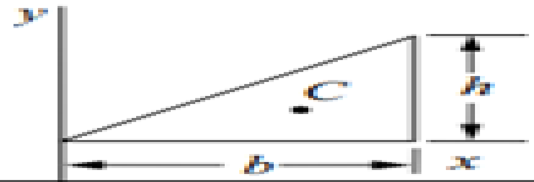
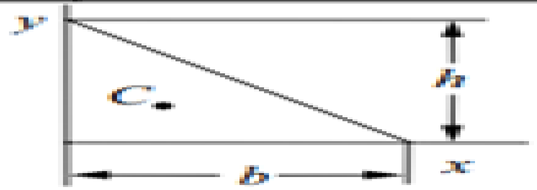
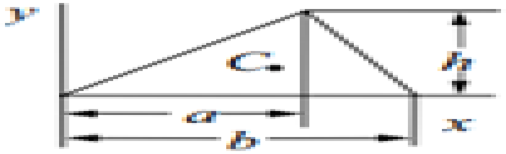
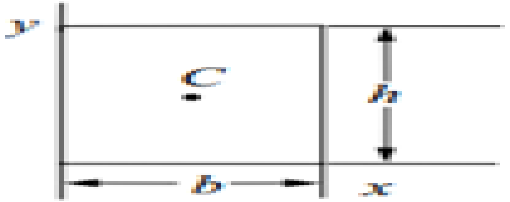
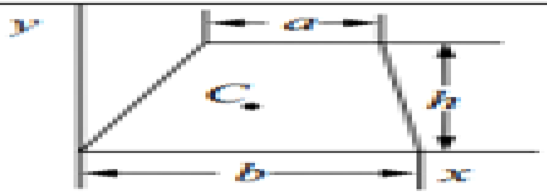
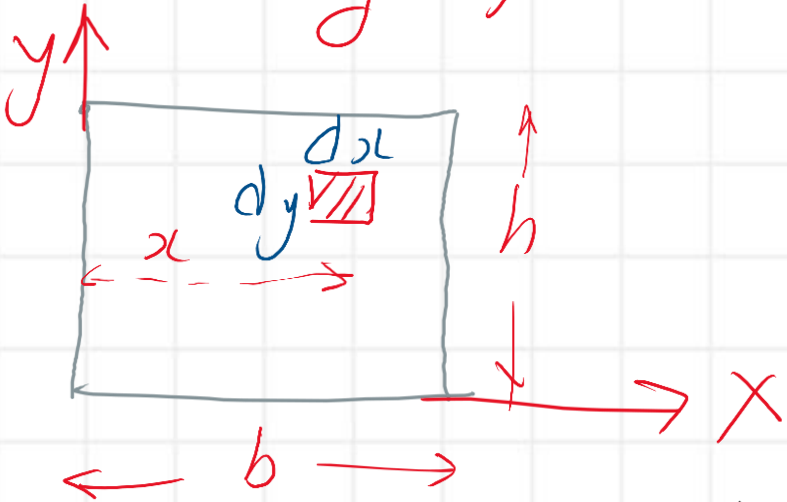
FE Reference Handbook 10.0

Figure	Area & Centroid
	$A = bh/2$ $x_c = 2b/3$ $y_c = h/3$
	$A = bh/2$ $x_c = b/3$ $y_c = h/3$
	$A = bh/2$ $x_c = (a + b)/3$ $y_c = h/3$
	$A = bh$ $x_c = b/2$ $y_c = h/2$
	$A = h(a + b)/2$ $y_c = \dfrac{h(2a + b)}{3(a + b)}$

Area and Cg of rectangle.



Area of small strip

$= dx.dy$

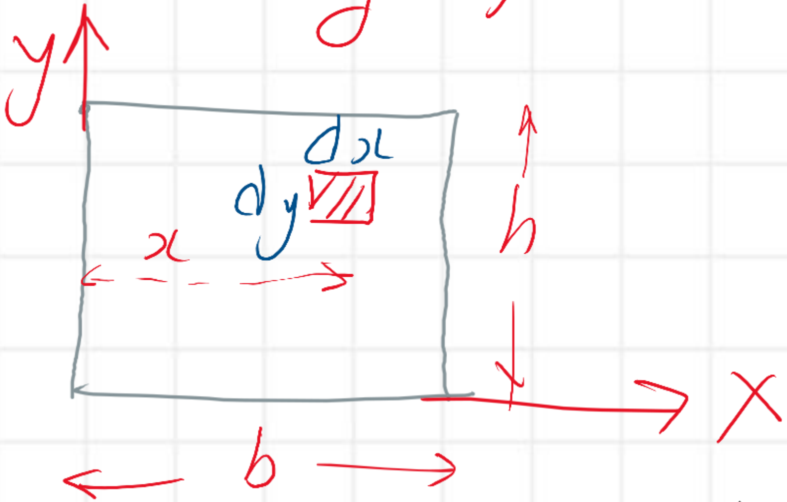
For $\bar{x}$ then $dA.x = dx(dy)(x)$

$$A.\bar{x} = \int_0^b dA.x = \iint dx(dy)(x)$$

Two operations : 1 First integerate From $y=0 \rightarrow y=h$ to create a vertical strip of $dx.h$

Prepared by Eng.Maged Kamel.

Area and Cg of rectangle.



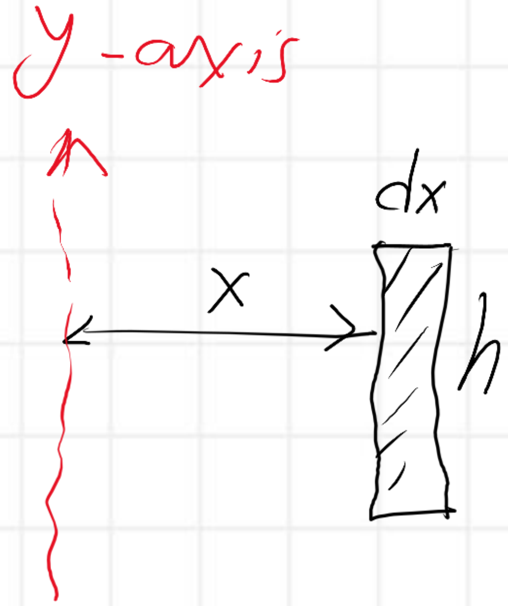
Area of small strip

$= dx \cdot dy$

For $\bar{x}$ then $dA \cdot x = dx(dy)(x)$

$$A \cdot \bar{x} = \int_0^b dA \cdot x = \iint dx(dy)(x)$$

Two operations :> (2) integrate the VL strip in x_direction For $A\bar{x}$



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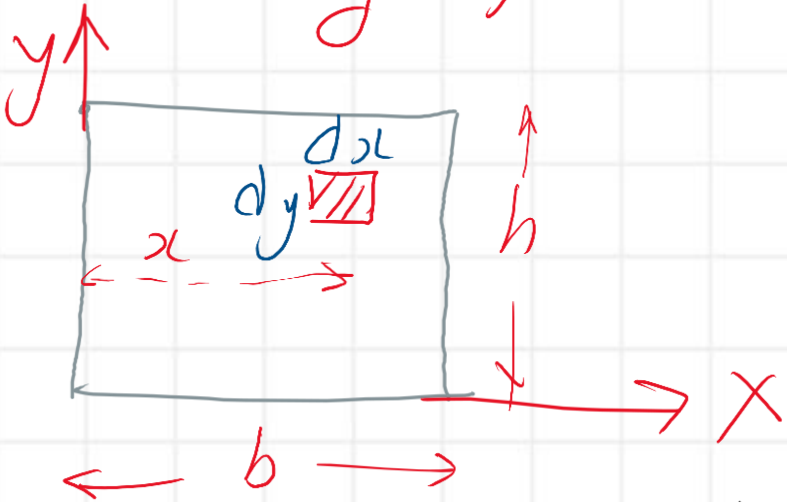
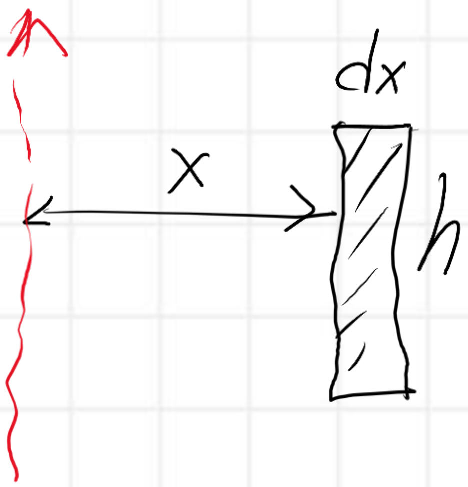
Area and Cg of rectangle.



Area of small strip

$= dx \cdot dy$

For $\bar{x}$ then $\quad dA \cdot x = dx(dy)(x)$



$$A \cdot \bar{x} = \int_0^b dA \cdot x = \iint dx(dy)(x)$$

$$A\bar{x} = \int_0^b x\,dx \int_0^h dy = \int_0^b x\,dx\,(y)\Big|_0^h$$

$$A\bar{x} = \int_0^b hx\,dx = \frac{hx^2}{2}\Big|_0^b = hb^2/2$$

Area of rectangle $= A = \int dA = \iint dx\, dy$

$$A = \int_0^h dy \int_0^b dx = y\Big|_0^h (x)\Big|_0^b = (h-0)(b-0) = bh$$

$$\bar{X} = \frac{\int dA \cdot x}{A} = \frac{1}{2} h b^2 \left(\frac{1}{bh}\right) = \frac{b}{2}.$$

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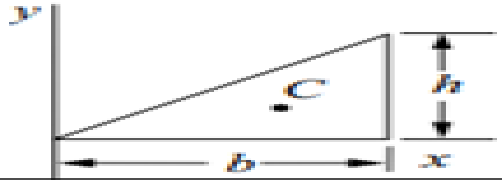
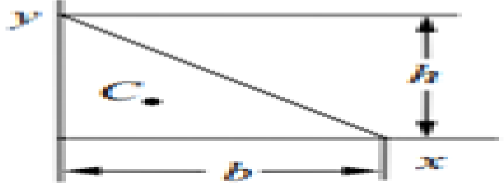
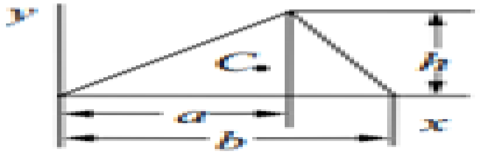
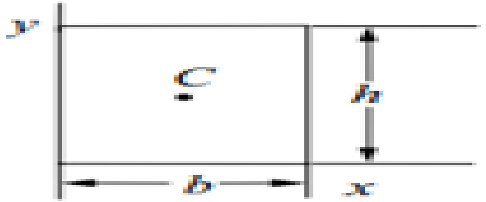
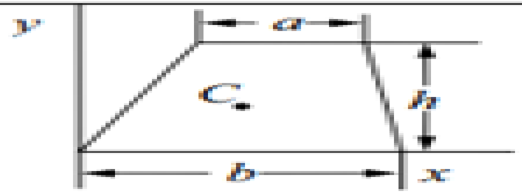
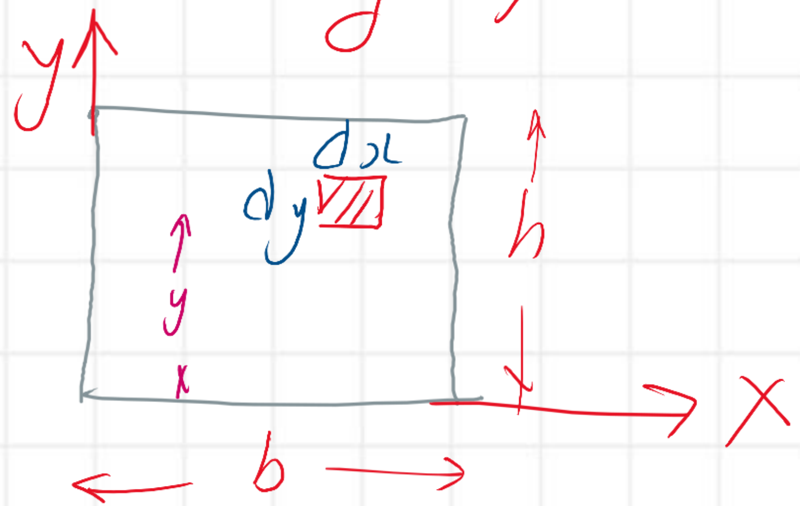
Figure	Area & Centroid
	$A = bh/2$ $x_c = 2b/3$ $y_c = h/3$
	$A = bh/2$ $x_c = b/3$ $y_c = h/3$
	$A = bh/2$ $x_c = (a + b)/3$ $y_c = h/3$
	$A = bh$ $x_c = b/2$ $y_c = h/2$
	$A = h(a + b)/2$ $y_c = \dfrac{h(2a + b)}{3(a + b)}$

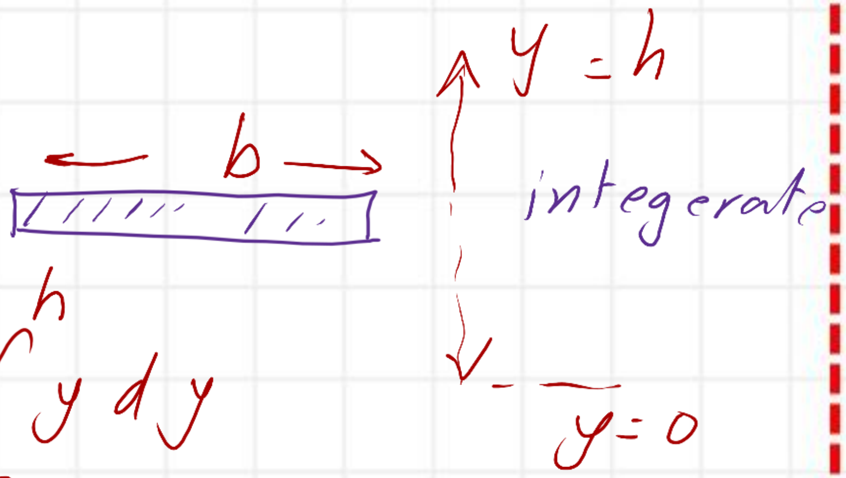
Area and Cg of rectangle.



$\bar{y}$ bar

Area of small strip

$= dx \cdot dy$



For $\bar{y}$ then $dA \cdot y = dx\, dy\, y$

$$\int dA \cdot y = A\bar{y} = \int_0^b dx \int_0^h y\, dy = x\Big|_0^b \int_0^h y\, dy$$

$$\int dA \cdot y = (b)\int_0^h y\, dy = b\frac{y^2}{2}\Big|_0^h = b\frac{h^2}{2}$$

Prepared by Eng.Maged Kamel.

Area of rectangle $= A = \int dA = \iint dx\, dy$

$$A = \int_0^h dy \int_0^b dx = y\Big|_0^h \, (x)\Big|_0^b = (h-0)(b-0) = bh$$

$$\bar{y} = \frac{\int dA \cdot y}{\int A}$$

$$\bar{y} = \frac{1}{(bh)} \left(\frac{bh^2}{2}\right) = \frac{h}{2}$$

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