E

Properties of Structural-Steel Shapes

In the following tables, the properties of a few structural-steel shapes are presented as an aid to the reader in solving problems in the text. These tables were compiled from the extensive tables in the *Manual of Steel Construction*, published by the American Institute of Steel Construction, Inc. (Ref. 5-4).

Notation:

I = moment of inertia

S = section modulus

$r = \sqrt{I/A}$ = radius of gyration

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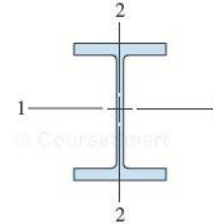**APPENDIX E   Properties of Structural-Steel Shapes   973**

TABLE E-1(a)   PROPERTIES OF WIDE-FLANGE SECTIONS (W SHAPES) – USCS UNITS (ABRIDGED LIST)

Designation	Weight per foot	Area	Depth	Web thickness	Flange		Axis 1-1			Axis 2-2		
					Width	Thickness	I	S	r	I	S	r
	lb	in.^{2}	in.	in.	in.	in.	in.^{4}	in.^{3}	in.	in.^{4}	in.^{3}	in.
W 30 × 211	211	62.2	30.9	0.775	15.1	1.32	10300	665	12.9	757	100	3.49
W 30 × 132	132	38.9	30.3	0.615	10.5	1.00	5770	380	12.2	196	37.2	2.25
W 24 × 162	162	47.7	25.0	0.705	13.0	1.22	5170	414	10.4	443	68.4	3.05
W 24 × 94	94.0	27.7	24.3	0.515	9.07	0.875	2700	222	9.87	109	24.0	1.98
W 18 × 119	119	35.1	19.0	0.655	11.3	1.06	2190	231	7.90	253	44.9	2.69
W 18 × 71	71.0	20.8	18.5	0.495	7.64	0.810	1170	127	7.50	60.3	15.8	1.70
W 16 × 100	100	29.5	17.0	0.585	10.4	0.985	1490	175	7.10	186	35.7	2.51
W 16 × 77	77.0	22.6	16.5	0.455	10.3	0.760	1110	134	7.00	138	26.9	2.47
W 16 × 57	57.0	16.8	16.4	0.430	7.12	0.715	758	92.2	6.72	43.1	12.1	1.60
W 16 × 31	31.0	9.13	15.9	0.275	5.53	0.440	375	47.2	6.41	12.4	4.49	1.17
W 14 × 120	120	35.3	14.5	0.590	14.7	0.940	1380	190	6.24	495	67.5	3.74
W 14 × 82	82.0	24.0	14.3	0.510	10.1	0.855	881	123	6.05	148	29.3	2.48
W 14 × 53	53.0	15.6	13.9	0.370	8.06	0.660	541	77.8	5.89	57.7	14.3	1.92
W 14 × 26	26.0	7.69	13.9	0.255	5.03	0.420	245	35.3	5.65	8.91	3.55	1.08
W 12 × 87	87.0	25.6	12.5	0.515	12.1	0.810	740	118	5.38	241	39.7	3.07
W 12 × 50	50.0	14.6	12.2	0.370	8.08	0.640	391	64.2	5.18	56.3	13.9	1.96
W 12 × 35	35.0	10.3	12.5	0.300	6.56	0.520	285	45.6	5.25	24.5	7.47	1.54
W 12 × 14	14.0	4.16	11.9	0.200	3.97	0.225	88.6	14.9	4.62	2.36	1.19	0.753
W 10 × 60	60.0	17.6	10.2	0.420	10.1	0.680	341	66.7	4.39	116	23.0	2.57
W 10 × 45	45.0	13.3	10.1	0.350	8.02	0.620	248	49.1	4.32	53.4	13.3	2.01
W 10 × 30	30.0	8.84	10.5	0.300	5.81	0.510	170	32.4	4.38	16.7	5.75	1.37
W 10 × 12	12.0	3.54	9.87	0.190	3.96	0.210	53.8	10.9	3.90	2.18	1.10	0.785
W 8 × 35	35.0	10.3	8.12	0.310	8.02	0.495	127	31.2	3.51	42.6	10.6	2.03
W 8 × 28	28.0	8.24	8.06	0.285	6.54	0.465	98.0	24.3	3.45	21.7	6.63	1.62
W 8 × 21	21.0	6.16	8.28	0.250	5.27	0.400	75.3	18.2	3.49	9.77	3.71	1.26
W 8 × 15	15.0	4.44	8.11	0.245	4.01	0.315	48.0	11.8	3.29	3.41	1.70	0.876

Note: Axes 1-1 and 2-2 are principal centroidal axes.

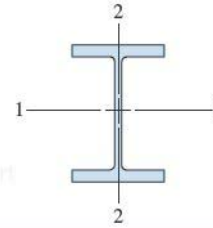**974   APPENDIX E   Properties of Structural-Steel Shapes**

TABLE E-1(b) PROPERTIES OF WIDE-FLANGE SECTIONS (W SHAPES) – SI UNITS (ABRIDGED LIST)

Designation	Mass per meter	Area	Depth	Web thickness	Flange Width	Flange Thickness	Axis 1-1 I	Axis 1-1 S	Axis 1-1 r	Axis 2-2 I	Axis 2-2 S	Axis 2-2 r
	kg	mm^2	mm	mm	mm	mm	$\times 10^6 mm^4$	$\times 10^3 mm^3$	mm	$\times 10^6 mm^4$	$\times 10^3 mm^3$	mm
W 760 × 314	314	40100	785	19.7	384	33.5	4290	10900	328	315	1640	88.6
W 760 × 196	196	25100	770	15.6	267	25.4	2400	6230	310	81.6	610	57.2
W 610 × 241	241	30800	635	17.9	330	31.0	2150	6780	264	184	1120	77.5
W 610 × 140	140	17900	617	13.1	230	22.2	1120	3640	251	45.4	393	50.3
W 460 × 177	177	22600	483	16.6	287	26.9	912	3790	201	105	736	68.3
W 460 × 106	106	13400	470	12.6	194	20.6	487	2080	191	25.1	259	43.2
W 410 × 149	149	19000	432	14.9	264	25.0	620	2870	180	77.4	585	63.8
W 410 × 114	114	14600	419	11.6	262	19.3	462	2200	178	57.4	441	62.7
W 410 × 85	85.0	10800	417	10.9	181	18.2	316	1510	171	17.9	198	40.6
W 410 × 46.1	46.1	5890	404	6.99	140	11.2	156	773	163	5.16	73.6	29.7
W 360 × 179	179	22800	368	15.0	373	23.9	574	3110	158	206	1110	95.0
W 360 × 122	122	15500	363	13.0	257	21.7	367	2020	154	61.6	480	63.0
W 360 × 79	79.0	10100	353	9.40	205	16.8	225	1270	150	24.0	234	48.8
W 360 × 39	39.0	4960	353	6.48	128	10.7	102	578	144	3.71	58.2	27.4
W 310 × 129	129	16500	318	13.1	307	20.6	308	1930	137	100	651	78.0
W 310 × 74	74.0	9420	310	9.40	205	16.3	163	1050	132	23.4	228	49.8
W 310 × 52	52.0	6650	318	7.62	167	13.2	119	747	133	10.2	122	39.1
W 310 × 21	21.0	2680	302	5.08	101	5.72	36.9	244	117	0.982	19.5	19.1
W 250 × 89	89.0	11400	259	10.7	257	17.3	142	1090	112	48.3	377	65.3
W 250 × 67	67.0	8580	257	8.89	204	15.7	103	805	110	22.2	218	51.1
W 250 × 44.8	44.8	5700	267	7.62	148	13.0	70.8	531	111	6.95	94.2	34.8
W 250 × 17.9	17.9	2280	251	4.83	101	5.33	22.4	179	99.1	0.907	18.0	19.9
W 200 × 52	52.0	6650	206	7.87	204	12.6	52.9	511	89.2	17.7	174	51.6
W 200 × 41.7	41.7	5320	205	7.24	166	11.8	40.8	398	87.6	9.03	109	41.1
W 200 × 31.3	31.3	3970	210	6.35	134	10.2	31.3	298	88.6	4.07	60.8	32.0
W 200 × 22.5	22.5	2860	206	6.22	102	8.00	20.0	193	83.6	1.42	27.9	22.3

Note: Axes 1-1 and 2-2 are principal centroidal axes.

APPENDIX E   Properties of Structural-Steel Shapes   **975**
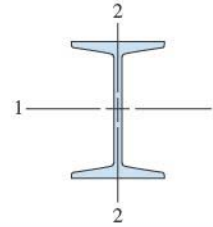
TABLE E-2(a) PROPERTIES OF I-BEAM SECTIONS (S SHAPES) – USCS UNITS (ABRIDGED LIST)

Designation	Weight per foot	Area	Depth	Web thickness	Flange		Axis 1-1			Axis 2-2		
					Width	Average thickness	I	S	r	I	S	r
	lb	in.²	in.	in.	in.	in.	in.⁴	in.³	in.	in.⁴	in.³	in.
S 24 × 100	100	29.3	24.0	0.745	7.25	0.870	2380	199	9.01	47.4	13.1	1.27
S 24 × 80	80.0	23.5	24.0	0.500	7.00	0.870	2100	175	9.47	42.0	12.0	1.34
S 20 × 96	96.0	28.2	20.3	0.800	7.20	0.920	1670	165	7.71	49.9	13.9	1.33
S 20 × 75	75.0	22.0	20.0	0.635	6.39	0.795	1280	128	7.62	29.5	9.25	1.16
S 18 × 70	70.0	20.5	18.0	0.711	6.25	0.691	923	103	6.70	24.0	7.69	1.08
S 18 × 54.7	54.7	16.0	18.0	0.461	6.00	0.691	801	89.0	7.07	20.7	6.91	1.14
S 15 × 50	50.0	14.7	15.0	0.550	5.64	0.622	485	64.7	5.75	15.6	5.53	1.03
S 15 × 42.9	42.9	12.6	15.0	0.411	5.50	0.622	446	59.4	5.95	14.3	5.19	1.06
S 12 × 50	50.0	14.6	12.0	0.687	5.48	0.659	303	50.6	4.55	15.6	5.69	1.03
S 12 × 35	35.0	10.2	12.0	0.428	5.08	0.544	228	38.1	4.72	9.84	3.88	0.980
S 10 × 35	35.0	10.3	10.0	0.594	4.94	0.491	147	29.4	3.78	8.30	3.36	0.899
S 10 × 25.4	25.4	7.45	10.0	0.311	4.66	0.491	123	24.6	4.07	6.73	2.89	0.950
S 8 × 23	23.0	6.76	8.00	0.441	4.17	0.425	64.7	16.2	3.09	4.27	2.05	0.795
S 8 × 18.4	18.4	5.40	8.00	0.271	4.00	0.425	57.5	14.4	3.26	3.69	1.84	0.827
S 6 × 17.2	17.3	5.06	6.00	0.465	3.57	0.359	26.2	8.74	2.28	2.29	1.28	0.673
S 6 × 12.5	12.5	3.66	6.00	0.232	3.33	0.359	22.0	7.34	2.45	1.80	1.08	0.702
S 4 × 9.5	9.50	2.79	4.00	0.326	2.80	0.293	6.76	3.38	1.56	0.887	0.635	0.564
S 4 × 7.7	7.70	2.26	4.00	0.193	2.66	0.293	6.05	3.03	1.64	0.748	0.562	0.576

Note: Axes 1-1 and 2-2 are principal centroidal axes.

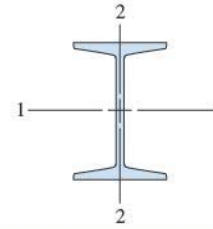**976**   **APPENDIX E   Properties of Structural-Steel Shapes**

TABLE E-2(b) PROPERTIES OF I-BEAM SECTIONS (S SHAPES) – SI UNITS (ABRIDGED LIST)

Designation	Mass per meter	Area	Depth	Web thickness	Flange		Axis 1-1			Axis 2-2		
					Width	Average thickness	I	S	r	I	S	r
	kg	mm^2	mm	mm	mm	mm	$\times 10^6$ mm^4	$\times 10^3$ mm^3	mm	$\times 10^6$ mm^4	$\times 10^3$ mm^3	mm
S 610 × 149	149	18900	610	18.9	184	22.1	991	3260	229	19.7	215	32.3
S 610 × 119	119	15200	610	12.7	178	22.1	874	2870	241	17.5	197	34.0
S 510 × 143	143	18200	516	20.3	183	23.4	695	2700	196	20.8	228	33.8
S 510 × 112	112	14200	508	16.1	162	20.2	533	2100	194	12.3	152	29.5
S 460 × 104	104	13200	457	18.1	159	17.6	384	1690	170	10.0	126	27.4
S 460 × 81.4	81.4	10300	457	11.7	152	17.6	333	1460	180	8.62	113	29.0
S 380 × 74	74.0	9480	381	14.0	143	15.8	202	1060	146	6.49	90.6	26.2
S 380 × 64	64.0	8130	381	10.4	140	15.8	186	973	151	5.95	85.0	26.9
S 310 × 74	74.0	9420	305	17.4	139	16.7	126	829	116	6.49	93.2	26.2
S 310 × 52	52.0	6580	305	10.9	129	13.8	94.9	624	120	4.10	63.6	24.9
S 250 × 52	52.0	6650	254	15.1	125	12.5	61.2	482	96.0	3.45	55.1	22.8
S 250 × 37.8	37.8	4810	254	7.90	118	12.5	51.2	403	103	2.80	47.4	24.1
S 200 × 34	34.0	4360	203	11.2	106	10.8	26.9	265	78.5	1.78	33.6	20.2
S 200 × 27.4	27.4	3480	203	6.88	102	10.8	23.9	236	82.8	1.54	30.2	21.0
S 150 × 25.7	25.7	3260	152	11.8	90.7	9.12	10.9	143	57.9	0.953	21.0	17.1
S 150 × 18.6	18.6	2360	152	5.89	84.6	9.12	9.16	120	62.2	0.749	17.7	17.8
S 100 × 14.1	14.1	1800	102	8.28	71.1	7.44	2.81	55.4	39.6	0.369	10.4	14.3
S 100 × 11.5	11.5	1460	102	4.90	67.6	7.44	2.52	49.7	41.7	0.311	9.21	14.6

Note: Axes 1-1 and 2-2 are principal centroidal axes.

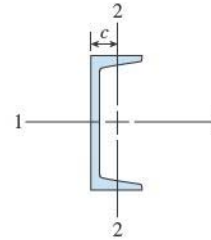**APPENDIX E   Properties of Structural-Steel Shapes   977**

TABLE E-3(a) PROPERTIES OF CHANNEL SECTIONS (C SHAPES) – USCS UNITS (ABRIDGED LIST)

Designation	Weight per foot	Area	Depth	Web thickness	Flange Width	Flange Average thickness	Axis 1-1 I	Axis 1-1 S	Axis 1-1 r	Axis 2-2 I	Axis 2-2 S	Axis 2-2 r	c
	lb	in.^{2}	in.	in.	in.	in.	in.^{4}	in.^{3}	in.	in.^{4}	in.^{3}	in.	in.
C 15 × 50	50.0	14.7	15.0	0.716	3.72	0.650	404	53.8	5.24	11.0	3.77	0.865	0.799
C 15 × 40	40.0	11.8	15.0	0.520	3.52	0.650	348	46.5	5.45	9.17	3.34	0.883	0.778
C 15 × 33.9	33.9	10.0	15.0	0.400	3.40	0.650	315	42.0	5.62	8.07	3.09	0.901	0.788
C 12 × 30	30.0	8.81	12.0	0.510	3.17	0.501	162	27.0	4.29	5.12	2.05	0.762	0.674
C 12 × 25	25.0	7.34	12.0	0.387	3.05	0.501	144	24.0	4.43	4.45	1.87	0.779	0.674
C 12 × 20.7	20.7	6.08	12.0	0.282	2.94	0.501	129	21.5	4.61	3.86	1.72	0.797	0.698
C 10 × 30	30.0	8.81	10.0	0.673	3.03	0.436	103	20.7	3.42	3.93	1.65	0.668	0.649
C 10 × 25	25.0	7.34	10.0	0.526	2.89	0.436	91.1	18.2	3.52	3.34	1.47	0.675	0.617
C 10 × 20	20.0	5.87	10.0	0.379	2.74	0.436	78.9	15.8	3.66	2.80	1.31	0.690	0.606
C 10 × 15.3	15.3	4.48	10.0	0.240	2.60	0.436	67.3	13.5	3.87	2.27	1.15	0.711	0.634
C 8 × 18.7	18.7	5.51	8.00	0.487	2.53	0.390	43.9	11.0	2.82	1.97	1.01	0.598	0.565
C 8 × 13.7	13.7	4.04	8.00	0.303	2.34	0.390	36.1	9.02	2.99	1.52	0.848	0.613	0.554
C 8 × 11.5	11.5	3.37	8.00	0.220	2.26	0.390	32.5	8.14	3.11	1.31	0.775	0.623	0.572
C 6 × 13	13.0	3.81	6.00	0.437	2.16	0.343	17.3	5.78	2.13	1.05	0.638	0.524	0.514
C 6 × 10.5	10.5	3.08	6.00	0.314	2.03	0.343	15.1	5.04	2.22	0.860	0.561	0.529	0.500
C 6 × 8.2	8.20	2.39	6.00	0.200	1.92	0.343	13.1	4.35	2.34	0.687	0.488	0.536	0.512
C 4 × 7.2	7.20	2.13	4.00	0.321	1.72	0.296	4.58	2.29	1.47	0.425	0.337	0.447	0.459
C 4 × 5.4	5.40	1.58	4.00	0.184	1.58	0.296	3.85	1.92	1.56	0.312	0.277	0.444	0.457

Notes: 1. Axes 1-1 and 2-2 are principal centroidal axes.
2. The distance c is measured from the centroid to the back of the web.
3. For axis 2-2, the tabulated value of S is the smaller of the two section moduli for this axis.

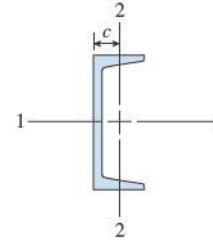**978**   APPENDIX E   Properties of Structural-Steel Shapes

TABLE E-3(b) PROPERTIES OF CHANNEL SECTIONS (C SHAPES) – SI UNITS (ABRIDGED LIST)

Designation	Mass per meter	Area	Depth	Web thickness	Flange Width	Flange Average thickness	Axis 1-1 I	Axis 1-1 S	Axis 1-1 r	Axis 2-2 I	Axis 2-2 S	Axis 2-2 r	c
	kg	mm²	mm	mm	mm	mm	$\times 10^6$ mm⁴	$\times 10^3$ mm³	mm	$\times 10^6$ mm⁴	$\times 10^3$ mm³	mm	mm
C 380 × 74	74.0	9480	381	18.2	94.5	16.5	168	882	133	4.58	61.8	22.0	20.3
C 380 × 60	60.0	7610	381	13.2	89.4	16.5	145	762	138	3.82	54.7	22.4	19.8
C 380 × 50.4	50.4	6450	381	10.2	86.4	16.5	131	688	143	3.36	50.6	22.9	20.0
C 310 × 45	45.0	5680	305	13.0	80.5	12.7	67.4	442	109	2.13	33.6	19.4	17.1
C 310 × 37	37.0	4740	305	9.83	77.5	12.7	59.9	393	113	1.85	30.6	19.8	17.1
C 310 × 30.8	30.8	3920	305	7.16	74.7	12.7	53.7	352	117	1.61	28.2	20.2	17.7
C 250 × 45	45.0	5680	254	17.1	77.0	11.1	42.9	339	86.9	1.64	27.0	17.0	16.5
C 250 × 37	37.0	4740	254	13.4	73.4	11.1	37.9	298	89.4	1.39	24.1	17.1	15.7
C 250 × 30	30.0	3790	254	9.63	69.6	11.1	32.8	259	93.0	1.17	21.5	17.5	15.4
C 250 × 22.8	22.8	2890	254	6.10	66.0	11.1	28.0	221	98.3	0.945	18.8	18.1	16.1
C 200 × 27.9	27.9	3550	203	12.4	64.3	9.91	18.3	180	71.6	0.820	16.6	15.2	14.4
C 200 × 20.5	20.5	2610	203	7.70	59.4	9.91	15.0	148	75.9	0.633	13.9	15.6	14.1
C 200 × 17.1	17.1	2170	203	5.59	57.4	9.91	13.5	133	79.0	0.545	12.7	15.8	14.5
C 150 × 19.3	19.3	2460	152	11.1	54.9	8.71	7.20	94.7	54.1	0.437	10.5	13.3	13.1
C 150 × 15.6	15.6	1990	152	7.98	51.6	8.71	6.29	82.6	56.4	0.358	9.19	13.4	12.7
C 150 × 12.2	12.2	1540	152	5.08	48.8	8.71	5.45	71.3	59.4	0.286	8.00	13.6	13.0
C 100 × 10.8	10.8	1370	102	8.15	43.7	7.52	1.91	37.5	37.3	0.177	5.52	11.4	11.7
C 100 × 8	8.00	1020	102	4.67	40.1	7.52	1.60	31.5	39.6	0.130	4.54	11.3	11.6

Notes: 1. Axes 1-1 and 2-2 are principal centroidal axes.
   2. The distance c is measured from the centroid to the back of the web.
   3. For axis 2-2, the tabulated value of S is the smaller of the two section moduli for this axis.

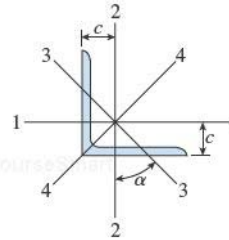**APPENDIX E   Properties of Structural-Steel Shapes   979**

TABLE E-4(a)   PROPERTIES OF ANGLE SECTIONS WITH EQUAL LEGS (L SHAPES) – USCS UNITS (ABRIDGED LIST)

Designation	Weight per foot	Area	Axis 1-1 and Axis 2-2				Axis 3-3
			I	S	r	c	r_{min}
in.	lb	in.^{2}	in.^{4}	in.^{3}	in.	in.	in.
L 8 × 8 × 1	51.0	15.0	89.1	15.8	2.43	2.36	1.56
L 8 × 8 × 3/4	38.9	11.4	69.9	12.2	2.46	2.26	1.57
L 8 × 8 × 1/2	26.4	7.75	48.8	8.36	2.49	2.17	1.59
L 6 × 6 × 1	37.4	11.0	35.4	8.55	1.79	1.86	1.17
L 6 × 6 × 3/4	28.7	8.46	28.1	6.64	1.82	1.77	1.17
L 6 × 6 × 1/2	19.6	5.77	19.9	4.59	1.86	1.67	1.18
L 5 × 5 × 7/8	27.2	7.98	17.8	5.16	1.49	1.56	0.971
L 5 × 5 × 1/2	16.2	4.75	11.3	3.15	1.53	1.42	0.980
L 5 × 5 × 3/8	12.3	3.61	8.76	2.41	1.55	1.37	0.986
L 4 × 4 × 3/4	18.5	5.44	7.62	2.79	1.18	1.27	0.774
L 4 × 4 × 1/2	12.8	3.75	5.52	1.96	1.21	1.18	0.776
L 4 × 4 × 3/8	9.80	2.86	4.32	1.50	1.23	1.13	0.779
L 3-1/2 × 3-1/2 × 3/8	8.50	2.48	2.86	1.15	1.07	1.00	0.683
L 3-1/2 × 3-1/2 × 1/4	5.80	1.69	2.00	0.787	1.09	0.954	0.688
L 3 × 3 × 1/2	9.40	2.75	2.20	1.06	0.895	0.929	0.580
L 3 × 3 × 1/4	4.90	1.44	1.23	0.569	0.926	0.836	0.585

Notes: 1. Axes 1-1 and 2-2 are centroidal axes parallel to the legs.
2. The distance c is measured from the centroid to the back of the legs.
3. For axes 1-1 and 2-2, the tabulated value of S is the smaller of the two section moduli for those axes.
4. Axes 3-3 and 4-4 are principal centroidal axes.
5. The moment of inertia for axis 3-3, which is the smaller of the two principal moments of inertia, can be found from the equation $I_{33} = Ar_{min}^2$.
6. The moment of inertia for axis 4-4, which is the larger of the two principal moments of inertia, can be found from the equation $I_{44} + I_{33} = I_{11} + I_{22}$.

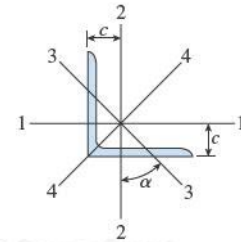**980**   APPENDIX E   Properties of Structural-Steel Shapes

TABLE E-4(b) PROPERTIES OF ANGLE SECTIONS WITH EQUAL LEGS (L SHAPES) – SI UNITS (ABRIDGED LIST)

Designation	Mass per meter	Area	Axis 1-1 and Axis 2-2				Axis 3-3
			I	S	r	c	r_{min}
mm	kg	mm²	× 10⁶ mm⁴	× 10³ mm³	mm	mm	mm
L 203 × 203 × 25.4	75.9	9680	37.1	259	61.7	59.9	39.6
L 203 × 203 × 19	57.9	7350	29.1	200	62.5	57.4	39.9
L 203 × 203 × 12.7	39.3	5000	20.3	137	63.2	55.1	40.4
L 152 × 152 × 25.4	55.7	7100	14.7	140	45.5	47.2	29.7
L 152 × 152 × 19	42.7	5460	11.7	109	46.2	45.0	29.7
L 152 × 152 × 12.7	29.2	3720	8.28	75.2	47.2	42.4	30.0
L 127 × 127 × 22.2	40.5	5150	7.41	84.6	37.8	39.6	24.7
L 127 × 127 × 12.7	24.1	3060	4.70	51.6	38.9	36.1	24.9
L 127 × 127 × 9.5	18.3	2330	3.65	39.5	39.4	34.8	25.0
L 102 × 102 × 19	27.5	3510	3.17	45.7	30.0	32.3	19.7
L 102 × 102 × 12.7	19.0	2420	2.30	32.1	30.7	30.0	19.7
L 102 × 102 × 9.5	14.6	1850	1.80	24.6	31.2	28.7	19.8
L 89 × 89 × 9.5	12.6	1600	1.19	18.8	27.2	25.4	17.3
L 89 × 89 × 6.4	8.60	1090	0.832	12.9	27.7	24.2	17.5
L 76 × 76 × 12.7	14.0	1770	0.916	17.4	22.7	23.6	14.7
L 76 × 76 × 6.4	7.30	929	0.512	9.32	23.5	21.2	14.9

Notes: 1. Axes 1-1 and 2-2 are centroidal axes parallel to the legs.
2. The distance c is measured from the centroid to the back of the legs.
3. For axes 1-1 and 2-2, the tabulated value of S is the smaller of the two section moduli for those axes.
4. Axes 3-3 and 4-4 are principal centroidal axes.
5. The moment of inertia for axis 3-3, which is the smaller of the two principal moments of inertia, can be found from the equation $I_{33} = Ar_{min}^2$.
6. The moment of inertia for axis 4-4, which is the larger of the two principal moments of inertia, can be found from the equation $I_{44} + I_{33} = I_{11} + I_{22}$.

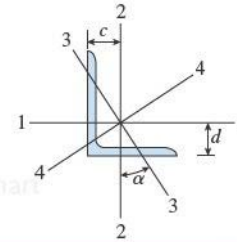**APPENDIX E   Properties of Structural-Steel Shapes   981**

TABLE E-5(a) PROPERTIES OF ANGLE SECTIONS WITH UNEQUAL LEGS (L SHAPES) – USCS UNITS (ABRIDGED LIST)

Designation	Weight per foot	Area	Axis 1-1				Axis 2-2				Axis 3-3	
			I	S	r	d	I	S	r	c	r_{min}	$\tan \alpha$
in.	lb	in.^{2}	in.^{4}	in.^{3}	in.	in.	in.^{4}	in.^{3}	in.	in.	in.	
L 8 × 6 × 1	44.2	13.0	80.9	15.1	2.49	2.65	38.8	8.92	1.72	1.65	1.28	0.542
L 8 × 6 × 1/2	23.0	6.75	44.4	8.01	2.55	2.46	21.7	4.79	1.79	1.46	1.30	0.557
L 7 × 4 × 3/4	26.2	7.69	37.8	8.39	2.21	2.50	9.00	3.01	1.08	1.00	0.855	0.324
L 7 × 4 × 1/2	17.9	5.25	26.6	5.79	2.25	2.40	6.48	2.10	1.11	0.910	0.866	0.334
L 6 × 4 × 3/4	23.6	6.94	24.5	6.23	1.88	2.07	8.63	2.95	1.12	1.07	0.856	0.428
L 6 × 4 × 1/2	16.2	4.75	17.3	4.31	1.91	1.98	6.22	2.06	1.14	0.981	0.864	0.440
L 5 × 3-1/2 × 3/4	19.8	5.81	13.9	4.26	1.55	1.74	5.52	2.20	0.974	0.993	0.744	0.464
L 5 × 3-1/2 × 1/2	13.6	4.00	10.0	2.97	1.58	1.65	4.02	1.55	1.00	0.901	0.750	0.479
L 5 × 3 × 1/2	12.8	3.75	9.43	2.89	1.58	1.74	2.55	1.13	0.824	0.746	0.642	0.357
L 5 × 3 × 1/4	6.60	1.94	5.09	1.51	1.62	1.64	1.41	0.600	0.853	0.648	0.652	0.371
L 4 × 3-1/2 × 1/2	11.9	3.50	5.30	1.92	1.23	1.24	3.76	1.50	1.04	0.994	0.716	0.750
L 4 × 3-1/2 × 1/4	6.20	1.81	2.89	1.01	1.26	1.14	2.07	0.794	1.07	0.897	0.723	0.759
L 4 × 3 × 1/2	11.1	3.25	5.02	1.87	1.24	1.32	2.40	1.10	0.858	0.822	0.633	0.542
L 4 × 3 × 3/8	8.50	2.48	3.94	1.44	1.26	1.27	1.89	0.851	0.873	0.775	0.636	0.551
L 4 × 3 × 1/4	5.80	1.69	2.75	0.988	1.27	1.22	1.33	0.585	0.887	0.725	0.639	0.558

Notes: 1. Axes 1-1 and 2-2 are centroidal axes parallel to the legs.
2. The distances c and d are measured from the centroid to the backs of the legs.
3. For axes 1-1 and 2-2, the tabulated value of S is the smaller of the two section moduli for those axes.
4. Axes 3-3 and 4-4 are principal centroidal axes.
5. The moment of inertia for axis 3-3, which is the smaller of the two principal moments of inertia, can be found from the equation $I_{33} = Ar_{min}^2$.
6. The moment of inertia for axis 4-4, which is the larger of the two principal moments of inertia, can be found from the equation $I_{44} + I_{33} = I_{11} + I_{22}$.

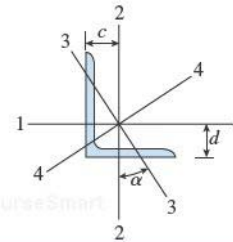**982**   **APPENDIX E   Properties of Structural-Steel Shapes**

TABLE E-5(b)   PROPERTIES OF ANGLE SECTIONS WITH UNEQUAL LEGS (L SHAPES) – SI UNITS (ABRIDGED LIST)

Designation	Mass per meter	Area	Axis 1-1				Axis 2-2			Axis 3-3		
			I	S	r	d	I	S	r	c	r_{min}	$\tan \alpha$
mm	kg	mm²	$\times 10^6$mm⁴	$\times 10^3$mm³	mm	mm	$\times 10^6$mm⁴	$\times 10^3$mm³	mm	mm	mm	
L 203 × 152 × 25.4	65.5	8390	33.7	247	63.2	67.3	16.1	146	43.7	41.9	32.5	0.542
L 203 × 152 × 12.7	34.1	4350	18.5	131	64.8	62.5	9.03	78.5	45.5	37.1	33.0	0.557
L 178 × 102 × 19	38.8	4960	15.7	137	56.1	63.5	3.75	49.3	27.4	25.4	21.7	0.324
L 178 × 102 × 12.7	26.5	3390	11.1	94.9	57.2	61.0	2.70	34.4	28.2	23.1	22.0	0.334
L 152 × 102 × 19	35.0	4480	10.2	102	47.8	52.6	3.59	48.3	28.4	27.2	21.7	0.428
L 152 × 102 × 12.7	24.0	3060	7.20	70.6	48.5	50.3	2.59	33.8	29.0	24.9	21.9	0.440
L 127 × 89 × 19	29.3	3750	5.79	69.8	39.4	44.2	2.30	36.1	24.7	25.2	18.9	0.464
L 127 × 89 × 12.7	20.2	2580	4.15	48.7	40.1	41.9	1.67	25.4	25.4	22.9	19.1	0.479
L 127 × 76 × 12.7	19.0	2420	3.93	47.4	40.1	44.2	1.06	18.5	20.9	18.9	16.3	0.357
L 127 × 76 × 6.4	9.80	1250	2.12	24.7	41.1	41.7	0.587	9.83	21.7	16.5	16.6	0.371
L 102 × 89 × 12.7	17.6	2260	2.21	31.5	31.2	31.5	1.57	24.6	26.4	25.2	18.2	0.750
L 102 × 89 × 6.4	9.20	1170	1.20	16.6	32.0	29.0	0.862	13.0	27.2	22.8	18.4	0.759
L 102 × 76 × 12.7	16.4	2100	2.09	30.6	31.5	33.5	0.999	18.0	21.8	20.9	16.1	0.542
L 102 × 76 × 9.5	12.6	1600	1.64	23.6	32.0	32.3	0.787	13.9	22.2	19.7	16.2	0.551
L 102 × 76 × 6.4	8.60	1090	1.14	16.2	32.3	31.0	0.554	9.59	22.5	18.4	16.2	0.558

Notes: 1. Axes 1-1 and 2-2 are centroidal axes parallel to the legs.
   2. The distances c and d are measured from the centroid to the backs of the legs.
   3. For axes 1-1 and 2-2, the tabulated value of S is the smaller of the two section moduli for those axes.
   4. Axes 3-3 and 4-4 are principal centroidal axes.
   5. The moment of inertia for axis 3-3, which is the smaller of the two principal moments of inertia, can be found from the equation $I_{33} = Ar^2_{min}$.
   6. The moment of inertia for axis 4-4, which is the larger of the two principal moments of inertia, can be found from the equation $I_{44} + I_{33} = I_{11} + I_{22}$.

F

Properties of Structural Lumber
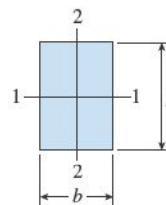
PROPERTIES OF SURFACED LUMBER (ABRIDGED LIST)

Nominal dimensions $b \times h$	Net dimensions $b \times h$	Area $A = bh$	Axis 1-1		Axis 2-2		Weight per linear foot (weight density = 35 lb/ft^3)
			Moment of inertia $I_1 = \dfrac{bh^3}{12}$	Section modulus $S_1 = \dfrac{bh^2}{6}$	Moment of inertia $I_2 = \dfrac{hb^3}{12}$	Section modulus $S_2 = \dfrac{hb^2}{6}$	
in.	in.	in.^{2}	in.^{4}	in.^{3}	in.^{4}	in.^{3}	lb
2 × 4	1.5 × 3.5	5.25	5.36	3.06	0.98	1.31	1.3
2 × 6	1.5 × 5.5	8.25	20.80	7.56	1.55	2.06	2.0
2 × 8	1.5 × 7.25	10.88	47.63	13.14	2.04	2.72	2.6
2 × 10	1.5 × 9.25	13.88	98.93	21.39	2.60	3.47	3.4
2 × 12	1.5 × 11.25	16.88	177.98	31.64	3.16	4.22	4.1
3 × 4	2.5 × 3.5	8.75	8.93	5.10	4.56	3.65	2.1
3 × 6	2.5 × 5.5	13.75	34.66	12.60	7.16	5.73	3.3
3 × 8	2.5 × 7.25	18.13	79.39	21.90	9.44	7.55	4.4
3 × 10	2.5 × 9.25	23.13	164.89	35.65	12.04	9.64	5.6
3 × 12	2.5 × 11.25	28.13	296.63	52.73	14.65	11.72	6.8
4 × 4	3.5 × 3.5	12.25	12.51	7.15	12.51	7.15	3.0
4 × 6	3.5 × 5.5	19.25	48.53	17.65	19.65	11.23	4.7
4 × 8	3.5 × 7.25	25.38	111.15	30.66	25.90	14.80	6.2
4 × 10	3.5 × 9.25	32.38	230.84	49.91	33.05	18.89	7.9
4 × 12	3.5 × 11.25	39.38	415.28	73.83	40.20	22.97	9.6
6 × 6	5.5 × 5.5	30.25	76.3	27.7	76.3	27.7	7.4
6 × 8	5.5 × 7.5	41.25	193.4	51.6	104.0	37.8	10.0
6 × 10	5.5 × 9.5	52.25	393.0	82.7	131.7	47.9	12.7
6 × 12	5.5 × 11.5	63.25	697.1	121.2	159.4	58.0	15.4
8 × 8	7.5 × 7.5	56.25	263.7	70.3	263.7	70.3	13.7
8 × 10	7.5 × 9.5	71.25	535.9	112.8	334.0	89.1	17.3
8 × 12	7.5 × 11.5	86.25	950.5	165.3	404.3	107.8	21.0

Note: Axes 1-1 and 2-2 are principal centroidal axes.

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