Announcements

- CBTF Quiz 5 starts tomorrow (Thu, 11/29)

Q0: Example Quiz

Total points: 0/60 — 0% — Assessment is **closed** and you cannot answer questions.

For this practice quiz you can use this Centroid and Moment of Inertia Table.

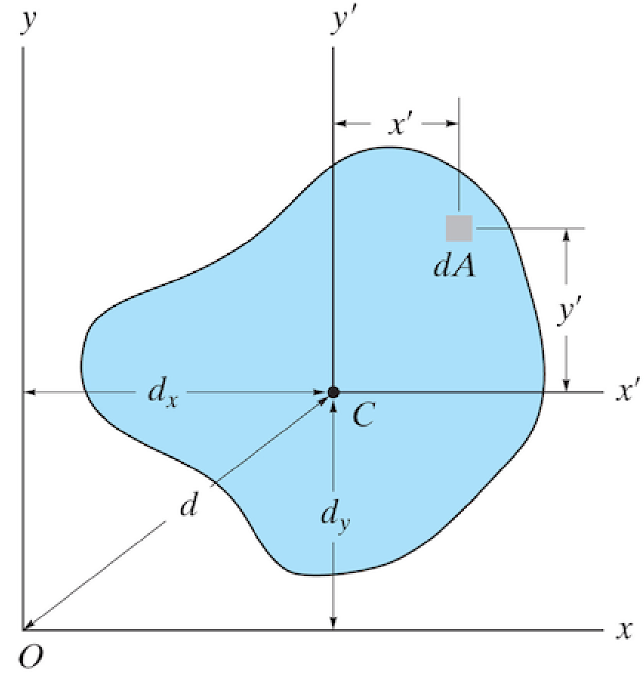
Question	Best submission ?	Available points ?	Awarded points ?
Question 1	unanswered	—	0 /10
Question 2	unanswered	—	0 /10
Question 3	unanswered	—	0 /10
Question 4	unanswered	—	0 /10

❑ Upcoming deadlines:

- Friday (11/30)
  - Written Assignment
- Tuesday (12/4)
  - PL HW

Parallel axis theorem

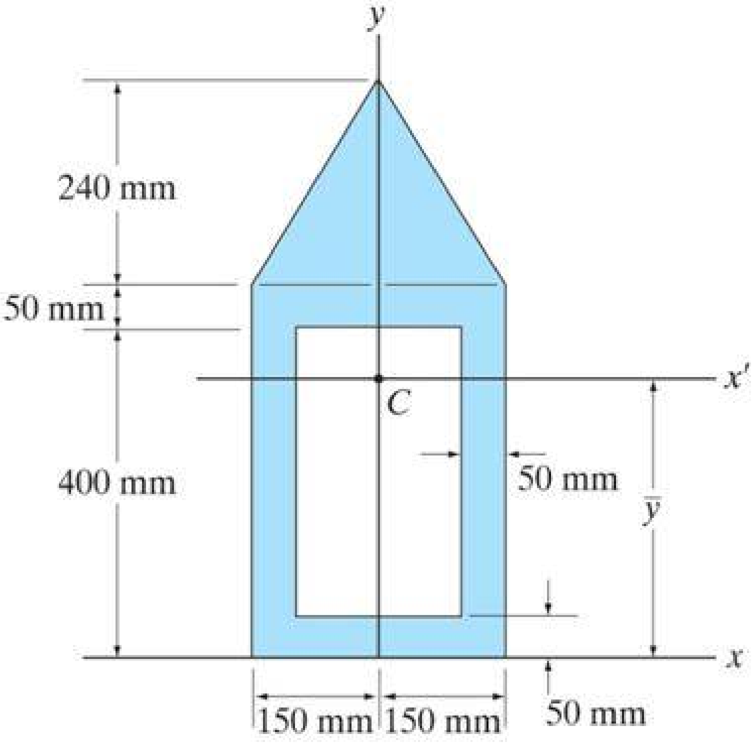
- Often, the **moment of inertia** of an area is known for an axis passing through the **centroid**; e.g., x' and y':
- The moments around other axes can be computed from the known $I_{x'}$ and $I_{y'}$:

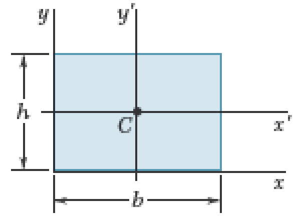
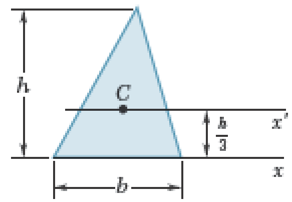
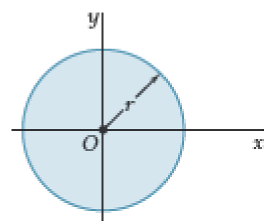
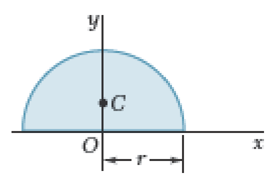
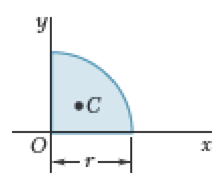
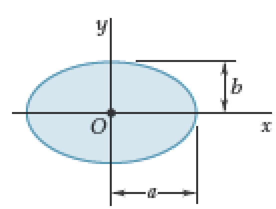


Note: the integral over y' gives zero *when done through the centroid axis*.

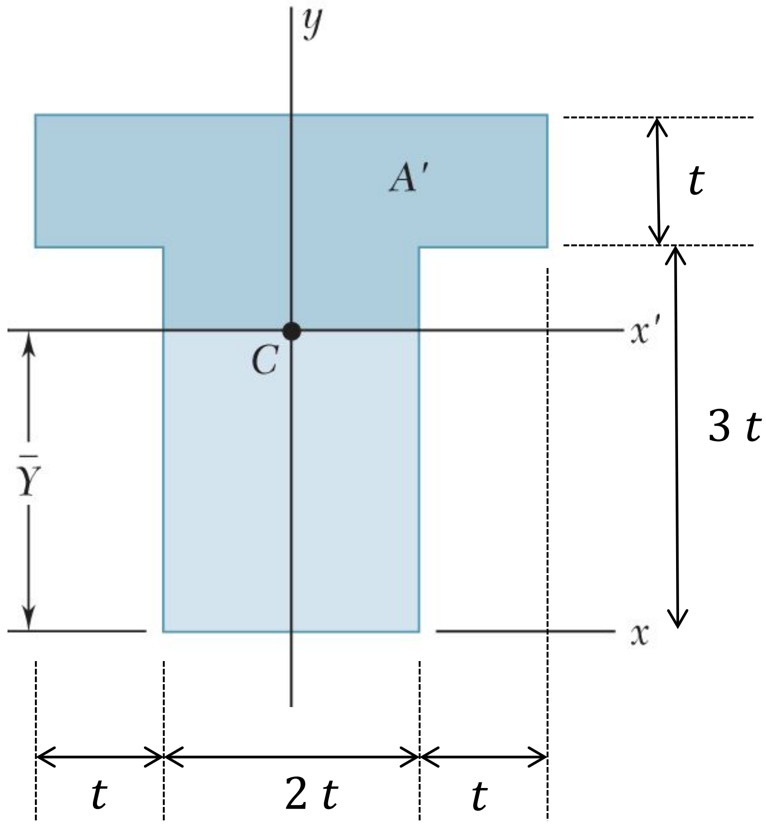
Moment of inertia of composite

- If individual bodies making up a **composite** body have individual areas *A* and moments of inertia *I* computed through their centroids, then the **composite area** and **moment of inertia** is a sum of the individual component contributions.
- This requires the **parallel axis theorem**:



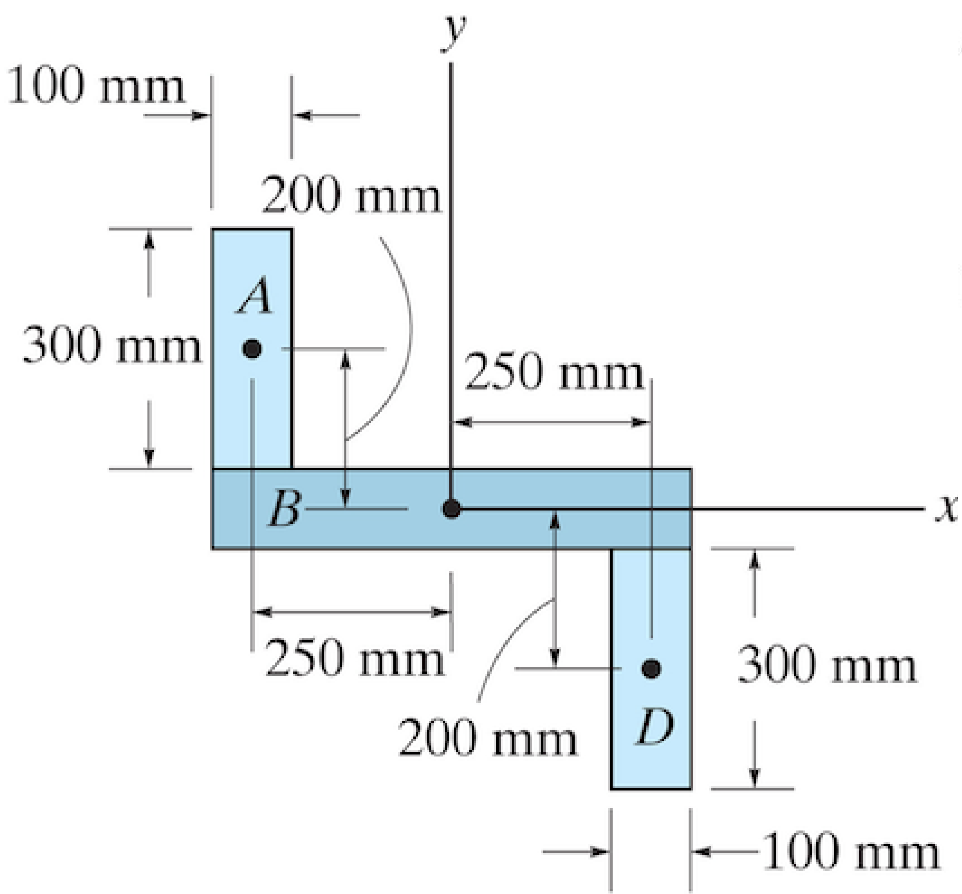
Rectangle		$\bar{I}_{x'} = \frac{1}{12}bh^3$ $\bar{I}_{y'} = \frac{1}{12}b^3h$ $I_x = \frac{1}{3}bh^3$ $I_y = \frac{1}{3}b^3h$ $J_C = \frac{1}{12}bh(b^2 + h^2)$
Triangle		$\bar{I}_{x'} = \frac{1}{36}bh^3$ $I_x = \frac{1}{12}bh^3$
Circle		$\bar{I}_x = \bar{I}_y = \frac{1}{4}\pi r^4$ $J_O = \frac{1}{2}\pi r^4$
Semicircle		$I_x = I_y = \frac{1}{8}\pi r^4$ $J_O = \frac{1}{4}\pi r^4$
Quarter circle		$I_x = I_y = \frac{1}{16}\pi r^4$ $J_O = \frac{1}{8}\pi r^4$
Ellipse		$\bar{I}_x = \frac{1}{4}\pi ab^3$ $\bar{I}_y = \frac{1}{4}\pi a^3b$ $J_O = \frac{1}{4}\pi ab(a^2 + b^2)$

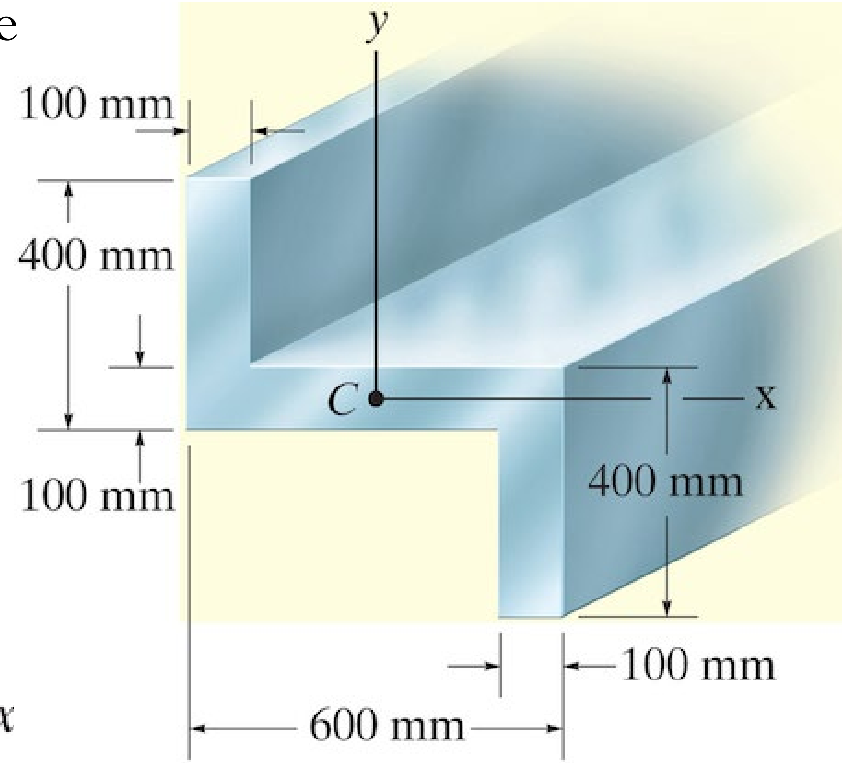
Find the moment of inertia about its centroid:



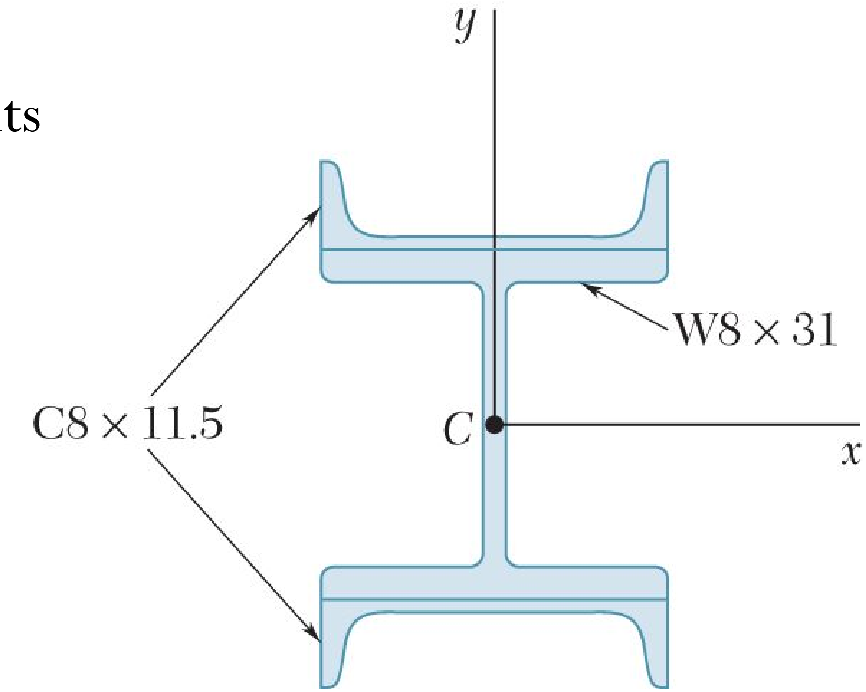
$$\bar{Y} = \frac{4t^2\,(3.5t) + 6t^2\,(1.5t)}{4t^2 + 6t^2} = \frac{23t}{10}$$

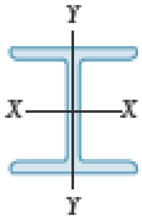
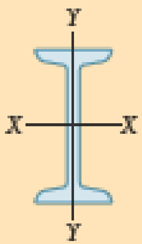
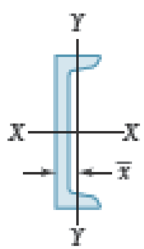
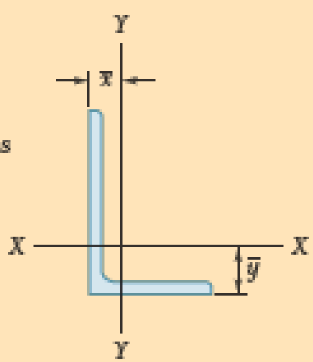
Determine the moment of inertia for the cross-sectional area about the x and y centroidal axes.

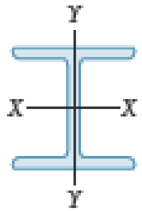
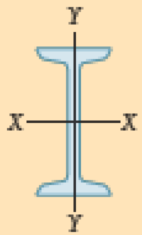
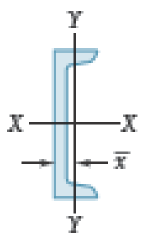
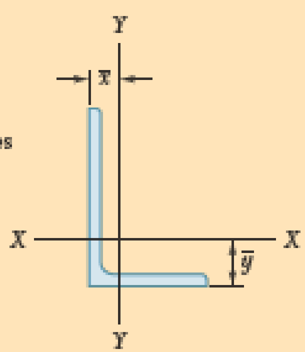




Two channels are welded to a rolled W section as shown. Determine the moments of inertia of the combined section with respect to the centroidal x and y axes.



		Designation	Area, in^2	Depth, in.	Width, in.	Axis X-X			Axis Y-Y		
						$\bar{I}_x$, in^4	$\bar{k}_x$, in.	$\bar{y}$, in.	$\bar{I}_y$, in^4	$\bar{k}_y$, in.	$\bar{x}$, in.
W Shapes (Wide-Flange Shapes)		W18 × 76†	22.3	18.2	11.0	1330	7.73		152	2.61	
		W16 × 57	16.8	16.4	7.12	758	6.72		43.1	1.60	
		W14 × 38	11.2	14.1	6.77	385	5.87		26.7	1.55	
		W8 × 31	9.12	8.00	8.00	110	3.47		37.1	2.02	
S Shapes (American Standard Shapes)		S18 × 54.7†	16.0	18.0	6.00	801	7.07		20.7	1.14	
		S12 × 31.8	9.31	12.0	5.00	217	4.83		9.33	1.00	
		S10 × 25.4	7.45	10.0	4.66	123	4.07		6.73	0.950	
		S6 × 12.5	3.66	6.00	3.33	22.0	2.45		1.80	0.702	
C Shapes (American Standard Channels)		C12 × 20.7†	6.08	12.0	2.94	129	4.61		3.86	0.797	0.698
		C10 × 15.3	4.48	10.0	2.60	67.3	3.87		2.27	0.711	0.634
		C8 × 11.5	3.37	8.00	2.26	32.5	3.11		1.31	0.623	0.572
		C6 × 8.2	2.39	6.00	1.92	13.1	2.34		0.687	0.536	0.512
Angles		L6 × 6 × 1‡	11.0			35.4	1.79	1.86	35.4	1.79	1.86
		L4 × 4 × $\frac{1}{2}$	3.75			5.52	1.21	1.18	5.52	1.21	1.18
		L3 × 3 × $\frac{1}{4}$	1.44			1.23	0.926	0.836	1.23	0.926	0.836
		L6 × 4 × $\frac{1}{2}$	4.75			17.3	1.91	1.98	6.22	1.14	0.981
		L5 × 3 × $\frac{1}{2}$	3.75			9.43	1.58	1.74	2.55	0.824	0.746
		L3 × 2 × $\frac{1}{4}$	1.19			1.09	0.953	0.980	0.390	0.569	0.487

	Designation	Area mm²	Depth mm	Width mm	Axis X-X			Axis Y-Y		
					$\bar{I}_x$ 10^6 mm⁴	$\bar{k}_x$ mm	$\bar{y}$ mm	$\bar{I}_y$ 10^6 mm⁴	$\bar{k}_y$ mm	$\bar{x}$ mm
W Shapes (Wide-Flange Shapes) 	W460 × 113†	14400	462	279	554	196		63.3	66.3	
	W410 × 85	10800	417	181	316	171		17.9	40.6	
	W360 × 57.8	7230	358	172	160	149		11.1	39.4	
	W200 × 46.1	5880	203	203	45.8	88.1		15.4	51.3	
S Shapes (American Standard Shapes) 	S460 × 81.4†	10300	457	152	333	180		8.62	29.0	
	S310 × 47.3	6010	305	127	90.3	123		3.88	25.4	
	S250 × 37.8	4810	254	118	51.2	103		2.80	24.1	
	S150 × 18.6	2360	152	84.6	9.16	62.2		0.749	17.8	
C Shapes (American Standard Channels) 	C310 × 30.8†	3920	305	74.7	53.7	117		1.61	20.2	17.7
	C250 × 22.8	2890	254	66.0	28.0	98.3		0.945	18.1	16.1
	C200 × 17.1	2170	203	57.4	13.5	79.0		0.545	15.8	14.5
	C150 × 12.2	1540	152	48.8	5.45	59.4		0.286	13.6	13.0
Angles 	L152 × 152 × 25.4‡	7100			14.7	45.5	47.2	14.7	45.5	47.2
	L102 × 102 × 12.7	2420			2.30	30.7	30.0	2.30	30.7	30.0
	L76 × 76 × 6.4	929			0.512	23.5	21.2	0.512	23.5	21.2
	L152 × 102 × 12.7	3060			7.20	48.5	50.3	2.59	29.0	24.9
	L127 × 76 × 12.7	2420			3.93	40.1	44.2	1.06	20.9	18.9
	L76 × 51 × 6.4	768			0.454	24.2	24.9	0.162	14.5	12.4