steelwise

14 SECRETS OF THE 14TH EDITION

BY CHRISTOPHER M. HEWITT, S.E., P.E., ERIN CRISTE, LEED GA, AND LEIGH ARBER, P.E.

An inside look at some of the more useful, yet less well-known, resources in the new AISC 14th Edition *Steel Construction Manual*.

THE AISC *STEEL CONSTRUCTION MANUAL* has provided design aids, convenient design tables, and other useful tools for the designer since 1928. With close to 2,000 pages of detailed information in the latest edition, one could (and most do) spend a lifetime mastering the intricacies of its contents. In this article we'll help unlock for you a few of the *Manual*'s "hidden secrets." Some of these items are new, and some existed previously, but we hope this article will give you new insights into a few features of this powerful handbook.

1. The Secret of Form

Over time, new shapes are incorporated into the relevant ASTM standards, like ASTM A6 and A500. Thereafter, these changes are reflected in the AISC *Manual*. Changes to the new shapes list in the 14th Edition include:

- HP 18 and HP 16 shapes have been added, to respond to needs for deeper and stronger foundation systems.
- A stair stringer channel section, the MC12×14.3, has been added; it provides a wider flange (enough to receive a handrail pipe size and still make the fillet weld) and a thicker web.

2. The Secret of Size

Plates and bars, as discussed on page 1-8, should be specified in the preferred increments to facilitate the ordering process. For structural plate used in connections, the preferred practice is to specify thickness in 1/16-in. increments up to 3/8-in., 1/8-in. increments over 3/8-in. to 1-in., and 1/4-in. increments over 1-in. thickness. For bars, the preferred practice is to specify width in 1/4-in. increments, and thickness and diameter in 1/8-in. increments.

The Shapes Database

Did you know that the AISC *Shapes Database* provides electronic access to dimensions and properties printed in the *Manual*? Version 14.0 of the AISC *Shapes Database* has been updated to match the data provided in the 14th Edition *Manual*. This resource is a free download at **www.aisc.org/shapesdatabase**.

3. The Second-Order Secret

Part 2 contains a section on "Simplified Determination of Required Strength," beginning on page 2-16. This section provides a simplified alternative approach for stability analysis that can help you to apply the second-order analysis requirements of the *Specification* with ease. That said, application of the other methods provided in the AISC *Specification* is fairly straightforward as well.

For additional insight on this subject, you can turn to the *Engineering Journal* article "A Comparison of Frame Stability Analysis Methods in ANSI/AISC 360-05" (Third Quarter, 2008). All *EJ* articles are available online at **www.aisc.org/ej** as free downloads for AISC members, and for a nominal fee for others.

Christopher M. Hewitt, S.E., P.E., is project associate at Sargent & Lundy, LLC, Chicago. Erin Criste, LEED GA, and Leigh Arber, P.E., are staff engineers at AISC.

Table 6-1
Combined Flexure and Axial Force
W-Shapes

F_y = 50 ksi

W44

Shape		W44×											
		335[c]				290[c]				262[c]			
Design		$p \times 10^3$ (kips)$^{-1}$		$b_x \times 10^3$ (kip-ft)$^{-1}$		$p \times 10^3$ (kips)$^{-1}$		$b_x \times 10^3$ (kip-ft)$^{-1}$		$p \times 10^3$ (kips)$^{-1}$		$b_x \times 10^3$ (kip-ft)$^{-1}$	
		ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD	ASD	LRFD
Effective length, KL (ft), with respect to least radius of gyration, r_y, or Unbraced Length, L_b (ft), for X-X axis bending	0	0.346	0.230	0.220	0.146	0.417	0.278	0.253	0.168	0.474	0.316	0.281	0.187
	11	0.378	0.251	0.220	0.146	0.454	0.302	0.253	0.168	0.516	0.343	0.281	0.187
	12	0.384	0.256	0.220	0.146	0.462	0.307	0.253	0.168	0.524	0.349	0.281	0.187
	13	0.392	0.261	0.222	0.148	0.470	0.313	0.255	0.170	0.533	0.355	0.284	0.189
	14	0.402	0.267	0.225	0.150	0.480	0.319	0.259	0.173	0.544	0.362	0.289	0.192
	15	0.412	0.274	0.229	0.152	0.490	0.326	0.264	0.175	0.555	0.369	0.294	0.196
	16	0.423	0.281	0.232	0.155	0.501	0.333	0.268	0.178	0.568	0.378	0.299	0.199
	17	0.435	0.290	0.236	0.157	0.514	0.342	0.273	0.181	0.582	0.387	0.304	0.203
	18	0.449	0.299	0.240	0.160	0.527	0.351	0.277	0.184	0.597	0.397	0.310	0.206
	19	0.463	0.308	0.244	0.162	0.542	0.361	0.282	0.188	0.613	0.408	0.316	0.210
	20	0.479	0.319	0.248	0.165	0.559	0.372	0.287	0.191	0.632	0.420	0.322	0.214
	22	0.515	0.343	0.256	0.171	0.597	0.397	0.298	0.198	0.674	0.448	0.335	0.223
	24	0.558	0.371	0.266	0.177	0.643	0.428	0.309	0.206	0.724	0.482	0.348	0.232
	26	0.608	0.405	0.275	0.183	0.702	0.467	0.321	0.214	0.785	0.522	0.363	0.242
	28	0.668	0.444	0.286	0.190	0.77	0.512	0.335	0.223	0.859	0.571	0.379	0.252
	30	0.738	0.491	0.297	0.198	0.851	0.567	0.349	0.232	0.950	0.632	0.397	0.264
	32	0.822	0.547	0.310	0.206	0.948	0.631	0.365	0.243	1.06	0.705	0.417	0.277
	34	0.923	0.614	0.323	0.215	1.06	0.708	0.382	0.254	1.19	0.793	0.438	0.292
	36	1.03	0.689	0.338	0.225	1.19	0.794	0.401	0.267	1.34	0.889	0.465	0.310
	38	1.15	0.767	0.354	0.235	1.33	0.885	0.429	0.286	1.49	0.990	0.507	0.337
	40	1.28	0.850	0.377	0.251	1.47	0.980	0.464	0.309	1.65	1.10	0.549	0.365
	42	1.41	0.937	0.404	0.269	1.62	1.08	0.499	0.332	1.82	1.21	0.592	0.394
	44	1.55	1.03	0.431	0.287	1.78	1.19	0.534	0.355	2.00	1.33	0.635	0.423
	46	1.69	1.12	0.459	0.305	1.95	1.30	0.570	0.379	2.18	1.45	0.679	0.452
	48	1.84	1.22	0.486	0.323	2.12	1.41	0.605	0.403	2.37	1.58	0.722	0.481
	50	2.00	1.33	0.514	0.342	2.30	1.53	0.641	0.426	2.58	1.71	0.766	0.510
Other Constants and Properties													
$b_y \times 10^3$, (kip-ft)$^{-1}$		1.51		1.00		1.74		1.16		1.96		1.30	
$t_y \times 10^3$, (kips)$^{-1}$		0.339		0.226		0.391		0.260		0.433		0.288	
$t_r \times 10^3$, (kips)$^{-1}$		0.417		0.278		0.480		0.320		0.531		0.354	
r_x/r_y		5.10				5.10				5.10			
r_y, in.		3.49				3.49				3.47			

[c] Shape is slender for compression with F_y = 50 ksi.

Table 6-1 from the 14th Edition *Manual* provides a handy way to quickly design a variety of structural steel members.

4. The Secret of Continuity

When framing beams continuously over the tops of columns, the details used must provide for the stability of the top of the column. The required column-top stability can be provided in several ways, a few of which are described in Figure 2-2 of the 14th Edition *Manual*.

5. Secrets of the Double-Agent Member: He works for the beams and the columns, too!

Table 6-1 provides a handy, simplified way to quickly design beam-columns. It also can be used to design beams, columns and tension members, all with one table. This table gives values that can be used to assess the combined axial load and flexure interaction equations of *Specification* Chapter H. The tabular values also can be used individually to design members subject to a single type of load. Just invert a few of the coefficients and compare the results to what is tabulated elsewhere in the *Manual* to get a feel for how to use Table 6-1 in these other cases.

6. The Powerful Bolt Secret

The published strengths for bolts in the AISC *Specification* have, for many years, included a 20% reduction to account for the uneven distribution of load in end-loaded joint configurations up to 50 in. in length. In the 2010 *Specification*, the reduction off the top has been reduced from 20% to 10% and the interval at which the long joint reduction further applies was reduced from 50 in. to 38 in. As a result, you will find an increase in connection strength when bolt shear strength controls. The connection tables in the 14th Edition *Manual* have been updated to reflect this change. Additional explanatory material is available in the article "Bolt Shear Design Considerations" (*Engineering Journal*, First Quarter, 2010).

7. The Secretly Eccentric Weld Group

In Part 8, eccentrically loaded weld group Tables 8-10 and 8-11 are clarified in this edition as being applicable for determining the strength of L-shaped welds loaded eccentrically from either side.

Also, when weld groups are loaded concentrically, the weld group coefficients are now based on the greater of the applicable provisions of Section J2.4 in the *Specification*. This new wrinkle improves the economy of welded joints.

8. Prying into Secrets

Previously introduced with the 13th Edition *Manual*, prying action calculations are now based on F_u rather than F_y to better match the performance of connections in actual tests. The 14th Edition *Manual* continues this practice and includes a more extensive discussion in Part 9.

The applicability of Tables 8-10 and 8-11 has been clarified in the 14th Edition *Manual*.

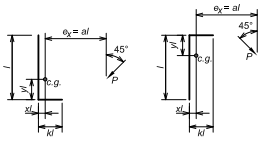
Table 8-10a (continued)
Coefficients, C, for Eccentrically Loaded Weld Groups
Angle = 45°

Available strength of a weld group, ϕR_n or R_n/Ω, is determined with $R_n = CC_1Dl$ (ϕ = 0.75, Ω = 2.00)

LRFD	ASD
$C_{min} = \frac{P_u}{\phi C_1 Dl}$ $D_{min} = \frac{P_u}{\phi C C_1 l}$ $l_{min} = \frac{P_u}{\phi C C_1 D}$	$C_{min} = \frac{\Omega P_a}{C_1 Dl}$ $D_{min} = \frac{\Omega P_a}{C C_1 l}$ $l_{min} = \frac{\Omega P_a}{C C_1 D}$

where
P = required force, P_u or P_a, kips
D = number of sixteenths-of-an-inch in the fillet weld size
l = characteristic length of weld group, in.
$a = e_x/l$
e_x = horizontal component of eccentricity of P with respect to centroid of weld group, in.
C = coefficient tabulated below
C_1 = electrode strength coefficient from Table 8-3 (1.0 for E70XX electrodes)

Note: Shaded values indicate the value is based on the greatest available strength permitted by AISC *Specification* Sections J2.4, J2.4(a), J2.4(b) and J2.4(c).



a	k															
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0
0.00	2.41	2.57	2.80	3.04	3.27	3.51	3.74	3.97	4.21	4.44	4.67	5.14	5.61	6.08	6.54	7.01
0.10	2.24	2.44	2.65	2.86	3.07	3.29	3.52	3.76	4.00	4.24	4.49	5.01	5.53	6.06	6.59	7.12
0.15	2.09	2.28	2.48	2.68	2.89	3.11	3.33	3.56	3.79	4.03	4.28	4.79	5.32	5.85	6.40	6.94
0.20	1.96	2.14	2.33	2.54	2.74	2.95	3.16	3.38	3.61	3.84	4.08	4.58	5.10	5.64	6.19	6.74
0.25	1.85	2.02	2.21	2.40	2.61	2.81	3.01	3.22	3.44	3.67	3.90	4.39	4.90	5.43	5.98	6.53
0.30	1.74	1.91	2.09	2.28	2.47	2.67	2.87	3.07	3.29	3.51	3.73	4.21	4.72	5.24	5.78	6.33
0.40	1.55	1.70	1.87	2.04	2.23	2.42	2.60	2.80	3.00	3.21	3.43	3.89	4.38	4.89	5.41	5.95
0.50	1.38	1.52	1.67	1.84	2.01	2.19	2.36	2.55	2.74	2.94	3.15	3.60	4.07	4.57	5.09	5.62
0.60	1.23	1.36	1.50	1.66	1.82	1.99	2.16	2.33	2.51	2.70	2.90	3.33	3.80	4.28	4.79	5.31
0.70	1.11	1.23	1.36	1.50	1.66	1.82	1.97	2.13	2.31	2.49	2.68	3.10	3.55	4.02	4.52	5.03
0.80	1.00	1.12	1.24	1.37	1.52	1.67	1.81	1.97	2.13	2.31	2.49	2.89	3.33	3.79	4.27	4.77
0.90	0.915	1.02	1.13	1.26	1.39	1.54	1.67	1.82	1.98	2.14	2.32	2.71	3.12	3.57	4.04	4.53
1.0	0.839	0.938	1.04	1.16	1.29	1.42	1.55	1.69	1.84	2.00	2.17	2.54	2.94	3.37	3.83	4.30
1.2	0.719	0.805	0.900	1.00	1.12	1.24	1.35	1.48	1.61	1.76	1.91	2.25	2.62	3.02	3.45	3.90
1.4	0.627	0.704	0.788	0.880	0.979	1.08	1.19	1.31	1.43	1.56	1.70	2.01	2.36	2.73	3.13	3.54
1.6	0.555	0.624	0.700	0.783	0.868	0.962	1.07	1.17	1.28	1.40	1.53	1.82	2.14	2.48	2.85	3.24
1.8	0.498	0.560	0.629	0.701	0.778	0.864	0.961	1.06	1.16	1.27	1.39	1.66	1.95	2.27	2.61	2.98
2.0	0.451	0.508	0.571	0.635	0.704	0.784	0.873	0.964	1.06	1.16	1.27	1.52	1.79	2.09	2.41	2.75
2.2	0.412	0.464	0.522	0.579	0.643	0.716	0.799	0.885	0.974	1.07	1.17	1.40	1.65	1.93	2.23	2.55
2.4	0.379	0.428	0.480	0.532	0.592	0.660	0.736	0.818	0.900	0.989	1.08	1.30	1.53	1.79	2.08	2.38
2.6	0.351	0.396	0.444	0.493	0.548	0.611	0.683	0.760	0.837	0.920	1.01	1.21	1.43	1.67	1.94	2.23
2.8	0.327	0.369	0.413	0.458	0.510	0.569	0.636	0.709	0.781	0.859	0.943	1.13	1.34	1.57	1.82	2.10
3.0	0.306	0.345	0.386	0.428	0.477	0.532	0.595	0.665	0.733	0.806	0.885	1.06	1.26	1.48	1.72	1.98
x	0.000	0.005	0.017	0.035	0.057	0.083	0.113	0.144	0.178	0.213	0.250	0.327	0.408	0.492	0.579	0.667
y	0.500	0.455	0.417	0.385	0.357	0.333	0.313	0.294	0.278	0.263	0.250	0.227	0.208	0.192	0.179	0.167

Design Examples

Did you know that the AISC *Design Examples* are now available in electronic format as a free download at **www.aisc.org/epubs**? The scope of this free resource has expanded, with design examples illustrating the application of each major provision of the 2010 AISC *Specification* and the use of each table in the 14th Edition AISC *Steel Construction Manual*.

9. Secretly Bent Out of Shape

Seemingly hiding in Part 10 of the 14th Edition *Manual* is a table providing the minimum inside radius for cold bending of plate. Find Table 10-13 on page 10-172 in the 14th Edition *Manual*, and it won't be able to hide from you ever again. Background information on this topic can be found in the article "Development of Fabrication Guidelines for Cold Bending of Plates" (*Engineering Journal*, First Quarter, 2006).

Table 10-13
Minimum Inside Radius for Cold-Bending[1]

Inside radius as a function of plate thickness

ASTM Designation[2]	Thickness, *t*, in.			
	Up to 3/4	Over 3/4 to 1	Over 1 to 2	Over 2
A36, A572-42	1 1/2 *t*	1 1/2 *t*	1 1/2 *t*	2*t*
A242, A529-50, A529-55, A572-50, A588, A992	1 1/2 *t*	1 1/2 *t*	2 *t*	2 1/2 *t*
A572-55, A852	1 1/2 *t*	1 1/2 *t*	2 1/2 *t*	3 *t*
A572-60, A572-65	1 1/2 *t*	1 1/2 *t*	3 *t*	3 1/2 *t*
A514	1 3/4 *t*	2 1/4 *t*	4 1/2 *t*	5 1/2 *t*

[1] Values are for bend lines perpendicular to direction of final rolling. If bend lines are parallel to final rolling direction, multiply values by 1.5.
[2] The grade designation follows the dash; where no grade is shown, all grades and/or classes are included.

▲ The minimum bending radius guidelines for plates of various thickness ranges are provided in Table 10-13 of the 14th Edition *Manual*.

10. Secret Joy-Rides (on the Fillet)

Part 10 discusses "riding the fillet"—a secret that is nothing new to connection detailers, but is perhaps unknown to some others. Page 10-7 provides a discussion of fillet encroachment and includes an illustration of typical dimensions in Figure 10-3. And while we are on the subject of connection design, you may want to note the entering and tightening clearances required for bolted connections, found in Tables 7-15 and Table 7-16, and welding clearance discussions on page 8-15. All of these items will help you check that your connection details are consistently constructable.

11. Bear-ly Secret

Table 14-2 of the *Manual* has historically contained recommended maximum sizes for anchor-rod holes in base plates; however, you may not have noticed that this table has stealthily added compatible sizes of washers that can be used with those anchor rod and hole sizes. This is a secret no more.

12. Safety (Shouldn't be a) Secret

Part 2 of the *Manual* provides some general design information and covers a wide spectrum of topics related to the steel construction industry. It includes a concise summary, beginning on page 2-6, that will help you understand the basic aspects of OSHA requirements as they apply to steel construction. The full text of OSHA requirements is available in the Federal Register (see 29 CFR 1926 Subpart R at **www.osha.gov**).

13. Secret Similarities

It has been said that the more things change, the more they stay the same. When writing the 2010 *Specification*, the AISC Committee on Specifications started with the intent of minimizing the impact that *Specification* changes would have on the engineering profession and steel industry. Therefore, *Specification* provisions that form the basis of the new *Manual* are largely the same as they were in 2005. The 14th Edition *Manual* follows suit—its format is very similar to that of the 13th Edition *Manual*, with ASD and LRFD presented side-by-side and with sections presented in the same order. User-friendly features of the previous edition, such as footnoting in shape designations to help correlate shapes to the applicable limit states, have been carried through to this edition. For current users of the 13th Edition, these similarities should help ease the transition to the 14th Edition *Manual*, and should help increase the economy of designs while maintaining design-office efficiency.

14. Secret Savings

OK, this one is no secret. AISC members can get the 14th Edition *Manual* for $175. That's the same price as the 13th Edition and half off the non-member price. In addition, the 14th Edition is the first *Manual* to be made available in a digital edition. As with the print version, AISC members pay just half the non-member price. Buy the digital edition and print edition together and save even more. Visit **www.aisc.org/manuals** for details and to order. MSC