SECTION 9 - COMPRESSION MEMBERS (COLUMNS)

Table of Contents

SECTION 9

COMPRESSION MEMBERS (COLUMNS)

Look for this blue line in the left margin of the Design Manual documents. This line shows you where the latest update has been made.

Rev.1013

SYMBOLS FOR COMPRESSION MEMBERS (COLUMNS)

A   Cross Sectional area (in^2)

D   Outside diameter of round tube (in)

E   Modulus of Elasticity (psi)

$\mathbf{F_a}$ Allowable compressive stress in short column mode (psi)

$\mathbf{F_{a'}}$ Allowable compressive stress in long column mode (psi)

$\mathbf{F_u}$ Ultimate compressive stress in short column mode (psi)

$\mathbf{F_{u'}}$ Ultimate compressive stress in long column mode (psi)

I   Moment of inertia (in^4)

K   Effective length factor for buckling

P   Axial load on column (lbs)

$\mathbf{P_a}$ Allowable Axial load on column (lbs)

b   Width of section (in)
             Outside dimension of square tube (in)

$\mathbf{b_f}$ Width of flange (in)

$\mathbf{f_a}$ Axial stress from applied loads (psi)

l   Length of column (center to center of supports) (in)

r   Radius of gyration (in)

$\mathbf{r_y}$ Radius of gyration about Y-Y axis (in)

t   Wall thickness of tubes (in)
             Thickness of section (in)

$\mathbf{t_f}$ Thickness of flange (in)

INTRODUCTION

Columns must be designed for both strength (resistance to fracture) and for stability (resistance to deformation). From a behavioral perspective, columns can be classified as "short" or "long". Both of these behavioral modes will exhibit distinct failure mechanisms.

The short column mode exhibits local buckling of the web or flanges (or other outstanding legs of the shape). Figure No. 1 is a photograph of a test in the Strongwell laboratory of the 6 x 6 x 1/4 W-shape exhibiting the local flange buckling. Typically, the ultimate stress is limited by the ratio of the dimension of the outstanding element to the thickness of the element. The long column mode is buckling of the whole shape about the axis exhibiting the largest value of Kl/r.

For design purposes, Strongwell has developed empirical relationships for the structural shapes from testing similar to that displayed in Figure No. 1. These relationships are based upon the proprietary **EXTREN**® composite/resin system and should not be utilized for other pultruded products. The ultimate load was measured as the actual failure (not buckling) of the structural member. Strongwell's test had one end rotating on a ball/socket joint and the other end resting on a flat surface. Although the original test set-up as well as most actual applications may not have a K=1, the tables shown in this section are established using K (effective length coefficient for buckling) = 1.0. Engineers are cautioned to consider the end conditions (Figure No. 2) in their specific designs.

NOTE:

For proper application of these relationships, the designer must establish whether the short or long column mode will limit the application. This is accomplished by calculating the allowable stress with both the short and long column equations at the desired slenderness ratio (Kl/r) and utilizing the **lower** value for design. An example of this will be discussed in a later section. The Allowable Load Tables were generated with a safety factor of 3.

FIGURE 1

COLUMN EQUATIONS FOR CONCENTRIC LOADS

STRESSES FROM APPLIED LOADS
Compressive stress:

$$f_a = \frac{P}{A} \tag{C-1}$$

ULTIMATE COMPRESSIVE STRESSES

EXTREN® W and I Shapes — Short Column Mode:

$$F_u = \frac{0.5E}{(b_f/t_f)^{1.5}} \leq \begin{cases} 30{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 500/525} \\ 30{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 625 (>4")} \\ 33{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 625 (≤4")} \end{cases} \tag{C-2}$$

EXTREN® W and I Shapes — Long Column Mode:

$$F_{u}' = \frac{4.9E}{(K l/r)^{1.7}} \tag{C-3}$$

EXTREN® Equal Leg Angles — Short Column Mode:

$$F_u = \frac{E}{27\,(b/t)^{.95}} \leq \begin{cases} 30{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 500/525} \\ 33{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 625} \end{cases} \tag{C-4}$$

EXTREN® Equal Leg Angles — Long Column Mode:

$$F_{u}' = \frac{E}{56(K l/r)^{.55}} \tag{C-5}$$

EXTREN® Round Tubes — Short Column Mode:

$$F_u = \frac{E}{16(D/t)^{.85}} \leq \begin{cases} 30{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 500/525} \\ 33{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 625} \end{cases} \tag{C-6}$$

EXTREN® Round Tubes — Long Column Mode:

$$F_{u}' = \frac{1.3E}{(K l/r)^{1.3}} \tag{C-7}$$

EXTREN® Square Tubes — Short Column Mode:

$$F_u = \frac{E}{16\,(b/t)^{.85}} \leq \begin{cases} 30{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 500/525} \\ 33{,}000 \text{ psi } \textbf{EXTREN}^® \text{ 625} \end{cases} \tag{C-8}$$

EXTREN® Square Tubes — Long Column Mode:

$$F_{u}' = \frac{1.3E}{(K l/r)^{1.3}} \tag{C-9}$$

ALLOWABLE COMPRESSIVE STRESSES AND LOADS

Short Column Mode:

$$F_a = \frac{F_u}{3.0} \tag{C-10}$$

Long Column Mode:

$$F_{a}' = \frac{F_{u}'}{3.0} \leq F_a \tag{C-11}$$

ALLOWABLE LOADS:

$$P_a = \begin{cases} F_a A \\ \text{or} \\ F_{a}' A \end{cases} \tag{C-12}$$

Rev.1013

FIGURE 2

Theoretical Effective Length Coefficients

End Condition	Theoretical "K" Value*	Mode of Buckling (Dashed)
1. Both ends pinned	1.00	
2. Both ends fixed	0.65	
3. One end pinned, One end fixed	0.80	
4. One end fixed, One end free	2.10	
5. One end fixed One end translated	1.20	
6. One end pinned One end translated	2.00	

* Values obtained from Reference 1, p. 278.

STRONGWELL®

EXAMPLE OF COLUMN SELECTION USING THE TABLES

PROBLEM #1

Determine if the **EXTREN**® Series 500 6 x 6 x 1/4 W-shape will support an axially concentric load of 5,000 lbs. for a column of height equal to 10 feet. For this example, the following assumptions are made:

1) The application is at room temperature.
2) There are no corrosive agents present which may damage the composite.
3) Both ends of the column are pinned (K = 1 from Figure No. 2) and there are no intermediate supports.
4) The ends of the column are square such that the load is evenly distributed over the entire cross-section of the structural shape; i.e., there is no eccentricity of load application.
5) The column is straight such that the load is initially entirely axially applied.

There are two approaches to this solution:

APPROACH A

From the Allowable Load Tables for the **EXTREN**® 6 x 6 x 1/4 W-shape (identified in this section), a load of 9736 lbs. is indicated. This exceeds the service load and the 6 x 6 x 1/4 W-shape is more than adequate.

APPROACH B

This approach will use the empirically determined equations for **EXTREN**® W and I shapes.

For the 6 x 6 x 1/4 W-shape:

$E = 2.5 \times 10^6$ psi (Section 3 — **PROPERTIES OF EXTREN**®)

$A = 4.39$ in^2, $r_x = 2.54$ in, $r_y = 1.44$ in, $b_f = 6$ in, $t_f = 1/4$ in
(Section 6 — **ELEMENTS OF SECTIONS**)

for short columns:

$$F_u = \frac{0.5E}{(b_f/t_f)^{1.5}} \tag{C-2}$$

$$F_u = \frac{0.5\,(2.5 \times 10^6)}{(6/.25)^{1.5}} = 10{,}631 \text{ psi} \leq 30{,}000 \text{ psi}$$

$$F_a = \frac{F_u}{3.0} \tag{C-10}$$

$$F_a = \frac{10{,}631}{3.0} = 3{,}544 \text{ psi}$$

and for long columns:

$$\frac{Kl}{r_y} = \frac{(1.0)\,(10 \times 12)}{1.44} = 83.3$$

$$F_u' = \frac{4.9E}{(Kl/r)^{1.7}} \tag{C-3}$$

$$F_u' = \frac{4.9\,(2.5 \times 10^6)}{(83.3)^{1.7}} = 6653 \text{ psi}$$

$$F_a' = \frac{F_u'}{3} \tag{C-11}$$

$$F_a' = \frac{6653}{3.0} = 2217.6 \text{ psi}$$

The long column mode controls (because it has the lower critical stress) and the allowable load is:

$$P_a = (2217.6)\,(4.39) = 9735.6 \text{ lbs.} \tag{C-12}$$

Rev.1013

PROBLEM #2

Will the 6 x 6 x 1/4 W-shape be adequate if operated continuously at 150° F? The allowable stress would be reduced to 50% of the original value from the table in Section 3 — **PROPERTIES OF EXTREN®**.

F_a' (150° F) = 0.50 F_a' (room temperature)
        = 0.50 (2218) = 1109 psi

This makes the allowable load at 150° F equal to 4868.5 pounds, which is less than the 5000 pound service load. The designer must review the decisions in selecting the service load of 5000 pounds and determine if the 4868.5 pounds is suitable.

PROBLEM #3

An assumption in PROBLEM #1 was that both ends were pinned with a K = 1. Another common mode of installation may be one end pinned and one end fixed, illustrated as Condition 3 in Figure No. 2. In this situation, K = 0.8. This change of end condition has the effect of increasing the allowable stress.

NOTE: The installation must develop the assumed end conditions.

At room temperature for K = 0.8:

$$\frac{Kl}{r_y} = \frac{(0.8)\,(10 \times 12)}{1.44} = 66.6$$

instead of the 83.3 slenderness ratio previously calculated.

$$F_u' = \frac{(4.9)(2.5 \times 10^6)}{(66.6)^{1.7}} = 9{,}732 \text{ psi} \tag{C-3}$$

$$F_a' = \frac{9732}{3.0} = 3{,}244 \text{ psi} \tag{C-11}$$

For K = 1, the allowable long column stress was 2218 psi. A 46% increase in the load capacity of the column is obtained simply due to a change in the restraint at one end of the member.

PROBLEM #4

The end restraints will be adjusted such that both ends are fixed; K = 0.65 in Figure No. 2, Condition 2.

At room temperature, for K = 0.65

$$\frac{Kl}{r_y} = \frac{(0.65)\,(10 \times 12)}{1.44} = 54.17$$

$$F_u' = \frac{(4.9)(2.5 \times 10^6)}{(54.17)^{1.7}} = 13{,}828 \text{ psi} \tag{C-3}$$

$$F_a' = \frac{13{,}828}{3.0} = 4{,}609 \text{ psi} \tag{C-11}$$

This exceeds the short column allowable stress (4,609 psi vs. 3,544 psi) and the application is limited by short column mode. The designer should use 3,544 psi.

INTRODUCTION TO
COMPRESSION MEMBER (COLUMN) LOAD TABLES

The following are the allowable load tables for **EXTREN**® W and I shapes, **EXTREN**® equal leg angles, and **EXTREN**® tubes when used as compressive members (columns).

These tables are based upon:

1) Ambient temperature

2) A safety factor of 3.0

3) A value of K = 1.0

4) No corrosive agents which may damage the composite

5) These tables show Kl/r values to 200 for reference. It is recommended that Kl/r be limited to 110 unless structural analysis indicates otherwise.

LONG COLUMN-ALLOWABLE COMPRESSION STRESSES
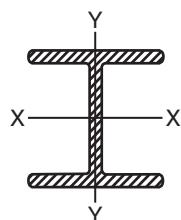
EXTREN®
W/ I SHAPES

E = 2.5 x 10^6 psi
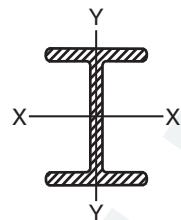
NOTE: These calculations assume the long column buckling mode for an axially applied load. The transition from the short column mode (limited by b_f/t_f) to the long column mode (limited by Kl/r) will vary with the member size.

Kl/r	F_a (psi)	Kl/r	F_a (psi)	Kl/r	F_a (psi)
45	6318	84	2186	123	1143
46	6086	85	2142	124	1128
47	5867	86	2101	125	1112
48	5661	87	2060	126	1097
49	5466	88	2020	127	1083
50	5282	89	1982	128	1068
51	5108	90	1944	129	1054
52	4940	91	1908	130	1041
53	4784	92	1873	131	1027
54	4634	93	1839	132	1014
55	4492	94	1806	133	1001
56	4356	95	1774	134	988
57	4227	96	1742	135	976
58	4104	97	1712	136	964
59	3986	98	1682	137	952
60	3874	99	1654	138	940
61	3767	100	1625	139	929
62	3664	101	1598	140	917
63	3566	102	1572	141	906
64	3471	103	1546	142	896
65	3381	104	1520	143	885
66	3294	105	1496	144	875
67	3211	106	1472	145	864
68	3131	107	1449	146	854
69	3054	108	1426	147	844
70	2981	109	1404	148	835
71	2910	110	1382	149	825
72	2842	111	1361	150	816
73	2776	112	1341	155	772
74	2712	113	1321	160	731
75	2651	114	1301	165	694
76	2592	115	1282	170	660
77	2535	116	1263	175	628
78	2480	117	1245	180	598
79	2427	118	1227	185	571
80	2376	119	1209	190	546
81	2326	120	1192	195	522
82	2278	121	1176	200	500
83	2231	122	1159		

STRONGWELL®

LONG COLUMN-ALLOWABLE COMPRESSION STRESSES
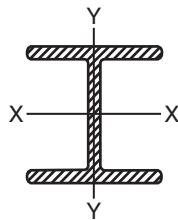
EXTREN®
W/ I SHAPES

E = 2.6 x 10⁶ psi
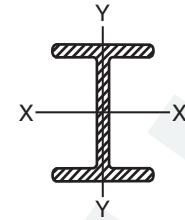
NOTE: These calculations assume the long column buckling mode for an axially applied load. The transition from the short column mode (limited by b_f/t_f) to the long column mode (limited by Kl/r) will vary with the member size.

Kl/r	F_a (psi)	Kl/r	F_a (psi)	Kl/r	F_a (psi)
45	6571	84	2273	123	1189
46	6329	85	2228	124	1173
47	6102	86	2185	125	1156
48	5887	87	2142	126	1141
49	5684	88	2101	127	1126
50	5493	89	2061	128	1111
51	5312	90	2022	129	1096
52	5138	91	1984	130	1082
53	4975	92	1948	131	1068
54	4819	93	1913	132	1055
55	4672	94	1878	133	1041
56	4530	95	1845	134	1027
57	4396	96	1812	135	1015
58	4268	97	1780	136	1003
59	4145	98	1749	137	990
60	4029	99	1720	138	978
61	3918	100	1690	139	966
62	3810	101	1662	140	954
63	3708	102	1635	141	942
64	3610	103	1608	142	932
65	3516	104	1581	143	920
66	3426	105	1556	144	910
67	3339	106	1531	145	899
68	3256	107	1507	146	888
69	3176	108	1483	147	878
70	3100	109	1460	148	868
71	3026	110	1437	149	858
72	2956	111	1415	150	849
73	2887	112	1395	155	803
74	2820	113	1373	160	760
75	2757	114	1353	165	722
76	2696	115	1333	170	686
77	2636	116	1313	175	653
78	2579	117	1295	180	622
79	2542	118	1272	185	594
80	2471	119	1257	190	568
81	2419	120	1240	195	543
82	2369	121	1223	200	520
83	2320	122	1205		

Rev.1013

LONG COLUMN-ALLOWABLE COMPRESSION STRESSES
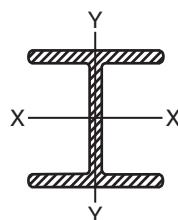
EXTREN®
W/ I SHAPES

E = 2.8 x 10⁶ psi
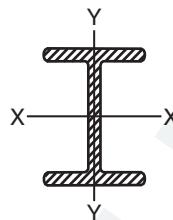
$E = 2.8 \times 10^6 \text{ psi}$

NOTE: These calculations assume the long column buckling mode for an axially applied load. The transition from the short column mode (limited by b_f/t_f) to the long column mode (limited by Kl/r) will vary with the member size.

| Kl/r	F_a (psi)	Kl/r	F_a (psi)	Kl/r	F_a (psi)
45	7076	84	2448	123	1280
46	6816	85	2399	124	1263
47	6571	86	2353	125	1245
48	6340	87	2307	126	1229
49	6122	88	2262	127	1213
50	5916	89	2220	128	1196
51	5721	90	2177	129	1180
52	5533	91	2137	130	1166
53	5358	92	2098	131	1150
54	5140	93	2059	132	1136
55	5031	94	2023	133	1121
56	4874	95	1987	134	1106
57	4734	96	1951	135	1093
58	4596	97	1917	136	1080
59	4464	98	1884	137	1066
60	4339	99	1852	138	1053
61	4219	100	1820	139	1040
62	4104	101	1790	140	1027
63	3994	102	1761	141	1015
64	3887	103	1732	142	1003
65	3787	104	1702	143	991
66	3689	105	1675	144	980
67	3596	106	1649	145	966
68	3507	107	1623	146	956
69	3420	108	1597	147	945
70	3339	109	1572	148	935
71	3259	110	1548	149	924
72	3183	111	1524	150	914
73	3109	112	1502	155	865
74	3037	113	1479	160	819
75	2969	114	1457	165	777
76	2903	115	1436	170	739
77	2839	116	1415	175	703
78	2778	117	1394	180	670
79	2718	118	1374	185	639
80	2661	119	1354	190	611
81	2605	120	1335	195	585
82	2551	121	1317	200	560
83	2499	122	1298		

STRONGWELL

LONG COLUMN-ALLOWABLE COMPRESSION STRESSES

EXTREN® 500/525
EQUAL LEG ANGLES

E = 2.6 x 10⁶ psi
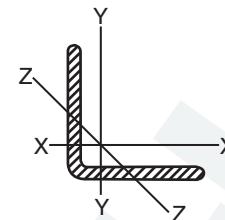
NOTE: These calculations assume the long column buckling mode for an axially applied load. The transition from the short column mode (limited by b/t) to the long column mode (limited by Kl/r) will vary with the angle size.

Kl/r	F$_a$ (psi)	Kl/r	F_a (psi)	Kl/r	F$_a$ (psi)
30	2384	74	1451	118	1122
31	2341	75	1440	119	1117
32	2301	76	1430	120	1112
33	2262	77	1419	121	1107
34	2225	78	1409	122	1102
35	2190	79	1399	123	1097
36	2156	80	1390	124	1092
37	2124	81	1380	125	1087
38	2093	82	1371	126	1083
39	2063	83	1362	127	1078
40	2034	84	1353	128	1073
41	2007	85	1344	129	1069
42	1981	86	1336	130	1064
43	1955	87	1327	131	1060
44	1931	88	1319	132	1055
45	1907	89	1311	133	1051
46	1884	90	1303	134	1047
47	1862	91	1295	135	1042
48	1841	92	1287	136	1038
49	1819	93	1279	137	1034
50	1800	94	1272	138	1030
51	1780	95	1264	139	1026
52	1761	96	1257	140	1022
53	1743	97	1250	141	1018
54	1725	98	1243	142	1014
55	1708	99	1236	143	1010
56	1691	100	1229	144	1006
57	1675	101	1223	145	1002
58	1659	102	1216	146	998
59	1643	103	1209	147	995
60	1628	104	1203	148	991
61	1613	105	1197	149	987
62	1599	106	1191	150	984
63	1585	107	1184	155	966
64	1571	108	1178	160	949
65	1558	109	1172	165	933
66	1545	110	1167	170	918
67	1532	111	1161	175	904
68	1520	112	1155	180	890
69	1508	113	1149	185	876
70	1496	114	1144	190	864
71	1484	115	1138	195	851
72	1473	116	1133	200	840
73	1462	117	1128		

Rev.1013

LONG COLUMN-ALLOWABLE COMPRESSION STRESSES

EXTREN® 625
EQUAL LEG ANGLES
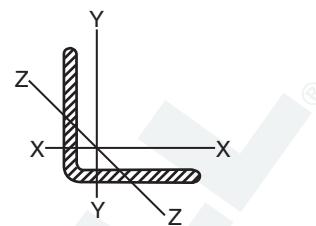
E = 2.8 x 10⁶ psi

NOTE: These calculations assume the long column buckling mode for an axially applied load. The transition from the short column mode (limited by b/t) to the long column mode (limited by Kl/r) will vary with the angle size.

Kl/r	F_a (psi)	Kl/r	F_a (psi)	Kl/r	F_a (psi)
30	2567	74	1563	118	1208
31	2521	75	1551	119	1203
32	2478	76	1540	120	1198
33	2436	77	1528	121	1192
34	2396	78	1517	122	1186
35	2358	79	1507	123	1181
36	2322	80	1497	124	1176
37	2287	81	1486	125	1171
38	2254	82	1476	126	1166
39	2222	83	1467	127	1161
40	2190	84	1457	128	1156
41	2161	85	1447	129	1151
42	2133	86	1439	130	1146
43	2105	87	1429	131	1142
44	2080	88	1420	132	1136
45	2054	89	1412	133	1132
46	2029	90	1403	134	1128
47	2005	91	1395	135	1122
48	1983	92	1386	136	1118
49	1959	93	1377	137	1114
50	1938	94	1370	138	1109
51	1917	95	1361	139	1105
52	1896	96	1354	140	1100
53	1877	97	1346	141	1096
54	1858	98	1339	142	1092
55	1839	99	1331	143	1088
56	1821	100	1324	144	1083
57	1804	101	1317	145	1079
58	1787	102	1310	146	1075
59	1769	103	1302	147	1072
60	1753	104	1296	148	1067
61	1737	105	1289	149	1063
62	1722	106	1283	150	1060
63	1707	107	1275	155	1040
64	1692	108	1269	160	1022
65	1678	109	1262	165	1005
66	1664	110	1257	170	989
67	1650	111	1250	175	974
68	1637	112	1244	180	958
69	1624	113	1237	185	943
70	1611	114	1232	190	930
71	1598	115	1226	195	916
72	1568	116	1220	200	905
73	1574	117	1214		

LONG COLUMN-ALLOWABLE COMPRESSION STRESSES

EXTREN® 500/525
ROUND/ SQUARE TUBES
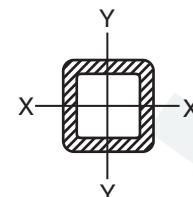
X —⊙— X   X —▢— X

E = 2.6 x 10⁶ psi

NOTE: These calculations assume the long column buckling mode for an axially applied load. The transition from the short column mode (limited by b/t -square tubes or D/t -round tubes) to the long column mode (limited by K*l*/r) will vary with the member size.

K*l*/r	F_a (psi)	K*l*/r	F_a (psi)	K*l*/r	F_a (psi)
50	6968	87	3392	124	2140
51	6791	88	3342	125	2117
52	6622	89	3293	126	2096
53	6460	90	3245	127	2074
54	6305	91	3199	128	2053
55	6156	92	3154	129	2032
56	6014	93	3110	130	2012
57	5877	94	3067	131	1992
58	5746	95	3025	132	1973
59	5619	96	2984	133	1953
60	5498	97	2944	134	1934
61	5381	98	2905	135	1916
62	5268	99	2867	136	1898
63	5160	100	2830	137	1880
64	5055	101	2794	138	1862
65	4955	102	2758	139	1844
66	4857	103	2723	140	1827
67	4763	104	2689	141	1811
68	4672	105	2656	142	1794
69	4584	106	2624	143	1778
70	4500	107	2592	144	1762
71	4417	108	2561	145	1746
72	4338	109	2530	146	1730
73	4261	110	2500	147	1715
74	4186	111	2471	148	1700
75	4114	112	2442	149	1685
76	4043	113	2414	150	1670
77	3975	114	2387	155	1601
78	3909	115	2360	160	1536
79	3845	116	2333	165	1476
80	3782	117	2308	170	1420
81	3722	118	2282	175	1367
82	3663	119	2257	180	1318
83	3606	120	2233	185	1272
84	3550	121	2209	190	1229
85	3496	122	2185	195	1188
86	3443	123	2162	200	1149

Rev.1013

LONG COLUMN-ALLOWABLE COMPRESSION STRESSES

EXTREN® 625
**ROUND/ SQUARE TUBES**
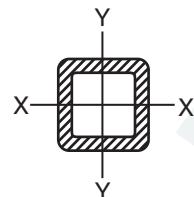
E = 2.8 x 10⁶ psi

NOTE: These calculations assume the long column buckling mode for an axially applied load. The transition from the short column mode (limited by b/t - square tubes or D/t - round tubes) to the long column mode (limited by Kl/r) will vary with the member size.

Kl/r	F$_a$ (psi)	Kl/r	F$_a$ (psi)	Kl/r	F$_a$ (psi)
50	7504	87	3653	124	2305
51	7313	88	3599	125	2280
52	7131	89	3546	126	2257
53	6957	90	3495	127	2234
54	6790	91	3445	128	2211
55	6630	92	3397	129	2188
56	6477	93	3349	130	2167
57	6329	94	3303	131	2145
58	6188	95	3258	132	2125
59	6051	96	3214	133	2103
60	5921	97	3170	134	2083
61	5795	98	3128	135	2063
62	5673	99	3088	136	2044
63	5557	100	3048	137	2025
64	5444	101	3009	138	2005
65	5336	102	2970	139	1986
66	5231	103	2932	140	1968
67	5129	104	2896	141	1950
68	5031	105	2860	142	1932
69	4937	106	2826	143	1915
70	4846	107	2791	144	1898
71	4757	108	2758	145	1880
72	4672	109	2725	146	1863
73	4589	110	2692	147	1847
74	4508	111	2661	148	1831
75	4430	112	2630	149	1815
76	4354	113	2600	150	1798
77	4281	114	2571	155	1724
78	4210	115	2542	160	1654
79	4141	116	2512	165	1590
80	4073	117	2486	170	1529
81	4008	118	2458	175	1472
82	3945	119	2431	180	1419
83	3883	120	2405	185	1370
84	3823	121	2379	190	1324
85	3765	122	2353	195	1279
86	3708	123	2328	200	1237

STRONGWELL

COLUMN

W SHAPE
3 x 3 x 1/4
Allowable Axial Stresses and Loads
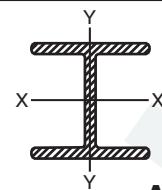
b$_f$ / t$_f$ = 12.0   **r$_y$ = 0.73 in.**   **A = 2.13 in^2**

EFFECTIVE COLUMN LENGTH (ft.)	Kl/r	EXTREN® 500/525 E = 2.6 x 10^6 psi		EXTREN® 625 E = 2.8 x 10^6 psi		
		F$_a$(psi)	P$_a$(lbs)	F$_a$(psi)	P$_a$(lbs)	
0.5	8.2	10000	21300	11000	23430	SHORT
1.0	16.4	10000	21300	11000	23430	
1.5	24.7	10000	21300	11000	23430	
2.0	32.9	10000	21300	11000	23430	
		F$_a$'(psi)	P$_a$(lbs)	F$_a$'(psi)	P$_a$(lbs)	
2.5	41.1	7665	16327	8254	17582	LONG
3.0	49.3	5626	11984	6059	12905	
3.5	57.5	4331	9226	4664	9935	
4.0	65.8	3444	7336	3709	7900	
4.5	74.0	2821	6008	3038	6470	
5.0	82.2	2359	5025	2541	5412	
5.5	90.4	2007	4275	2161	4604	
6.0	98.6	1732	3688	1865	3972	
6.5	106.8	1512	3220	1628	3468	
7.0	115.1	1331	2835	1433	3053	
7.5	123.3	1184	2522	1275	2716	
8.0	131.5	1061	2261	1143	2435	
8.5	139.7	958	2040	1031	2197	
9.0	147.9	869	1851	936	1994	
9.5	156.2	792	1687	853	1817	
10.0	164.4	726	1547	782	1666	
10.5	172.6	668	1424	720	1533	
11.0	180.8	618	1316	665	1417	
11.5	189.0	573	1220	617	1314	
12.0	197.3	533	1134	573	1221	

Rev.1013

COLUMN

W SHAPE

4 x 4 x 1/4

Allowable Axial Stresses and Loads

$b_f / t_f = 16.0$ $r_y = 0.97$ in. $A = 2.89$ in^2

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	6.2	6771	19568	7292	21073	SHORT
1.0	12.4	6771	19568	7292	21073	
1.5	18.6	6771	19568	7292	21073	
2.0	24.7	6771	19568	7292	21073	
2.5	30.9	6771	19568	7292	21073	
3.0	37.1	6771	19568	7292	21073	
3.5	43.3	6771	19568	7292	21073	
		F_a'(psi)	P_a(lbs)	F_a'(psi)	P_a(lbs)	
4.0	49.5	5588	16148	6017	17390	LONG
4.5	55.7	4572	13213	4923	14229	
5.0	61.9	3821	11043	4115	11892	
5.5	68.0	3257	9412	3507	10136	
6.0	74.2	2808	8114	3024	8738	
6.5	80.4	2450	7080	2638	7624	
7.0	86.6	2159	6240	2325	6720	
7.5	92.8	1920	5547	2067	5974	
8.0	99.0	1720	4970	1852	5352	
8.5	105.2	1551	4482	1670	4827	
9.0	111.3	1409	4073	1518	4386	
9.5	117.5	1285	3714	1384	4000	
10.0	123.7	1178	3403	1268	3665	
10.5	129.9	1084	3132	1167	3373	
11.0	136.1	1001	2893	1078	3116	
11.5	142.3	928	2682	999	2888	
12.0	148.5	863	2495	930	2686	
12.5	154.6	806	2330	868	2509	
13.0	160.8	754	2179	812	2347	
13.5	167.0	707	2043	761	2200	
14.0	173.2	665	1920	716	2068	
14.5	179.4	626	1817	674	1948	
15.0	185.6	591	1708	636	1839	
15.5	191.8	559	1615	602	1739	
16.0	197.9	530	1531	571	1650	

STRONGWELL

COLUMN

W SHAPE

6 x 6 x 1/4

Allowable Axial Stresses and Loads

b_f / t_f = 24.0 r_y = 1.44 in.   A = 4.39 in^2
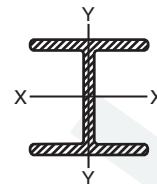
EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525/625		
		E = 2.5 x 10^6 psi		
		F_a(psi)	P_a(lbs)	
0.5	4.2	3543	15554	SHORT
1.0	8.3	3543	15554	
1.5	12.5	3543	15554	
2.0	16.7	3543	15554	
2.5	20.8	3543	15554	
3.0	25.0	3543	15554	
3.5	29.2	3543	15554	
4.0	33.3	3543	15554	
4.5	37.5	3543	15554	
5.0	41.7	3543	15554	
5.5	45.8	3543	15554	
6.0	50.0	3543	15554	
6.5	54.2	3543	15554	
7.0	58.3	3543	15554	
7.5	62.5	3543	15554	
		$F_a{}'$ (psi)	P_a(lbs)	
8.0	66.7	3236	14206	LONG
8.5	70.8	2924	12836	
9.0	75.0	2651	11638	
9.5	79.2	2416	10608	
10.0	83.3	2218	9736	
10.5	87.5	2040	8955	
11.0	91.7	1884	8269	
11.5	95.8	1749	7678	
12.0	100.0	1626	7138	
12.5	104.2	1516	6654	
13.0	108.3	1420	6233	
13.5	112.5	1331	5841	
14.0	116.7	1250	5488	
14.5	120.8	1179	5176	
15.0	125.0	1112	4882	
15.5	129.2	1052	4617	
16.0	133.3	997	4378	
16.5	137.5	946	4153	
17.0	141.7	899	3946	
17.5	145.8	856	3758	
18.0	150.0	816	3582	
18.5	154.2	779	3420	
19.0	158.3	745	3269	
19.5	162.5	712	3126	
20.0	166.7	682	2994	

Rev.1013

COLUMN

W SHAPE

6 x 6 x 3/8

Allowable Axial Stresses and Loads

$b_f / t_f = 16.0$ $r_y = 1.45$ in. $A = 6.48$ in^2
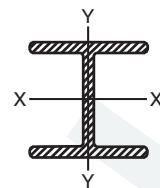
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625 $E = 2.5 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	
0.5	4.1	6510	42185	SHORT
1.0	8.3	6510	42185	
1.5	12.4	6510	42185	
2.0	16.6	6510	42185	
2.5	20.7	6510	42185	
3.0	24.8	6510	42185	
3.5	29.0	6510	42185	
4.0	33.1	6510	42185	
4.5	37.2	6510	42185	
5.0	41.4	6510	42185	
		$F_a{}'$(psi)	P_a(lbs)	
5.5	45.5	6200	40176	LONG
6.0	49.7	5336	34577	
6.5	53.8	4663	30218	
7.0	57.9	4116	26671	
7.5	62.1	3654	23677	
8.0	66.2	3278	21239	
8.5	70.3	2959	19174	
9.0	74.5	2681	17375	
9.5	78.6	2448	15862	
10.0	82.8	2241	14522	
10.5	86.9	2064	13374	
11.0	91.0	1908	12366	
11.5	95.2	1767	11453	
12.0	99.3	1645	10660	
12.5	103.4	1536	9952	
13.0	107.6	1435	9301	
13.5	111.7	1347	8728	
14.0	115.9	1265	8199	
14.5	120.0	1192	7726	
15.0	124.1	1126	7298	
15.5	128.3	1064	6896	
16.0	132.4	1009	6537	
16.5	136.6	957	6199	
17.0	140.7	910	5895	
17.5	144.8	866	5614	
18.0	149.6	825	5348	
18.5	153.1	788	5107	
19.0	157.2	753	4882	
19.5	161.4	720	4668	
20.0	165.5	690	4473	

STRONGWELL.

COLUMN

W SHAPE

8 x 8 x 3/8
Allowable Axial Stresses and Loads

$b_f / t_f = 21.3$ $r_y = 1.92$ in. $A = 8.73$ in^2
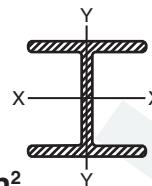
EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525/625 E = 2.5 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	
0.5	3.1	4239	37006	SHORT
1.0	6.2	4239	37006	
1.5	9.4	4239	37006	
2.0	12.5	4239	37006	
2.5	15.6	4239	37006	
3.0	18.8	4239	37006	
3.5	21.9	4239	37006	
4.0	25.0	4239	37006	
4.5	28.1	4239	37006	
5.0	31.3	4239	37006	
5.5	34.4	4239	37006	
6.0	37.5	4239	37006	
6.5	40.6	4239	37006	
7.0	43.8	4239	37006	
7.5	46.9	4239	37006	
8.0	50.0	4239	37006	
8.5	53.1	4239	37006	
9.0	56.2	4239	37006	
		F_a' (psi)	P_a(lbs)	
9.5	59.4	3941	34403	LONG
10.0	62.5	3614	31550	
10.5	65.6	3329	29062	
11.0	68.8	3070	26800	
11.5	71.9	2848	24863	
12.0	75.0	2651	23143	
12.5	78.1	2475	21607	
13.0	81.2	2316	20220	
13.5	84.4	2169	18935	
14.0	87.5	2040	17809	
14.5	90.6	1923	16788	
15.0	93.8	1812	15819	
15.5	96.9	1715	14972	
16.0	100.0	1626	14192	
16.5	103.1	1543	13474	
17.0	106.2	1468	12812	
17.5	109.4	1395	12178	
18.0	112.5	1331	11620	
18.5	115.6	1271	11092	
19.0	118.8	1213	10589	
19.5	121.9	1161	10135	
20.0	125.0	1112	9708	

Rev.1013

COLUMN

W SHAPE

* 8 x 8 x 1/2
Allowable Axial Stresses and Loads

$b_f / t_f = 16.0$ $r_y = 1.93$ in. $A = 11.51$ in^2
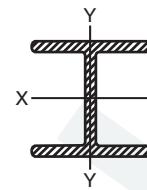
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625 $E = 2.5 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	
0.5	3.1	6510	74930	SHORT
1.0	6.2	6510	74930	
1.5	9.3	6510	74930	
2.0	12.4	6510	74930	
2.5	15.5	6510	74930	
3.0	18.7	6510	74930	
3.5	21.8	6510	74930	
4.0	24.9	6510	74930	
4.5	28.0	6510	74930	
5.0	31.1	6510	74930	
5.5	34.2	6510	74930	
6.0	37.3	6510	74930	
6.5	40.4	6510	74930	
7.0	43.5	6510	74930	
		$F_a{'}$ (psi)	P_a (lbs)	
7.5	46.6	5953	68519	LONG
8.0	49.7	5336	61416	
8.5	52.8	4814	55409	
9.0	56.0	4356	50138	
9.5	59.1	3975	45752	
10.0	62.6	3644	41942	
10.5	65.3	3355	38616	
11.0	68.4	3100	35681	
11.5	71.5	2875	33091	
12.0	74.6	2675	30789	
12.5	77.7	2496	28729	
13.0	80.8	2336	26887	
13.5	83.9	2191	25218	
14.0	87.0	2060	23711	
14.5	90.2	1937	22295	
15.0	93.3	1829	21052	
15.5	96.4	1730	19912	
16.0	99.5	1640	18876	
16.5	102.6	1556	17909	
17.0	105.7	1479	17023	
17.5	108.8	1408	16206	
18.0	111.9	1343	15458	
18.5	115.0	1282	14755	
19.0	118.1	1225	14100	
19.5	121.2	1172	13489	
20.0	124.4	1122	12914	

*Non-stock size subject to mill run requirements.

STRONGWELL.

COLUMN

W SHAPE

10 x 10 x 3/8
Allowable Axial Stresses and Loads

$b_f / t_f = 26.7$ $r_y = 2.39$ in. $A = 10.98$ in^2
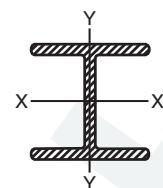
EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525/625 E = 2.5 x 10^6 psi		
		F_a(psi)	P_a(lbs)	
0.5	2.5	3020	33160	SHORT
1.0	5.0	3020	33160	
1.5	7.5	3020	33160	
2.0	10.0	3020	33160	
2.5	12.6	3020	33160	
3.0	15.1	3020	33160	
3.5	17.6	3020	33160	
4.0	20.1	3010	33160	
4.5	22.6	3020	33160	
5.0	25.1	3020	33160	
5.5	27.6	3020	33160	
6.0	30.1	3020	33160	
6.5	32.6	3020	33160	
7.0	35.1	3020	33160	
7.5	37.7	3020	33160	
8.0	40.2	3020	33160	
8.5	42.7	3020	33160	
9.0	45.2	3020	33160	
9.5	47.7	3020	33160	
10.0	50.2	3020	33160	
10.5	52.7	3020	33160	
11.0	55.2	3020	33160	
11.5	57.7	3020	33160	
12.0	60.3	3020	33160	
12.5	62.8	3020	33160	
13.0	65.3	3020	33160	
13.5	67.8	3020	33160	
		F_a' (psi)	P_a (lbs)	
14.0	70.3	2959	32490	LONG
14.5	72.8	2789	30623	
15.0	75.3	2633	28910	
15.5	77.8	2491	27351	
16.0	80.3	2380	26132	
16.5	82.8	2241	24606	
17.0	85.4	2126	23342	
17.5	87.9	2024	22224	
18.0	90.4	1930	21190	
18.5	92.9	1842	20225	
19.0	95.4	1761	19337	
19.5	97.9	1685	18501	
20.0	100.4	1615	17733	

Rev.1013

COLUMN

W SHAPE
* 10 x 10 x 1/2
Allowable Axial Stresses and Loads

$b_f / t_f = 20.0$ $r_y = 2.40$ in. $A = 14.55$ in^2
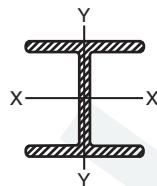
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625 E = 2.5 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	
0.5	2.5	4658	67774	SHORT
1.0	5.0	4658	67774	
1.5	7.5	4658	67774	
2.0	10.0	4658	67774	
2.5	12.5	4658	67774	
3.0	15.0	4658	67774	
3.5	17.5	4658	67774	
4.0	20.0	4658	67774	
4.5	22.5	4658	67774	
5.0	25.0	4658	67774	
5.5	27.5	4658	67774	
6.0	30.0	4658	67774	
6.5	32.5	4658	67774	
7.0	35.0	4658	67774	
7.5	37.5	4658	67774	
8.0	40.0	4658	67774	
8.5	42.5	4658	67774	
9.0	45.0	4658	67774	
9.5	47.5	4658	67774	
10.0	50.0	4658	67774	
10.5	52.5	4658	67774	
		F_a' (psi)	P_a(lbs)	
11.0	55.0	4491	65344	LONG
11.5	57.5	4165	60601	
12.0	60.0	3874	56366	
12.5	62.5	3614	52584	
13.0	65.0	3381	49195	
13.5	67.5	3171	46138	
14.0	70.0	2981	43372	
14.5	72.5	2808	40856	
15.0	75.0	2651	38572	
15.5	77.5	2507	36477	
16.0	80.0	2375	34556	
16.5	82.5	2254	32796	
17.0	85.0	2143	31179	
17.5	87.5	2040	29682	
18.0	90.0	1944	28285	
18.5	92.5	1856	27004	
19.0	95.0	1774	25812	
19.5	97.5	1697	24691	
20.0	100.0	1625	23644	

*Non-stock size subject to mill run requirements.

COLUMN

W SHAPE
* 12 x 12 x 1/2
Allowable Axial Stresses and Loads

$b_f / t_f = 24.0$ $r_y = 2.88$ in. $A = 17.51$ in^2
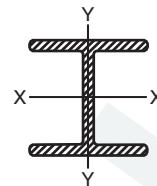
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625	
		E = 2.5 x 10^6 psi	
		F_a(psi)	P_a(lbs)
0.5	2.1	3544	62055	SHORT
1.0	4.2	3544	62055
1.5	6.3	3544	62055
2.0	8.3	3544	62055
2.5	10.4	3544	62055
3.0	12.5	3544	62055
3.5	14.6	3544	62055
4.0	16.7	3544	62055
4.5	18.8	3544	62055
5.0	20.8	3544	62055
5.5	22.9	3544	62055
6.0	25.0	3544	62055
6.5	27.1	3544	62055
7.0	29.2	3544	62055
7.5	31.3	3544	62055
8.0	33.3	3544	62055
8.5	35.4	3544	62055
9.0	37.5	3544	62055
9.5	39.6	3544	62055
10.0	41.7	3544	62055
10.5	43.8	3544	62055
11.0	45.8	3544	62055
11.5	47.9	3544	62055
12.0	50.0	3544	62055
12.5	52.1	3544	62055
13.0	54.2	3544	62055
13.5	56.3	3544	62055
14.0	58.3	3544	62055
14.5	60.4	3544	62055
15.0	62.5	3544	62055
		F_a' (psi)	P_a(lbs)
15.5	64.6	3417	59832	LONG
16.0	66.7	3235	56644
16.5	68.8	3069	53758
17.0	70.8	2923	51181
17.5	72.9	2782	48713
18.0	75.0	2651	46419
18.5	77.1	2529	44283
19.0	79.2	2416	42304
19.5	81.3	2311	40466
20.0	83.3	2217	38820

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

I SHAPE

3 x 1-1/2 x 1/4

Allowable Axial Stresses and Loads
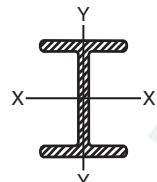
$b_f / t_f = 6$ $r_y = 0.32$ in. $A = 1.38$ in^2

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10^6 psi		EXTREN® 625 E = 2.8 x 10^6 psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	18.8	10000	13800	11000	15180	SHORT
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
1.0	37.5	8957	12361	9646	13312	LONG
1.5	56.3	4489	6195	4834	6671	
2.0	75.0	2757	3805	2969	4097	
2.5	93.8	1885	2601	2020	2801	
3.0	112.5	1384	1910	1490	2056	
3.5	131.3	1064	1468	1150	1581	
4.0	150.0	849	1171	914	1261	
4.5	168.8	694	958	748	1032	
5.0	187.5	581	801	625	863	

STRONGWELL.

COLUMN

I SHAPE
4 x 2 x 1/4
Allowable Axial Stresses and Loads

$b_f / t_f = 8.0$ $r_y = 0.43$ in. $A = 1.89$ in^2

EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	14.0	10000	18900	11000	20790	SHORT
1.0	27.9	10000	18900	11000	20790	
		F_a' (psi)	P_a (lbs)	F_a' (psi)	P_a (lbs)	
1.5	41.9	7418	14020	7988	15098	LONG
2.0	55.8	4558	8614	4908	9277	
2.5	69.8	3115	5888	3355	6341	
3.0	83.7	2288	4324	2464	4656	
3.5	97.7	1759	3324	1894	3580	
4.0	111.6	1403	2651	1510	2855	
4.5	125.6	1148	2169	1236	2336	
5.0	139.5	960	1814	1034	1954	
5.5	153.5	816	1542	879	1661	
6.0	167.4	704	1331	758	1433	
6.5	181.4	614	1161	662	1250	
7.0	195.3	542	1024	583	1103	

Rev.1013

COLUMN

I SHAPE

5-1/2 x 2-1/2 x 1/4
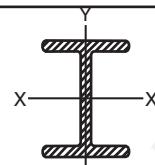
Allowable Axial Stresses and Loads

$b_f / t_f = 10.0$ $r_y = 0.50$ in. $A = 2.48$ in^2

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525/625		
		E = 2.5 x 10^6 psi		
		F_a(psi)	P_a(lbs)	
0.5	12.0	10000	24800	SHORT
1.0	24.0	10000	24800	
		$F_{a'}$ (psi)	P_a(lbs)	
1.5	36.0	9232	22895	LONG
2.0	48.0	5661	14040	
2.5	60.0	3874	9607	
3.0	72.0	2842	7048	
3.5	84.0	2186	5422	
4.0	96.0	1742	4320	
4.5	108.0	1426	3536	
5.0	120.0	1192	2956	
5.5	132.0	1014	2515	
6.0	144.0	875	2168	
6.5	156.0	763	1892	
7.0	168.0	673	1669	
7.5	180.0	598	1483	
8.0	192.0	536	1329	

STRONGWELL.

COLUMN

I SHAPE
*6 x 3 x 1/4
Allowable Axial Stresses and Loads

$b_f / t_f = 12.0$ $r_y = 0.63$ in. $A = 2.88$ in^2
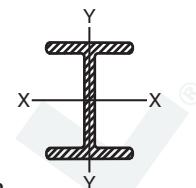
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625 E = 2.5 x 10^6 psi		
		F_a(psi)	P_a(lbs)	
0.5	9.5	10000	28800	SHORT
1.0	19.0	10000	28800	
1.5	28.6	10000	28800	
		F_a' (psi)	P_a(lbs)	
2.0	38.1	8384	24145	LONG
2.5	47.6	5742	16538	
3.0	57.1	4214	12137	
3.5	66.7	3236	9319	
4.0	76.2	2580	7432	
4.5	85.7	2113	6086	
5.0	95.2	1767	5090	
5.5	104.8	1501	4323	
6.0	114.3	1295	3730	
6.5	123.8	1131	3257	
7.0	133.3	997	2872	
7.5	142.9	886	2552	
8.0	152.4	794	2287	
8.5	161.9	717	2064	
9.0	171.4	650	1873	
9.5	181.0	593	1707	
10.0	190.5	543	1565	
10.5	200.0	500	1441	

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

I SHAPE

* 6 x 3 x 3/8
Allowable Axial Stresses and Loads

$b_f / t_f = 8.0$ $r_y = 0.64$ in. $A = 4.23 in^2$
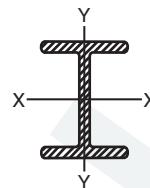
EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525/625		
		$E = 2.5 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	
0.5	9.4	10000	42300	SHORT
1.0	18.8	10000	42300	
1.5	28.1	10000	42300	
		F_a' (psi)	P_a(lbs)	
2.0	37.5	8613	36434	LONG
2.5	46.9	5889	24909	
3.0	56.3	4316	18257	
3.5	65.6	3328	14077	
4.0	75.0	2651	11214	
4.5	84.4	2169	9174	
5.0	93.8	1812	7667	
5.5	103.1	1543	6529	
6.0	112.5	1330	5629	
6.5	121.9	1161	4911	
7.0	131.3	1023	4328	
7.5	140.6	911	3853	
8.0	150.0	816	3451	
8.5	159.4	736	3113	
9.0	168.8	667	2823	
9.5	178.1	609	2577	
10.0	187.5	558	2361	
10.5	196.9	514	2173	

*Non-stock size subject to mill run requirements.

STRONGWELL.

COLUMN

I SHAPE

8 x 4 x 3/8

Allowable Axial Stresses and Loads

b_f / t_f = 12.0   **r_y = 0.84 in.**   **A = 5.73 in^2**
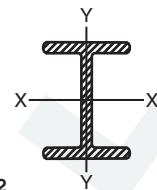
| EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625		
		E = 2.5 x 10^6 psi		
		F_a(psi)	P_a(lbs)	
0.5	7.1	10000	57300	SHORT
1.0	14.3	10000	57300	
1.5	21.4	10000	57300	
2.0	28.6	10000	57300	
		F_a' (psi)	P_a(lbs)	
2.5	35.7	9364	53656	LONG
3.0	42.9	6853	39267	
3.5	50.0	5281	30260	
4.0	57.1	4214	24146	
4.5	64.3	3444	19734	
5.0	71.4	2882	16514	
5.5	78.6	2448	14027	
6.0	85.7	2113	12107	
6.5	92.9	1842	10565	
7.0	100.0	1625	9311	
7.5	107.1	1446	8289	
8.0	114.3	1295	7420	
8.5	121.4	1169	6699	
9.0	128.6	1060	6074	
9.5	135.7	967	5541	
10.0	142.9	886	5077	
10.5	150.0	816	4675	
11.0	157.1	754	4322	
11.5	164.3	699	4004	
12.0	171.4	650	3727	
12.5	178.6	606	3475	
13.0	185.7	567	3252	
13.5	192.9	532	3049	
14.0	200.0	500	2867	

Rev.1013

COLUMN

I SHAPE
*8 x 4 x 1/2
Allowable Axial Stresses and Loads

$b_f / t_f = 8.0$ $r_y = 0.85$ in. $A = 7.51$ in^2
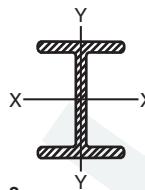
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625 $E = 2.5 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	
0.5	7.1	10000	75100	SHORT
1.0	14.1	10000	75100	
1.5`	21.2	10000	75100	
2.0	28.2	10000	75100	
		F_a' (psi)	P_a(lbs)	
2.5	35.3	9545	71683	LONG
3.0	42.4	6990	52495	
3.5	49.4	5391	40487	
4.0	56.5	4291	32223	
4.5	63.5	3518	26420	
5.0	70.6	2938	22064	
5.5	77.6	2501	18782	
6.0	84.7	2155	16198	
6.5	91.8	1880	14120	
7.0	98.8	1659	12459	
7.5	105.9	1474	11069	
8.0	112.9	1322	9928	
8.5	120.0	1192	8952	
9.0	127.1	1081	8181	
9.5	134.1	987	7412	
10.0	141.2	904	6791	
10.5	148.2	833	6255	
11.0	155.3	769	5776	
11.5	162.4	713	5354	
12.0	169.4	663	4983	
12.5	176.5	618	4647	
13.0	183.5	579	4350	
13.5	190.6	543	4078	
14.0	197.6	510	3835	

*Non-stock size subject to mill run requirements.

STRONGWELL®

COLUMN

I SHAPE
*10 x 5 x 3/8
Allowable Axial Stresses and Loads

$b_f / t_f = 13.3$ $r_y = 1.04$ in. $A = 7.23 in^2$
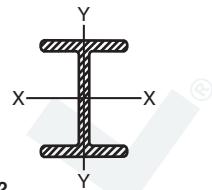
EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525/625		
		E = 2.5 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	
0.5	5.8	8590	62106	SHORT
1.0	11.5	8590	62106	
1.5	17.3	8590	62106	
2.0	23.1	8590	62106	
2.5	28.8	8590	62106	
3.0	34.6	8590	62106	
		F_a' (psi)	P_a(lbs)	
3.5	40.4	7588	54861	LONG
4.0	46.2	6041	43676	
4.5	51.9	4957	35839	
5.0	57.7	4140	29933	
5.5	63.5	3518	25435	
6.0	69.2	3039	21972	
6.5	75.0	2651	19166	
7.0	80.8	2335	16882	
7.5	86.5	2080	15039	
8.0	92.3	1862	13462	
8.5	98.1	1679	12139	
9.0	103.8	1525	11026	
9.5	109.6	1391	10057	
10.0	115.4	1274	9211	
10.5	121.2	1172	8474	
11.0	126.9	1084	7837	
11.5	132.7	1005	7266	
12.0	138.5	934	6753	
12.5	144.2	872	6308	
13.0	150.0	816	5899	
13.5	155.8	765	5531	
14.0	161.5	719	5203	
14.5	167.3	677	4895	
15.0	177.1	615	4448	
15.5	178.8	605	4376	
16.0	184.6	573	4143	
16.5	190.4	544	3933	
17.0	196.2	517	3737	

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

I SHAPE

* 10 x 5 x 1/2
Allowable Axial Stresses and Loads

$b_f / t_f = 10.0$ $r_y = 1.06$ in. $A = 9.51$ in^2
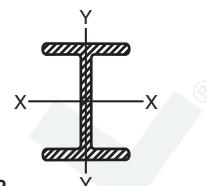
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625 E = 2.5 x 10^6 psi		
		F_a(psi)	P_a(lbs)	
0.5	5.7	10000	95100	SHORT
1.0	11.3	10000	95100	
1.5	17.0	10000	95100	
2.0	22.6	10000	95100	
2.5	28.3	10000	95100	
3.0	34.0	10000	95100	
		$F_a{'}$ (psi)	P_a(lbs)	
3.5	39.6	7851	74664	LONG
4.0	45.3	6246	59399	
4.5	50.9	5123	48719	
5.0	56.6	4277	40674	
5.5	62.3	3634	34559	
6.0	67.9	3139	29851	
6.5	73.6	2737	26029	
7.0	79.2	2416	22976	
7.5	84.9	2147	20418	
8.0	90.6	1922	18279	
8.5	96.2	1736	16509	
9.0	101.9	1574	14969	
9.5	107.5	1437	13666	
10.0	113.2	1316	12515	
10.5	118.9	1211	11518	
11.0	124.5	1120	10651	
11.5	130.2	1038	9871	
12.0	135.8	966	9189	
12.5	141.5	901	8569	
13.0	147.2	842	8012	
13.5	152.8	790	7519	
14.0	158.5	743	7066	
14.5	164.2	699	6654	
15.0	169.8	660	6284	
15.5	175.5	624	5942	
16.0	181.1	592	5633	
16.5	186.8	562	5344	
17.0	192.5	534	5078	
17.5	198.1	508	4836	

*Non-stock size subject to mill run requirements.

STRONGWELL®

COLUMN

I SHAPE

* 12 x 6 x 1/2

Allowable Axial Stresses and Loads

b_f / t_f = 12.0 r_y = 1.26 in.   A = 11.51 in^2
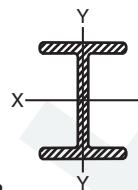
EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525/625		
		E = 2.5 x 10^6 psi		
		F_a(psi)	P_a(lbs)	
0.5	4.8	10000	115100	SHORT
1.0	9.5	10000	115100	
1.5	14.3	10000	115100	
2.0	19.0	10000	115100	
2.5	23.8	10000	115100	
3.0	28.6	10000	115100	
3.5	33.3	10000	115100	
		F_a' (psi)	P_a(lbs)	
4.0	38.1	8383	96488	LONG
4.5	42.9	6852	78866	
5.0	47.6	5742	66090	
5.5	52.4	4877	56134	
6.0	57.1	4214	48503	
6.5	61.9	3674	42288	
7.0	66.7	3536	37246	
7.5	71.4	2882	33172	
8.0	76.2	2580	29765	
8.5	81.0	2326	26772	
9.0	85.7	2113	24321	
9.5	90.5	1926	22168	
10.0	95.2	1767	20338	
10.5	100.0	1625	18704	
11.0	104.8	1501	17277	
11.5	109.5	1393	16035	
12.0	114.3	1295	14908	
12.5	119.0	1209	13916	
13.0	123.8	1130	13006	
13.5	128.6	1060	12201	
14.0	133.3	997	11475	
14.5	138.1	939	10808	
15.0	142.9	886	10198	
15.5	147.6	838	9652	
16.0	152.4	794	9141	
16.5	157.1	754	8681	
17.0	161.9	716	8248	
17.5	166.7	682	7849	
18.0	171.4	650	7484	
18.5	176.2	620	7143	
19.0	181.0	593	6824	
19.5	185.7	567	6533	
20.0	190.5	543	6256	

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

EQUAL LEG ANGLES
2 x 2 x 1/4
Allowable Axial Stresses and Loads
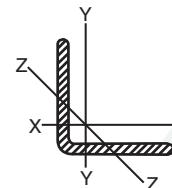
b/t = 8.0 r_z = 0.39 in.   A = 0.92 in²

EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi	
		F_a' (psi)	P_a (lbs)	F_a' (psi)	P_a (lbs)
0.5	15.4	3440	3165	3704	3407
1.0	30.8	2349	2161	2530	2327
1.5	46.2	1880	1729	2024	1862
2.0	61.5	1606	1478	1730	1591
2.5	76.9	1420	1307	1530	1407
3.0	92.3	1285	1182	1383	1273
3.5	107.7	1180	1086	1271	1169
4.0	123.1	1096	1009	1181	1086
4.5	138.5	1028	945	1107	1018
5.0	153.8	970	893	1045	961
5.5	169.2	920	847	991	912
6.0	184.6	877	807	945	869
6.5	200.0	840	772	904	832

LONG

STRONGWELL.
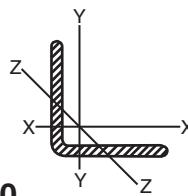
COLUMN

EQUAL LEG ANGLES
3 x 3 x 1/4
Allowable Axial Stresses and Loads

b/t = 12.0 r_z = 0.58 in.   **A = 1.42 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525 $E = 2.6 \times 10^6$ psi		EXTREN® 625 $E = 2.8 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	10.3	3029	4301	3262	4632	SHORT
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
1.0	20.7	2923	4151	3148	4470	LONG
1.5	31.0	2341	3324	2521	3580	
2.0	41.4	1997	2835	2150	3053	
2.5	51.7	1767	2509	1903	2702	
3.0	62.1	1598	2269	1720	2443	
3.5	72.4	1468	2085	1581	2245	
4.0	82.8	1364	1937	1469	2086	
4.5	93.1	1279	1816	1377	1955	
5.0	103.4	1207	1714	1300	1846	
5.5	113.8	1145	1626	1233	1751	
6.0	124.1	1092	1550	1176	1669	
6.5	134.5	1044	1438	1125	1597	
7.0	144.8	1003	1424	1080	1534	
7.5	155.2	965	1371	1040	1476	
8.0	165.5	932	1323	1003	1425	
8.5	176.9	898	1276	967	1374	
9.0	186.2	873	1240	940	1335	
9.5	196.6	848	1206	913	1296	

Rev.1013

COLUMN

EQUAL LEG ANGLES
3 x 3 x 3/8
Allowable Axial Stresses and Loads

b/t = 8.0 r_z = 0.58 in.   **A = 2.09 in^2**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi	
		F_a'(psi)	P_a(lbs)	F_a'(psi)	P_a(lbs)
0.5	10.3	4281	8948	4611	9636
1.0	20.7	2923	6109	3148	6579
1.5	31.0	2341	4893	2521	5269
2.0	41.4	1997	4173	2150	4494
2.5	51.7	1767	3693	1903	3977
3.0	62.1	1598	3339	1720	3595
3.5	72.4	1468	3068	1581	3304
4.0	82.8	1364	2851	1469	3070
4.5	93.1	1279	2673	1377	2878
5.0	103.4	1207	2523	1300	2717
5.5	113.8	1145	2393	1233	2577
6.0	124.1	1092	2282	1176	2458
6.5	134.5	1044	2182	1125	2351
7.0	144.8	1003	2096	1080	2257
7.5	155.2	965	2017	1040	2174
8.0	165.5	932	1948	1003	2096
8.5	176.9	898	1877	967	2021
9.0	186.2	873	1825	946	1965
9.5	196.6	848	1772	913	1908

LONG

STRONGWELL®

COLUMN

EQUAL LEG ANGLES

4 x 4 x 1/4

Allowable Axial Stresses and Loads
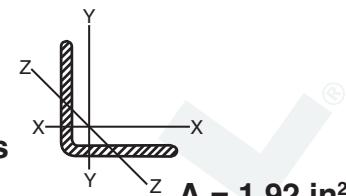
b/t = 16.0 r_z = 0.79 in.   **A = 1.92 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	7.6	2304	4424	2481	4764	SHORT
1.0	15.2	2304	4424	2481	4764	
1.5	22.8	2304	4424	2481	4764	
2.0	30.4	2304	4424	2481	4764	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
2.5	38.0	2093	4019	2254	4328	LONG
3.0	45.6	1893	3635	2039	3914	
3.5	53.2	1739	3340	1873	3596	
4.0	60.8	1616	3103	1741	3342	
4.5	68.4	1515	2909	1631	3132	
5.0	75.9	1431	2747	1541	2958	
5.5	83.5	1357	2606	1462	2807	
6.0	91.1	1294	2484	1393	2675	
6.5	98.7	1238	2377	1333	2560	
7.0	106.3	1189	2282	1280	2458	
7.5	113.9	1144	2197	1232	2366	
8.0	121.5	1104	2120	1189	2284	
8.5	129.1	1068	2051	1150	2209	
9.0	136.7	1035	1987	1115	2140	
9.5	144.3	1005	1929	1082	2077	
10.0	151.9	977	1875	1052	2020	
10.5	159.5	951	1826	1024	1966	
11.0	167.1	927	1780	998	1916	
11.5	174.7	904	1737	974	1870	
12.0	182.3	884	1696	951	1827	
12.5	189.9	864	1659	930	1786	
13.0	197.5	845	1623	910	1748	

Rev.1013

STRONGWELL

COLUMN

EQUAL LEG ANGLES
4 x 4 x 3/8
Allowable Axial Stresses and Loads
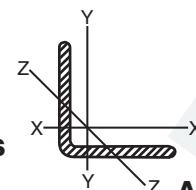
b/t = 10.67 r_z = 0.78 in.   **A = 2.84 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	7.7	3386	9616	3646	10356	SHORT
1.0	15.4	3386	9616	3646	10356	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
1.5	23.1	2752	7816	2964	8417	LONG
2.0	30.8	2349	6672	2530	7185	
2.5	38.5	2078	5901	2238	6356	
3.0	46.2	1880	5339	2024	5749	
3.5	53.8	1729	4910	1862	5287	
4.0	61.5	1606	4561	1730	4912	
4.5	69.2	1505	4275	1621	4604	
5.0	76.9	1420	4034	1530	4344	
5.5	84.6	1348	3828	1451	4122	
6.0	92.3	1285	3649	1383	3929	
6.5	100.0	1229	3491	1324	3760	
7.0	107.7	1180	3352	1271	3609	
7.5	115.4	1136	3227	1224	3475	
8.0	123.1	1096	3114	1181	3354	
8.5	130.8	1060	3012	1142	3244	
9.0	138.5	1028	2919	1107	3143	
9.5	146.2	998	2833	1074	3051	
10.0	153.8	970	2755	1045	2967	
10.5	161.5	944	2682	1017	2888	
11.0	169.2	920	2614	991	2815	
11.5	176.9	898	2551	967	2747	
12.0	184.6	877	2492	945	2684	
12.5	192.3	858	2437	924	2624	
13.0	200.0	840	2385	904	2568	

STRONGWELL.

COLUMN

EQUAL LEG ANGLES
4 x 4 x 1/2
Allowable Axial Stresses and Loads
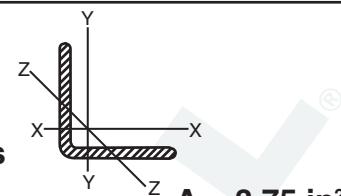
b/t = 8.0 r_z= 0.78 in.   **A = 3.75 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	7.7	4451	16691	4793	17976	SHORT
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
1.0	15.4	3440	12899	3704	13892	LONG
1.5	23.1	2752	10320	2964	11114	
2.0	30.8	2349	8810	2529	9488	
2.5	38.5	2078	7793	2238	8393	
3.0	46.2	1879	7049	2023	7591	
3.5	53.8	1728	6482	1861	6981	
4.0	61.5	1606	6023	1729	6486	
4.5	69.2	1505	5644	1620	6078	
5.0	76.9	1420	5326	1529	5736	
5.5	84.6	1347	5054	1450	5443	
6.0	92.3	1284	4817	1382	5187	
6.5	100.0	1229	4609	1323	4963	
7.0	107.7	1180	4425	1270	4765	
7.5	115.4	1136	4261	1223	4589	
8.0	123.1	1096	4112	1180	4428	
8.5	130.8	1060	3977	1141	4283	
9.0	138.5	1027	3853	1106	4149	
9.5	146.2	997	3740	1073	4027	
10.0	153.8	970	3638	1044	3918	
10.5	161.5	944	3542	1016	3814	
11.0	169.2	920	3452	990	3717	
11.5	176.9	898	3369	967	3625	
12.0	184.6	877	3290	944	3543	
12.5	192.3	857	3217	922	3464	
13.0	200.0	839	3148	903	3390	

Rev.1013

COLUMN

EQUAL LEG ANGLES
* 5 x 5 x 1/2
Allowable Axial Stresses and Loads
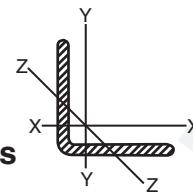
b/t = 10.0   **r$_z$ = 1.02 in.**   **A = 4.71 in^2**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10^6 psi		EXTREN® 625 E = 2.8 x 10^6 psi		
		F$_a$(psi)	P$_a$(lbs)	F$_a$(psi)	P$_a$(lbs)	
0.5	5.9	3602	16963	3879	18268	SHORT
1.0	11.8	3602	16963	3879	18268	
		F$_a$' (psi)	P$_a$(lbs)	F$_a$' (psi)	P$_a$(lbs)	
1.5	17.7	3191	15031	3437	16187	LONG
2.0	23.5	2724	12832	2934	13819	
2.5	29.4	2410	11350	2596	12224	
3.0	35.3	2180	10268	2348	11058	
3.5	41.2	2003	9432	2157	10158	
4.0	47.0	1861	8764	2004	9439	
4.5	52.9	1744	8215	1878	8847	
5.0	58.8	1646	7753	1773	8349	
5.5	64.7	1562	7357	1682	7923	
6.0	70.6	1489	7013	1603	7552	
6.5	76.5	1425	6711	1534	7227	
7.0	82.4	1368	6443	1473	6938	
7.5	88.2	1317	6203	1418	6680	
8.0	94.1	1271	5986	1369	6447	
8.5	100.0	1229	5790	1324	6235	
9.0	105.9	1191	5611	1283	6043	
9.5	111.8	1156	5447	1245	5866	
10.0	117.7	1124	5295	1211	5702	
10.5	123.5	1094	5155	1179	5551	
11.0	129.4	1067	5025	1149	5411	
11.5	135.3	1041	4903	1121	5281	
12.0	141.2	1017	4790	1095	5158	
12.5	147.1	994	4683	1071	5044	
13.0	152.9	973	4583	1048	4936	
13.5	158.8	953	4489	1026	4835	
14.0	164.7	934	4401	1006	4739	
14.5	170.6	916	4316	987	4648	
15.0	176.5	899	4237	969	4563	
15.5	182.4	883	4161	951	4401	
16.0	188.2	868	4089	935	4403	
16.5	194.1	854	4020	919	4329	
17.0	200.0	840	3955	904	4259	
17.5	205.9	826	3892	890	4192	
18.0	211.8	814	3832	876	4127	
18.5	217.7	801	3775	863	4065	
19.0	223.5	790	3720	851	4006	
19.5	229.4	771	3667	839	3949	
20.0	235.3	768	3617	827	3895	

STRONGWELL

COLUMN

EQUAL LEG ANGLES
* 6 x 6 x 3/8
Allowable Axial Stresses and Loads
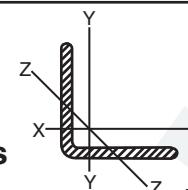
b/t = 16.0 r_z = 1.18 in.   A = 4.34 in²

EFFECTIVE COLUMN LENGTH (ft.)	Kl/r	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	5.1	2304	9999	2481	10768	SHORT
1.0	10.2	2304	9999	2481	10768	
1.5	15.2	2304	9999	2481	10768	
2.0	20.3	2304	9999	2481	10768	
2.5	25.4	2304	9999	2481	10768	
3.0	30.5	2304	9999	2481	10768	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
3.5	35.6	2170	9418	2336	10138	LONG
4.0	40.7	2016	8749	2170	9418	
4.5	45.8	1889	8197	2034	8228	
5.0	50.8	1784	7743	1921	8337	
5.5	55.9	1693	7346	1823	7911	
6.0	61.0	1613	7000	1737	7540	
6.5	66.1	1544	6700	1662	7213	
7.0	71.2	1482	6431	1596	6926	
7.5	76.3	1427	6191	1536	6667	
8.0	81.4	1377	5975	1482	6436	
8.5	86.4	1332	5782	1435	6227	
9.0	91.5	1291	5602	1390	6033	
9.5	96.6	1253	5438	1349	5856	
10.0	101.7	1218	5286	1312	5692	
10.5	106.8	1186	5146	1277	5541	
11.0	111.9	1156	5015	1244	5401	
11.5	116.9	1128	4896	1215	5273	
12.0	122.0	1102	4782	1187	5150	
12.5	127.1	1077	4676	1160	5036	
13.0	132.2	1054	4576	1135	4927	
13.5	137.3	1033	4482	1112	4826	
14.0	142.4	1012	4393	1090	4730	
14.5	147.5	993	4308	1069	4640	
15.0	152.4	975	4232	1050	4557	
15.5	157.6	957	4154	1031	4474	
16.0	162.7	941	4082	1013	4396	
16.5	167.8	925	4013	996	4322	
17.0	172.9	910	3948	980	4251	
17.5	178.0	895	3885	964	4184	
18.0	183.0	882	3826	949	4121	
18.5	188.1	868	3769	935	4059	
19.0	193.2	856	3714	922	4000	
19.5	198.3	844	3661	908	3943	

*Non-stock size subject to mill run requirements.

Rev.1013

STRONGWELL

COLUMN

EQUAL LEG ANGLES
6 x 6 x 1/2
Allowable Axial Stresses and Loads

b/t = 12.0　　　　　$r_z = 1.17$ in.　　　　　**A = 5.72 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	5.1	3029	17326	3262	18658	SHORT
1.0	10.3	3029	17326	3262	18658	
1.5	15.4	3029	17326	3262	18658	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
2.0	20.5	2938	16805	3164	18097	LONG
2.5	25.6	2599	14864	2798	16007	
3.0	30.8	2351	13446	2531	14480	
3.5	35.9	2160	12353	2326	13303	
4.0	41.0	2007	11478	2161	12361	
4.5	46.2	1881	10758	2025	11586	
5.0	51.3	1775	10153	1911	10933	
5.5	56.4	1684	9634	1814	10375	
6.0	61.5	1606	9184	1729	9890	
6.5	66.7	1536	8788	1655	9464	
7.0	71.8	1475	8437	1588	9086	
7.5	76.9	1420	8123	1529	8748	
8.0	82.1	1371	7840	1476	8442	
8.5	87.2	1325	7582	1427	8166	
9.0	92.3	1285	7348	1383	7913	
9.5	97.4	1247	7133	1343	7681	
10.0	102.6	1212	6934	1306	7468	
10.5	107.7	1180	6751	1271	7270	
11.0	112.8	1150	6580	1239	7086	
11.5	117.9	1123	6421	1209	6915	
12.0	123.1	1097	6273	1181	6755	
12.5	128.2	1072	6134	1155	6605	
13.0	133.3	1049	6003	1130	6464	
13.5	138.5	1028	5879	1107	6331	
14.0	143.6	1007	5763	1085	6206	
14.5	148.7	988	5653	1064	6087	
15.0	153.8	970	5548	1045	5975	
15.5	159.0	952	5445	1026	5858	
16.0	164.1	936	5355	1008	5767	
16.5	169.2	920	5265	991	5670	
17.0	174.4	905	5179	975	5577	
17.5	179.5	891	5097	960	5489	
18.0	184.6	877	5019	945	5405	
18.5	189.7	864	4944	931	5324	
19.0	194.9	852	4872	917	5246	
19.5	200.0	840	4803	904	5172	

STRONGWELL®

COLUMN

ROUND TUBE
1-1/2 x 1/4
Allowable Axial Stresses and Loads

X ——⊘—— X
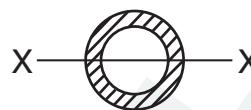
D/t = 6.0   **r = 0.45 in.**   **A = 0.98 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	13.3	10000	9800	11000	10780	SHORT
1.0	26.7	10000	9800	11000	10780	
		$F_a{}'$ (psi)	P_a(lbs)	$F_a{}'$ (psi)	P_a(lbs)	
1.5	40.0	9314	9127	10030	9829	LONG
2.0	53.3	6413	6284	6906	6768	
2.5	66.7	4791	4695	5159	5056	
3.0	80.0	3782	3707	4073	3992	
3.5	93.3	3097	3035	3335	3268	
4.0	106.7	2601	2549	2801	2745	
4.5	120.0	2233	2188	2404	2356	
5.0	133.3	1948	1909	2097	2055	
5.5	146.7	1720	1685	1852	1815	
6.0	160.0	1536	1505	1654	1621	
6.5	177.3	1344	1317	1447	1418	
7.0	186.7	1257	1232	1354	1327	
7.5	200.0	1149	1126	1238	1213	

Rev.1013

COLUMN

ROUND TUBE
*1-3/4 x 1/4
Allowable Axial Stresses and Loads

X —⊙— X

D/t = 7   **r = 0.54 in.**   **A = 1.18 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	11.1	10000	11800	11000	12980	SHORT
1.0	22.2	10000	11800	11000	12980	
1.5	33.3	10000	11800	11000	12980	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
2.0	44.4	8132	9596	8757	10334	LONG
2.5	55.6	6070	7163	6537	7713	
3.0	66.7	4791	5653	5159	6088	
3.5	77.8	3922	4628	4224	4984	
4.0	88.9	3298	3891	3551	4191	
4.5	100.0	2830	3339	3048	3596	
5.0	111.1	2468	2912	2658	3136	
5.5	122.2	2181	2573	2348	2771	
6.0	133.3	1948	2298	2097	2475	
6.5	144.4	1755	2071	1890	2231	
7.0	155.6	1593	1880	1715	2024	
7.5	166.7	1456	1718	1568	1851	
8.0	177.8	1339	1580	1442	1702	
8.5	188.9	1238	1461	1333	1573	
9.0	200.0	1149	1356	1238	1461	

*Non-stock size subject to mill run requirements.

STRONGWELL.

COLUMN

ROUND TUBE
2 x 1/4
Allowable Axial Stresses and Loads

X — ⊙ — X
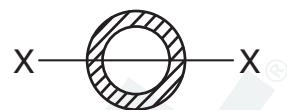
D/t = 8.0   **r = 0.62 in.**   **A = 1.37 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525		EXTREN® 625		
		E = 2.6 x 10⁶ psi		E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	9.7	9249	12671	9960	13645	SHORT
1.0	19.4	9249	12671	9960	13645	
1.5	29.0	9249	12671	9960	13645	
2.0	38.7	9249	12671	9960	13645	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
2.5	48.4	7269	9959	7828	10725	LONG
3.0	58.1	5733	7854	6174	8458	
3.5	67.7	4699	6438	5061	6933	
4.0	77.4	3948	5409	4252	5825	
4.5	87.1	3387	4640	3647	4997	
5.0	96.8	2952	4044	3179	4356	
5.5	106.5	2608	3572	2808	3847	
6.0	116.1	2331	3193	2510	3439	
6.5	125.8	2100	2877	2261	3098	
7.0	135.5	1907	2612	2053	2813	
7.5	145.2	1743	2388	1877	2571	
8.0	154.8	1604	2197	1727	2366	
8.5	164.5	1482	2030	1596	2186	
9.0	174.2	1375	1884	1481	2029	
9.5	183.9	1282	1756	1380	1891	
10.0	193.5	1200	1644	1292	1770	

Rev.1013

STRONGWELL

COLUMN

ROUND TUBE
2-1/2 x 1/4
Allowable Axial Stresses and Loads

X —⊙— X

D/t = 10.0   **r = 0.80 in.**   **A = 1.77 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	7.5	7651	13542	8240	14584	SHORT
1.0	15.0	7651	13542	8246	14584	
1.5	22.5	7651	13542	8246	14584	
2.0	30.0	7651	13542	8246	14584	
2.5	37.5	7651	13542	8246	14584	
3.0	45.0	7651	13542	8246	14584	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
3.5	52.5	6540	11576	7043	12466	LONG
4.0	60.0	5498	9731	5921	10480	
4.5	67.5	4717	8350	5080	8992	
5.0	75.0	4114	7281	4430	7841	
5.5	82.5	3634	6432	3914	6927	
6.0	90.0	3245	5745	3495	6168	
6.5	97.5	2925	5177	3150	5574	
7.0	105.0	2656	4701	2860	5063	
7.5	112.5	2428	4298	2615	4629	
8.0	120.0	2233	3952	2405	4256	
8.5	127.5	2063	3653	2222	3934	
9.0	135.0	1916	3391	2063	3652	
9.5	142.5	1786	3161	1923	3403	
10.0	150.0	1671	2957	1799	3184	
10.5	157.5	1568	2775	1689	2989	
11.0	165.0	1476	2612	1589	2813	
11.5	172.5	1393	2466	1500	2655	
12.0	180.0	1318	2333	1419	2512	
12.5	187.5	1250	2212	1346	2383	
13.0	195.0	1188	2102	1279	2264	

STRONGWELL

COLUMN

ROUND TUBE
*2-3/4 x 1/4
Allowable Axial Stresses and Loads

X —⬤— X ®
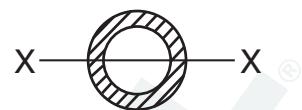
D/t = 11   **r = 0.89 in.**   **A = 1.96 in²**

EFFECTIVE COLUMN LENGTH (ft.)	K*l*/r	EXTREN® 500/525		EXTREN® 625	
		E = 2.6 x 10⁶ psi		E = 2.8 x 10⁶ psi	
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)
0.5	6.7	7056	13830	7599	14894
1.0	13.4	7056	13830	7599	14894
1.5	20.2	7056	13830	7599	14894
2.0	27.0	7056	13830	7599	14894
2.5	33.7	7056	13830	7599	14894
3.0	40.4	7056	13830	7599	14894
3.5	47.2	7056	13830	7599	14894
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)
4.0	53.9	6320	12388	6806	13340
4.5	60.7	5416	10615	5832	11431
5.0	67.4	4726	9264	5090	9976
5.5	74.2	4171	8176	4492	8804
6.0	80.9	3728	7307	4015	7869
6.5	87.6	3362	6589	3620	7095
7.0	94.3	3054	5987	3289	6447
7.5	101.1	2790	5469	3005	5889
8.0	107.9	2564	5025	2761	5411
8.5	114.6	2371	4646	2553	5004
9.0	121.3	2202	4316	2371	4647
9.5	128.1	2051	4020	2209	4329
10.0	134.8	1920	3762	2067	4052
10.5	141.6	1801	3529	1939	3801
11.0	148.3	1696	3323	1826	3579
11.5	155.1	1600	3135	1723	3376
12.0	161.8	1514	2967	1630	3196
12.5	168.5	1436	2815	1547	3031
13.0	175.3	1364	2674	1469	2880
13.5	182.0	1299	2574	1399	2742
14.0	188.8	1239	2428	1334	2615
14.5	195.5	1184	2320	1275	2499

SHORT (rows 0.5–3.5)
LONG (rows 4.0–14.5)

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

ROUND TUBE
*2-3/4 x 3/8
Allowable Axial Stresses and Loads

D/t = 9.33   **r = 0.85 in.**   **A = 2.80 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 $E = 2.5 \times 10^6$ psi		EXTREN® 625 $E = 2.8 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	7.1	8116	22724	8740	24472	SHORT
1.0	14.1	8116	22724	8740	24472	
1.5	21.2	8116	22724	8740	24472	
2.0	28.2	8116	22724	8740	24472	
2.5	35.3	8116	22724	8740	24472	
3.0	42.4	8116	22724	8740	24472	
		$F_a{}'$ (psi)	P_a(lbs)	$F_a{}'$ (psi)	P_a(lbs)	
3.5	49.4	7076	19814	7621	21338	LONG
4.0	56.5	5949	16657	6406	17938	
4.5	63.5	5104	14292	5497	15391	
5.0	70.6	4451	12462	4793	13421	
5.5	77.6	3932	11010	4235	11857	
6.0	84.7	3512	9833	3782	10589	
6.5	91.8	3165	8861	3408	9542	
7.0	98.8	2874	8047	3095	8666	
7.5	105.9	2627	7357	2829	7923	
8.0	112.9	2416	6765	2602	7285	
8.5	120.0	2233	6252	2405	6733	
9.0	127.1	2073	5804	2232	6251	
9.5	134.1	1932	5410	2081	5826	
10.0	141.2	1808	5061	1947	5451	
10.5	148.2	1697	4750	1827	5116	
11.0	155.3	1597	4471	1720	4815	
11.5	162.4	1507	4220	1623	4545	
12.0	169.4	1426	3993	1536	4300	
12.5	176.5	1352	3787	1456	4078	
13.0	183.5	1285	3599	1384	3875	
13.5	190.6	1224	3426	1318	3690	
14.0	197.6	1167	3268	1257	3519	

*Non-stock size subject to mill run requirements.

STRONGWELL®

COLUMN

ROUND TUBE
3 x 1/4
Allowable Axial Stresses and Loads

X —⬡— X
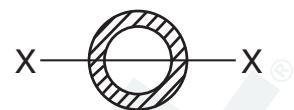
D/t = 12.0　　　　　　　　**r = 0.98 in.**　　　　　　　　**A = 2.16 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	6.1	6553	14154	7057	15243	SHORT
1.0	12.2	6553	14154	7057	15243	
1.5	18.4	6553	14154	7057	15243	
2.0	24.5	6553	14154	7057	15243	
2.5	30.6	6553	14154	7057	15243	
3.0	36.7	6553	14154	7057	15243	
3.5	42.9	6553	14154	7057	15243	
4.0	49.0	6553	14154	7057	15243	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
4.5	55.1	6142	13266	6614	14287	LONG
5.0	61.2	5358	11574	5770	12464	
5.5	67.3	4736	10229	5100	11016	
6.0	73.5	4223	9122	4548	9832	
6.5	79.6	3807	8224	4100	8856	
7.0	85.7	3459	7471	3725	8045	
7.5	91.8	3163	6832	3406	7357	
8.0	98.0	2905	6276	3129	6758	
8.5	104.1	2686	5802	2893	6248	
9.0	110.2	2494	5388	2686	5802	
9.5	116.3	2326	5023	2504	5410	
10.0	122.4	2176	4700	2343	5062	
10.5	128.6	2041	4410	2198	4747	
11.0	134.7	1921	4140	2069	4469	
11.5	140.8	1814	3918	1953	4219	
12.0	146.9	1717	3708	1849	3993	
12.5	153.1	1627	3514	1752	3784	
13.0	159.2	1546	3340	1665	3597	
13.5	165.3	1472	3180	1586	3425	
14.0	171.4	1405	3034	1513	3267	
14.5	177.6	1341	2897	1444	3120	
15.0	183.7	1284	2773	1382	2986	
15.5	189.8	1230	2657	1325	2862	
16.0	195.9	1181	2550	1272	2747	

Rev.1013

COLUMN
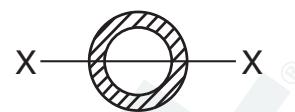
ROUND TUBE
* 3-1/2 x 1/2
Allowable Axial Stresses and Loads

D/t = 7.0   **r = 1.07 in.**   **A = 4.71 in²**

EFFECTIVE COLUMN LENGTH (ft.)	Kl/r	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	5.6	10000	47100	11000	51810	SHORT
1.0	11.2	10000	47100	11000	51810	
1.5	16.8	10000	47100	11000	51810	
2.0	22.4	10000	47100	11000	51810	
2.5	28.0	10000	47100	11000	51810	
3.0	33.6	10000	47100	11000	51810	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
3.5	39.3	9538	44922	10271	48377	LONG
4.0	44.8	8018	37763	8634	40668	
4.5	50.5	6879	32401	7409	34894	
5.0	56.1	5999	28254	6460	30427	
5.5	61.7	5300	24962	5707	26881	
6.0	67.3	4733	22292	5097	24007	
6.5	72.9	4265	20089	4593	21634	
7.0	78.5	3873	18244	4171	19647	
7.5	84.1	3541	16678	3814	17961	
8.0	89.7	3256	15336	3507	16516	
8.5	95.3	3009	14174	3241	15265	
9.0	100.9	2794	13159	3009	14171	
9.5	106.5	2604	12266	2805	13210	
10.0	112.1	2436	11475	2624	12357	
10.5	117.7	2287	10770	2462	11598	
11.0	123.3	2152	10138	2318	10917	
11.5	129.0	2031	9568	2188	10304	
12.0	134.6	1922	9053	2070	9750	
12.5	140.2	1822	8585	1963	9246	
13.0	145.8	1732	8159	1865	8786	
13.5	151.4	1649	7768	1776	8366	
14.0	157.0	1573	7409	1694	7979	
14.5	162.6	1503	7079	1619	7623	
15.0	168.2	1438	6773	1549	7295	
15.5	173.8	1378	6491	1484	6990	
16.0	179.4	1322	6229	1424	6707	
16.5	185.0	1271	5984	1368	6445	
17.0	190.7	1222	5757	1316	6199	
17.5	196.3	1177	5544	1268	5970	
18.0	201.9	1135	5344	1222	5755	
18.5	207.5	1095	5157	1179	5554	
19.0	213.1	1058	4982	1139	5364	
19.5	218.7	1023	4816	1101	5187	
20.0	224.3	989	4660	1066	5019	

*Non-stock size subject to mill run requirements.

COLUMN

ROUND TUBE

* 4 x 1/4

Allowable Axial Stresses and Loads

**D/t = 16.0**   **r = 1.33 in.**   **A = 2.94 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	4.5	5131	15085	5526	16246	SHORT
1.0	9.0	5131	15085	5526	16246	
1.5	13.5	5131	15085	5526	16246	
2.0	18.0	5131	15085	5526	16246	
2.5	22.6	5131	15085	5526	16246	
3.0	27.1	5131	15085	5526	16246	
3.5	31.6	5131	15085	5526	16246	
4.0	36.1	5131	15085	5526	16246	
4.5	40.6	5131	15085	5526	16246	
5.0	45.1	5131	15085	5526	16246	
5.5	49.6	5131	15085	5526	16246	
6.0	54.1	5131	15085	5526	16246	
6.5	58.6	5131	15085	5526	16246	
7.0	63.2	5131	15085	5526	16246	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
7.5	67.7	4699	13816	5061	14878	LONG
8.0	72.2	4322	12707	4654	13684	
8.5	76.7	3995	11747	4303	12650	
9.0	81.2	3710	10907	3995	11746	
9.5	85.7	3459	10169	3725	10951	
10.0	90.2	3236	9514	3485	10246	
10.5	94.7	3038	8931	3271	9618	
11.0	99.2	2860	8408	3080	9054	
11.5	103.8	2696	7927	2903	8536	
12.0	108.3	2551	7501	2748	8078	
12.5	112.8	2420	7114	2606	7662	
13.0	117.3	2300	6762	2477	7281	
13.5	121.8	2190	6439	2358	6934	
14.0	126.3	2089	6142	2250	6614	
14.5	130.8	1996	5869	2150	6320	
15.0	135.3	1910	5616	2057	6048	
15.5	139.8	1831	5382	1972	5796	
16.0	144.4	1755	5161	1890	5558	
16.5	148.9	1687	4959	1816	5340	
17.0	153.4	1623	4771	1747	5137	
17.5	157.9	1563	4595	1683	4948	
18.0	162.4	1507	4430	1623	4770	
18.5	166.9	1454	4275	1566	4604	
19.0	171.4	1405	4130	1513	4447	
19.5	175.9	1358	3993	1463	4300	
20.0	180.5	1313	3861	1414	4158	

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

ROUND TUBE
* 5 x 1/4
Allowable Axial Stresses and Loads

X —⊙— X

D/t = 20.0   **r = 1.68 in.**   **A = 3.73 in²**

EFFECTIVE COLUMN LENGTH (ft.)	K*l*/r	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	3.6	4245	15833	4571	17050	SHORT
1.0	7.1	4245	15833	4571	17050	
1.5	10.7	4245	15833	4571	17050	
2.0	14.3	4245	15833	4571	17050	
2.5	17.9	4245	15833	4571	17050	
3.0	21.4	4245	15833	4571	17050	
3.5	25.0	4245	15833	4571	17050	
4.0	28.6	4245	15833	4571	17050	
4.5	32.1	4245	15833	4571	17050	
5.0	35.7	4245	15833	4571	17050	
5.5	39.3	4245	15833	4571	17050	
6.0	42.9	4245	15833	4571	17050	
6.5	46.4	4245	15833	4571	17050	
7.0	50.0	4245	15833	4571	17050	
7.5	53.6	4245	15833	4571	17050	
8.0	57.1	4245	15833	4571	17050	
8.5	60.7	4245	15833	4571	17050	
9.0	64.3	4245	15833	4571	17050	
9.5	67.9	4245	15833	4571	17050	
10.0	71.4	4245	15833	4571	17050	
		F_a'(psi)	P_a(lbs)	F_a'(psi)	P_a(lbs)	
10.5	75.0	4114	15344	4430	16523	LONG
11.0	78.6	3870	14436	4168	15546	
11.5	82.1	3657	13641	3938	14690	
12.0	85.7	3459	12901	3725	13893	
12.5	89.3	3279	12229	3531	13170	
13.0	92.9	3114	11617	3354	12510	
13.5	96.4	2968	11071	3196	11923	
14.0	100.0	2830	10556	3048	11368	
14.5	103.6	2703	10082	2911	10857	
15.0	107.1	2589	9656	2788	10398	
15.5	110.7	2480	9249	2670	9961	
16.0	114.3	2379	8872	2562	9555	
16.5	117.9	2285	8522	2460	9177	
17.0	121.4	2199	8204	2369	8835	
17.5	125.0	2117	7898	2280	8505	
18.0	128.6	2041	7612	2198	8197	
18.5	132.1	1971	7351	2122	7916	
19.0	135.7	1903	7098	2049	7644	
19.5	139.3	1839	6861	1981	7388	
20.0	142.9	1779	6639	1916	7147	

*Non-stock size subject to mill run requirements.

STRONGWELL®

COLUMN

ROUND TUBE

* 6 x 1/4

Allowable Axial Stresses and Loads

X —⃝— X
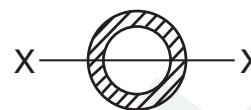
D/t = 24.0 **r = 2.04 in.** **A = 4.52 in²**

EFFECTIVE COLUMN LENGTH (ft.)	K*l*/r	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	2.9	3635	16430	3915	17696	SHORT
1.0	7.1	3635	16430	3915	17696	
1.5	5.9	3635	16430	3915	17696	
2.0	8.8	3635	16430	3915	17696	
2.5	14.7	3635	16430	3915	17696	
3.0	17.6	3635	16430	3915	17696	
3.5	20.6	3635	16430	3915	17696	
4.0	23.5	3635	16430	3915	17696	
4.5	26.5	3635	16430	3915	17696	
5.0	29.4	3635	16430	3915	17696	
5.5	32.4	3635	16430	3915	17696	
6.0	35.3	3635	16430	3915	17696	
6.5	38.2	3635	16430	3915	17696	
7.0	41.2	3635	16430	3915	17696	
7.5	44.1	3635	16430	3915	17696	
8.0	47.0	3635	16430	3915	17696	
8.5	50.0	3635	16430	3915	17696	
9.0	52.9	3635	16430	3915	17696	
9.5	55.9	3635	16430	3915	17696	
10.0	58.8	3635	16430	3915	17696	
10.5	61.8	3635	16430	3915	17696	
11.0	64.7	3635	16430	3915	17696	
11.5	67.6	3635	16430	3915	17696	
12.0	70.6	3635	16430	3915	17696	
12.5	73.5	3635	16430	3915	17696	
13.0	76.5	3635	16430	3915	17696	
13.5	79.4	3635	16430	3915	17696	
14.0	82.4	3635	16430	3915	17696	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
14.5	85.3	3480	15729	3747	16939	LONG
15.0	88.2	3332	15060	3588	16218	
15.5	91.2	3190	14419	3535	15528	
16.0	94.1	3063	13844	3298	14909	
16.5	97.1	2940	13290	3167	14313	
17.0	100.0	2830	12792	3048	13776	
17.5	102.9	2727	12325	2937	13273	
18.0	105.9	2627	11873	2829	12786	
18.5	108.8	2536	11463	2731	12345	
19.0	111.8	2448	11065	2636	11916	
19.5	114.7	2368	10703	2550	11526	
20.0	117.6	2292	10361	2468	11157	

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

SQUARE TUBE

* 1-1/2 x 1/4

Allowable Axial Stresses and Loads
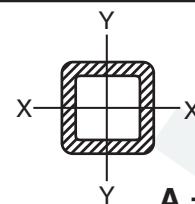
b/t = 6.0 **r = 0.52 in.** **A = 1.24 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	11.5	10000	12400	11000	13640	SHORT
1.0	23.1	10000	12400	11000	13640	
1.5	34.6	10000	12400	11000	13640	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
2.0	46.2	7723	9576	8316	10312	LONG
2.5	57.7	5786	7173	6229	7724	
3.0	69.2	4567	5663	4919	6099	
3.5	80.8	3734	4630	4021	4986	
4.0	92.3	3141	3894	3382	4194	
4.5	103.8	2696	3343	2903	3600	
5.0	115.4	2349	2913	2530	3137	
5.5	126.9	2076	2575	2236	2773	
6.0	138.5	1853	2298	1996	2475	
6.5	150.0	1671	2071	1799	2231	
7.0	161.5	1518	1882	1634	2027	
7.5	173.1	1387	1720	1493	1852	
8.0	184.6	1276	1582	1374	1703	
8.5	196.2	1179	1462	1269	1574	

*Non-stock size subject to mill run requirements.

STRONGWELL®

COLUMN

SQUARE TUBE
* 1-3/4 x 1/4
Allowable Axial Stresses and Loads
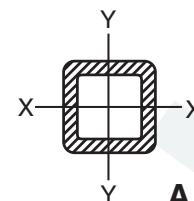
b/t = 7.0   **r = 0.62 in.**   **A = 1.49 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 $E = 2.6 \times 10^6$ psi		EXTREN® 625 $E = 2.8 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	9.7	10000	14900	11000	16390	SHORT
1.0	19.4	10000	14900	11000	16390	
1.5	29.0	10000	14900	11000	16390	
		$F_a{}'$ (psi)	P_a(lbs)	$F_a{}'$ (psi)	P_a(lbs)	
2.0	38.7	9722	14486	10470	15600	LONG
2.5	48.4	7269	10831	7828	11664	
3.0	58.1	5732	8542	6147	9199	
3.5	67.7	4699	7002	5061	7540	
4.0	77.4	3949	5883	4252	6336	
4.5	87.1	3387	5046	3647	5434	
5.0	96.8	2952	4399	3179	4737	
5.5	106.5	2608	3885	2808	4184	
6.0	116.1	2331	3473	2510	3740	
6.5	125.8	2100	3129	2261	3370	
7.0	135.5	1907	2841	2053	3059	
7.5	145.2	1743	2597	1877	2796	
8.0	154.8	1604	2389	1727	2573	
8.5	164.5	1482	2208	1596	2377	
9.0	174.2	1375	2049	1481	2207	
9.5	183.9	1282	1910	1380	2057	
10.0	193.5	1200	1788	1292	1925	

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

SQUARE TUBE

** 2 x 1/4

Allowable Axial Stresses and Loads
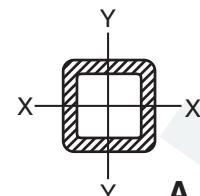
b/t = 8.0   r = 0.73 in.   A = 1.74 in^2

EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10^6 psi		EXTREN® 625 E = 2.8 x 10^6 psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	8.2	9249	16093	9960	17330	SHORT
1.0	16.4	9249	16093	9960	17330	
1.5	24.7	9249	16093	9960	17330	
2.0	32.9	9249	16093	9960	17330	
		$F_a{}'$ (psi)	P_a(lbs)	$F_a{}'$ (psi)	P_a(lbs)	
2.5	41.1	8991	15644	9682	16847	LONG
3.0	49.3	7097	12349	7643	13299	
3.5	57.5	5811	10111	6258	10888	
4.0	65.8	4876	8485	5251	9137	
4.5	74.0	4186	7284	4508	7844	
5.0	82.2	3651	6353	3932	6842	
5.5	90.4	3227	5615	3475	6046	
6.0	98.6	2882	5015	3104	5401	
6.5	106.8	2598	4521	2798	4868	
7.0	115.1	2357	4102	2538	4417	
7.5	123.3	2155	3750	2321	4039	
8.0	131.5	1982	3449	2139	3715	
8.5	139.7	1832	3189	1973	3434	
9.0	147.9	1702	2961	1832	3188	
9.5	156.2	1585	2758	1707	2970	
10.0	164.4	1483	2580	1597	2779	
10.5	172.6	1392	2422	1499	2608	
11.0	180.8	1311	2280	1411	2456	
11.5	189.0	1237	2152	1332	2318	
12.0	197.3	1170	2035	1260	2192	

** Stocked in yellow, Series 525 only.

COLUMN

SQUARE TUBE
3 x 1/4
Allowable Axial Stresses and Loads
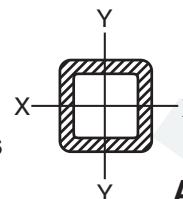
**b/t = 12.0**   **r = 1.13 in.**   **A = 2.74 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	5.3	6553	17955	7057	19336	SHORT
1.0	10.6	6553	17955	7057	19336	
1.5	15.9	6553	17955	7057	19336	
2.0	21.2	6553	17955	7057	19336	
2.5	26.5	6553	17955	7057	19336	
3.0	31.9	6553	17955	7057	19336	
3.5	37.2	6553	17955	7057	19336	
4.0	42.5	6553	17955	7057	19336	
4.5	47.8	6553	17955	7057	19336	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
5.0	53.1	6444	17657	6940	19015	LONG
5.5	58.4	5695	15603	6132	16803	
6.0	63.7	5086	13937	5478	15009	
6.5	69.0	4584	12561	4937	13527	
7.0	74.3	4164	11409	4484	12287	
7.5	79.6	3807	10431	4100	11234	
8.0	85.0	3496	9579	3765	10315	
8.5	90.3	3231	8854	3480	9535	
9.0	95.6	3001	8221	3231	8854	
9.5	100.9	2797	7665	3012	8254	
10.0	106.2	2617	7171	2818	7723	
10.5	111.5	2457	6731	2646	7249	
11.0	116.8	2313	6337	2491	6824	
11.5	122.1	2183	5982	2351	6842	
12.0	127.4	2066	5660	2225	6095	
12.5	132.7	1959	5368	2110	5781	
13.0	138.1	1860	5097	2003	5489	
13.5	143.4	1771	4853	1907	5226	
14.0	148.7	1690	4630	1820	4986	
14.5	154.0	1614	4424	1739	4764	
15.0	159.3	1545	4233	1664	4559	
15.5	164.6	1481	4057	1594	4369	
16.0	169.9	1420	3893	1530	4192	
16.5	175.2	1365	3741	1470	4028	
17.0	180.5	1313	3599	1414	3875	
17.5	185.8	1265	3466	1362	3732	
18.0	191.2	1219	3339	1312	3596	
18.5	196.4	1177	3224	1267	3472	

Rev.1013

COLUMN

SQUARE TUBE

3 x 3 x 3/8

Allowable Axial Stresses and Loads
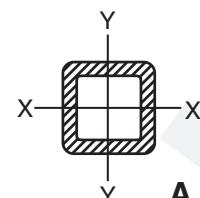
b/t = 8.0   **r = 1.08 in.**   **A = 3.90 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	5.6	9234	36014	9944	38785	SHORT
1.0	11.1	9234	36014	9944	38785	
1.5	16.7	9234	36014	9944	38785	
2.0	22.3	9234	36014	9944	38785	
2.5	27.8	9234	36014	9944	38785	
3.0	33.3	9234	36014	9944	38785	
3.5	38.9	9234	36014	9944	38785	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
4.0	44.4	8115	31649	8739	34084	LONG
4.5	50.0	6963	27156	7499	29245	
5.0	55.6	6072	23680	6539	25501	
5.5	61.1	5364	20920	5777	22530	
6.0	66.7	4790	18683	5159	20120	
6.5	72.2	4317	16836	4649	18132	
7.0	77.8	3920	15290	4222	16466	
7.5	83.3	3584	13978	3859	15054	
8.0	88.9	3296	12854	3549	13842	
8.5	94.4	3046	11879	3280	12793	
9.0	99.9	2827	11029	3045	11877	
9.5	105.6	2636	10280	2839	11071	
10.0	111.1	2466	9617	2656	10357	
10.5	116.7	2314	9025	2492	9720	
11.0	122.2	2178	8496	2346	9150	
11.5	127.8	2056	8019	2214	8636	
12.0	133.3	1945	7587	2095	8171	
12.5	138.9	1845	7195	1987	7749	
13.0	144.4	1753	6838	1888	7364	
13.5	150.0	1669	6510	1798	7011	
14.0	155.5	1592	6210	1715	6687	
14.5	161.1	1521	5933	1638	6389	
15.0	166.7	1456	5677	1568	6114	
15.5	172.2	1395	5440	1502	5859	
16.0	177.8	1338	5220	1441	5622	
16.5	183.3	1286	5015	1385	5401	
17.0	188.9	1237	4824	1332	5196	
17.5	194.4	1191	4646	1283	5003	
18.0	200.0	1148	4479	1237	4824	
18.5	205.6	1108	4322	1194	4655	
19.0	211.1	1070	4175	1153	4496	
19.5	216.7	1035	4036	1115	4347	
20.0	222.2	1001	3906	1079	4206	

STRONGWELL®

COLUMN

SQUARE TUBE
3-1/2 x 1/4
Allowable Axial Stresses and Loads
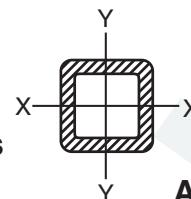
b/t = 14.0   **r = 1.34 in.**   **A = 3.25 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\dfrac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	4.5	5748	18681	6190	20118	SHORT
1.0	9.0	5748	18681	6190	20118	
1.5	13.4	5748	18681	6190	20118	
2.0	18.0	5748	18681	6190	20118	
2.5	22.4	5748	18681	6190	20118	
3.0	26.9	5748	18681	6190	20118	
3.5	31.3	5748	18681	6190	20118	
4.0	35.8	5748	18681	6190	20118	
4.5	40.3	5748	18681	6190	20118	
5.0	44.8	5748	18681	6190	20118	
5.5	49.3	5748	18681	6190	20118	
6.0	53.7	5748	18681	6190	20118	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
6.5	58.2	5718	18585	6158	20015	LONG
7.0	62.7	5193	16878	5592	18176	
7.5	67.2	4748	15431	5113	16618	
8.0	71.6	4366	14189	4701	15281	
8.5	76.1	4035	13113	4345	14122	
9.0	80.6	3746	12174	4034	13111	
9.5	85.1	3492	11349	3760	12222	
10.0	89.6	3266	10616	3517	11433	
10.5	94.0	3066	9964	3301	10731	
11.0	98.5	2886	9379	3108	10101	
11.5	103.0	2724	8853	2933	9534	
12.0	107.5	2577	8376	2775	9020	
12.5	111.9	2444	7943	2632	8554	
13.0	116.4	2322	7548	2501	8129	
13.5	120.9	2211	7186	2381	7739	
14.0	125.4	2109	6855	2271	7382	
14.5	129.9	2015	6548	2170	7052	
15.0	134.3	1928	6267	2076	6749	
15.5	138.8	1848	6006	1990	6468	
16.0	143.3	1773	5762	1909	6205	
16.5	147.8	1703	5536	1834	5962	
17.0	152.2	1638	5325	1764	5735	
17.5	156.7	1578	5128	1699	5523	
18.0	161.2	1521	4944	1638	5324	
18.5	165.7	1468	4771	1580	5138	
19.0	170.1	1418	4608	1527	4963	
19.5	174.6	1371	4455	1476	4798	
20.0	179.1	1326	4311	1428	4643	

*Non-stock size subject to mill run requirements.

Rev.1013

COLUMN

SQUARE TUBE
4 x 1/4
Allowable Axial Stresses and Loads

b/t = 16.0   **r = 1.53 in.**   **A = 3.74 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	3.9	5131	19190	5526	20667	SHORT
1.0	7.8	5131	19190	5526	20667	
1.5	11.8	5131	19190	5526	20667	
2.0	15.7	5131	19190	5526	20667	
2.5	19.6	5131	19190	5526	20667	
3.0	23.5	5131	19190	5526	20667	
3.5	27.5	5131	19190	5526	20667	
4.0	31.4	5131	19190	5526	20667	
4.5	35.3	5131	19190	5526	20667	
5.0	39.2	5131	19190	5526	20667	
5.5	43.1	5131	19190	5526	20667	
6.0	47.1	5131	19190	5526	20667	
6.5	51.0	5131	19190	5526	20667	
7.0	54.9	5131	19190	5526	20667	
7.5	58.8	5131	19190	5526	20667	
8.0	62.7	5131	19190	5526	20667	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
8.5	66.7	4791	17918	5159	19295	LONG
9.0	70.6	4450	16643	4792	17922	
9.5	74.5	4149	15519	4469	16712	
10.0	78.4	3883	14523	4181	15640	
10.5	82.4	3646	13613	3920	14660	
11.0	86.3	3428	12819	3691	13805	
11.5	90.2	3236	12103	3485	13034	
12.0	94.1	3063	11455	3298	12336	
12.5	98.0	2905	10866	3129	11702	
13.0	102.0	2758	10315	2970	11108	
13.5	105.9	2627	9824	2829	10580	
14.0	109.8	2506	9373	2699	10094	
14.5	113.7	2395	8957	2579	9646	
15.0	117.6	2292	8573	2469	9232	
15.5	121.6	2195	8208	2364	8840	
16.0	125.5	2106	7878	2268	8484	
16.5	129.4	2024	7571	2180	8153	
17.0	133.3	1948	7284	2097	7844	
17.5	137.3	1874	7010	2018	7549	
18.0	141.2	1807	6759	1946	7279	
18.5	145.1	1744	6524	1878	7025	
19.0	149.0	1685	6303	1815	6787	
19.5	152.9	1630	6094	1755	6563	
20.0	156.9	1576	5893	1697	6346	

STRONGWELL.

COLUMN

SQUARE TUBE
4 x 4 x 3/8
Allowable Axial Stresses and Loads
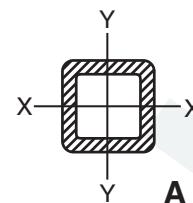
b/t = 10.67   **r = 1.48 in.**   **A = 5.48 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	4.1	7229	39038	7785	42041	SHORT
1.0	8.1	7229	39038	7785	42041	
1.5	12.2	7229	39038	7785	42041	
2.0	16.2	7229	39038	7785	42041	
2.5	20.3	7229	39038	7785	42041	
3.0	24.3	7229	39038	7785	42041	
3.5	28.4	7229	39038	7785	42041	
4.0	32.4	7229	39038	7785	42041	
4.5	36.5	7229	39038	7785	42041	
5.0	40.5	7229	39038	7785	42041	
5.5	44.6	7229	39038	7785	42041	
		F_a' (psi)	P_a(lbs)	F_a' (psi)	P_a(lbs)	
6.0	48.6	7215	38964	7771	41961	LONG
6.5	52.7	6502	35113	7003	37814	
7.0	56.8	5905	31888	6359	34341	
7.5	60.8	5399	29153	5814	31395	
8.0	64.9	4964	26807	5346	28869	
8.5	68.9	4588	24775	4941	26681	
9.0	73.0	4259	23001	4587	24770	
9.5	77.0	3970	21440	4276	23089	
10.0	81.1	3714	20057	4000	21600	
10.5	85.1	3486	18824	3754	20272	
11.0	89.2	3281	17719	3534	19082	
11.5	93.2	3097	16725	3335	18010	
12.0	97.3	2930	15824	3156	17041	
12.5	101.4	2779	15006	2993	16161	
13.0	105.4	2641	14260	2844	15357	
13.5	109.4	2514	13578	2708	14622	
14.0	113.5	2398	12951	2583	13947	
14.5	117.6	2291	12373	2468	13325	
15.0	121.6	2193	11840	2361	12750	
15.5	125.7	2101	11346	2263	12218	
16.0	129.7	2016	10887	2171	11724	
16.5	133.8	1937	10460	2086	11265	
17.0	137.8	1863	10062	2007	10836	
17.5	141.9	1794	9690	1932	10435	
18.0	145.9	1730	9341	1863	10060	
18.5	150.0	1669	9014	1798	9708	
19.0	154.1	1612	8707	1736	9377	
19.5	158.1	1559	8418	1679	9066	
20.0	162.1	1508	8146	1624	8772	

Rev.1013

COLUMN

SQUARE TUBE
6 x 6 x 3/8
Allowable Axial Stresses and Loads

b/t = 16.0   **r = 2.28 in.**   **A = 8.16 in²**
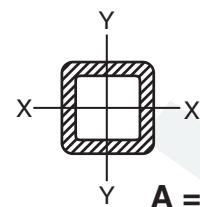
EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 E = 2.6 x 10⁶ psi		EXTREN® 625 E = 2.8 x 10⁶ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
1.0	5.3	5131	41872	5526	45093	SHORT
1.5	7.9	5131	41872	5526	45093	
2.0	10.5	5131	41872	5526	45093	
2.5	13.2	5131	41872	5526	45093	
3.0	15.8	5131	41872	5526	45093	
3.5	18.4	5131	41872	5526	45093	
4.0	21.1	5131	41872	5526	45093	
4.5	23.7	5131	41872	5526	45093	
5.0	26.3	5131	41872	5526	45093	
5.5	28.9	5131	41872	5526	45093	
6.0	31.6	5131	41872	5526	45093	
6.5	34.2	5131	41872	5526	45093	
7.0	36.8	5131	41872	5526	45093	
7.5	39.7	5131	41872	5526	45093	
8.0	42.1	5131	41872	5526	45093	
8.5	47.0	5131	41872	5526	45093	
9.0	47.4	5131	41872	5526	45093	
9.5	50.0	5131	41872	5526	45093	
10.0	52.6	5131	41872	5526	45093	
10.5	55.3	5131	41872	5526	45093	
11.0	57.9	5131	41872	5526	45093	
11.5	60.5	5131	41872	5526	45093	
12.0	63.1	5131	41872	5526	45093	
		$F_a{}'$ (psi)	P_a(lbs)	$F_a{}'$(psi)	P_a(lbs)	
12.5	65.8	4877	39800	5253	42861	LONG
13.0	68.4	4635	37822	4992	40731	
13.5	71.1	4413	36011	4753	38781	
14.0	73.7	4209	34348	4533	36990	
14.5	76.3	4022	32816	4331	35340	
15.0	78.9	3848	31401	4144	33817	
15.5	81.6	3688	30091	3971	32406	
16.0	84.2	3538	28874	3811	31095	
16.5	86.8	3400	27742	3661	29876	
17.0	89.5	3270	26686	3522	28739	
17.5	92.1	3149	25699	3392	27676	
18.0	94.7	3036	24775	3270	26681	
18.5	97.4	2930	23908	3155	25747	
19.0	100.0	2830	23093	3048	24870	
19.5	102.6	2736	22326	2947	24044	
20.0	105.3	2648	21604	2851	23265	

STRONGWELL

COLUMN

RECTANGULAR TUBE
7 x 4 x 1/4
Allowable Axial Stresses and Loads

b/t = 28.0   **r = 1.64 in.**   **A = 5.25 in²**

EFFECTIVE COLUMN LENGTH (ft.)	$\frac{Kl}{r}$	EXTREN® 500/525 $E = 2.6 \times 10^6$ psi		EXTREN® 625 $E = 2.8 \times 10^6$ psi		
		F_a(psi)	P_a(lbs)	F_a(psi)	P_a(lbs)	
0.5	3.7	3183	16715	3428	18001	SHORT
1.0	7.3	3183	16715	3428	18001	
1.5	11.0	3183	16715	3428	18001	
2.0	14.6	3183	16715	3428	18001	
2.5	18.3	3183	16715	3428	18001	
3.0	22.0	3183	16715	3428	18001	
3.5	25.6	3183	16715	3428	18001	
4.0	29.3	3183	16715	3428	18001	
4.5	32.9	3183	16715	3428	18001	
5.0	36.6	3183	16715	3428	18001	
5.5	40.2	3183	16715	3428	18001	
6.0	43.9	3183	16715	3428	18001	
6.5	47.6	3183	16715	3428	18001	
7.0	51.2	3183	16715	3428	18001	
7.5	54.9	3183	16715	3428	18001	
8.0	58.5	3183	16715	3428	18001	
8.5	62.2	3183	16715	3428	18001	
9.0	65.9	3183	16715	3428	18001	
9.5	69.5	3183	16715	3428	18001	
10.0	73.1	3183	16715	3428	18001	
10.5	76.8	3183	16715	3428	18001	
11.0	80.5	3183	16715	3428	18001	
11.5	84.1	3183	16715	3428	18001	
12.0	87.8	3183	16715	3428	18001	
		$F_a{}'$ (psi)	P_a(lbs)	$F_a{}'$(psi)	P_a(lbs)	
12.5	91.5	3175	16672	3420	17955	LONG
13.0	95.1	3018	15844	3250	17062	
13.5	98.8	2873	15085	3094	16245	
14.0	102.4	2741	14389	2951	15495	
14.5	106.1	2618	13747	2820	14804	
15.0	109.8	2506	13154	2698	14166	
15.5	113.4	2401	12605	2586	13575	
16.0	117.1	2304	12096	2481	13026	
16.5	120.7	2214	11621	2384	12515	
17.0	124.4	2129	11179	2293	12039	
17.5	128.0	2051	10765	2208	11594	
18.0	131.7	1977	10378	2129	11176	
18.5	135.4	1908	10015	2054	10786	
19.0	139.0	1843	9674	1984	10418	
19.5	142.7	1781	9353	1919	10072	
20.0	146.3	1724	9050	1857	9746	
20.5	150.0	1669	8764	1798	9438	
21.0	153.6	1618	8494	1742	9147	
21.5	157.3	1569	8238	1690	8871	
22.0	161.0	1523	7995	1640	8610	
22.5	164.6	1479	7765	1593	8362	
23.0	168.3	1438	7546	1548	8127	
23.5	171.9	1398	7338	1505	7903	
24.0	175.6	1360	7140	1465	7689	
24.5	179.3	1324	6951	1426	7486	
25.0	182.9	1289	6771	1389	7292	

Rev.1013