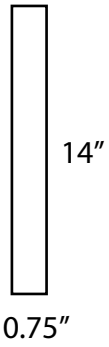
Structural Steel Design

NAME

Quizzam Module 3 : Cross Sections

Find the centroids and moments of inertia (I_x only) for each of the following cross sections. Note the centroid clearly by marking dimensions.

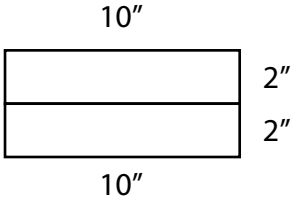
1



Regular rectangular section.

$I_x =$ ____

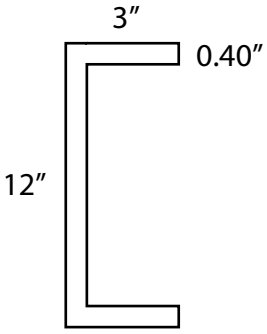
2



Laminate beam.

$I_x =$ ____

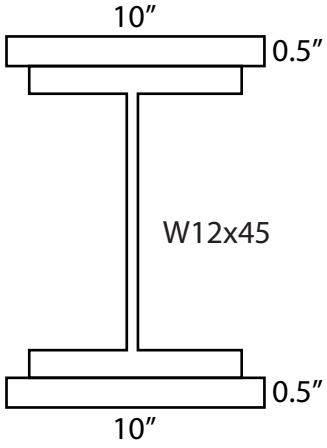
3



C-channel.

$I_x =$ ____

4



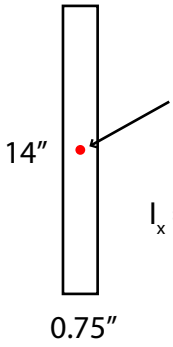
Reinforced W-flange section.
HINT: Get I_x for the wide-flange from the steel chart. Don't calculate it!

$I_x =$ ____

SOLUTIONS

Note that you must notate the location of the centroid explicitly as well as calculate the moment of inertia!

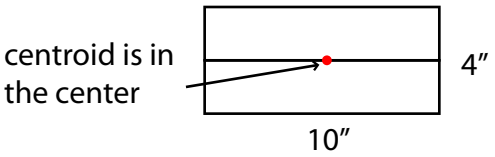
1



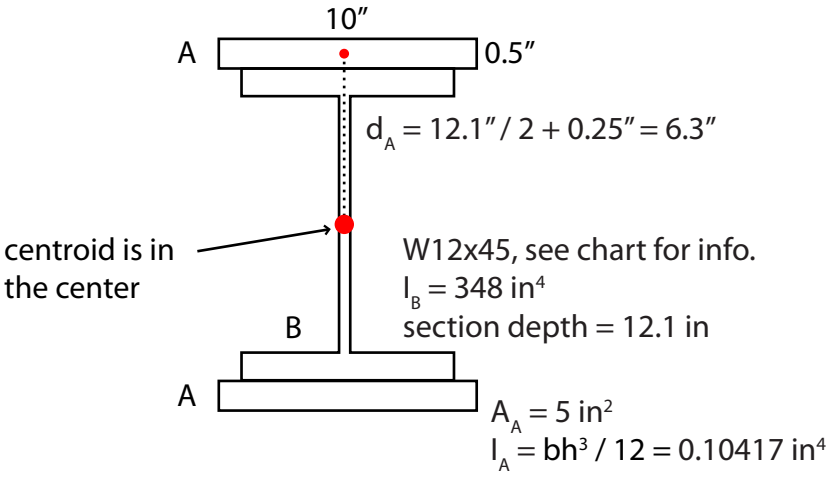
$I_x = bh^3 / 12 = 0.75 * 14^3 / 12 =$ **171.5 in⁴**

2 Treat this section as if it is a single rectangle. If it is laminated together, it doesn't matter that it was originally two separate pieces. It still behaves like a single rectangle.

$I_x = bh^3 / 12 = 10.0 * 4^3 / 12 =$ **53.3 in⁴**



4 For this one, since you have a W12x45, don't calculate its moment of inertia independently. Just get the value from the chart.



Combine the known values with the parallel axis theorem.

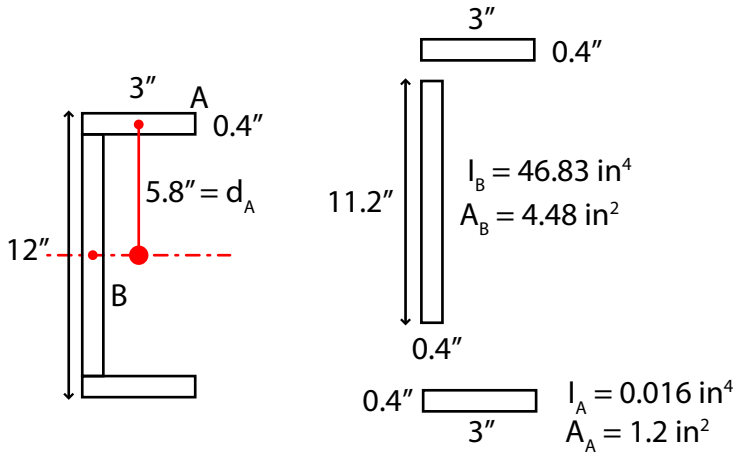
	I	A	d	$I + Ad^2$
Part A	0.10417 in⁴	5 in²	6.3 in	198.55 in⁴
Part B	348 in⁴	n/a	0	348 in⁴

Add the values together. Remember, we have two part As.

$I_{total} = 198.55$ in⁴ * 2 + 348 in⁴ = **745.1 in⁴**

The shape is symmetrical in both the x- and y- directions. Thus the centroid is in the center.

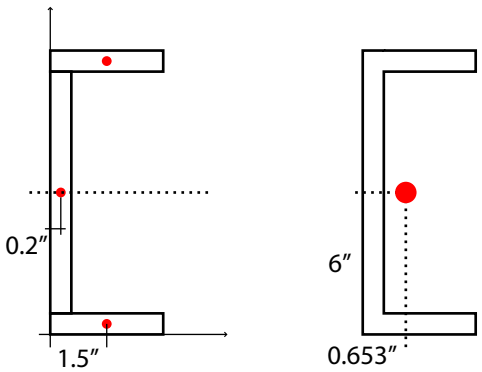
3 Divide the section up into manageable pieces (A and B below). Then note the distance from their centroids to the major centroid. (Although we don't know yet exactly where it is, we do know where it is vertically.)



Combine the known values with the parallel axis theorem.

	I	A	d	$I + Ad^2$
Part A	0.016 in^4	1.2 in^2	5.8 in	40.384 in^4
Part B	46.83 in^4	4.48 in^2	0	46.83 in^4

Add the values together. Remember, we have two part As.
40.384 in^4 * 2 + 46.83 in^4 = **127.60 in^4**



Find the x-coordinate of the centroid. See lectures on cross sections for more details on this process.

$$\bar{x} = \frac{\sum_{i=1}^{n} \bar{x}_i A_i}{A} = \frac{1.5'' * 1.2\ in^2 + 1.5'' * 1.2\ in^2 + 0.2'' * 4.48\ in^2}{6.88\ in^2}$$

$$= \frac{4.496\ in^3}{6.88\ in^2} = \mathbf{0.653\ in}$$