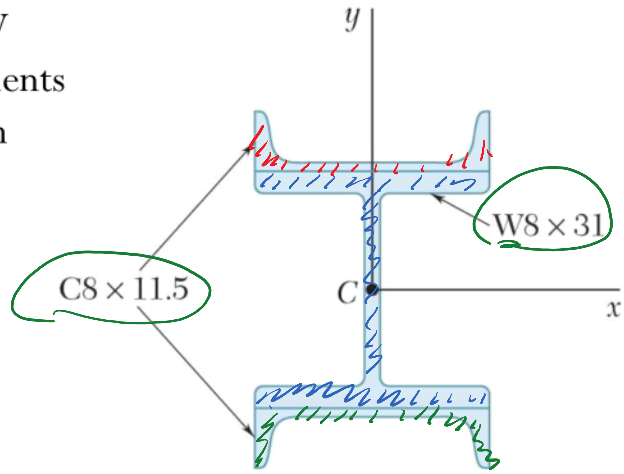
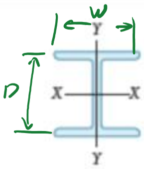
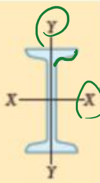
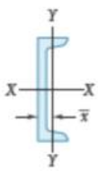
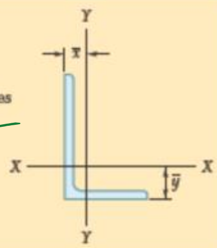
Lec32

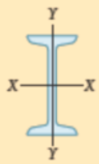
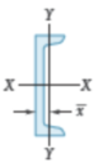
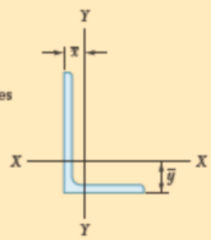
Monday, December 7, 2020 7:58 AM

H, C, I

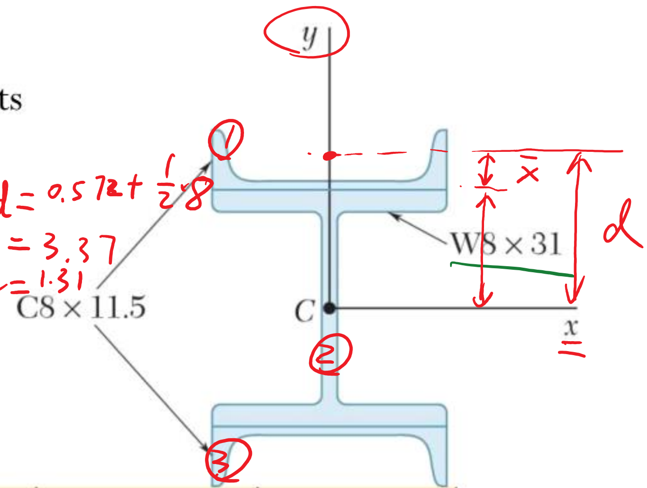
Two channels are welded to a rolled W section as shown. Determine the moments of inertia of the combined section with respect to the centroidal x-axis.



	Designation	Area in²	Depth in.	Width in.	Axis X-X $\bar{I}_x$, in⁴	Axis X-X $\bar{k}_x$, in.	Axis X-X $\bar{y}$, in.	Axis Y-Y $\bar{I}_y$, in⁴	Axis Y-Y $\bar{k}_y$, in.	Axis Y-Y $\bar{x}$, 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: $\bar{I}_x$ 10^6 mm⁴	Axis X-X: $\bar{k}_x$ mm	Axis X-X: $\bar{y}$ mm	Axis Y-Y: $\bar{I}_y$ 10^6 mm⁴	Axis Y-Y: $\bar{k}_y$ mm	Axis Y-Y: $\bar{x}$ 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

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.



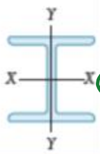
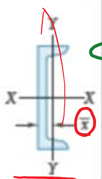
$d = 0.572 + \frac{1}{2} \cdot 8$

$A = 3.37$

$\bar{I}_Y = 1.31$

$$I_x = \Sigma \begin{cases} I_{x_1} = \bar{I}_Y + d^2 A \\ I_{x_2} = 110 \text{ in}^4 \\ I_{x_3} = I_{x_1} \end{cases}$$

$$I_y = I_{y_1} + I_{y_2} + I_{y_3}$$

		Designation	Area in²	Depth in.	Width in.	Axis X-X $\bar{I}_x$, in⁴	Axis X-X $\bar{k}_x$, in.	Axis X-X $\bar{y}$, in.	Axis Y-Y $\bar{I}_y$, in⁴	Axis Y-Y $\bar{k}_y$, in.	Axis Y-Y $\bar{x}$, 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	
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

Determine the moments of inertia of the bracket with respect to the x- and y-axes.

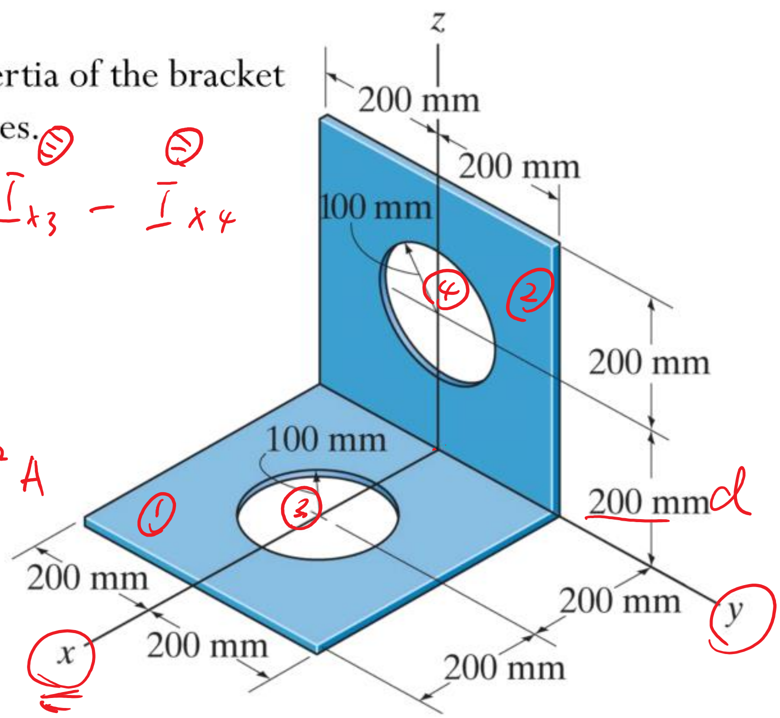


Figure: 10_P106-107

$$\bar{I}_x = \bar{I}_{x_1} + \bar{I}_{x_2} - \bar{I}_{x_3} - \bar{I}_{x_4}$$

$$I_{x_1} = I_{x'} = \frac{1}{12} b h^3$$

$$I_{x_2} = J_o + d^2 A$$

$$= \frac{1}{12} b \cdot h (b^2 + h^2) + d^2 A$$

$$I_{x_3} = I_{x'} = \frac{1}{4} \pi r^4$$

$$I_{x_4} = J_o + d^2 A$$

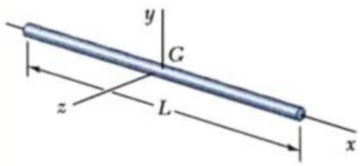
$$= \frac{1}{2} \pi r^4 + d^2 A$$

$$I_y = 2(I_{y_1} - I_{y_3})$$

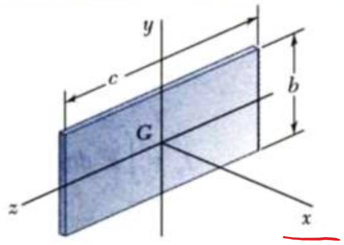
Seventh Edition

Vector Mechanics for Engineers: Statics

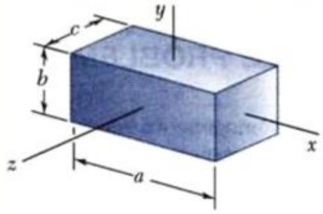
Moments of Inertia of Common Geometric Shapes



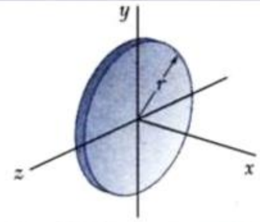
$$I_y = I_z = \frac{1}{12} mL^2$$



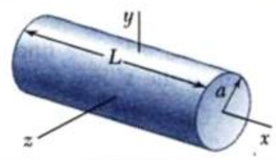
$$I_x = \frac{1}{12} m(b^2 + c^2)$$
$$I_y = \frac{1}{12} mc^2$$
$$I_z = \frac{1}{12} mb^2$$



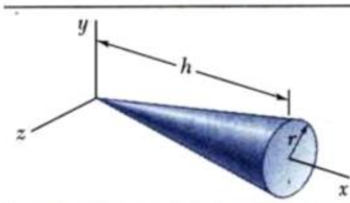
$$I_x = \frac{1}{12} m(b^2 + c^2)$$
$$I_y = \frac{1}{12} m(c^2 + a^2)$$
$$I_z = \frac{1}{12} m(a^2 + b^2)$$



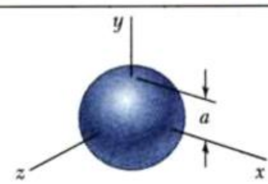
$$I_x = \frac{1}{2} mr^2$$
$$I_y = I_z = \frac{1}{4} mr^2$$



$$I_x = \frac{1}{2} ma^2$$
$$I_y = I_z = \frac{1}{12} m(3a^2 + L^2)$$



$$I_x = \frac{3}{10} ma^2$$
$$I_y = I_z = \frac{3}{5} m(\frac{1}{4} a^2 + h^2)$$

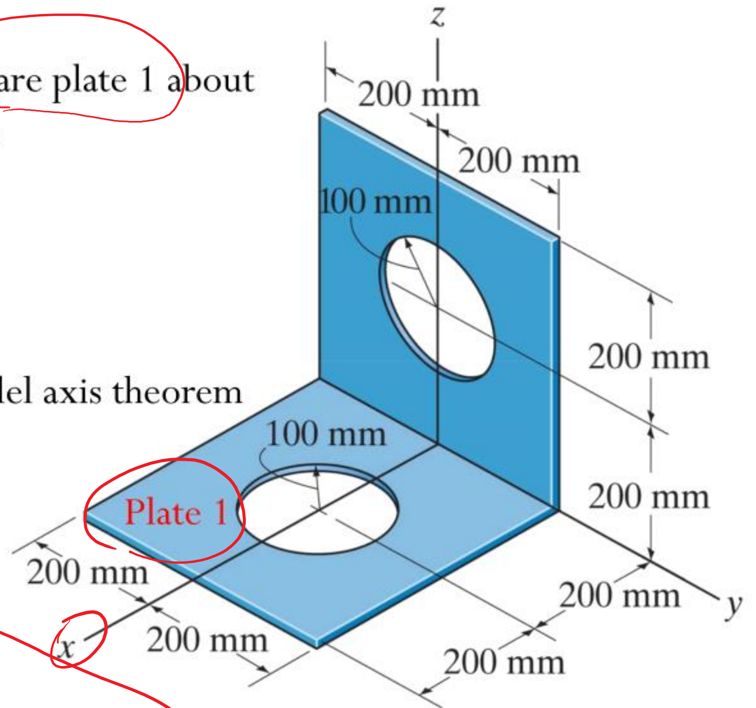


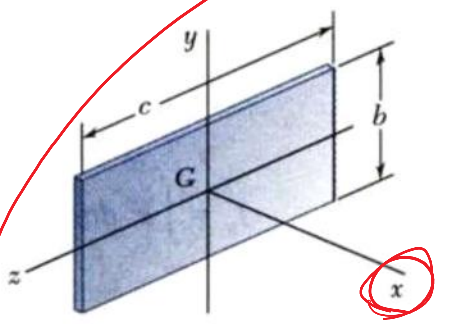
$$I_x = I_y = I_z = \frac{2}{5} ma^2$$

Mc Graw Hill

The moment of inertia for square plate 1 about the x-axis can be calculated by:

A) I_x from table below
B) I_y from table below
C) I_z from table below
D) I_x from table below + parallel axis theorem
E) None of the above





$$I_x = \frac{1}{12} m(b^2 + c^2)$$

$$I_y = \frac{1}{12} mc^2$$

$$I_z = \frac{1}{12} mb^2$$

The moment of inertia for square plate 2 about the x-axis can be calculated by:

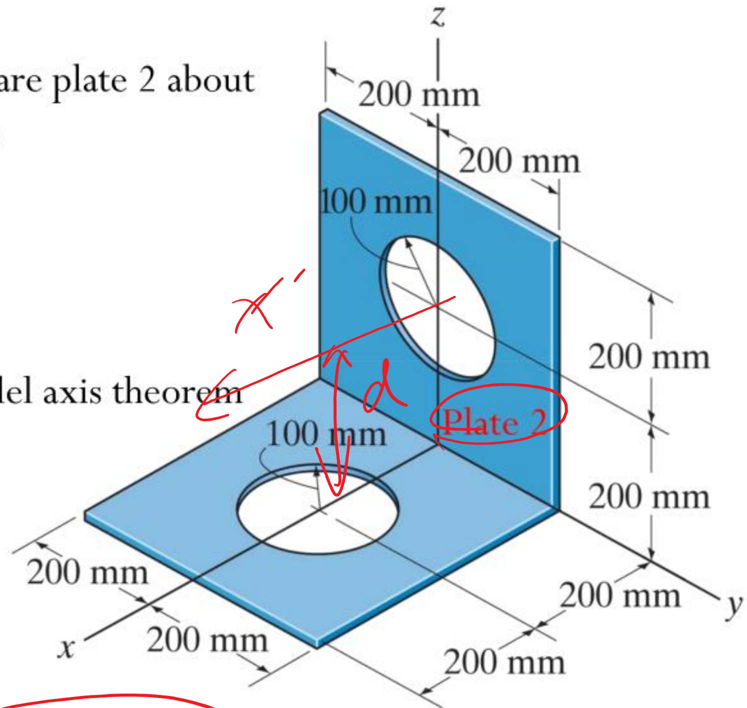
A) I_x from table below

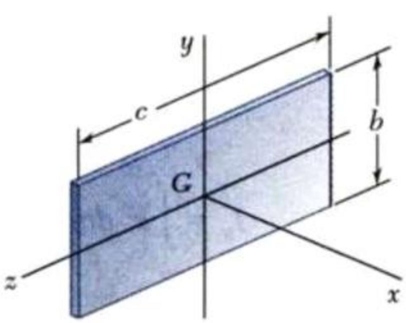
B) I_y from table below

C) I_z from table below

D) I_x from table below + parallel axis theorem

E) None of the above





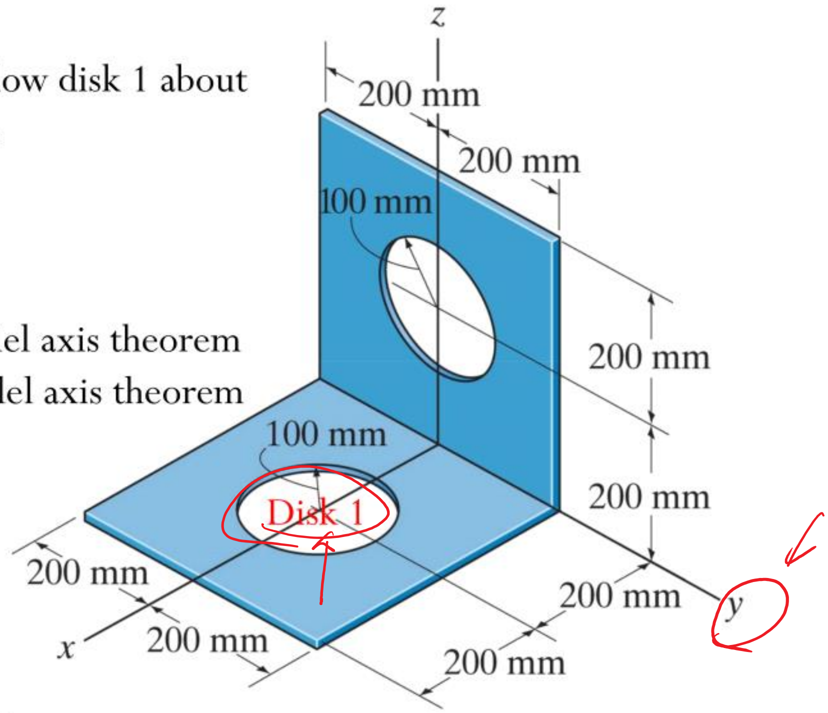
$$I_x = \frac{1}{12} m(b^2 + c^2)$$

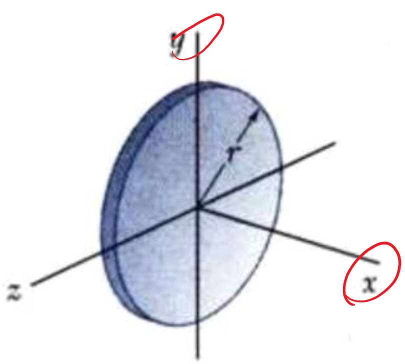
$$I_y = \frac{1}{12} mc^2$$

$$I_z = \frac{1}{12} mb^2$$

The moment of inertia for hollow disk 1 about the y-axis can be calculated by:

A) I_x from table below
B) I_y from table below
C) I_x from table below + parallel axis theorem
D) I_y from table below + parallel axis theorem
E) None of the above

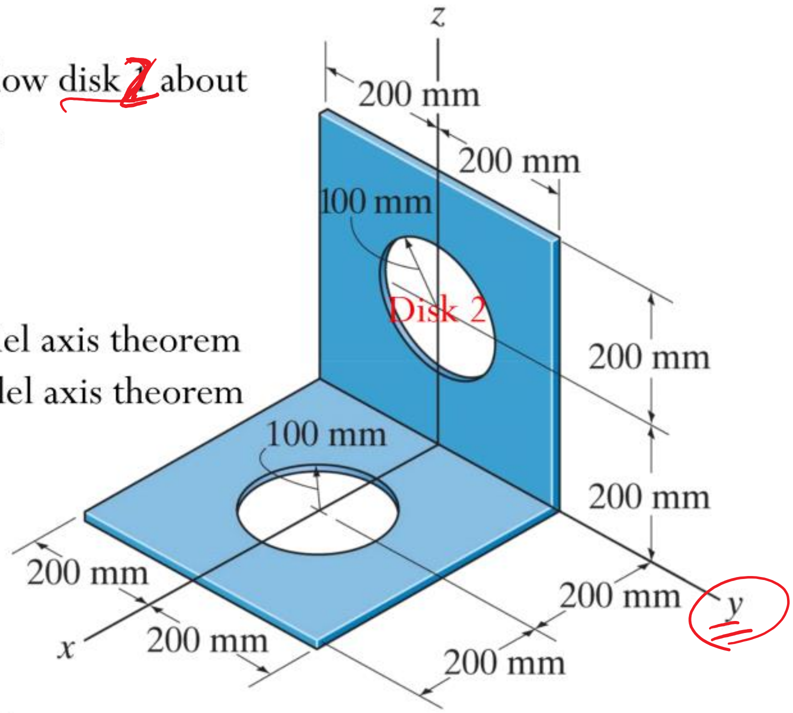


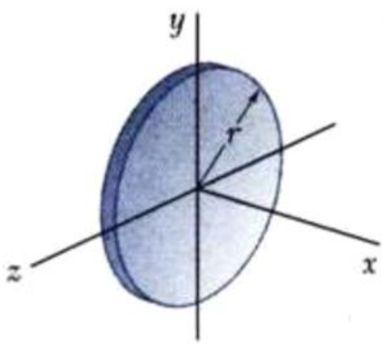


$I_x = \frac{1}{2} mr^2$
$I_y = I_z = \frac{1}{4} mr^2$

The moment of inertia for hollow disk ~~1~~ 2 about the y-axis can be calculated by:

A) I_x from table below
B) I_y from table below
C) I_x from table below + parallel axis theorem
D) I_y from table below + parallel axis theorem
E) None of the above





$$I_x = \frac{1}{2} m r^2$$
$$I_y = I_z = \frac{1}{4} m r^2$$