ENSC 2113
Engineering Mechanics: Statics

Lecture 13
Section 9.1

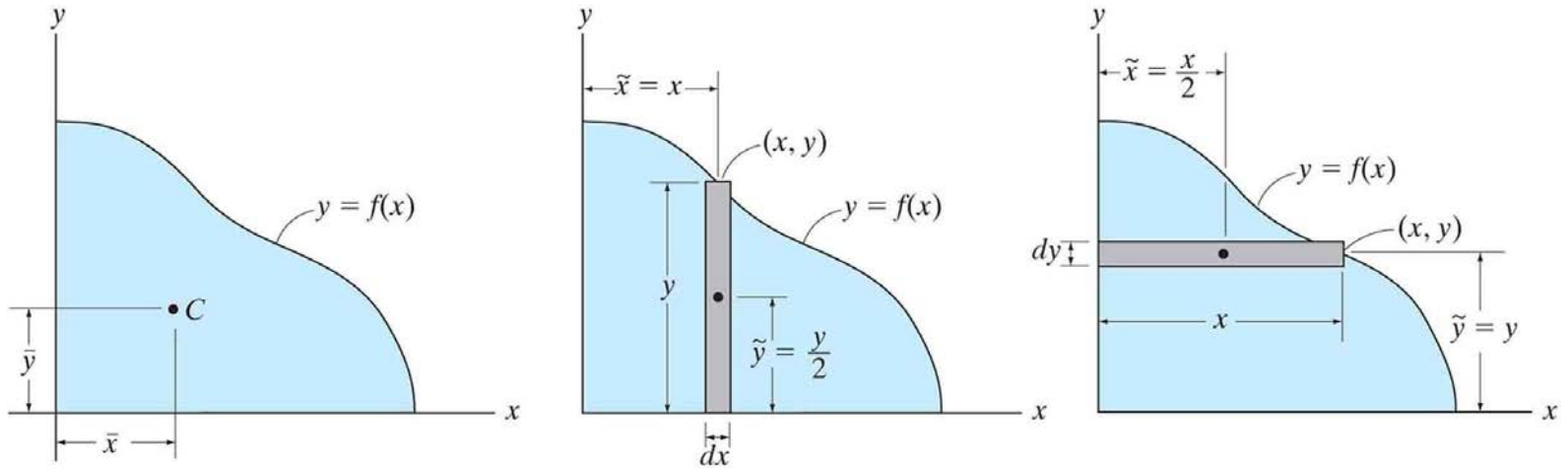
College of Engineering, Architecture & Technology

Centroid: A point that defines the geometric center of an object.

For homogenous bodies, the *centroid* coincides with the *center of gravity*.

Area: Object is subdivided into area elements ***dA***.

integrate over the area to obtain the centroidal distance from the x and y axes

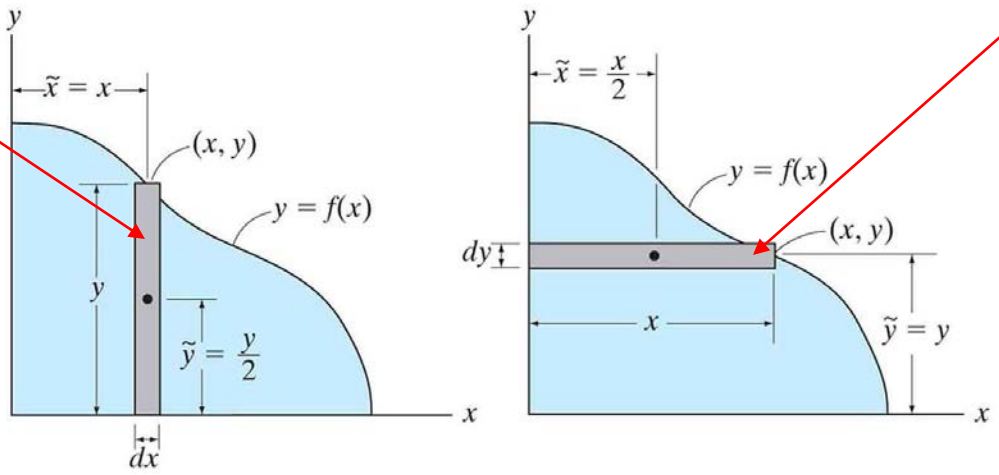


Object is subdivided into area elements ***dA***.

$$\bar{x} = \frac{\int_A \tilde{x}\, dA}{\int_A dA} \qquad \bar{y} = \frac{\int_A \tilde{y}\, dA}{\int_A dA}$$

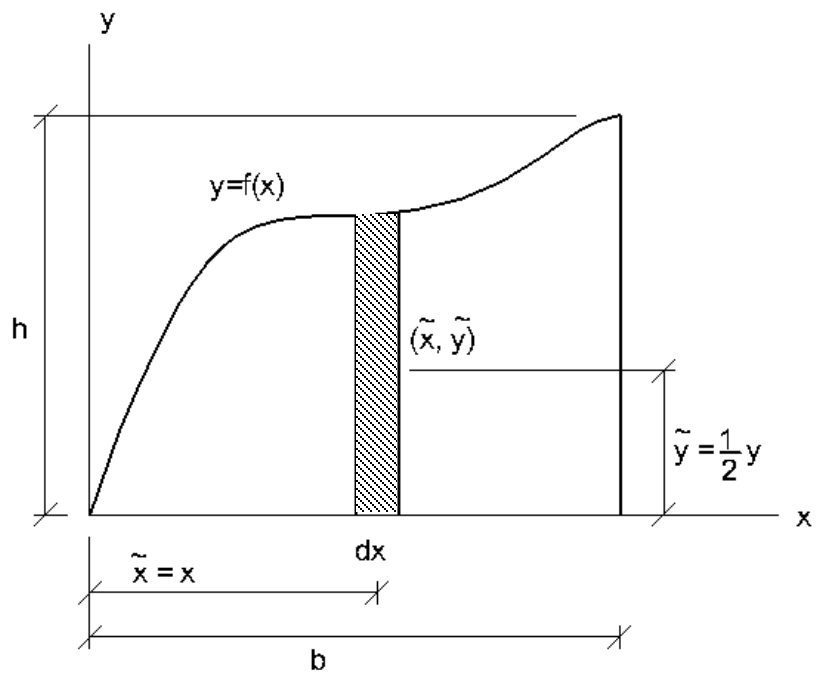
dA=dx(y)

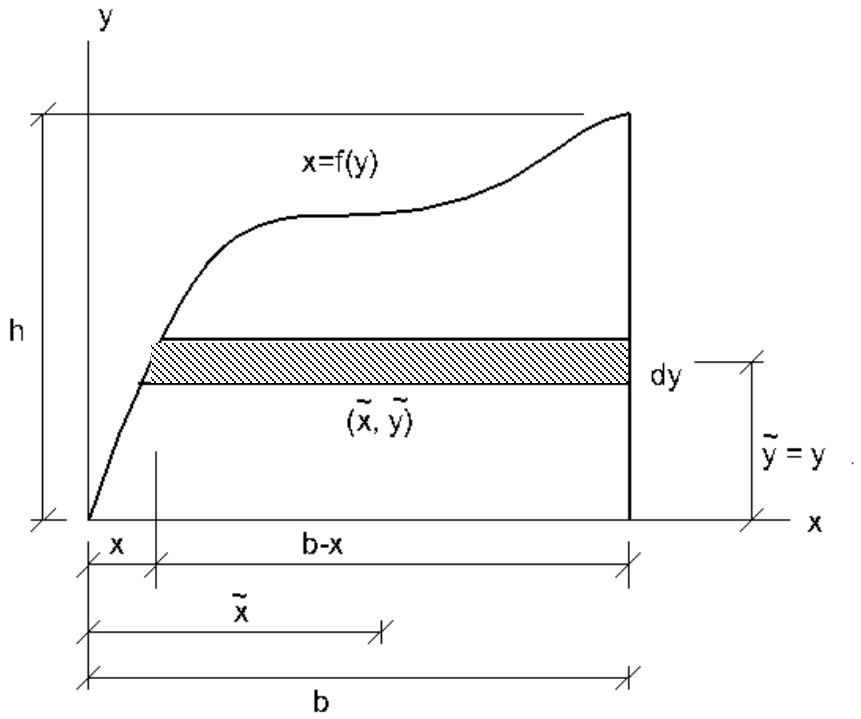
dA=dy(x)



For finding centroid of an ***area***:

$$\bar{x} = \frac{\int_A \tilde{x}\, dA}{\int_A dA} \qquad \bar{y} = \frac{\int_A \tilde{y}\, dA}{\int_A dA}$$



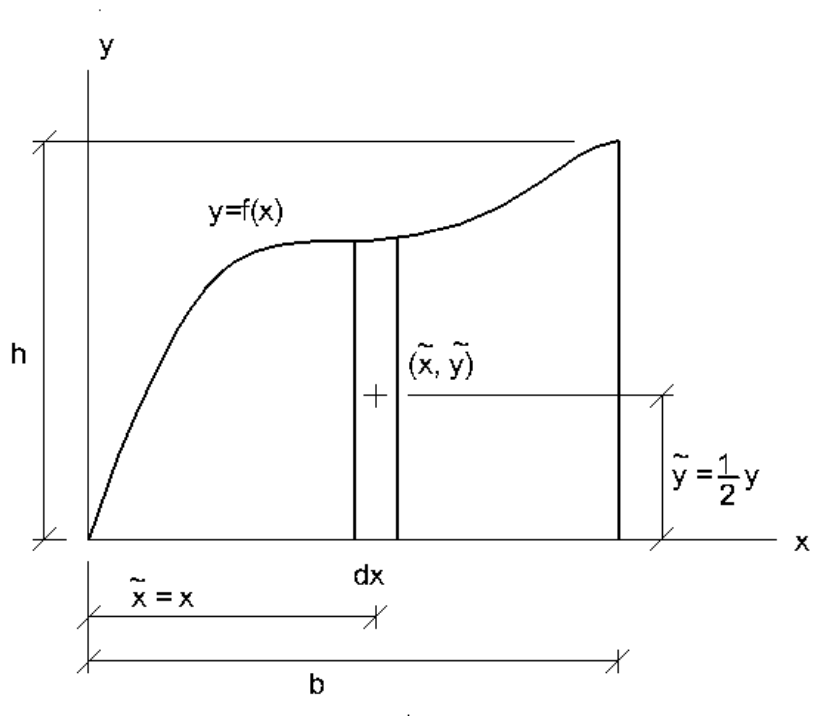


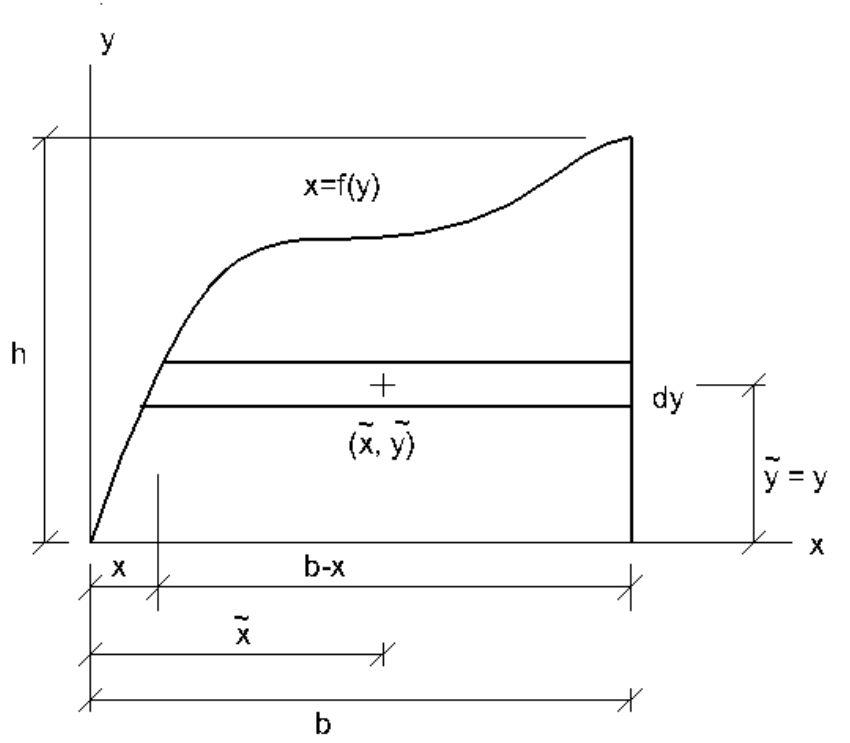
Definition of values in the eqns:

$\bar{x} = \bar{y}$ = Centroidal distance from **y** or **x** axis

$\tilde{x}_i = \tilde{y}$ = Distance from **y** or **x** axis to centroid of segment

dA = Differential area of segment

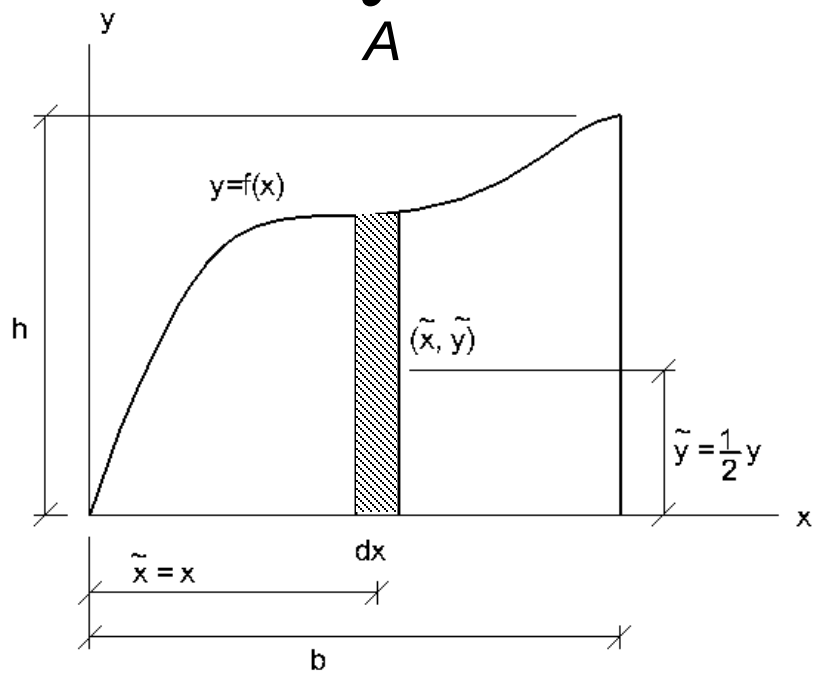


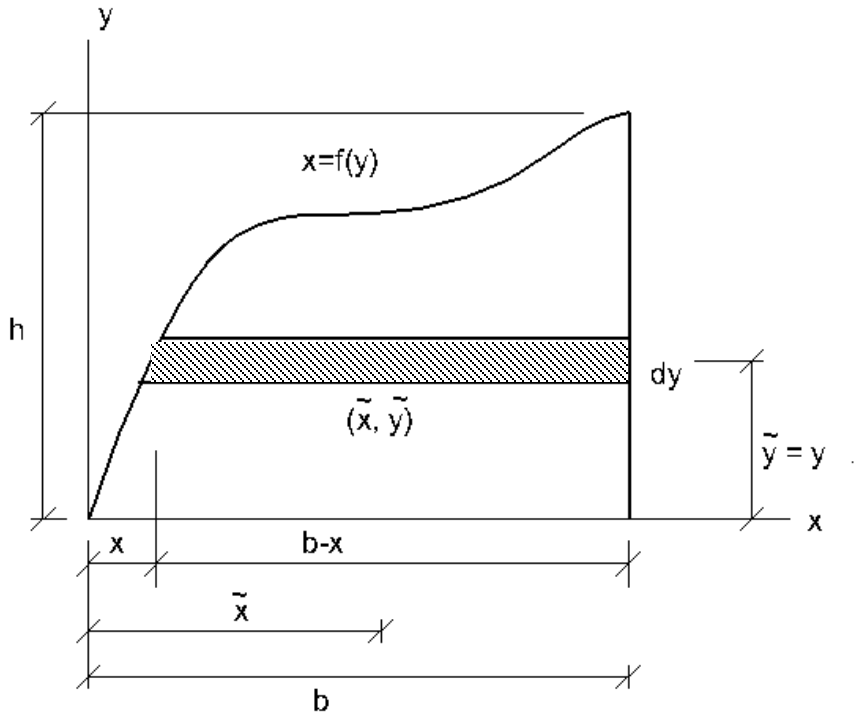


Finding the centroidal $\bar{x}$ distance:

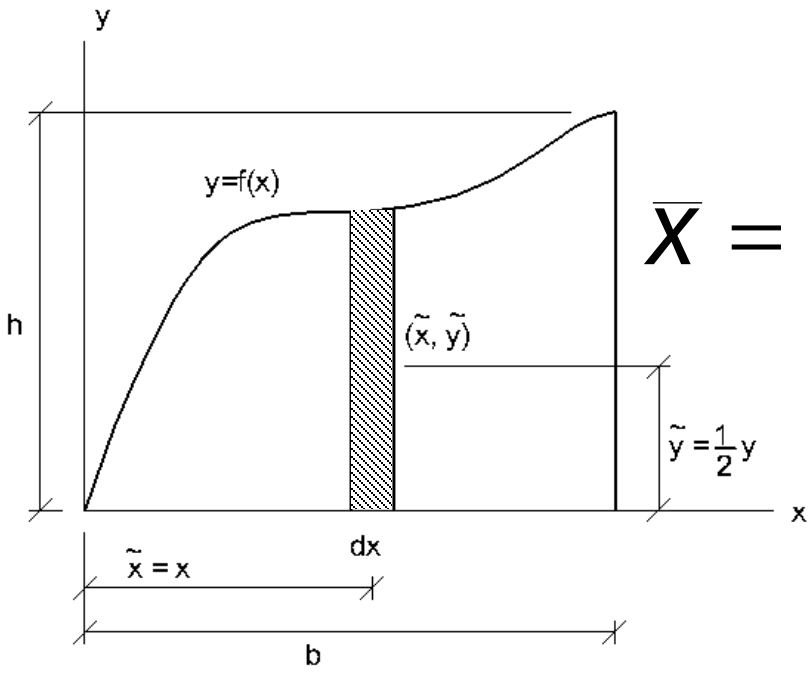
$$\bar{X} = \frac{\int_A \tilde{x}\,dA}{\int_A dA}$$

May use either vertical or horizontal segment

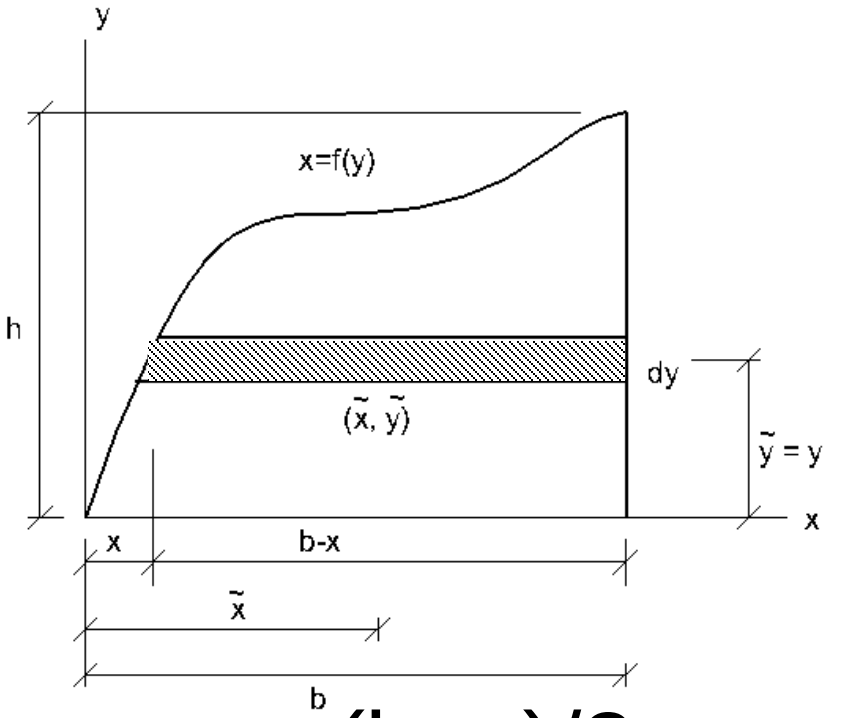




Let's look at each term in the eqn:



$$\bar{x} = \frac{\int_A \tilde{x} dA}{\int_A dA}$$



$\tilde{x} = x$

$dA = y\ dx$

y must be written in terms of **x**

Integrate from 0 to b

$\tilde{x} = (b+x)/2$

$dA = (b\text{-}x)\ dy$

x must be written in terms of **y** for both eqns.

Integrate from 0 to h

The procedure for finding the centroid:

Step 1: Choose a differential segment to use - choose a segment that touches one of the reference axes throughout the integration.

Step 2: Define the segment size and moment arm to be used. Draw these on the sketch for reference.

Step 3: Perform the integrations and apply the equations derived in the text.

Step 4: Ask yourself "*Does the answer make sense?*"

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