

Design Examples

The AISC *Design Examples* CD provides a practical bridge between the 2005 specification and the 13th Edition *Steel Construction Manual*.

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The AISC *Design Examples* CD will be included with the 13th Edition *Steel Construction Manual* and is intended to provide examples that make a practical bridge between the *Manual* and the 2005 *Specification for Structural Steel Buildings*. The emphasis of the *Design Examples* CD is on simplicity of design and use of the tables found in the new manual.

The *Manual* tables have been extensively revised to provide ready answers to the most common design problems, including tension member selection, bending member selection, column selection, design for combined loading, and connection design. An excellent example is column selection. As with previous editions of both the ASD and LRFD manuals, the fastest way to select a column is to establish the required strength and the effective unbraced length, and then enter the column tables, proceeding down the weights of members at the proper effective length until reaching the most economical column section with an available strength that equals or exceeds the required strength. One important aspect of this selection process is that the design engineer does not need to know the exact stress in the member to be confident that the selected column will carry the applied load.

The beam selection process is also similar to the process from previous editions of the ASD and LRFD manuals. Only the maximum required moment strength and the unbraced length are needed to select an appropriate member using the available moment versus unbraced length charts. The section curve that is above and to the right of the moment-unbraced length coordinates is the one to be selected. Again, the exact stress in the beam can be found, but is unimportant in the selection process.

The emphasis of the design examples follows a guiding principle: quick se-

Design a W-shape column using both LRFD and ASD

Given

Select an ASTM A992 W-shape column to carry an axial load consisting of a dead load of 140 kips and a live load of 420 kips. The column length is 30' and the ends are pinned. Limit the column size to a nominal 14" series.



Solution

Calculate the required strength

LRFD	ASD
$P_u = 1.2(140) + 1.6(420) = 840$ kips	$P_a = 140 + 420 = 560$ kips

Select column

From the *Manual*, enter Table 4-1 with an effective length of 30' and proceed down the sizes (across the page) until a W14×132 is found, which has sufficient available strength to carry the axial load at this effective length. Note that for an effective length of 30', the available axial load capacity is 892 kips for LRFD and 594 kips for ASD. A portion of Table 4-1 is shown below.

LRFD	ASD
892 kips > 840 kips o.k.	594 kips > 560 kips o.k.

Table 4-1 (continued)
Available Strength in Axial Compression, kips
W Shapes

$F_y = 50$ ksi



Shape	W14											
	140		120		120		100		90		90	
	$\phi_c P_n$	P_n/Ω_c										
Design	ASD	LRFD										
8	1290	1830	1160	1740	1360	1930	2690	1440	870	1210	750	1160
9	1250	1810	1130	1700	1330	1900	2640	1400	840	1180	730	1130
10	1210	1780	1100	1660	1300	1870	2590	1360	810	1150	700	1100
11	1170	1750	1070	1620	1270	1840	2540	1320	780	1120	670	1070
12	1130	1720	1040	1580	1240	1810	2490	1280	750	1090	640	1040
13	1090	1690	1010	1540	1210	1780	2440	1240	720	1060	610	1010
14	1050	1660	980	1500	1180	1750	2390	1200	690	1030	580	980
15	1010	1630	950	1460	1150	1720	2340	1160	660	1000	550	950
16	970	1600	920	1420	1120	1690	2290	1120	630	970	520	920
17	930	1570	890	1380	1090	1660	2240	1080	600	940	490	890
18	890	1540	860	1340	1060	1630	2190	1040	570	910	460	860
19	850	1510	830	1300	1030	1600	2140	1000	540	880	430	830
20	810	1480	800	1260	1000	1570	2090	960	510	850	400	800
22	770	1450	770	1220	970	1540	2040	920	480	820	370	770
24	730	1420	740	1180	940	1510	1990	880	450	790	340	740
26	690	1390	710	1140	910	1480	1940	840	420	760	310	710
28	650	1360	680	1100	880	1450	1890	800	390	730	280	680
30	610	1330	650	1060	850	1420	1840	760	360	700	250	650

Effective length (KL) with respect to least radius of gyration, r_y .

lection of ordinary members using the design aids of the *Manual*, which have already accounted for the variety of requirements of the *Specification* appropriate for that design aid. One very good example of the automatic adjustments included in the tables is hollow structural sections (HSS) with slender webs or flanges. While an HSS bending member with very thin walls is not sensitive to unbraced length issues, its moment strength must be adjusted to account for the slender walls. This reduction is already incorporated into the tabulated available moment strength values, and the listed value can be directly compared to the required moment strength. As with the column and beam selection process above, the exact stress in the HSS section can be found, but is unimportant in the selection process.

The material on the *Design Examples* CD is presented side by side in LRFD and ASD format, consistent with the design philosophy of the *Specification*. The two design approaches are shown to be similar, with the largest difference being the appropriate load combinations and load factors from the building code or ASCE 7-02. An example of the side-by-

side presentation method is illustrated in the column selection problem on the previous page.

The figures on the preceding page include a portion of the column available strength tables with both ASD and LRFD available strengths given. For ASD, allowable strength values are given in black text with a green background. For LRFD, design strength values are printed in blue. All of the tables in the *Manual* follow this color scheme, with those values that apply to both ASD and LRFD printed in black with no background color.

The applied design problems using the *Manual* design aids are followed on the CD by more detailed calculations to illustrate how one would arrive at the same available strengths through the use of the *Specification* formulas. All calculations give references in the right hand column to indicate the source of the information in the *Specification*, *Manual*, or other references.

Throughout the *Specification*, the first provisions in each chapter address the most common cases, making the application of this *Specification* straightforward for the most common member de-

signs. If noncompact or slender built-up shapes are used, designs become more challenging. Examples have also been included to address design methods for these more complicated shapes with special design considerations. Often the complexity of design may be reduced by making use of the design aids listed in the *Manual* or by selecting compact built-up shapes.

The *Design Examples* CD also includes substantial guidance on the selection and design of simple shear connections, largely by illustrating the use of the tables of the *Manual*. In both the examples and in the *Manual*, information for both LRFD and ASD is presented side by side.

In addition to these features, the *Design Examples* CD includes coverage of all other design requirements of the *Specification*, from bracing requirements to combined forces. This work is expected to serve as a useful reference for understanding and applying the 2005 AISC *Specification for Structural Steel Buildings* and the 13th Edition *Steel Construction Manual*. ★

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