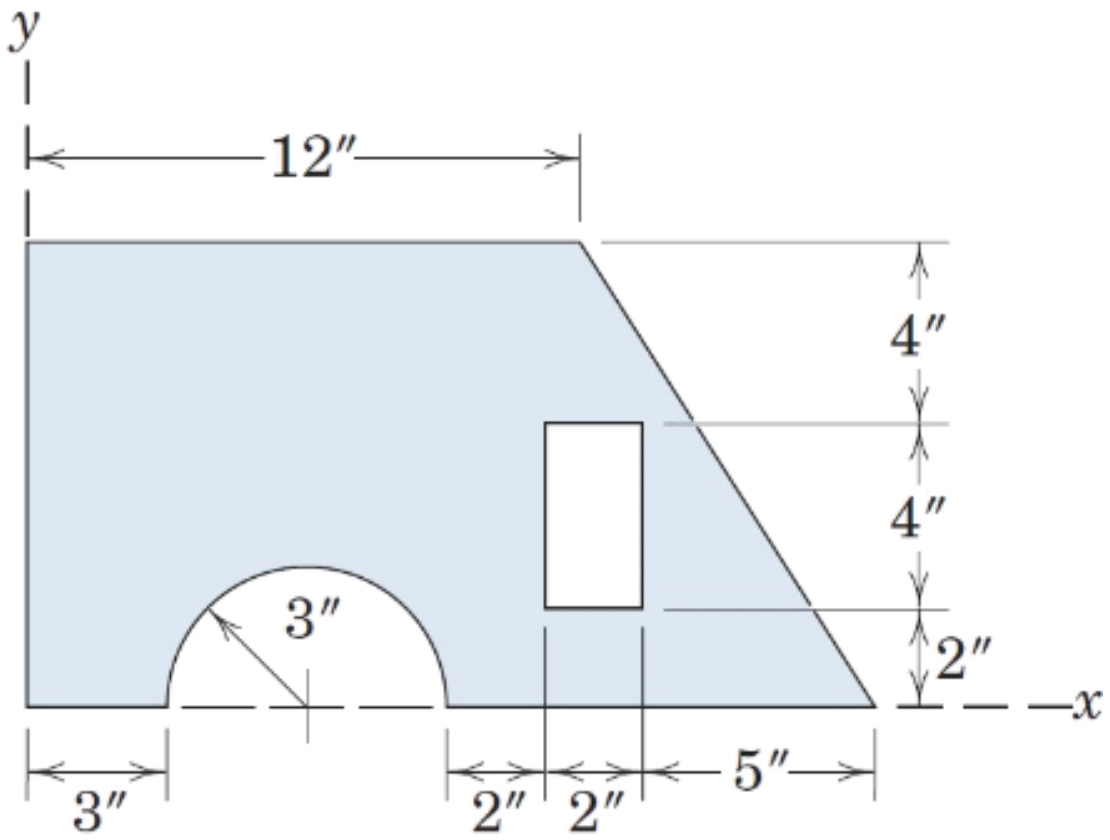
Example:

- Calculate the centroid of the shaded area:



Example:

- Calculate the centroid of the shaded area: