Joining Forces

AISC's Steel Design Specifications Merge in 2005

By Cynthia J. Duncan

The new 2005 unified design specification for structural steel buildings will combine individual ASD and LRFD specifications with one document. The document is on schedule for completion in early 2005, and will replace the two existing AISC building design specifications: the 1989 *Specification for Structural Steel Buildings-Allowable Stress Design (ASD) and Plastic Design* and the 1999 *Load and Resistance Factor Design Specification (LRFD) for Structural Steel Buildings.*

It also will replace the two AISC special-member design specifications, the 2000 *Load and Resistance Factor Design Specification for Steel Hollow Structural Sections*, and the 2000 *Load and Resistance Factor Design Specification for Single-Angle Members*. This means that all HSS and single-angle member and connection-design provisions will be incorporated into the 2005 specification. The organization of the combined specifications is very similar to the existing individual specifications to ease the transition to the new document.

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It's No Longer ASD vs. LRFD

By Jason Ericksen, Senior Advisor, Steel Solutions Center

In 2005, AISC will issue a new specification for structural steel buildings that will supersede both of the existing specifications (Allowable Stress Design and Load & Resistance Factor Design). This new unified specification will reflect the current state of engineering knowledge and allow engineers to use either factored loads or service loads in their calculations. As Louis Geschwindner, AISC Vice President of Engineering and Research, said: "There is no intention to phase out ASD. As long as ASCE 7 has service-load combinations, there will be ASD design procedures."

Rightly or wrongly, when the *LRFD Specification* was introduced in 1986, it was widely viewed as a difficult design methodology foisted on the industry by the academic community. The new unified specification should avoid those difficulties if for no other reason than that more than two-thirds of the current Committee on Specifications, including the current chair, comes from either the design community or fabrication industry. According to Geschwindner, the new specification:

- is practice oriented.
- provides economical designs.
- meets the engineering requirement of providing safe designs with predictable behavior and response.

A key reason that ASD often was viewed as easier than LRFD (besides the obvious factors of familiarity and resistance to change) is that the current *ASD Specification* essentially is unchanged since 1961. If AISC had never introduced LRFD but had instead simply updated ASD design procedures, then ASD would look a lot like LRFD. In discussing this issue, Geschwindner often relates the story of the designer who stated that "If I have to do leaning columns in LRFD then I'm going to use ASD." But steel doesn't know whether you're using LRFD or ASD—and there are still leaning columns!

The limit states for both methods are the same—and always have been. And you can easily look at using stress as opposed to member strength: If you follow the math, allowable bending stress is $(Z/S)^*0.6F_y$. If (Z/S) is taken as 1.1, as was done in the *ASD Specification*, then the allowable bending stress would be $0.66F_y$ as it is in the 1989 *ASD Specification* and has been since 1961. And a designer could certainly continue to use that value.

F_y = 50 ksi
$P_n = F_{cr} A_g$
Ω_c = 1.67
ϕ_c = 0.90

Table 4-2.
W-Shapes
Available Strength in Axial
Compression, kips
P_n / Ω_c (ASD)
$\phi_c P_n$ (LRFD)

Shape		W14x											
Wt/ft		120		109		99[††]		90[††]		82		74	
Design		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	0	1059	1588	960	1440	875	1313	798	1196	720	1080	654	982
	6	1031	1546	932	1398	847	1271	776	1165	677	1015	615	922
	7	1024	1535	925	1387	840	1260	762	1144	662	993	601	902
	8	1009	1514	918	1376	833	1249	755	1133	645	968	586	879
	9	995	1493	904	1355	819	1228	748	1122	627	940	570	854
	10	981	1472	889	1334	812	1218	734	1101	607	911	551	827
	11	967	1451	875	1313	798	1196	727	1091	585	[illegible]	532	797
	12	953	1429	861	1292	784	1175	713	[illegible]	[illegible]	[illegible]	511	767
	13	932	1398	847	1271	769	1154	698	[illegible]	[illegible]	[illegible]	490	735
	14	911	1366	826	1239	748	1122	[illegible]	[illegible]	[illegible]	772	467	701
	15	896	1345	812	1218	734	[illegible]	[illegible]	[illegible]	[illegible]	735	445	667
	16	875	1313	791	1186	720	[illegible]	[illegible]	979	464	697	422	633
	17	854	1281	769	1154	700	[illegible]	[illegible]	955	439	659	399	598
	18	833	1249	[illegible]	[illegible]	681	[illegible]	620	930	414	620	376	563
	19	805	1207	[illegible]	[illegible]	662	993	602	903	388	582	352	528
	20	784	[illegible]	[illegible]	[illegible]	643	965	584	877	363	544	330	494
	22	[illegible]	[illegible]	666	998	603	904	548	822	314	471	286	429
	24	[illegible]	[illegible]	620	931	562	843	510	766	268	402	244	365
	26	[illegible]	955	575	863	520	780	473	709	229	343	208	311
	28	[illegible]	881	530	795	479	719	435	652	197	295	179	268
	30	538	807	486	728	438	658	398	597	172	257	156	234
	32	490	735	443	664	399	598	361	542	151	227	137	205
	34	443	665	400	600	361	541	327	490	133	200	121	182
	36	399	598	359	539	323	485	293	439	119	179	108	162
	38	358	537	323	484	290	435	263	394	107	160	97.4	146
	40	323	484	291	436	262	393	237	356	96.7	145	87.5	131
Properties													
P_{wo}, kips		151	227	128	192	111	167	96	144	123	185	103	155
P_{wi}, kips/in.		19.7	29.5	17.5	26.3	16.2	24.3	14.7	22.0	17.0	25.5	15.0	22.5
P_{wb}, kips		331	497	233	349	184	275	137	205	213	320	226	339
P_{fb}, kips		176	264	147	220	121	181	100	150	145	218	154	231
L_p, ft		13.2		13.2		13.5		15.1		8.76		8.76	
L_r, ft		46.2		43.2		40.6		38.4		29.5		27.9	
A_g, in.^{2}		35.3		32.0		29.1		26.5		24.0		21.8	
I_x, in.^{4}		1380		1240		1110		999		881		795	
I_y, in.^{4}		495		447		402		362		148		134	
r_y, in.		3.74		3.73		3.71		3.70		2.48		2.48	
Ratio r_x/r_y		1.67		1.67		1.66		1.66		2.44		2.44	
$P_{ex}(KL^2)/10^4$		39500		35500		31800		28600		25200		22800	
$P_{ey}(KL^2)/10^4$		14200		12800		11500		10400		4240		3840	

[††] Flanges are non-compact; See AISC Specification Section B4.

Example of column table for the next manual, using draft provisions of the 2005 Specification. ASD design values will be shaded in green, and LRFD design values will be shown in blue. Member design tables are for F_y = 50 ksi.

Expanded Scope

The new unified format of the 2005 specification is the most visible change, incorporating both ASD and LRFD methods into one specification. The document begins with a substantial revision: an expanded scope in Chapter A will affect the applicability of the entire document by stating that the specification sets forth criteria for the "design of structural steel buildings and other structures." Chapter B provides a roadmap to help the user locate specific provisions in the specification. Chapter C handles the stability provisions of the overall structure, and incorporates new analysis provisions, including a direct-analysis method using notional loads and $K = 1$.

Member Design

Chapters D through I cover member-design provisions, and Chapter J covers connection-design provisions. Chapter D, "Design of Members for Tension," will include simplified shear-lag criteria for determining the effective area in a new tabulated format. The other remaining member-design chapters contain several revisions. Chapter F, "Design of Members for Flexure," has expanded in length with the addition of hollow structural section and single-angle provisions. However, it is helpful to note that the user need not go past Section F2 if designing the typical, compact wide-flange shape.

Other notable revisions to member design are in Chapter I, where "Design of Composite Members" has been reorganized and updated extensively to reflect recent research, higher-strength materials, and consistency with ACI 318. The usual bolt, weld, and general connection-design provisions remain in Chapter J, and a new Chapter K addresses only HSS and box-member connection-design provisions. The concentrated-force provisions have been relocated to Chapter J. Some revisions in Chapter J include new block shear rupture criteria, improved details for weld-access holes, and revised slip-strength calculations for slip-critical connections.

User Notes Added

Other important features of the new specification are found in the appendices and "User Notes." The appendices are intended to contain less frequently used criteria, including "Design for Fatigue, Evaluation and Repair," and a new appendix on "Structural Design for Fire Conditions." The latter provides a more performance-oriented approach to design for fire than the traditional prescriptive methods used in the building code. The "User Notes" are brief commentaries interspersed throughout the text that supplement the historical "Commentary" that follows the specification. They provide concise, practical guidance to assist the user when applying the provisions.

Availability

The final, ANSI-accredited AISC *Specification for Structural Steel Buildings* will be introduced in 2005 in conjunction with a completely updated *Manual of Steel Construction*. The *Manual* will provide the discussion, tables, and design aids that the user will need to make the most of the new specification. ★

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