

**TABLE A16-4** Properties of American Standard steel beams, S-shapes\*

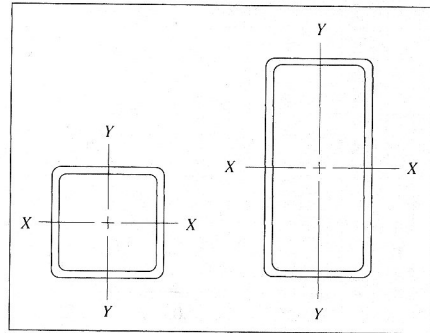
Designation	Area (in <sup>2</sup> )	Depth (in)	Web thickness (in)	Flange		Axis X-X		Axis Y-Y	
				Width (in)	Average thickness (in)	<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )	<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )
S24 × 90	26.5	24.00	0.625	7.125	0.870	2250	187	44.9	12.6
S20 × 96	28.2	20.30	0.800	7.200	0.920	1670	165	50.2	13.9
S20 × 75	22.0	20.00	0.635	6.385	0.795	1280	128	29.8	9.32
S20 × 66	19.4	20.00	0.505	6.255	0.795	1190	119	27.7	8.85
S18 × 70	20.6	18.00	0.711	6.251	0.691	926	103	24.1	7.72
S15 × 50	14.7	15.00	0.550	5.640	0.622	486	64.8	15.7	5.57
S12 × 50	14.7	12.00	0.687	5.477	0.659	305	50.8	15.7	5.74
S12 × 35	10.3	12.00	0.428	5.078	0.544	229	38.2	9.87	3.89
S10 × 35	10.3	10.00	0.594	4.944	0.491	147	29.4	8.36	3.38
S10 × 25.4	7.46	10.00	0.311	4.661	0.491	124	24.7	6.79	2.91
S8 × 23	6.77	8.00	0.441	4.171	0.426	64.9	16.2	4.31	2.07
S8 × 18.4	5.41	8.00	0.271	4.001	0.426	57.6	14.4	3.73	1.86
S7 × 20	5.88	7.00	0.450	3.860	0.392	42.4	12.1	3.17	1.64
S6 × 12.5	3.67	6.00	0.232	3.332	0.359	22.1	7.37	1.82	1.09
S5 × 10	2.94	5.00	0.214	3.004	0.326	12.3	4.92	1.22	0.809
S4 × 7.7	2.26	4.00	0.193	2.663	0.293	6.08	3.04	0.764	0.574
S3 × 5.7	1.67	3.00	0.170	2.330	0.260	2.52	1.68	0.455	0.390

\*Data are taken from a variety of sources. Sizes listed represent a small sample of the sizes available.

Notes: Example designation: S10 × 35

10 = nominal depth (in); 35 = weight per unit length (lb/ft)

*I* = moment of inertia; *S* = section modulus.



**TABLE A16-5** Properties of steel structural tubing, square and rectangular\*

Size	Area (in <sup>2</sup> )	Weight per foot (lb)	Axis X-X			Axis Y-Y		
			<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )	<i>r</i> (in)	<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )	<i>r</i> (in)
8 × 8 × 1/2	14.4	48.9	131	32.9	3.03	131	32.9	3.03
8 × 8 × 1/4	7.59	25.8	75.1	18.8	3.15	75.1	18.8	3.15
8 × 4 × 1/2	10.4	35.2	75.1	18.8	2.69	24.6	12.3	1.54
8 × 4 × 1/4	5.59	19.0	45.1	11.3	2.84	15.3	7.63	1.65
8 × 2 × 1/4	4.59	15.6	30.1	7.52	2.56	3.08	3.08	0.819
6 × 6 × 1/2	10.4	35.2	50.5	16.8	2.21	50.5	16.8	2.21
6 × 6 × 1/4	5.59	19.0	30.3	10.1	2.33	30.3	10.1	2.33
6 × 4 × 1/4	4.59	15.6	22.1	7.36	2.19	11.7	5.87	1.60
6 × 2 × 1/4	3.59	12.2	13.8	4.60	1.96	2.31	2.31	0.802
4 × 4 × 1/2	6.36	21.6	12.3	6.13	1.39	12.3	6.13	1.39
4 × 4 × 1/4	3.59	12.2	8.22	4.11	1.51	8.22	4.11	1.51
4 × 2 × 1/4	2.59	8.81	4.69	2.35	1.35	1.54	1.54	0.770
3 × 3 × 1/4	2.59	8.81	3.16	2.10	1.10	3.16	2.10	1.10
3 × 2 × 1/4	2.09	7.11	2.21	1.47	1.03	1.15	1.15	0.742
2 × 2 × 1/4	1.59	5.41	0.766	0.766	0.694	0.766	0.766	0.694

\*Data are taken from a variety of sources. Sizes listed represent a small sample of the sizes available.

Notes: Example size: 6 × 4 × 1/4

6 = vertical depth (in); 4 = width (in); 1/4 = wall thickness (in).

*I* = moment of inertia; *S* = section modulus; *r* = radius of gyration.

APPENDIX 16 STEEL STRUCTURAL SHAPES

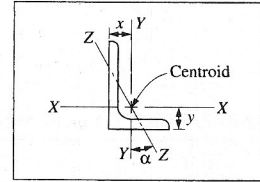
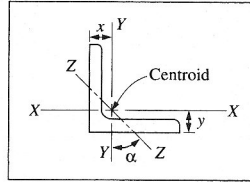


TABLE A16-1 Properties of steel angles, equal legs and unequal legs, L-shapes\*

Designation	Area (in <sup>2</sup> )	Weight per foot (lb)	Axis X-X			Axis Y-Y			Axis Z-Z		
			<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )	<i>y</i> (in)	<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )	<i>x</i> (in)	<i>r</i> (in)	$\alpha$ (deg)	
L8 × 8 × 1	15.0	51.0	89.0	15.8	2.37	89.0	15.8	2.37	1.56	45.0	
L8 × 8 × 1/2	7.75	26.4	48.6	8.36	2.19	48.6	8.36	2.19	1.59	45.0	
L8 × 4 × 1	11.0	37.4	69.6	14.1	3.05	11.6	3.94	1.05	0.846	13.9	
L8 × 4 × 1/2	5.75	19.6	38.5	7.49	2.86	6.74	2.15	0.859	0.865	14.9	
L6 × 6 × 3/4	8.44	28.7	28.2	6.66	1.78	28.2	6.66	1.78	1.17	45.0	
L6 × 6 × 3/8	4.36	14.9	15.4	3.53	1.64	15.4	3.53	1.64	1.19	45.0	
L6 × 4 × 3/4	6.94	23.6	24.5	6.25	2.08	8.68	2.97	1.08	0.860	23.2	
L6 × 4 × 3/8	3.61	12.3	13.5	3.32	1.94	4.90	1.60	0.941	0.877	24.0	
L4 × 4 × 1/2	3.75	12.8	5.56	1.97	1.18	5.56	1.97	1.18	0.782	45.0	
L4 × 4 × 1/4	1.94	6.6	3.04	1.05	1.09	3.04	1.05	1.09	0.795	45.0	
L4 × 3 × 1/2	3.25	11.1	5.05	1.89	1.33	2.42	1.12	0.827	0.639	28.5	
L4 × 3 × 1/4	1.69	5.8	2.77	1.00	1.24	1.36	0.599	0.896	0.651	29.2	
L3 × 3 × 1/2	2.75	9.4	2.22	1.07	0.932	2.22	1.07	0.932	0.584	45.0	
L3 × 3 × 1/4	1.44	4.9	1.24	0.577	0.842	1.24	0.577	0.842	0.592	45.0	
L2 × 2 × 3/8	1.36	4.7	0.479	0.351	0.636	0.479	0.351	0.636	0.389	45.0	
L2 × 2 × 1/4	0.938	3.19	0.348	0.247	0.592	0.348	0.247	0.592	0.391	45.0	
L2 × 2 × 1/8	0.484	1.65	0.190	0.131	0.546	0.190	0.131	0.546	0.398	45.0	

\*Data are taken from a variety of sources. Sizes listed represent a small sample of the sizes available.

Notes: Example designation: L4 × 3 × 1/2

4 = length of longer leg (in); 3 = length of shorter leg (in); 1/2 = thickness of legs (in)

Z-Z is axis of minimum moment of inertia (*I*) and radius of gyration (*r*).

*I* = moment of inertia; *S* = section modulus; *r* = radius of gyration.

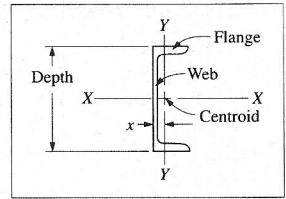


TABLE A16-2 Properties of American Standard steel channels, C-shapes\*

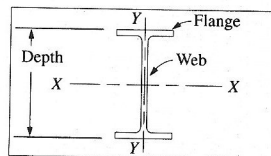
Designation	Area (in <sup>2</sup> )	Depth (in)	Web thickness (in)	Flange		Axis X-X		Axis Y-Y		
				Width (in)	Average thickness (in)	$I$ (in <sup>4</sup> )	$S$ (in <sup>3</sup> )	$I$ (in <sup>4</sup> )	$S$ (in <sup>3</sup> )	$x$ (in)
C15 × 50	14.7	15.00	0.716	3.716	0.650	404	53.8	11.0	3.78	0.798
C15 × 40	11.8	15.00	0.520	3.520	0.650	349	46.5	9.23	3.37	0.777
C12 × 30	8.82	12.00	0.510	3.170	0.501	162	27.0	5.14	2.06	0.674
C12 × 25	7.35	12.00	0.387	3.047	0.501	144	24.1	4.47	1.88	0.674
C10 × 30	8.82	10.00	0.673	3.033	0.436	103	20.7	3.94	1.65	0.649
C10 × 20	5.88	10.00	0.379	2.739	0.436	78.9	15.8	2.81	1.32	0.606
C9 × 20	5.88	9.00	0.448	2.648	0.413	60.9	13.5	2.42	1.17	0.583
C9 × 15	4.41	9.00	0.285	2.485	0.413	51.0	11.3	1.93	1.01	0.586
C8 × 18.75	5.51	8.00	0.487	2.527	0.390	44.0	11.0	1.98	1.01	0.565
C8 × 11.5	3.38	8.00	0.220	2.260	0.390	32.6	8.14	1.32	0.781	0.571
C6 × 13	3.83	6.00	0.437	2.157	0.343	17.4	5.80	1.05	0.642	0.514
C6 × 8.2	2.40	6.00	0.200	1.920	0.343	13.1	4.38	0.693	0.492	0.511
C5 × 9	2.64	5.00	0.325	1.885	0.320	8.90	3.56	0.632	0.450	0.478
C5 × 6.7	1.97	5.00	0.190	1.750	0.320	7.49	3.00	0.479	0.378	0.484
C4 × 7.25	2.13	4.00	0.321	1.721	0.296	4.59	2.29	0.433	0.343	0.459
C4 × 5.4	1.59	4.00	0.184	1.584	0.296	3.85	1.93	0.319	0.283	0.457
C3 × 6	1.76	3.00	0.356	1.596	0.273	2.07	1.38	0.305	0.268	0.455
C3 × 4.1	1.21	3.00	0.170	1.410	0.273	1.66	1.10	0.197	0.202	0.436

\*Data are taken from a variety of sources. Sizes listed represent a small sample of the sizes available.

Notes: Example designation: C15 × 50

15 = depth (in); 50 = weight per unit length (lb/ft)

$I$  = moment of inertia;  $S$  = section modulus.



**TABLE A16-3** Properties of steel wide-flange shapes, W-shapes\*

Designation	Area (in <sup>2</sup> )	Depth (in)	Web thickness (in)	Flange		Axis X-X		Axis Y-Y	
				Width (in)	Thickness (in)	<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )	<i>I</i> (in <sup>4</sup> )	<i>S</i> (in <sup>3</sup> )
W24 × 76	22.4	23.92	0.440	8.990	0.680	2100	176	82.5	18.4
W24 × 68	20.1	23.73	0.415	8.965	0.585	1830	154	70.4	15.7
W21 × 73	21.5	21.24	0.455	8.295	0.740	1600	151	70.6	17.0
W21 × 57	16.7	21.06	0.405	6.555	0.650	1170	111	30.6	9.35
W18 × 55	16.2	18.11	0.390	7.530	0.630	890	98.3	44.9	11.9
W18 × 40	11.8	17.90	0.315	6.015	0.525	612	68.4	19.1	6.35
W14 × 43	12.6	13.66	0.305	7.995	0.530	428	62.7	45.2	11.3
W14 × 26	7.69	13.91	0.255	5.025	0.420	245	35.3	8.91	3.54
W12 × 30	8.79	12.34	0.260	6.520	0.440	238	38.6	20.3	6.24
W12 × 16	4.71	11.99	0.220	3.990	0.265	103	17.1	2.82	1.41
W10 × 15	4.41	9.99	0.230	4.000	0.270	69.8	13.8	2.89	1.45
W10 × 12	3.54	9.87	0.190	3.960	0.210	53.8	10.9	2.18	1.10
W8 × 15	4.44	8.11	0.245	4.015	0.315	48.0	11.8	3.41	1.70
W8 × 10	2.96	7.89	0.170	3.940	0.205	30.8	7.81	2.09	1.06
W6 × 15	4.43	5.99	0.230	5.990	0.260	29.1	9.72	9.32	3.11
W6 × 12	3.55	6.03	0.230	4.000	0.280	22.1	7.31	2.99	1.50
W5 × 19	5.54	5.15	0.270	5.030	0.430	26.2	10.2	9.13	3.63
W5 × 16	4.68	5.01	0.240	5.000	0.360	21.3	8.51	7.51	3.00
W4 × 13	3.83	4.16	0.280	4.060	0.345	11.3	5.46	3.86	1.90

\*Data are taken from a variety of sources. Sizes listed represent a small sample of the sizes available.

Notes: Example designation: W14 × 43

14 = nominal depth (in); 43 = weight per unit length (lb/ft)

*I* = moment of inertia; *S* = section modulus.

TABLE A16-6 Properties of American National Standard Schedule 40 welded and seamless wrought steel pipe

Nominal	Diameter (in)		Wall thickness (in)	Cross-sectional area of metal (in <sup>2</sup> )	Properties of sections			
	Actual inside	Actual outside			Moment of inertia, $I$ (in <sup>4</sup> )	Radius of gyration (in)	Section modulus, $S$ (in <sup>3</sup> )	Polar section modulus, $Z_p$ (in <sup>3</sup> )
1/8	0.269	0.405	0.068	0.072	0.001 06	0.122	0.005 25	0.010 50
1/4	0.364	0.540	0.088	0.125	0.003 31	0.163	0.012 27	0.024 54
3/8	0.493	0.675	0.091	0.167	0.007 29	0.209	0.021 60	0.043 20
1/2	0.622	0.840	0.109	0.250	0.017 09	0.261	0.040 70	0.081 40
3/4	0.824	1.050	0.113	0.333	0.037 04	0.334	0.070 55	0.1411
1	1.049	1.315	0.133	0.494	0.087 34	0.421	0.1328	0.2656
1 $\frac{1}{4}$	1.380	1.660	0.140	0.669	0.1947	0.539	0.2346	0.4692
1 $\frac{1}{2}$	1.610	1.900	0.145	0.799	0.3099	0.623	0.3262	0.6524
2	2.067	2.375	0.154	1.075	0.6658	0.787	0.5607	1.121
2 $\frac{1}{2}$	2.469	2.875	0.203	1.704	1.530	0.947	1.064	2.128
3	3.068	3.500	0.216	2.228	3.017	1.163	1.724	3.448
3 $\frac{1}{2}$	3.548	4.000	0.226	2.680	4.788	1.337	2.394	4.788
4	4.026	4.500	0.237	3.174	7.233	1.510	3.215	6.430
5	5.047	5.563	0.258	4.300	15.16	1.878	5.451	10.90
6	6.065	6.625	0.280	5.581	28.14	2.245	8.496	16.99
8	7.981	8.625	0.322	8.399	72.49	2.938	16.81	33.62
10	10.020	10.750	0.365	11.91	160.7	3.674	29.91	59.82
12	11.938	12.750	0.406	15.74	300.2	4.364	47.09	94.18
16	15.000	16.000	0.500	24.35	732.0	5.484	91.50	183.0
18	16.876	18.000	0.562	30.79	1172	6.168	130.2	260.4