

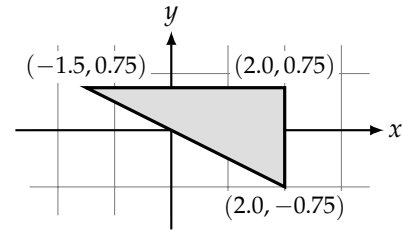
Engineering Statics - 04 Centroids - Instructor Copy

Exercise 1: Determine the coordinates of the centroid of the triangle shown.

$$\bar{x} = (2.0) - \frac{2.0 - (-1.5)}{3} = 0.83333$$

$$\bar{y} = (0.75) - \frac{0.75 - (-0.75)}{3} = 0.25000$$

$$(\bar{x}, \bar{y}) = (0.83, 0.25)$$



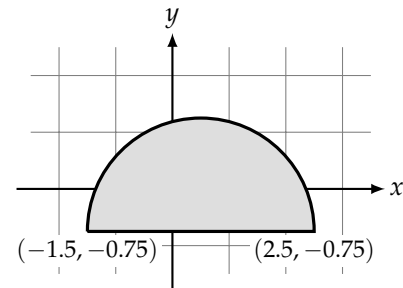
Exercise 2: Determine the coordinates of the centroid of the semi-circle shown.

$$r = 2.0$$

$$\bar{x} = \frac{(-1.5) + (2.5)}{2} = 0.50$$

$$\bar{y} = -0.75 + \frac{4 \times 2.0}{3\pi} = 0.098826$$

$$(\bar{x}, \bar{y}) = (0.50, 0.99)$$



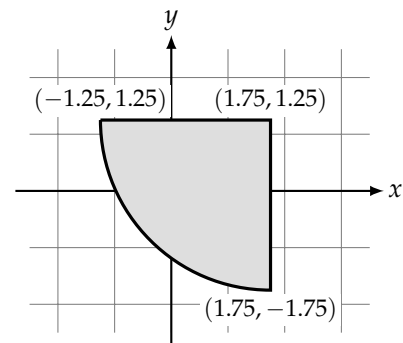
Exercise 3: Determine the location of the centroid of the quarter-circle shown.

$$r = 3.00$$

$$\bar{x} = 1.75 - \frac{4 \times 3.00}{3\pi} = 0.47676$$

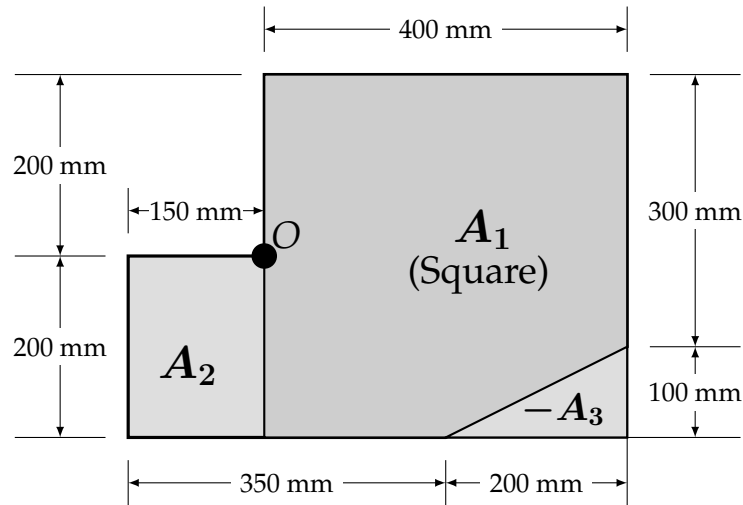
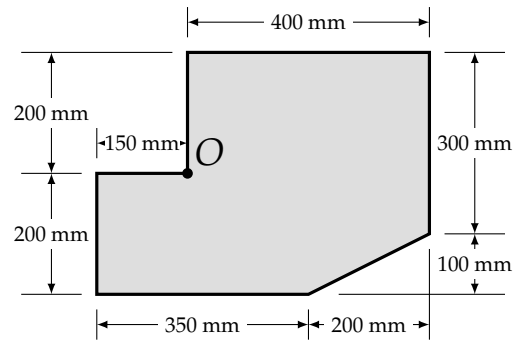
$$\bar{y} = 1.25 - \frac{4 \times 3.00}{3\pi} = -0.023240$$

$$(\bar{x}, \bar{y}) = (0.477, -0.0232)$$



Exercise 4

Find the location of the centroid, C , relative to the point O .



Shape	Area (m ²)	x_i (m)	y_i (m)	$A_i x_i$ (m ³)	$A_i y_i$ (m ³)
A_1	0.4×0.4	0.2	0	0.032000	0
A_2	0.15×0.2	-0.075	-0.1	-0.0022500	-0.0030000
A_3	$-(0.2 \times 0.1) / 2$	0.33333	-0.16667	-0.0033333	0.0016667
Σ	0.18			0.026417	-0.0013333

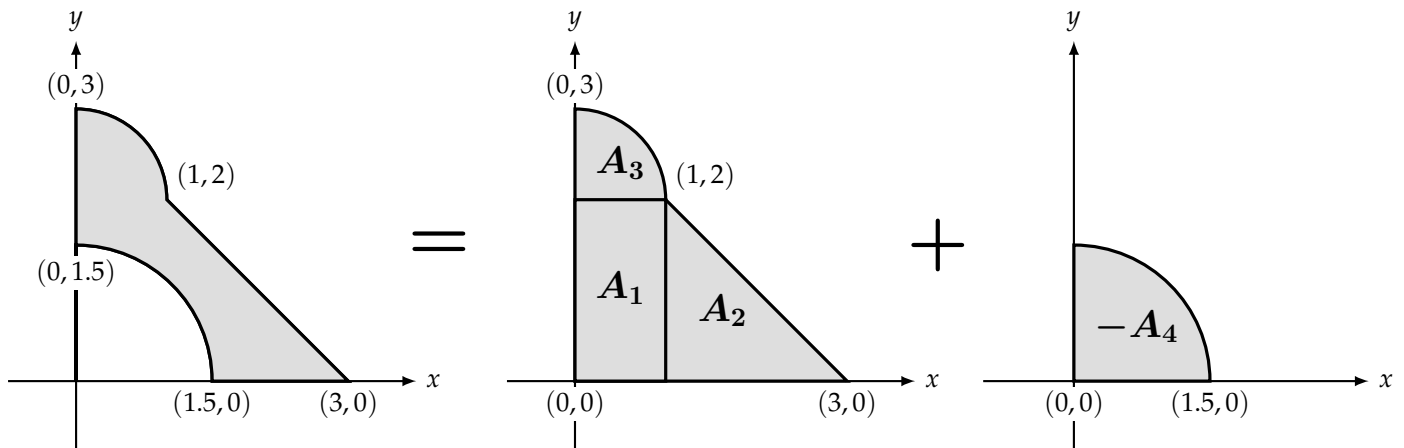
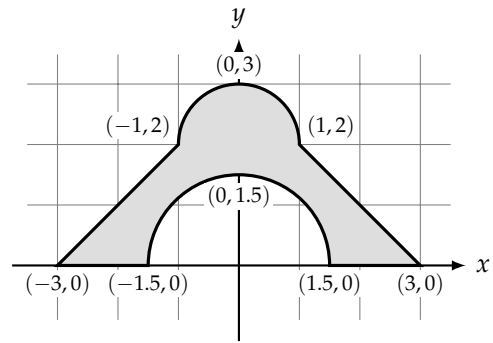
$$\bar{x} = \frac{\sum A_i x_i}{\sum A_i} = \frac{0.026417}{0.18} = 0.14676 \text{ m}$$

$$\bar{y} = \frac{\sum A_i y_i}{\sum A_i} = \frac{-0.0013333}{0.18} = -0.0074072 \text{ m}$$

$$(\bar{x}, \bar{y}) = (147 \text{ mm}, -7.41 \text{ mm})$$

Exercise 5

Find the location of the centroid, C , relative to the coordinate origin.



Shape	Area	y_i	$A_i y_i$
A_1	1×2	1	2
A_2	$(2 \times 2) / 2$	0.66667	1.3333
A_3	$\pi / 4$	$2 + \frac{4}{3\pi}$	1.9041
$-A_4$	$-\frac{\pi(1.5)^2}{4}$	$\frac{4 \times 1.5}{3\pi}$	-1.125
Σ	3.0183		4.1124

$$\bar{y} = \frac{\Sigma A_i y_i}{\Sigma A_i} = \frac{4.1124}{3.0183} = 1.3625$$

$$(\bar{x}, \bar{y}) = (0, 1.36)$$

Exercise 6

Three C130X13 channels and a steel plate (15mm×174mm) are welded together.

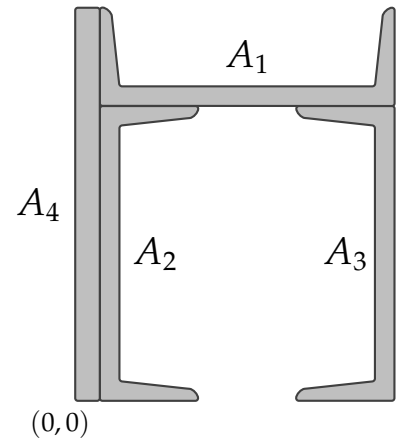
Determine the location of the centroid, relative to the bottom left hand corner of the composite area.

Properties for C130X13:

Area = 1700 mm²

Depth = 127 mm

$\bar{x} = 12$ mm



Shape	Area(mm ²)	x_i (mm)	y_i (mm)	$A_i x_i$ (mm ³)	$A_i y_i$ (mm ³)
A_1	1700	$15 + \frac{127}{2}$	$127 + 12$	133450	219300
A_2	1700	$15 + 12$	$\frac{127}{2}$	45900	107950
A_3	1700	$15 + 127 - 12$	$\frac{127}{2}$	221000	107950
A_4	2610	7.5	87	19575	227070
Σ	7710			419925	662270

$$\bar{x} = \frac{\sum A_i x_i}{\sum A_i} = \frac{419925}{7710} = 54.465$$

$$\bar{y} = \frac{\sum A_i y_i}{\sum A_i} = \frac{662270}{7710} = 85.898$$

$$(\bar{x}, \bar{y}) = (54.5 \text{ mm}, 85.9 \text{ mm})$$