

Statics and Strength of Materials for Architecture and Building Construction | (3rd Edition)

Step-by-step solution

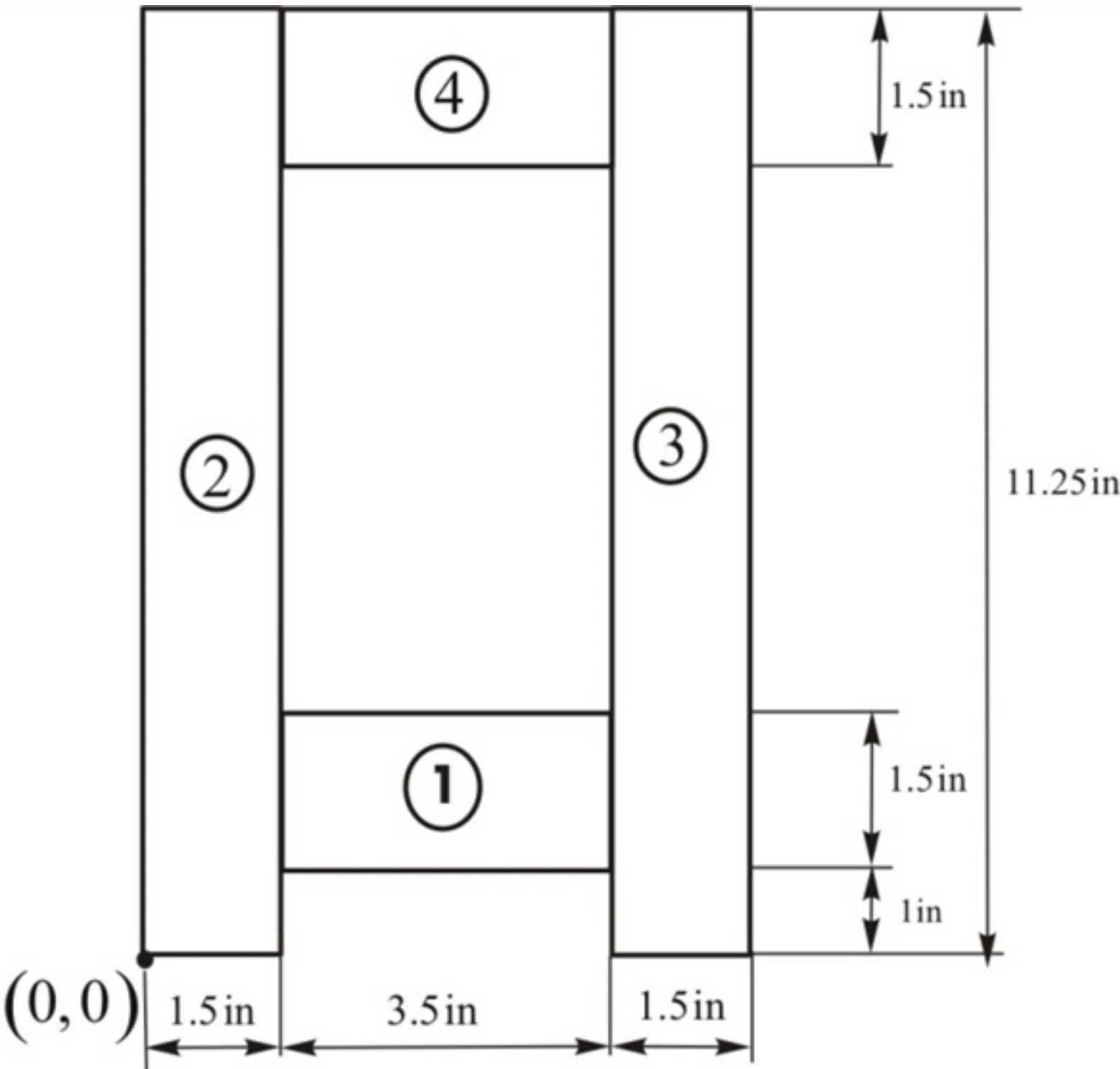
Step 1 of 8

We have reference origin O, it is usually taken so that x and y - distances are measured in the positive direction to avoid dealing with negative signs.

Divide the figure into simpler geometric shapes, four rectangles of which first and last rectangles are identical and rest two rectangles are also identical in dimensions but arranged differently.

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Step 2 of 8



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Step 3 of 8

Obtain the data from the table for structural design.

Nominal size	Surface Dry size (in.) ($b \times h$)	Area $A=bh$ (in.^2)	$I=\frac{b(h)^3}{12}$ (in.^4)
2 x 4	1.5 x 3.5	5.25	5.36
2 x 12	1.5 x 11.25	16.88	177.98

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Step 4 of 8

Calculate the centroid of the structure.

Component	Area ΔA (in.^2)	y	$y(\Delta A)$ (in.^3)
Part 1	$3.5 \times 1.5 = 5.25$	$\left(1 + \frac{1.5}{2}\right) = 1.75$	9.1875
Part 2	$11.25 \times 1.5 = 16.875$	$\left(\frac{11.25}{2}\right) = 5.625$	94.95
Part 3	$11.25 \times 1.5 = 16.875$	$\left(\frac{11.25}{2}\right) = 5.625$	94.95
Part 4	$3.5 \times 1.5 = 5.25$	$\left(9.75 + \frac{1.5}{2}\right) = 10.5$	55.125
	$\Sigma(\Delta A) = 44.26$		$\Sigma y(\Delta A) = 254.22$

[Comment](#)

Step 5 of 8

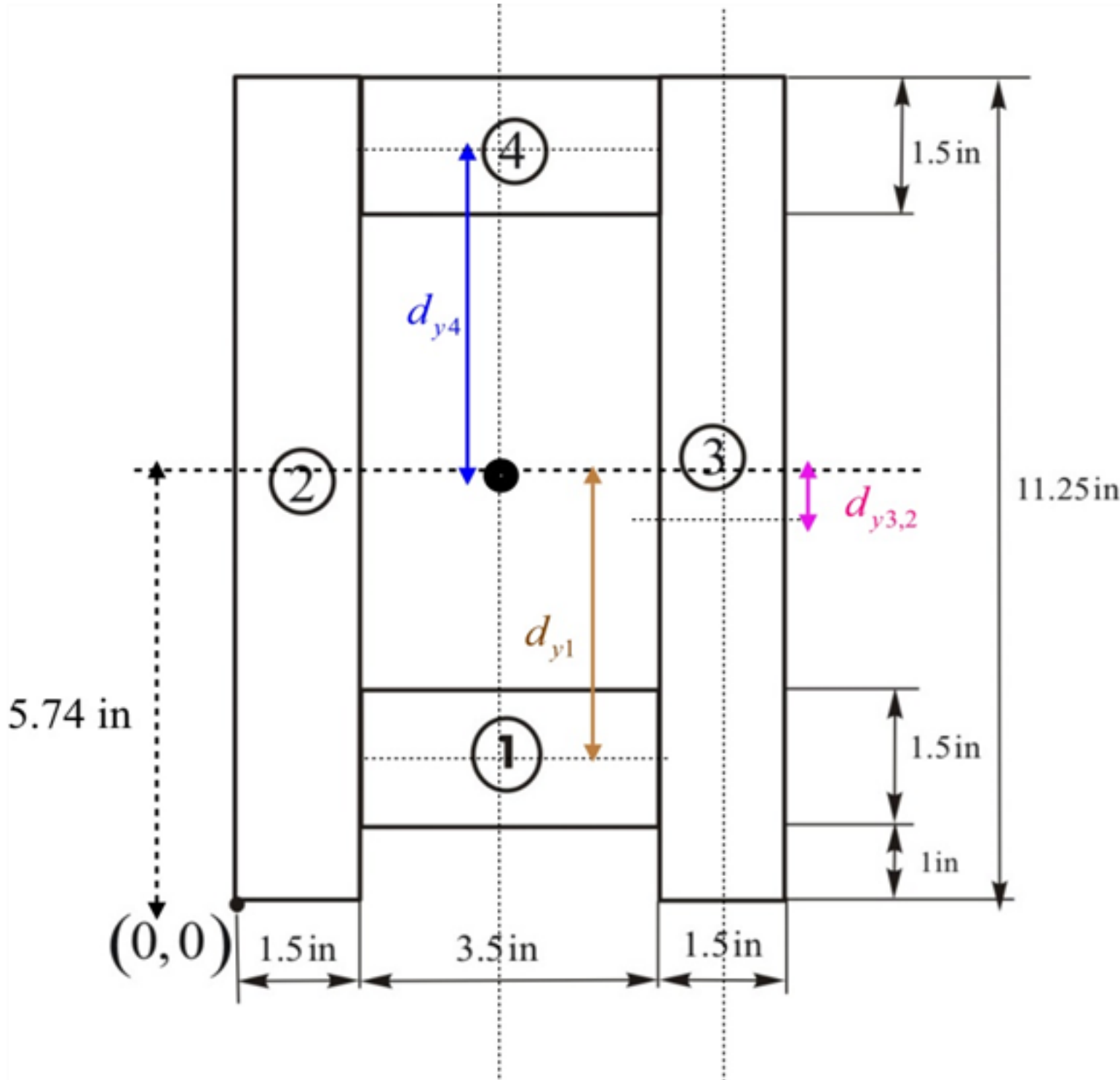
The centroidal distances $\bar{y}$ from the reference origin are

$$\bar{y} = \frac{\sum y(\Delta A)}{\sum \Delta A} = \frac{254.22}{44.26}$$
$$\bar{y} = 5.74 \text{ in.}$$

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Step 6 of 8

Consider the structure with centroid.



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Step 7 of 8

Calculation of moment of inertia:

Component	Area (in.^2)	I_{x_c} (in.^4)	dy	Ad_y^2 (in.^4)
Part 1	5.25	5.36	$5.74 - \left(1 + \frac{1.5}{2}\right) = 3.99 \text{ in}$	83.58
Part 2	16.88	177.98	$5.74 - \left(\frac{11.25}{2}\right) = 0.115$	0.2232
Part 3	16.88	177.98	$5.74 - \left(\frac{11.25}{2}\right) = 0.115$	0.2232
Part 4	5.25	5.36	$\left(\frac{11.25}{2} - \frac{1.5}{2}\right) - 5.74 = 4.76 \text{ in}$	118.95
		$\Sigma I_{x_c} = 366.68$		$\Sigma Ad_y^2 = 202.9788$

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Step 8 of 8

The moment of inertia about the x -axis,

$$I_x = \Sigma I_{x_c} + \Sigma Ad_y^2$$
$$= 366.68 + 202.9788$$
$$= 569.66 \text{ in}^4$$

Therefore, the moment of inertia about x-axis is 569.66 in^4 .

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Was this solution helpful?

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4

Recommended solutions for you in Chapter 6

Chapter 6, Solution 13P

We have reference origin O, it is usually taken so that x and y - distances are measured in the positive direction to avoid dealing...

[See solution](#)



Chapter 6, Solution 11P

Divide the figure into simpler geometric shapes, a rectangle and a rectangle.

[See solution](#)

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