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 $h$. 

![Diagram of a triangle with base $b$ and height $h$.]
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

<table>
<thead>
<tr>
<th>Shape</th>
<th>Figure</th>
<th>$\bar{x}$</th>
<th>$\bar{y}$</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Right-triangular area</strong></td>
<td><img src="image" alt="Right-triangular area" /></td>
<td>$\frac{b}{3}$</td>
<td>$\frac{h}{3}$</td>
<td>$\frac{bh}{2}$</td>
</tr>
<tr>
<td><strong>Quarter-circular area</strong></td>
<td><img src="image" alt="Quarter-circular area" /></td>
<td>$\frac{4r}{3\pi}$</td>
<td>$\frac{4r}{3\pi}$</td>
<td>$\frac{\pi r^2}{4}$</td>
</tr>
<tr>
<td><strong>Semicircular area</strong></td>
<td><img src="image" alt="Semicircular area" /></td>
<td>0</td>
<td>$\frac{4r}{3\pi}$</td>
<td>$\frac{\pi r^2}{2}$</td>
</tr>
<tr>
<td><strong>Quarter-elliptical area</strong></td>
<td><img src="image" alt="Quarter-elliptical area" /></td>
<td>$\frac{4a}{3\pi}$</td>
<td>$\frac{4b}{3\pi}$</td>
<td>$\frac{\pi ab}{4}$</td>
</tr>
<tr>
<td><strong>Semielliptical area</strong></td>
<td><img src="image" alt="Semielliptical area" /></td>
<td>0</td>
<td>$\frac{4b}{3\pi}$</td>
<td>$\frac{\pi ab}{2}$</td>
</tr>
</tbody>
</table>

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

\[
\bar{x} = \frac{\sum \tilde{x}W}{\sum W} \quad \bar{x} = \frac{\sum \tilde{x}A}{\sum A}
\]

\[
\bar{y} = \frac{\sum \tilde{y}W}{\sum W} \quad \bar{y} = \frac{\sum \tilde{y}A}{\sum A}
\]

\[
\bar{z} = \frac{\sum \tilde{z}W}{\sum W} \quad \bar{z} = \frac{\sum \tilde{z}A}{\sum A}
\]
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.

1. Rear wheels 18 lb
2. Mechanical components 85 lb
3. Frame 120 lb
4. Front wheel 8 lb