Double-Tee Members in Axial Compression

LEIGH ARBER, MENG WANG and PAT MCMANUS

ABSTRACT

This paper presents tabulated compressive strengths of double-tee members, which are comprised of two WT members oriented with their flanges back to back (referred to as "2WTs" or "double WTs" hereafter). The benefits and typical use of these members are described, including schematic details of connection designs. All WT members built from the WT7 and WT6 series are included in the table, which gives available strengths in both ASD and LRFD. Slenderness effects and the effects of shear deformations of intermediate connectors are taken into account.

Keywords: compression member, WT section, double WT section, truss.

INTRODUCTION AND DISCUSSION

WT and angle sections, both in single and back-to-back configurations, are commonly used as web members in trusses and as vertical and horizontal bracing members. This is particularly true in industrial construction. While WT and angle sections make for economical tension members, they are generally less economical than wide-flange or HSS sections when utilized as singular members in compression with relatively large unbraced lengths. However, when used in back-to-back built-up configurations, the least radius of gyration is increased, and the sections become more economical. To date, determination of the available compressive strength of built-up back-to-back WT sections involved significant calculation effort on the part of the engineer because compression strength tables had not been made readily available. This paper, however, now provides tables of available strength in axial compression for back-to-back WT sections to assist the engineer in designing with these sections.

WT sections are not rolled directly from the mill but are split from wide-flange sections. Splitting is typically performed by the fabricator or as an additional process by an outside entity before delivery to the fabrication facility. Often, the residual stresses resulting from the mill rolling and splitting processes induce undesirable curvature of the WT sections such that a straightening process may be required. The costs of splitting and straightening vary depending on the processes used but, together, typically result in a cost increase over unsplit wide-flange material of between approximately 50% for relatively light wide-flange sections (around 35 lb/ft) to approximately 10% for relatively heavy sections (200 lb/ft). The cost of intermediate connectors to create the built-up WT sections is additional to this. While these premium costs may be a reasonably high percentage of the cost of the brace member, they may not be a significant cost to the project in absolute terms. Though costs vary by fabricator and erector, these premium costs can be offset by the savings realized from using inherently more economical end connections.

The greatest advantage of WT connections is that the cross-sectional component of greatest area (the flange) can be directly connected to the support element, typically a gusset plate, using either welds or bolts. An example of such a connection is illustrated in Figure 1. Note that bolted connections at the ends of built-up members require the use of pretensioned bolts with Class A or B faying surfaces in accordance with AISC *Specification* Section E6.1 (AISC, 2010).

Connections for wide-flange braces, on the other hand, require additional connection elements such as plates and angles to transfer forces from the brace to the gusset. As shown in Figure 2, wide-flange member connections typically require fasteners to transfer forces from the brace to the connection elements and then from the connection elements to the gusset plate. The result is twice the total number of fasteners required to connect an equivalent built-up WT section directly to a gusset. Additionally, where large forces are involved, the geometry associated with connection angles attached to the flanges of the brace result in large gusset plates, which are undesirable economically and often aesthetically.

With regard to HSS material, the cold bending and seam

Leigh Arber, P.E., S.E., American Institute of Steel Construction, 1 E. Wacker Dr., Chicago, IL (corresponding). Email: arber@aisc.org

Meng Wang, Stanford University, 6 Comstock Circle, Stanford, CA. Email: mwang15@stanford.edu

Pat McManus, Ph.D., P.E., S.E Martin/Martin Wyoming, 4020 Laramie St., Cheyenne, WY. Email: pmcmanus@martinmartin.com

Paper No. 2014-10

welding processes used to create HSS sections cost approximately 15% more than a wide-flange section of equivalent area. The large radius of gyration in each direction results in a smaller required area to carry compression forces and generally offsets the increased material costs. However, end connections for HSS members are costly. Field-bolted connections can only be achieved by transferring forces through additional connection elements similar to wide-flange sections and are typically only economical under relatively small forces. Consequently, HSS connections are normally slotted and field welded to gusset plates as illustrated in Figure 3. While gusset plates in such a configuration are more compact than large-capacity wide-flange brace connections, HSS connections may require greater connection length than equivalent WT connections to reduce the effects of shear lag. Depending on the fabricator, preparation of the slot can also be costly. Most detrimental to the economy of large-capacity HSS connections is the field welding of the brace to the gusset because field welding is arguably the most expensive process in structural steel construction. As a result, the use of back-to-back WT sections as axial members can prove more economical than wide-flange or HSS sections, particularly where large capacities are required.

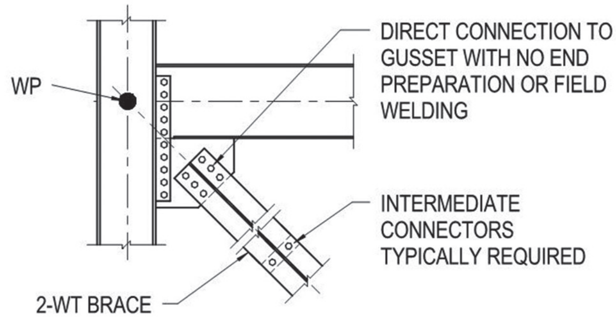

Fig. 1. Example of WT brace connection.

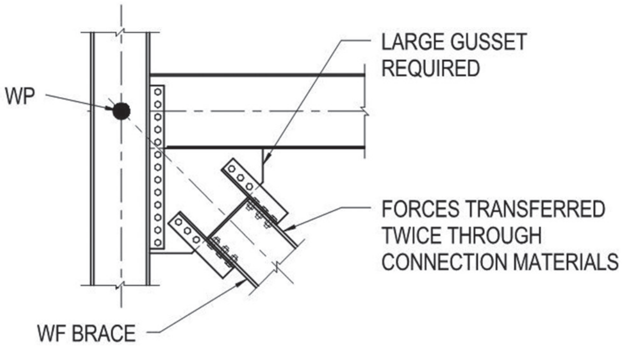

Fig. 2. Example of wide-flange brace connection.

DESIGN EXAMPLE AND TABLE

In the table, which appears at the end of this paper, available strengths in axial compression, including the limit states of flexural buckling and torsional buckling, are given for 2WTs. Both ASD and LRFD values are given. The material used is ASTM A992 with $F_y = 50$ ksi, and ⅜-in. separation between the flanges is assumed. The values in this table can be used conservatively when a larger separation is provided. The shape slenderness and reduction factor, Q_s, for the 2WT section is calculated in the same manner as for a single WT, and the values of Q_s are taken directly from the AISC Shape Database V14.0 for single WTs. Torsional elastic buckling stress is calculated per *Specification* Equation E4-4, omitting the term with C_w because of its negligible effect. Justification for this omission is illustrated in the design example.

Separate tabulated values are given for the effective lengths with respect to the X-X and Y-Y axes, $(KL)_x$ and $(KL)_y$, respectively, where the lesser of flexural buckling

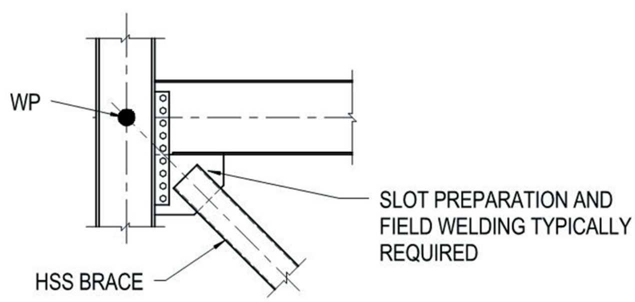

Fig. 3. Example of HSS brace connection.

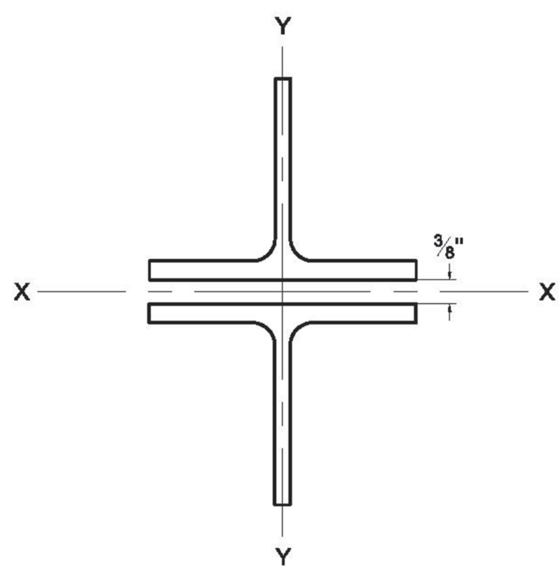

Fig.4. Orientation of 2WT built-up section.

about the given axis and torsional buckling are reported about each axis. The orientation of the axes is shown in Figure 4.

For buckling about the Y-Y axis, the available strength is not affected by the number of intermediate connectors because slip between the two WTs is not a concern. The slenderness ratio need not be modified by AISC *Specification* Equation E6-1 because the buckling mode does not involve relative deformations that produce shear forces in the connectors between individual shapes. The available compressive strength for buckling about the Y-Y axis for 2WT shapes is twice that of a single WT.

For buckling about the X-X axis, the number of intermediate connectors must be considered. The tabulated values for $(KL)_x$ used to compute the available strength have been adjusted for the shear deformation in accordance with AISC *Specification* Equations E6-2a and E6-2b, which are applicable to welded and pretensioned bolted intermediate shear connectors. The number of intermediate connectors, n, is given in the table and is selected such that the available compression buckling strength about the X-X axis is equal to or greater than 90% of that for compression buckling for the two WTs as a continuously-connected unit. This is the same design choice used for double angles in AISC *Manual* Tables 4-8, 4-9 and 4-10 (AISC, 2011). If fewer connectors or snug-tightened bolted intermediate connectors are used, the available strength must be recalculated per AISC *Specification* Section E6. According to AISC *Specification* Section E6.2, the slenderness of the individual components of the built-up member based upon the distance between intermediate connectors, a, must not exceed three-quarters of the controlling slenderness of the overall built-up compression member. The connectors are assumed to be equally spaced, and the distance between connectors, a (in.), is calculated as $L/(n+1)$. K is assumed conservatively to be 1.0 when checking the slenderness of individual components between intermediate connectors.

The following equations are used to calculate geometric properties of 2WT, ⅜-in. back to back (symbols without "_2WT" are properties of a single WT):

$$I_{x\_2WT} = 2[I_x + A(\bar{y} + 3/16 \text{ in.})^2]$$

$$r_{x\_2WT} = \sqrt{I_{x\_2WT}/(2A)}$$

$$I_{y\_2WT} = 2I_y$$

$$r_{y\_2WT} = r_y$$

$$J_{\_2WT} = 2J$$

Design Example

Calculate the available strength of a 2WT7×21.5 section in axial compression with a 14.0-ft unbraced length. As noted in the footnote in AISC *Manual* Table 1-8, this shape is slender for compression. For a single WT7×21.5, from Table 1-8:

$A = 6.31$ in.^{2}
$t_f = 0.530$ in.
$b_f = 8.00$ in.
$t_w = 0.305$ in.
$h = 6.83$ in.
$I_x = 21.9$ in.^{4}
$I_y = 22.6$ in.^{4}
$r_x = 1.86$ in.
$r_y = 1.89$ in.
$J = 0.522$ in.^{4}
$\bar{y} = 1.31$ in.
$Q_s = 0.773$

The combined properties, using the preceding equations, are:

$A_{\_2WT} = 12.62$ in.^{2}
$I_{x\_2WT} = 72.1$ in.^{4}
$I_{y\_2WT} = 45.2$ in.^{4}
$r_{x\_2WT} = 2.39$ in.
$r_{y\_2WT} = 1.89$ in.
$J_{\_2WT} = 1.04$ in.^{4}

Each applicable limit state will be checked separately. AISC *Specification* Section E7 states that slender-element members shall be designed for flexural buckling, torsional buckling and flexural-torsional buckling.

Torsional buckling:

AISC *Specification* Equation E4-4 applies for torsional buckling of 2WT sections. As discussed previously, the term containing C_w is conservatively omitted here.

$$\begin{aligned} F_e &= \frac{GJ_{\_2WT}}{I_{x\_2WT} + I_{y\_2WT}} \\ &= \frac{11{,}200 \text{ ksi}\left(1.04 \text{ in.}^4\right)}{72.1 \text{ in.}^4 + 45.2 \text{ in.}^4} \\ &= 99.3 \text{ ksi} \end{aligned}$$

If the term C_w were used, it would have a negligible effect. Using AISC *Design Guide* 9 Equation 3.35 (Seaburg and Carter, 2003):

$$\begin{aligned} C_{w\_2WT} &= 2 \text{ tees}\left[\frac{t_f^3 b_f^3}{144} + \frac{t_w^3 h^3}{36}\right] \\ &= 2\left[\frac{(0.530 \text{ in.})^3 (8.00 \text{ in.})^3}{144} + \frac{(0.305 \text{ in.})^3 (6.83 \text{ in.})^3}{36}\right] \\ &= 1.56 \text{ in.}^6 \end{aligned}$$

$$\begin{aligned} F_e &= \left[\frac{\pi^2 E C_{w\_2WT}}{(K_z L)^2} + GJ_{\_2WT}\right]\left[\frac{1}{I_{x\_2WT} + I_{y\_2WT}}\right] \\ &= \left[\frac{\pi^2 (29{,}000 \text{ ksi})\left(1.56 \text{ in.}^6\right)}{(14.0 \text{ ft} \times 12 \text{ in./ft})^2} + 11{,}200 \text{ ksi}\left(1.04 \text{ in.}^4\right)\right]\left[\frac{1}{72.1 \text{ in.}^4 + 45.2 \text{ in.}^4}\right] \\ &= 99.4 \text{ ksi} \end{aligned}$$

Including the C_w term results in approximately a 0.1% difference. This would vary with length, but is negligible and will not be included in the strength tables.

As noted in AISC *Specification* Section E7, F_{cr} is determined according to Equation E7-2 or E7-3.

With $QF_y/F_e < 2.25$, Equation E7-2 applies, where $Q = Q_s$.

$$\begin{aligned} F_{cr} &= Q\left(0.658^{\frac{QF_y}{F_e}}\right)F_y \\ &= 0.773\left(0.658^{\frac{0.773\,(50 \text{ ksi})}{99.3 \text{ ksi}}}\right)(50 \text{ ksi}) \\ &= 32.8 \text{ ksi} \end{aligned}$$

The available strength in axial compression is:

LRFD	ASD
$\phi P_n = 0.9\left(12.62 \text{ in.}^2\right)\left(32.8 \text{ ksi}\right)$ $= 373 \text{ kips}$	$\dfrac{P_n}{\Omega} = \dfrac{\left(12.62 \text{ in.}^2\right)\left(32.8 \text{ ksi}\right)}{1.67}$ $= 248 \text{ ksi}$

Flexural buckling about the Y-Y axis:

For buckling about the Y-Y axis, there is no issue of slip between the two WT sections and the strength is not dependent on connectors. The slenderness ratio is:

$$\frac{KL}{r_{y\_2WT}} = \frac{1.0(14 \text{ ft})(12.0 \text{ in./ft})}{1.89 \text{ in.}}$$
$$= 88.9$$

The elastic bucking stress, from AISC *Specification* Equation E3-4, is:

$$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$
$$= \frac{\pi^2 (29{,}000 \text{ ksi})}{(88.9)^2}$$
$$= 36.2 \text{ ksi}$$

With $QF_y/F_e < 2.25$, Equation E7-2 applies, where $Q = Q_s$.

$$F_{cr} = Q\left(0.658^{\frac{Q_s F_y}{F_e}}\right)F_y$$
$$= 0.773\left(0.658^{\frac{0.773 \text{ (50 ksi)}}{36.2 \text{ ksi}}}\right)(50 \text{ ksi})$$
$$= 24.7 \text{ ksi}$$

The available strength in axial compression is:

LRFD	ASD
$\phi P_n = 0.9\left(12.62 \text{ in.}^2\right)\left(24.7 \text{ ksi}\right)$ $= 281 \text{ kips}$	$\frac{P_n}{\Omega} = \frac{\left(12.62 \text{ in.}^2\right)\left(24.7 \text{ ksi}\right)}{1.67}$ $= 187 \text{ ksi}$

Flexural buckling about the X-X axis:

For buckling about the X-X axis, the number of connectors affects the available strength. Start by determining the strength of the member as though the 2WT member acts as a continuously connected unit:

$$\frac{KL}{r_{x\_2WT}} = \frac{1.0(14 \text{ ft})(12.0 \text{ in./ft})}{2.39 \text{ in.}}$$
$$= 70.3$$

The elastic bucking stress, from AISC *Specification* Equation E3-4, is:

$$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$

$$= \frac{\pi^2(29{,}000 \text{ ksi})}{(70.3)^2}$$

$$= 57.9 \text{ ksi}$$

With $QF_y/F_e < 2.25$, Equation E7-2 applies, where $Q = Q_s$.

$$F_{cr} = Q\left(0.658^{\frac{QF_y}{F_e}}\right)F_y$$

$$= 0.773\left(0.658^{\frac{0.773\,(50 \text{ ksi})}{57.9 \text{ ksi}}}\right)(50 \text{ ksi})$$

$$= 29.2 \text{ ksi}$$

The available strength in axial compression is:

LRFD	ASD
$\phi P_n = 0.9\left(12.62 \text{ in.}^2\right)\left(29.2 \text{ ksi}\right)$ $= 332 \text{ kips}$	$\dfrac{P_n}{\Omega} = \dfrac{\left(12.62 \text{ in.}^2\right)\left(29.2 \text{ ksi}\right)}{1.67}$ $= 221 \text{ ksi}$

However, this strength is for a continuously connected section. Now consider the effect of connectors on the strength.

Determine the minimum number of intermediate connectors:

As stated earlier, the number of connectors will be chosen so that the strength about the X-X axis is at least 90% of the strength of the member acting as a unit (for any applicable compression limit state). That strength, with flexural buckling about the Y-Y axis as the governing limit state, is:

LRFD	ASD
$\phi P_n = 90\% \text{ (281 kips)}$ $= 253 \text{ kips}$	$\dfrac{P_n}{\Omega} = 90\% \text{ (187 kips)}$ $= 168 \text{ ksi}$

Start with one connector following the provisions of AISC *Specification* Section E6. Assume that connectors are welded or connected by pretensioned bolts. One connector at the midspan of the member would result in an unbraced length of 7 ft.

$$\frac{a}{r_i} = \frac{(7.0 \text{ ft})(12.0 \text{ in./ft})}{1.86 \text{ in.}}$$

$$= 45.2$$

where a and r_i are as defined in AISC *Specification* Section E6. Because a/r_i is greater than 40, use Equation E6-2b to determine the modified slenderness ratio of the built-up member:

$$\left(\frac{KL}{r}\right)_m = \sqrt{\left(\frac{14.0 \text{ ft } (12.0 \text{ in./ft})}{2.39 \text{ in.}}\right)^2 + \left(\frac{0.86(7.0 \text{ ft})(12.0 \text{ in./ft})}{1.86 \text{ in.}}\right)^2}$$
$$= 80.3$$

$$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$
$$= \frac{\pi^2 (29{,}000 \text{ ksi})}{(80.3)^2}$$
$$= 44.4 \text{ ksi}$$

With $QF_y/F_e < 2.25$, Equation E7-2 applies, where $Q = Q_s$.

$$F_{cr} = Q\left(0.658^{\frac{QF_y}{F_e}}\right)F_y$$
$$= 0.773\left(0.658^{\frac{0.773\ (50 \text{ ksi})}{44.4 \text{ ksi}}}\right)(50 \text{ ksi})$$
$$= 26.85 \text{ ksi}$$

The available strength in axial compression for the limit state of flexural buckling about the X-X axis with one intermediate connector is:

LRFD	ASD
$\phi P_n = 0.9\left(12.62 \text{ in.}^2\right)\left(26.85 \text{ ksi}\right)$ $= 305 \text{ kips}$	$\frac{P_n}{\Omega} = \frac{\left(12.62 \text{ in.}^2\right)\left(26.85 \text{ ksi}\right)}{1.67}$ $= 203 \text{ ksi}$

This is greater than 90% of the governing strength; therefore, one connector is adequate.

Summarize available strengths:

For buckling about the Y-Y axis, flexural buckling governs over torsional buckling, and the available strength is:

LRFD	ASD
$\phi P_n = 281 \text{ kips}$	$\frac{P_n}{\Omega} = 187 \text{ kips}$

For buckling about the X-X axis, one intermediate connector is required. Flexural buckling governs over torsional buckling, and the available strength is:

LRFD	ASD
$\phi P_n = 305 \text{ kips}$	$\frac{P_n}{\Omega} = 203 \text{ kips}$

These results match the available strengths given in the attached tables for a 2WT7×21.5 section in axial compression with a 14.0-ft unbraced length.

In addition, AISC *Specification* Section E6.2 states that the effective slenderness ratio of each of the component shapes between fasteners must not exceed three-fourths of the governing slenderness ratio of the built-up member. As calculated previously, the effective slenderness ratio of the single WT component shape is:

$$\begin{aligned}\frac{a}{r_i} &= \frac{7.0 \text{ ft } (12.0 \text{ in./ft})}{1.86 \text{ in.}} \\ &= 45.2\end{aligned}$$

The governing slenderness ratio of the built-up member is about the Y-Y axis:

$$\begin{aligned}\frac{KL}{r_{y\_2WT}} &= \frac{1.0(14 \text{ ft})(12.0 \text{ in./ft})}{1.89 \text{ in.}} \\ &= 88.9\end{aligned}$$

This requirement is satisfied, because $45.2 \le 0.75(88.9) = 66.7$.

ACKNOWLEDGMENTS

The authors would like to recognize Puma Steel, Central Texas Iron Works, Prospect Steel Co. and Nucor Yamato Steel for assistance with cost information.

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Available Strength in Axial Compression, kips										
Shape			2WT7×365		2WT7×332.5		2WT7×302.5		2WT7×275	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	6330	9520	5780	8690	5250	7900	4770	7170
		10	6080	9140	5530	8310	5000	7510	4510	6780
		12	5950	8940	5390	8100	4860	7300	4370	6570
		14	5790	8700	5230	7860	4700	7060	4210	6330
		16	5610	8430	5050	7590	4520	6790	4030	6060
		18	5420	8140	4850	7300	4330	6500	3840	5770
		20	5210	7820	4650	6980	4120	6190	3640	5470
		22	4980	7490	4420	6650	3900	5870	3420	5150
		24	4750	7140	4190	6300	3680	5530	2930	4400
		26	4510	6780	3610	5430	3120	4700	2980	4490
		28	3860	5810	3720	5590	3220	4840	2760	4150
		30	4020	6040	3480	5230	2990	4490	2540	3820
		32	3770	5660	3240	4860	2760	4150	2120	3190
		34	3520	5280	2740	4120	2300	3460	1910	2870
		36	2980	4480	2500	3760	2320	3480	1910	2880
	Y-Y Axis	**0**	6330	9520	5780	8690	5250	7900	4770	7170
		10	6110	9180	5570	8380	5060	7610	4600	6910
		12	5980	8990	5450	8200	4950	7440	4490	6750
		14	5830	8770	5310	7990	4820	7250	4370	6570
		16	5670	8520	5160	7750	4680	7030	4240	6370
		18	5490	8250	4990	7500	4520	6790	4090	6150
		20	5290	7960	4800	7220	4350	6530	3930	5910
		22	5090	7640	4610	6930	4170	6260	3760	5650
		24	4870	7310	4400	6620	3970	5970	3590	5390
		26	4640	6970	4190	6300	3780	5680	3400	5110
		28	4410	6620	3970	5970	3570	5370	3220	4830
		30	4170	6270	3750	5640	3370	5060	3030	4550
		32	3930	5910	3530	5300	3160	4750	2840	4260
		34	3690	5550	3300	4970	2960	4450	2650	3980
		36	3450	5190	3080	4630	2750	4140	2460	3700
Number of Connectors		**10**	2		2		2		2	
		12	2		2		2		2	
		14	2		2		2		2	
		16	2		2		2		2	
		18	2		2		2		2	
		20	2		2		2		2	
		22	2		2		2		2	
		24	2		2		2		2	
		26	2		2		2		3	
		28	2		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	
		34	3		3		3		3	
		36	3		3		4		4	

"—" indicates that *KL*/*r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT7×250		2WT7×227.5		2WT7×213		2WT7×199	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, KL (ft), with Respect to Indicated Axis	X-X Axis	**0**	4320	6500	3930	5900	3670	5520	3420	5130
		10	4070	6110	3670	5520	3420	5140	3170	4760
		12	3930	5900	3530	5310	3280	4930	3030	4550
		14	3770	5660	3380	5080	3130	4700	2880	4330
		16	3590	5400	3200	4820	2960	4440	2710	4070
		18	3400	5120	3020	4540	2770	4170	2530	3810
		20	3200	4820	2830	4250	2580	3880	2350	3530
		22	3000	4510	2410	3620	2180	3280	1970	2950
		24	2530	3800	2190	3280	2190	3300	1970	2960
		26	2570	3870	2220	3340	2000	3000	1790	2680
		28	2360	3550	2020	3040	1810	2710	1600	2410
		30	2150	3240	1670	2510	1470	2210	1290	1940
		32	1770	2660	1640	2470	1440	2170	1130	1710
		34	1760	2640	1460	2190	1280	1920	1010	1510
		36	1570	2360	1300	1960	1060	1600	897	1350
	Y-Y Axis	**0**	4320	6500	3930	5900	3670	5520	3420	5130
		10	4170	6270	3790	5700	3550	5340	3310	4970
		12	4070	6120	3700	5560	3460	5210	3220	4850
		14	3960	5950	3600	5410	3360	5060	3130	4710
		16	3840	5760	3480	5230	3250	4890	3030	4550
		18	3700	5560	3350	5040	3130	4710	2910	4380
		20	3550	5340	3210	4830	3000	4510	2790	4190
		22	3390	5100	3070	4610	2860	4300	2660	4000
		24	3230	4850	2920	4390	2720	4090	2530	3800
		26	3060	4600	2760	4150	2570	3870	2390	3590
		28	2890	4340	2600	3910	2420	3640	2250	3380
		30	2710	4080	2440	3670	2270	3410	2100	3160
		32	2540	3820	2280	3430	2120	3180	1960	2950
		34	2360	3550	2120	3190	1970	2960	1820	2740
		36	2190	3300	1960	2950	1820	2730	1680	2530
Number of Connectors		**10**	2		2		2		2	
		12	2		2		2		2	
		14	2		2		2		2	
		16	2		2		2		2	
		18	2		2		2		2	
		20	2		2		2		2	
		22	2		2		2		2	
		24	2		2		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		4		4		3	
		34	4		4		4		3	
		36	4		4		4		3	

"—" indicates that KL/r is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT7×185		2WT7×171		2WT7×155.5		2WT7×141.5	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	0	3170	4770	2930	4400	2650	3980	2400	3600
		10	2930	4400	2690	4040	2420	3630	2180	3280
		12	2790	4200	2560	3840	2290	3440	2050	3090
		14	2640	3970	2410	3620	1940	2920	1730	2600
		16	2480	3730	2250	3380	1990	3000	1770	2660
		18	2300	3460	2080	3130	1830	2750	1610	2430
		20	2130	3190	1910	2870	1520	2290	1330	2000
		22	1760	2640	1560	2350	1500	2260	1300	1960
		24	1760	2650	1560	2350	1340	2020	1150	1730
		26	1580	2380	1390	2090	1190	1780	920	1380
		28	1290	1940	1120	1680	939	1410	793	1190
		30	1120	1690	973	1460	818	1230	691	1040
		32	987	1480	855	1290	719	1080	608	913
		34	874	1310	758	1140	637	957	538	809
		36	780	1170	676	1020	568	854	480	721
	Y-Y Axis	0	3170	4770	2930	4400	2650	3980	2400	3600
		10	3080	4620	2840	4270	2580	3870	2340	3520
		12	3000	4510	2770	4160	2510	3770	2280	3430
		14	2910	4370	2680	4040	2430	3660	2210	3320
		16	2810	4220	2590	3900	2350	3530	2130	3210
		18	2700	4060	2490	3740	2260	3390	2050	3080
		20	2590	3890	2380	3580	2160	3240	1950	2940
		22	2460	3700	2270	3410	2050	3080	1860	2790
		24	2340	3510	2150	3230	1940	2920	1760	2640
		26	2210	3320	2030	3050	1830	2750	1650	2480
		28	2070	3120	1900	2860	1710	2580	1550	2330
		30	1940	2910	1780	2670	1600	2400	1440	2170
		32	1810	2710	1650	2480	1490	2230	1340	2010
		34	1670	2520	1530	2300	1370	2060	1240	1860
		36	1540	2320	1410	2120	1260	1900	1130	1710
Number of Connectors		10	2		2		1		1	
		12	2		2		1		1	
		14	2		2		1		1	
		16	2		2		2		2	
		18	2		2		2		2	
		20	2		2		2		2	
		22	2		2		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	
		34	3		3		3		3	
		36	3		3		3		3	

"—" indicates that *KL*/*r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT7×128.5		2WT7×116.5		2WT7×105.5		2WT7×96.5	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	2170	3260	1950	2930	1750	2630	1590	2390
		10	1960	2940	1750	2630	1570	2370	1430	2140
		12	1840	2760	1640	2460	1460	2200	1210	1820
		14	1700	2560	1510	2270	1340	2020	1200	1810
		16	1560	2350	1380	2070	1220	1830	1080	1630
		18	1420	2130	1240	1860	1090	1630	880	1320
		20	1150	1730	992	1490	959	1440	840	1260
		22	1120	1690	965	1450	835	1260	725	1090
		24	983	1480	836	1260	717	1080	566	850
		26	775	1170	654	984	560	842	482	725
		28	668	1000	564	848	483	726	416	625
		30	582	875	491	739	421	632	362	544
		32	512	769	432	649	370	556	318	478
		34	453	681	383	575	328	492	282	424
		36	404	608	341	513	292	439	251	378
	Y-Y Axis	**0**	2170	3260	1950	2930	1750	2630	1590	2390
		10	2130	3200	1920	2890	1740	2620	1590	2390
		12	2070	3110	1870	2810	1690	2550	1550	2330
		14	2010	3010	1810	2720	1640	2460	1500	2250
		16	1930	2900	1750	2620	1580	2370	1440	2170
		18	1850	2790	1670	2510	1510	2270	1380	2080
		20	1770	2660	1590	2400	1440	2160	1320	1980
		22	1680	2520	1510	2270	1360	2050	1250	1870
		24	1590	2380	1430	2150	1290	1930	1180	1770
		26	1490	2240	1340	2020	1210	1810	1100	1660
		28	1400	2100	1250	1890	1130	1690	1030	1550
		30	1300	1950	1170	1750	1050	1570	955	1430
		32	1200	1810	1080	1620	968	1450	882	1320
		34	1110	1670	994	1490	890	1340	810	1220
		36	1020	1530	911	1370	814	1220	740	1110
Number of Connectors		**10**	1		1		1		1	
		12	1		1		1		1	
		14	2		2		2		2	
		16	2		2		2		2	
		18	2		2		2		2	
		20	2		2		3		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	
		34	3		3		3		3	
		36	3		3		3		3	

"—" indicates that *KL*/*r* is greater than 200.

Available Strength in Axial Compression, kips								
Shape			2WT7×88		2WT7×79.5		2WT7×72.5	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	1430	2150	1270	1920	1140	1720
		10	1290	1940	1150	1730	1040	1560
		12	1090	1630	962	1450	862	1300
		14	1080	1630	954	1430	852	1280
		16	968	1460	848	1270	753	1130
		18	781	1170	675	1020	595	894
		20	743	1120	639	960	560	842
		22	637	957	541	814	470	707
		24	495	744	420	631	365	549
		26	422	634	358	538	311	468
		28	364	547	309	464	269	404
		30	317	476	269	404	234	352
		32	278	419	236	355	206	309
		34	247	371	209	315	182	274
		36	220	331	187	281	162	244
	Y-Y Axis	**0**	1430	2150	1270	1920	1140	1720
		10	1430	2150	1270	1920	1140	1720
		12	1410	2120	1270	1920	1140	1720
		14	1370	2050	1230	1850	1120	1680
		16	1310	1970	1180	1780	1080	1620
		18	1260	1890	1130	1700	1030	1550
		20	1200	1800	1080	1620	978	1470
		22	1130	1700	1020	1530	925	1390
		24	1070	1600	959	1440	870	1310
		26	999	1500	898	1350	814	1220
		28	931	1400	836	1260	758	1140
		30	863	1300	774	1160	702	1060
		32	796	1200	714	1070	647	972
		34	731	1100	654	983	592	890
		36	667	1000	597	897	540	811
Number of Connectors		**10**	1		1		1	
		12	1		1		1	
		14	2		2		2	
		16	2		2		2	
		18	2		2		2	
		20	3		3		3	
		22	3		3		3	
		24	3		3		3	
		26	3		3		3	
		28	3		3		3	
		30	3		3		3	
		32	3		3		3	
		34	3		3		3	
		36	3		3		3	

"—" indicates that *KL/r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT7×66		2WT7×60		2WT7×54.5		2WT7×49.5	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, KL (ft), with Respect to Indicated Axis	X-X Axis	**0**	1040	1560	927	1390	819	1230	725	1090
		10	947	1420	857	1290	765	1150	694	1040
		12	789	1190	709	1070	627	943	567	852
		14	779	1170	699	1050	616	926	556	836
		16	689	1040	615	925	538	809	484	728
		18	546	821	484	727	418	628	374	563
		20	514	772	453	681	389	585	347	522
		22	432	649	379	569	323	485	287	432
		24	336	505	295	443	252	378	225	337
		26	286	431	251	378	215	322	191	288
		28	247	371	217	326	185	278	165	248
		30	215	323	189	284	161	242	144	216
		32	189	284	166	249	142	213	126	190
		34	168	252	147	221	125	189	112	168
		36	149	225	131	197	112	168	—	—
	Y-Y Axis	**0**	1040	1560	927	1390	819	1230	725	1090
		10	1040	1560	927	1390	819	1230	725	1090
		12	1040	1560	927	1390	819	1230	725	1090
		14	1000	1510	914	1370	819	1230	725	1090
		16	960	1440	874	1310	790	1190	719	1080
		18	912	1370	830	1250	750	1130	682	1030
		20	862	1300	784	1180	708	1060	644	968
		22	810	1220	736	1110	665	999	604	907
		24	756	1140	686	1030	620	932	563	846
		26	702	1050	636	957	575	864	521	784
		28	648	973	587	882	530	796	480	721
		30	594	893	537	808	485	730	439	660
		32	541	814	489	736	442	664	400	600
		34	491	738	443	666	400	601	361	543
		36	441	663	398	598	359	540	324	487
Number of Connectors		**10**	1		1		1		1	
		12	1		1		1		1	
		14	2		2		2		2	
		16	2		2		2		2	
		18	2		2		2		2	
		20	3		3		3		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	
		34	3		3		3		3	
		36	3		3		3		N/A	

"—" indicates that KL/r is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT7×45		2WT7×41		2WT7×37		2WT7×34	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	0	634	953	646	970	577	867	519	780
		10	622	935	602	904	540	812	493	742
		12	506	760	556	836	497	747	453	681
		14	494	743	507	762	451	678	410	616
		16	428	644	456	685	402	605	365	549
		18	329	494	404	607	354	532	320	481
		20	303	455	319	479	276	415	276	415
		22	250	376	304	457	262	393	235	353
		24	196	294	258	387	220	331	197	296
		26	167	251	203	305	174	262	156	235
		28	144	216	175	263	150	226	135	202
		30	125	188	153	229	131	197	117	176
		32	110	166	134	202	115	173	103	155
		34	97.6	147	119	179	102	153	91.3	137
		36	—	—	106	159	90.8	137	81.4	122
	Y-Y Axis	0	634	953	646	970	577	867	519	780
		10	634	953	606	911	550	826	503	757
		12	634	953	562	845	510	766	466	701
		14	634	953	514	773	466	701	426	641
		16	634	953	464	698	421	632	384	577
		18	616	926	414	622	374	563	341	513
		20	581	874	363	546	329	494	299	450
		22	545	819	315	473	285	428	259	389
		24	508	763	269	404	242	364	220	331
		26	470	707	229	344	207	311	187	282
		28	433	651	197	297	178	268	162	243
		30	396	595	172	258	155	233	141	212
		32	360	541	151	227	136	205	124	186
		34	325	489	134	201	121	182	110	165
		36	292	438	119	179	108	162	97.8	147
Number of Connectors		10	1		1		1		1	
		12	1		1		1		1	
		14	2		2		2		2	
		16	2		2		2		2	
		18	2		2		2		2	
		20	3		2		2		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	
		34	3		3		3		3	
		36	N/A		3		3		3	

"—" indicates that *KL/r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT7×30.5		2WT7×26.5		2WT7×24		2WT7×21.5	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	440	662	388	584	320	480	248	373
		10	429	645	378	567	318	478	248	373
		12	394	593	351	527	297	446	238	358
		14	357	536	290	436	249	374	203	305
		16	318	478	291	437	249	374	203	305
		18	279	419	259	390	224	336	184	277
		20	217	326	208	312	182	274	153	230
		22	205	307	198	298	157	235	133	201
		24	172	258	169	255	150	226	129	193
		26	136	205	134	201	119	179	103	155
		28	117	176	115	174	103	155	89.2	134
		30	102	154	101	151	89.6	135	77.7	117
		32	89.9	135	88.4	133	78.8	118	68.3	103
		34	79.6	120	78.3	118	69.8	105	60.5	90.9
		36	71.0	107	69.9	105	62.2	93.5	54.0	81.1
	Y-Y Axis	**0**	440	662	388	584	320	480	248	373
		10	439	660	340	511	289	434	233	350
		12	408	612	302	453	258	388	211	316
		14	373	560	262	393	226	340	187	281
		16	337	506	222	334	194	292	163	245
		18	300	451	185	277	163	245	140	210
		20	263	396	150	226	134	202	118	177
		22	228	343	124	187	111	167	97.5	147
		24	195	293	104	157	93.1	140	81.9	123
		26	166	249	88.9	134	79.4	119	69.8	105
		28	143	215	76.7	115	68.4	103	60.2	90.4
		30	125	187	66.8	100	59.6	89.6	52.4	78.8
		32	109	165	58.7	88.2	—	—	—	—
		34	97.0	146	—	—	—	—	—	—
		36	86.5	130	—	—	—	—	—	—
Number of Connectors		**10**	1		1		1		1	
		12	1		1		1		1	
		14	2		1		1		1	
		16	2		2		2		2	
		18	2		2		2		2	
		20	2		2		2		2	
		22	3		3		2		2	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		N/A		N/A	
		34	3		N/A		N/A		N/A	
		36	3		N/A		N/A		N/A	

"—" indicates that *KL*/*r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT7×19		2WT7×17		2WT7×15		2WT7×13	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	210	315	162	244	125	188	101	152
		10	210	315	162	244	125	188	101	152
		12	197	297	160	240	125	188	98.4	148
		14	204	306	148	222	123	185	99.9	150
		16	178	267	146	219	113	170	93.6	141
		18	162	243	134	201	113	170	91.9	138
		20	162	244	122	183	104	156	85.7	129
		22	137	206	116	174	99.6	150	82.5	124
		24	122	183	105	157	90.9	137	76.4	115
	Y-Y Axis	**0**	210	315	162	244	125	188	101	152
		10	181	272	148	222	121	182	75.9	114
		12	156	235	129	194	106	160	61.2	92.0
		14	131	197	110	166	91.5	138	47.4	71.2
		16	107	162	92.0	138	76.9	116	36.3	54.5
		18	85.7	129	74.7	112	63.1	94.8	—	—
		20	69.4	104	60.5	91.0	51.1	76.8	—	—
		22	57.4	86.2	50.0	75.2	42.2	63.5	—	—
		24	48.2	72.4	42.0	63.2	35.5	53.3	—	—
Number of Connectors		**10**	1		1		1		1	
		12	1		1		1		1	
		14	2		1		1		2	
		16	2		2		1		2	
		18	2		2		2		N/A	
		20	3		2		2		N/A	
		22	3		3		3		N/A	
		24	3		3		3		N/A	

"—" indicates that *KL/r* is greater than 200.

Available Strength in Axial Compression, kips				
Shape			2WT7×11	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	68.1	102
		10	68.1	102
		12	68.1	102
		14	66.6	100
		16	61.4	92.2
	Y-Y Axis	**0**	68.1	102
		10	56.3	84.6
		12	46.4	69.7
		14	36.9	55.5
		16	28.5	42.9
Number of Connectors		**10**	1	
		12	1	
		14	1	
		16	1	

"—" indicates that *KL/r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT6×168		2WT6×152.5		2WT6×139.5		2WT6×126	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, KL (ft), with Respect to Indicated Axis	X-X Axis	0	2910	4380	2630	3950	2400	3610	2170	3260
		10	2670	4010	2390	3590	2170	3260	1940	2910
		12	2550	3830	2270	3410	2050	3080	1820	2740
		14	2420	3630	2140	3210	1920	2890	1700	2550
		16	2270	3410	1990	3000	1780	2680	1570	2350
		18	2110	3180	1840	2770	1640	2460	1430	2140
		20	1780	2680	1530	2310	1350	2030	1290	1930
		22	1790	2690	1530	2300	1340	2020	1150	1720
		24	1620	2440	1380	2070	1200	1800	1010	1520
		26	1460	2200	1120	1680	961	1440	796	1200
		28	1180	1780	1080	1630	922	1390	686	1030
		30	1160	1740	947	1420	803	1210	598	899
		32	1020	1530	774	1160	658	990	526	790
		34	836	1260	686	1030	583	877	465	700
		36	746	1120	612	920	520	782	415	624
	Y-Y Axis	0	2910	4380	2630	3950	2400	3610	2170	3260
		10	2710	4080	2450	3680	2240	3370	2020	3040
		12	2610	3930	2350	3540	2150	3230	1940	2910
		14	2500	3750	2250	3370	2050	3080	1850	2780
		16	2370	3560	2130	3200	1940	2920	1740	2620
		18	2230	3350	2000	3010	1820	2740	1640	2460
		20	2090	3130	1870	2810	1700	2550	1520	2290
		22	1940	2910	1730	2610	1570	2360	1410	2110
		24	1790	2690	1600	2400	1440	2170	1290	1940
		26	1640	2460	1460	2190	1320	1980	1170	1760
		28	1490	2240	1330	1990	1190	1790	1060	1590
		30	1340	2020	1190	1800	1070	1610	950	1430
		32	1210	1810	1070	1610	956	1440	844	1270
		34	1070	1610	948	1420	847	1270	748	1120
		36	955	1440	846	1270	755	1140	667	1000
Number of Connectors		10	2		2		2		2	
		12	2		2		2		2	
		14	2		2		2		2	
		16	2		2		2		2	
		18	2		2		2		2	
		20	2		2		2		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		4		4		3	
		30	4		4		4		3	
		32	4		4		4		3	
		34	4		4		4		3	
		36	4		4		4		3	

"—" indicates that KL/r is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT6×115		2WT6×105		2WT6×95		2WT6×85	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	1970	2960	1790	2700	1620	2430	1440	2160
		10	1750	2630	1580	2370	1410	2120	1240	1870
		12	1640	2460	1340	2010	1180	1780	1030	1550
		14	1520	2280	1350	2040	1190	1800	1040	1560
		16	1390	2090	1230	1850	1080	1620	927	1390
		18	1150	1730	1010	1510	867	1300	737	1110
		20	1120	1690	979	1470	840	1260	708	1060
		22	994	1490	857	1290	726	1090	605	910
		24	794	1190	673	1010	562	844	465	700
		26	676	1020	573	861	479	720	397	596
		28	583	877	494	743	413	620	342	514
		30	508	764	430	647	360	540	298	448
		32	447	671	378	569	316	475	262	393
		34	396	595	335	504	280	421	232	349
		36	353	530	299	449	250	375	207	311
	Y-Y Axis	**0**	1970	2960	1790	2700	1620	2430	1440	2160
		10	1840	2760	1680	2520	1520	2280	1350	2030
		12	1760	2650	1610	2410	1450	2180	1290	1940
		14	1680	2520	1530	2300	1380	2070	1230	1840
		16	1580	2380	1440	2160	1300	1950	1150	1730
		18	1480	2230	1350	2020	1210	1820	1080	1620
		20	1380	2070	1250	1880	1120	1690	997	1500
		22	1270	1910	1150	1730	1030	1550	915	1380
		24	1160	1750	1050	1580	943	1420	834	1250
		26	1060	1590	954	1430	853	1280	753	1130
		28	954	1430	858	1290	766	1150	675	1010
		30	854	1280	766	1150	682	1030	600	901
		32	756	1140	677	1020	601	904	528	794
		34	670	1010	600	901	533	801	468	703
		36	598	898	535	804	475	714	417	627
Number of Connectors		**10**	2		1		1		1	
		12	2		1		1		1	
		14	2		2		2		2	
		16	2		2		2		2	
		18	2		2		2		2	
		20	3		3		3		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	
		34	3		3		3		3	
		36	3		3		3		3	

"—" indicates that KL/r is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT6×76		2WT6×68		2WT6×60		2WT6×53	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, KL (ft), with Respect to Indicated Axis	X-X Axis	0	1280	1920	1130	1690	979	1470	855	1280
		10	1100	1650	966	1450	839	1260	728	1090
		12	1000	1510	879	1320	759	1140	652	981
		14	904	1360	786	1180	674	1010	573	861
		16	801	1200	633	951	537	808	449	675
		18	698	1050	596	896	504	757	417	626
		20	599	901	506	761	423	637	344	517
		22	463	695	387	582	323	485	262	394
		24	389	584	326	489	271	408	220	331
		26	331	498	277	417	231	347	188	282
		28	286	429	239	360	199	299	162	243
		30	249	374	208	313	174	261	141	212
		32	219	329	183	275	153	229	124	186
		34	194	291	162	244	135	203	110	165
		36	173	260	145	218	—	—	—	—
	Y-Y Axis	0	1280	1920	1130	1690	979	1470	855	1280
		10	1210	1820	1080	1620	946	1420	838	1260
		12	1150	1740	1030	1550	902	1360	799	1200
		14	1090	1640	973	1460	853	1280	755	1130
		16	1030	1550	913	1370	800	1200	707	1060
		18	958	1440	850	1280	743	1120	657	987
		20	885	1330	784	1180	685	1030	605	909
		22	811	1220	718	1080	626	940	552	829
		24	737	1110	651	979	567	852	499	750
		26	665	999	586	880	509	765	448	673
		28	594	893	522	785	453	681	398	598
		30	527	791	462	694	399	600	350	526
		32	463	696	406	610	351	527	308	463
		34	410	616	359	540	311	467	273	410
		36	366	550	321	482	277	416	243	366
Number of Connectors		10	1		1		1		1	
		12	2		2		2		2	
		14	2		2		2		2	
		16	2		2		2		2	
		18	3		3		3		3	
		20	3		3		3		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	
		34	3		3		3		3	
		36	3		3		N/A		N/A	

"—" indicates that KL/r is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT6×48		2WT6×43.5		2WT6×39.5		2WT6×36	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	760	1140	676	1020	599	900	533	801
		10	649	976	586	880	482	724	435	654
		12	578	869	520	782	465	699	419	629
		14	504	758	452	680	402	605	360	542
		16	391	588	349	524	308	463	274	412
		18	360	541	321	482	282	423	249	374
		20	295	443	262	393	212	319	187	282
		22	225	339	200	301	175	264	155	233
		24	189	285	168	253	147	221	130	196
		26	161	242	143	215	126	189	111	167
		28	139	209	124	186	108	163	95.6	144
		30	121	182	108	162	94.3	142	83.3	125
		32	106	160	94.6	142	82.9	125	—	—
	Y-Y Axis	**0**	760	1140	676	1020	599	900	533	801
		10	756	1140	676	1020	599	900	533	801
		12	721	1080	652	980	590	887	533	801
		14	681	1020	615	924	557	836	507	762
		16	637	958	575	864	520	782	474	712
		18	591	889	533	801	482	724	438	658
		20	544	817	489	735	442	664	402	604
		22	496	745	445	669	402	604	365	548
		24	448	674	401	603	362	544	328	493
		26	401	603	359	539	323	486	293	440
		28	357	536	318	478	286	430	259	389
		30	313	471	278	418	251	377	226	340
		32	275	414	245	368	220	331	199	299
Number of Connectors		**10**	1		1		1		1	
		12	2		2		2		2	
		14	2		2		2		2	
		16	2		2		2		2	
		18	3		3		3		3	
		20	3		3		3		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		N/A	

"—" indicates that *KL/r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT6×32.5		2WT6×29		2WT6×26.5		2WT6×25	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	464	698	438	659	388	583	383	576
		10	388	582	385	578	351	528	344	517
		12	372	559	340	510	310	466	310	466
		14	319	479	293	441	268	403	274	411
		16	240	361	224	337	205	309	237	356
		18	217	327	204	307	187	281	201	303
		20	164	246	166	249	152	228	168	252
		22	135	203	127	191	116	175	128	193
		24	114	171	107	161	97.9	147	108	162
		26	96.8	145	91.0	137	83.4	125	92.0	138
		28	83.5	125	78.5	118	71.9	108	79.3	119
		30	72.7	109	68.4	103	62.6	94.1	69.1	104
		32	—	—	60.1	90.3	55	82.7	60.7	91.3
	Y-Y Axis	**0**	464	698	438	659	388	583	383	576
		10	464	698	431	648	388	583	333	500
		12	464	698	401	602	364	547	295	444
		14	456	685	367	552	333	501	256	385
		16	425	639	332	499	301	452	218	327
		18	393	591	296	445	268	402	181	272
		20	360	542	261	392	235	353	147	221
		22	327	492	227	341	204	306	122	183
		24	294	442	194	291	174	261	102	154
		26	262	394	165	248	148	222	87.1	131
		28	232	348	142	214	128	192	75.1	113
		30	202	304	124	187	111	167	65.4	98.3
		32	178	267	109	164	97.7	147	57.5	86.4
Number of Connectors		**10**	1		1		1		1	
		12	2		2		2		2	
		14	2		2		2		2	
		16	2		2		2		2	
		18	3		3		3		3	
		20	3		3		3		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	N/A		3		3		3	

"—" indicates that *KL*/*r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT6×22.5		2WT6×20		2WT6×17.5		2WT6×15	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	335	503	262	393	223	335	154	231
		10	306	461	247	371	223	335	154	231
		12	275	413	202	303	187	281	139	209
		14	242	364	198	298	190	285	141	211
		16	191	287	160	240	158	238	121	181
		18	177	265	134	201	138	207	107	161
		20	146	220	125	187	134	202	105	158
		22	112	168	95.9	144	107	161	86.6	130
		24	94.1	141	80.5	121	90.1	135	74.9	113
		26	80.2	121	68.6	103	76.8	115	63.9	96.1
		28	69.1	104	59.2	88.9	66.2	99.5	55.1	82.8
		30	60.2	90.5	51.5	77.5	57.7	86.7	48.0	72.2
		32	52.9	79.6	45.3	68.1	50.7	76.2	42.2	63.4
	Y-Y Axis	**0**	335	503	262	393	223	335	154	231
		10	298	447	242	363	181	271	135	203
		12	264	396	217	326	153	230	117	176
		14	228	343	191	286	125	188	99.3	149
		16	194	291	164	247	99.5	150	81.9	123
		18	160	241	139	209	78.6	118	65.7	98.8
		20	130	196	115	173	63.7	95.7	53.2	80.0
		22	108	162	94.9	143	52.6	79.1	44.0	66.1
		24	90.6	136	79.7	120	44.2	66.5	37.0	55.6
		26	77.2	116	67.9	102	—	—	—	—
		28	66.6	100	58.6	88.0	—	—	—	—
		30	58.0	87.2	51.0	76.7	—	—	—	—
		32	51.0	76.6	44.9	67.4	—	—	—	—
Number of Connectors		**10**	1		1		1		1	
		12	2		1		1		1	
		14	2		2		2		2	
		16	2		2		2		2	
		18	3		2		2		2	
		20	3		3		3		3	
		22	3		3		3		3	
		24	3		3		3		3	
		26	3		3		3		3	
		28	3		3		3		3	
		30	3		3		3		3	
		32	3		3		3		3	

"—" indicates that *KL/r* is greater than 200.

Available Strength in Axial Compression, kips										
Shape			2WT6×13		2WT6×11		2WT6×9.5		2WT6×8	
Design			P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD	P_n/Ω_c ASD	$\phi_c P_n$ LRFD
Effective Length, *KL* (ft), with Respect to Indicated Axis	X-X Axis	**0**	106	159	110	165	76.5	115	52.4	78.7
		10	106	159	102	153	76.5	115	52.4	78.7
		12	102	154	104	156	76.5	115	52.4	78.7
		14	93.8	141	101	152	72.0	108	52.4	78.7
		16	91.0	137	96.3	145	71.0	107	51.1	76.9
		18	82.9	125	87.6	132	68.2	102	51.4	77.3
		20	74.6	112	81.9	123	64.5	96.9	50.0	75.1
	Y-Y Axis	**0**	106	159	110	165	76.5	115	52.4	78.7
		10	99.5	150	48.6	73.1	39.2	59.0	29.4	44.2
		12	88.7	133	33.8	50.8	27.3	41.0	20.4	30.7
		14	77.3	116	24.8	37.3	—	—	—	—
		16	66.1	99.3	—	—	—	—	—	—
		18	55.2	83.0	—	—	—	—	—	—
		20	45.2	67.9	—	—	—	—	—	—
Number of Connectors		**10**	1		1		1		1	
		12	1		2		2		1	
		14	1		3		2		2	
		16	2		4		3		2	
		18	2		4		4		3	
		20	2		5		5		4	

"—" indicates that *KL*/*r* is greater than 200.