

# 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 <b>o.k.</b>	594 kips > 560 kips <b>o.k.</b>

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

$F_y = 50$  ksi



Shape	W14											
	140		120		120		100		90		90	
	$\phi_c P_n$	$P_n/\Omega_c$	$\phi_c P_n$	$P_n/\Omega_c$	$\phi_c P_n$	$P_n/\Omega_c$	$\phi_c P_n$	$P_n/\Omega_c$	$\phi_c P_n$	$P_n/\Omega_c$	$\phi_c P_n$	$P_n/\Omega_c$
6	1290	1830	1160	1740	1360	1930	2690	1440	870	1210	750	1160
8	1250	1670	1130	1700	1330	1900	2640	1400	840	1180	730	1130
7	1240	1660	1120	1690	1320	1890	2630	1390	840	1180	730	1130
8	1220	1640	1110	1680	1310	1880	2620	1370	820	1160	710	1110
9	1210	1630	1100	1670	1300	1870	2610	1360	820	1160	710	1110
10	1200	1620	1090	1660	1290	1860	2600	1340	800	1140	700	1100
11	1190	1610	1080	1650	1280	1850	2590	1320	790	1120	700	1090
12	1180	1600	1070	1640	1270	1840	2580	1300	780	1100	690	1080
13	1170	1590	1060	1630	1260	1830	2570	1280	770	1080	680	1070
14	1160	1580	1050	1620	1250	1820	2560	1260	750	1060	670	1060
15	1150	1570	1040	1610	1240	1810	2550	1240	740	1040	660	1050
16	1140	1560	1030	1600	1230	1800	2540	1220	720	1020	650	1040
17	1130	1550	1020	1590	1220	1790	2530	1200	710	1000	640	1030
18	1120	1540	1010	1580	1210	1780	2520	1180	690	980	630	1020
19	1110	1530	1000	1570	1200	1770	2510	1160	680	960	620	1010
20	1100	1520	990	1560	1190	1760	2500	1140	660	940	610	1000
22	1090	1510	980	1550	1180	1750	2490	1120	650	920	600	990
24	1080	1500	970	1540	1170	1740	2480	1100	640	900	590	980
26	1070	1490	960	1530	1160	1730	2470	1080	630	880	580	970
28	1060	1480	950	1520	1150	1720	2460	1060	620	860	570	960
30	1050	1470	940	1510	1140	1710	2450	1040	610	840	560	950

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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