

Steel Design for the 21st Century

By Christopher M. Hewitt

The 1980s were pretty innovative years. They brought us wonderful technical advances, like cell phones, Microsoft DOS, and AISC's familiar ASD Manual. With time, each of these innovations has seen substantial improvement, embracing the technical advances of the new century — none of us continue to carry around the clunky car phones of the 80s, but pocket sized phones are now a way of life. Bill Gates' Microsoft has evolved into an intricate and expanded Windows operating system for the business world.

In that same time, the technology surrounding steel design has continued to advance. With all of the research and innovation that has surfaced in the last 16 years, it seems appropriate for steel design to evolve from a world defined by green computer screens, four-function calculators, Beta recorders and Marty McFly. The 13th Edition AISC *Steel Construction Manual* gives ASD and LRFD designers alike a way to realize the advances in steel design technology in the 21st century.

One Manual to Rule Them All

The new AISC *Steel Construction Manual*, 13th edition, brings ASD and LRFD together in a familiar context. The structure of the book is largely the same as it has been for many years — all of the classic design tables for member and connection design have been carried forward. Tabulated design values for ASD and LRFD are presented side-by-side.

Much like the new AISC *Specification*, the *Steel Construction Manual* includes coverage for all member types, including hollow structural sections and single angles, in a single volume.

Defined By Color

Color plays an important role in this edition of the *Manual*. Tabulated values applicable only to design by ASD are presented in green shading, and tabulated values applicable only to design by LRFD are presented in blue print. Values that are independent of design method are presented in black print.

Perhaps the most elegant realization of this approach can be seen in the unbraced beam design charts of the *Manual*. Because the

performance of a steel beam is the same regardless of the design method used by the structural engineer, only one set of curves is required for structures designed by ASD or LRFD. The strength level corresponding to each point of the curve need only change to reflect whether the loads were calculated using ASD load combinations or LRFD load combinations. As

seen in *Figure 1 on page 29*, this is accomplished by providing an ASD scale and an LRFD scale for the vertical axis. All other tables similarly integrate ASD and LRFD values for convenient and consistent usage.

The Shape of Things

Shape information in the AISC Manual is based upon that which is published in the ASTM A6 Standard. Many changes have occurred in the ASTM A6 standard since the printing of the last LRFD Manual, and even more have occurred since the printing of the last ASD Manual. The most significant change is found in the W36 shapes series, in which an entire group of shapes has been revised for current rolling practices. The *k*-distances for rolled shapes have also been updated to reflect the variation in rolling practices of current

shape producers, with the presentation of separate *k*-values applicable to the design and detailing of members.

Pipe (ASTM A53) and HSS (ASTM A500) members are treated similarly in the 2005 *Manual*. The 7% reduction on the wall thickness that has historically been used in calculating the design properties of HSS to account for tolerances in the production process has now been applied in the calculation of the design properties of Pipe cross-sections, to account for a common practice by HSS manufacturers to downgrade their product and supply it as meeting the requirements of ASTM A53

without a pressure test.

In addition to these broad updates, throughout the *Manual*, footnotes have been added to point out shapes that require special design considerations. For example, the designation W40x593^h indicates that the shape is a heavy section, with a flange thickness greater than 2 in., and that special requirements may apply by Specification Section A3.1. Or, the designation W14x99^f highlights that when a W14x99 section is used in flexure, it cannot be designed as a compact section.

Leading By Example

The AISC Committee on Manuals and Textbooks began the effort of overhauling the *Manual* three years ago. From the onset of the project, the committee sought to return the text to its origins as a true handbook for practicing structural engineers. In line with this approach, users of the *Manual* will notice that there are no design examples included in the printed version. However, even more design examples than were available in the past are included on a CD companion titled AISC *Design Examples*. The companion text was developed by the AISC Committee on Manuals and Textbooks with consultant Charles Page, P.E. of Page McNaghten Associates in the Kansas City, Missouri area. AISC *Design Examples* provides hundreds of design examples on the application of the 2005 AISC *Specification for Structural Steel Buildings*, and the design aids of the AISC *Steel Construction Manual*, with an easy to follow, side-by-side presentation of design equations.

More Design Power

New design aids in this manual include tabulated values for the critical stress of compression members, design curves for the available stress of plate girders, and simplified design procedures for considering second-order effects on a structure.

Many improvements realized in the development of the LRFD design manuals can now be used for design by ASD, such as improved design methods for composite members, design aids for members subjected to combined bending and axial forces, eccentric load coefficients for loads applied at various angles, and tension member design aids. But even these design aids have been im-

proved — tables for the design of members subjected to combined axial load and bending now can be applied to the case of combined tensile and bending forces, and coefficients have been provided for calculating the strength of weld groups when they are loaded concentrically.

Some connection design procedures have been modified in this edition of the *Manual*. Design procedures for prying action now make use of the tensile strength rather than the yield strength, to better align the design provisions with the tested performance of bolted parts subjected to prying action. Procedures for the design of connection elements subject to bending have been modified to use the plastic section modulus in the calculation of bending strength, rather than the elastic section modulus; the exception to this being the design of a coped beam end for flexure, which is still based upon the elastic section modulus.

Simple shear connections now include a revised design procedure for conventional single-plate shear connections, a new design procedure for the design of extended single-plate shear connections, and the most current procedures for the design of end-plate moment connections.

But, perhaps the most significant contribution of this *Manual* is that it recognizes that the strength of steel is constant, and eliminates the annoying differences between design methods, allowing the designer to scrutinize the merits of steel designs, rather than the merits of design methods. By returning to a single design approach, a single *Manual*, and a single method for determining the strength of steel structures, structural engineers can better pursue innovations and improvements in the art and practice of design. ■

Christopher Hewitt is Staff Engineer in the AISC Engineering and Research Department where he is directly responsible for the ongoing development and maintenance of the AISC Steel Construction Manual. Christopher serves as Secretary to the AISC Committee on Manuals and Textbooks. He also serves on the NCSEA Advocacy Committee and the ASCE Committee on Structural Connections.

The new 13th Edition AISC *Steel Construction Manual* will be available beginning December, 2005 at www.aisc.org/bookstore.

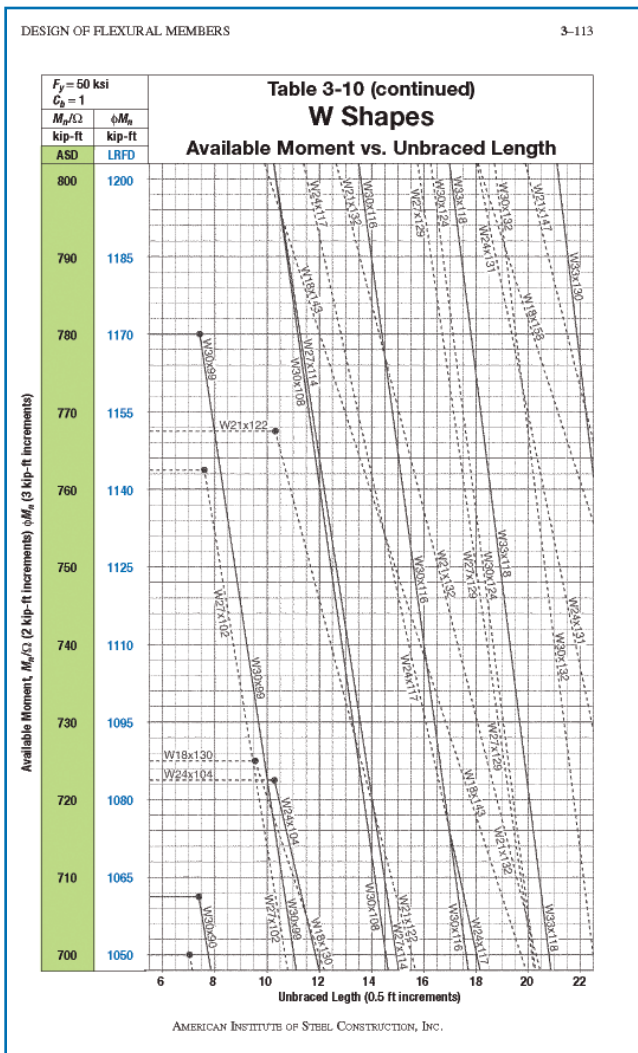


Figure 1

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