

A New Approach for Design of Steel Beam-Columns

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ABSTRACT

Design aids are developed using the AISC-LRFD Specifications for design of steel beam-columns. These aids give designers more options in design and often allow selection of sections that are more efficient for a given set of conditions than the current design aids do. Several examples are worked out using the current method of practice as well as the proposed method developed in this paper.

INTRODUCTION

The design of steel beam-columns consists of a trial-and-error process in which the designer selects a trial section and checks the selection for compliance with the appropriate equation in the AISC Specifications. The trial section is normally selected from the Column Load Tables in the AISC *LRFD Manual of Steel Construction* using P_{ueq} , an "equivalent" axial load calculated based on the applied axial load as well as the equivalent effects of bending moments about the x- and y-axes.

A number of methods have been used in the past for determining P_{ueq} . Generally, these methods use multiplier coefficients to convert bending moments about the two axes to equivalent axial loads. These equivalent axial loads will then be added to the applied axial load to obtain P_{ueq} . Burgett (1973) introduced helpful aids for preliminary design of beam-columns based on the Allowable Stress Design method. Later, Uang, Wattar, and Leet (1990) recommended similar values for design based on the LRFD method. Both of these methods were utilized in the subsequent AISC Manuals.

While such methods are easy to follow and produce reasonable results, the process of selecting a trial "column" section based on an equivalent load for a beam-column and checking it for compliance with the AISC Specifications introduces limitations in the process. Further, the work involved in checking trial sections may be reduced by developing design aids for this purpose.

This paper presents development and application of design aids that, while consistent with the AISC-LRFD Specifications, provide more ease, speed, and flexibility for the de-

signer. They also avoid some of the limitations that exist with the current method of practice. It should be noted that while the basic concepts utilized in this process apply to any prismatic singly or doubly symmetric shape subjected to flexure and axial compression, the focus of the discussions as well as design aids developed in this paper apply to W-shapes only.

CURRENT PRACTICE

Over the years, the design of beam-columns has gone through a number of major changes (Sputo, 1993). However, the method currently recommended in Part 3 of the AISC *LRFD Manual of Steel Construction* (subsequently referred to as the AISC Manual) (AISC, 1994) to design a beam-column consists of the following steps:

1. With the known value of KL (effective length), select a first approximate value of m from Table 3-2 in the AISC Manual. Let u equal 2.
2. Solve for P_{ueq} using the following equation.

$$P_{ueq} = P_u + M_{ux}m + M_{uy}mu \quad (1)$$

where

- P_u = actual factored axial load, kips
- M_{ux} = factored bending moment about the strong axis, kip-ft
- M_{uy} = factored bending moment about the weak axis, kip-ft
- m = factor taken from Table 3-2 of the AISC Manual
- u = factor taken from Column Load Tables in the AISC Manual

3. From the appropriate Column Load Table, select a tentative section to support P_{ueq} .
4. Based on the section selected in Step 3, select a "subsequent approximate" value of m from Table 3-2 and a u value from the Column Load Tables.
5. With the values selected in Step 4, solve for P_{ueq} .
6. Repeat Steps 3 and 4 until the values of m and u stabilize.
7. Check section obtained in Step 6 per AISC Equation H1-1a or H1-1b, as applicable.

It is not clearly pointed out in the AISC Manual whether KL , the effective length, used in step 1 should be with respect to the x- or y-axis. However, it appears from the referenced source of the tabulated values that (KL), is to be used for this

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purpose. If flexural buckling about the strong axis controls, the equivalent effective length, $(KL)_y'$, should be used instead.

In the development of this method, the following assumptions were made.

- $L_b = (KL)_y$. This is usually a conservative assumption.
- $\phi M_n = \phi M_p = \frac{0.9ZF_y}{12}$ This assumption is correct if the

section is compact (most sections are), and $L_b \leq L_p$, and the condition $\phi M_p \leq 1.5\phi S_y F_y$ is satisfied about both axes, as per AISC Specifications requirements. For almost all W-sections, however, the condition $\phi M_p \leq 1.5\phi S_y F_y$ is not satisfied for bending about the weak axis and the $1.5\phi S_y F_y$ limit should be used for ϕM_{ny} instead. Further discussion of this issue will follow in later sections.

DISCUSSION OF THE AISC-LRFD SPECIFICATIONS

In this paper, AISC Equations H1-1a and H1-1b are labeled as Equations 2 and 3, respectively as follows.

(a) For $\frac{P_u}{\phi P_n} \geq 0.2$

$$\frac{P_u}{\phi P_n} + \left(\frac{8}{9}\right) \left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) \leq 1.0 \quad (2)$$

(b) For $\frac{P_u}{\phi P_n} < 0.2$

$$\frac{P_u}{2\phi P_n} + \left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) \leq 1.0 \quad (3)$$

The bi-linear interaction Equations 2 and 3 were developed on the basis of inelastic solutions of 82 beam-columns (Kanchanalai, 1977). They apply to both sway and non-sway beam-columns and address strength as well as stability of members. Detailed review of the development of Equations 2 and 3 is provided in the ASCE (1997) reference.

In Equations 2 and 3, ϕP_n is the design axial compressive strength of the member based on the limit states of elastic or inelastic flexural buckling or local buckling of the web or flange elements. It is determined as if the member were subjected to an axial load only. Chapter H of the AISC Specifications Commentary states that P_n , the nominal compressive strength of the member, should be determined using the actual effective length, KL , rather than always using $K=1$. The Commentary further states that while inclusion of beneficial second order effects for combined tension and bending is optional, for combined compression and bending, the second order effects must be considered.

Similarly, ϕM_{nx} and ϕM_{ny} in Equations 2 and 3 are the design flexural strengths of the member about the x- and y-axes. The nominal strength M_{nx} is determined based on the limit states of yielding, lateral-torsional buckling, local flange

buckling, or local web buckling, as applicable. Therefore, such factors as compression element width-thickness ratios, L_b , and C_b are considered in determining M_{nx} . For bending about the y-axis, only the limit states of yielding and local flange and web buckling are considered.

As stated earlier, M_{ux} and M_{uy} in Equations 1-3, represent the factored bending moments about the strong and weak axes, respectively. For structures designed on the basis of elastic analysis, M_u may be determined from a second-order elastic analysis or from Equation 4, which approximates second-order analysis.

$$M_u = B_1 M_{nt} + B_2 M_{lt} \quad (4)$$

The formula given in Equation 4, applies to bending about both x- and y-axes. Coefficient B_1 in this equation accounts for the P - δ moment due to member deflection in both braced and unbraced frames. Coefficient B_2 , on the other hand, accounts for the P - Δ moment due to the drift of the story for unbraced frames. Calculation of B_1 and B_2 are described in detail in Chapter C of the AISC LRFD Specifications. It is noted that for braced frames, $B_2 M_{lt}$ in Equation 4 is zero. Further, if bending does not exist about one of the x- or y-axes, the corresponding terms in Equations 1-3 are zero. Figure 1 illustrates the interaction between the axial load and bending

moment about the x-axis for all $\frac{P_u}{\phi P_n}$ ratios.

LIMITATIONS OF THE CURRENT METHOD OF SELECTING A TRIAL SECTION

As noted earlier, the current practice in design of beam-columns begins with selecting a trial section from the Column Load Tables in Part 3 of the AISC LRFD Manual of Steel Construction based on P_{ueq} . This section is then checked for compliance with AISC Equation H1-1a or H1-1b. It should be emphasized that the section selected using P_{ueq} is only a trial shape and whether P_{ueq} is larger or smaller than ϕP_n of the

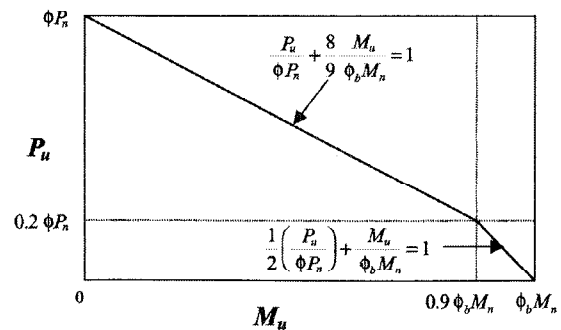


Fig. 1. Interaction of axial load and bending moment about the x-axis for a beam-column.

trial section as a column does not indicate that the trial section will or will not be adequate as a beam-column. The only way to confirm the adequacy of the selection is to check AISC Equation H1-1a or H1-1b, whichever applies. This process, however, introduces a number of limitations, including the following.

Potentially Lengthy Process: Checking a beam-column section for compliance with AISC Equation H1-1a or H1-1b could become a rather tedious process. To do so, both column and beam action need to be considered, potentially with respect to both the x- and y-axes. This requires checking such factors as the width-thickness ratios of the compression elements for flexural and axial compression, L_b , and $(KL)_x$ versus $(KL)_y$, to determine ϕM_{nx} , ϕM_{ny} , and ϕP_n . Subsequently, these results are combined in the AISC bi-linear interaction Equation H1-1a or H1-1b to see if the section meets the AISC Specification requirements as a beam-column. This task may become particularly lengthy if the section is not compact, if $L_b > L_p$, or if the section is not listed in the Column Load Tables.

Having to repeat the process of checking trial sections this way could become a drawn-out endeavor. It is noted that it is not suggested here that these considerations are not necessary. Rather, the point is that design aids may be developed so that some of these steps may be simplified or shortened and to avoid the designer having to go through these calculations repeatedly.

Selections Limited to "Columns" Sections: The current recommended method of selecting a trial beam-column section restricts the designer to the sections listed in the Column Load Tables of the AISC Manual. The W-sections listed in these tables are limited to those W4 to W14's that are more appropriate for use as columns. In fact, not all sections within each of these nominal depths are included in the tables. This situation eliminates consideration of other sections, which may be more effective as beam-columns, unless the designer chooses to consider them on his/her own. At times, deeper sections such as W16, W18, and W21 are more efficient and more economical as beam-columns, particularly when relatively large bending moments are present about the x-axis and considerations such as architectural and other criteria do not limit the designer's selection to a certain nominal depth.

Beam and column sections have different cross sectional characteristics. Column sections often have fairly stocky flanges while beam sections have more slender flanges. Beam sections are generally relatively deep, whereas, column sections are typically shallower. Further, column sections have r_x/r_y ratios in the range of about 1.6 to about 3.0, while this range for beam sections is usually much higher. Consequently, what may be considered as a good "beam" section, is not necessarily a good "column" section. Yet, what is more efficient as a beam-column, depends on the relative magnitude of the axial load and bending moment(s) present. Therefore, selecting a "column" section as a beam-column may not be a good idea.

	Case 1	Case 2	Case 3	Case 4
P_u	50	950	200	600
$M_{ux} m$	950	50	500	200
$M_{uy} mu$	0	0	300	200
P_{ueq}	1,000	1,000	1,000	1,000

It is noted that in cases where the applied axial load is relatively dominant, sections listed in the Column Load Tables are fairly effective as beam-columns. However, in other situations, those sections are not as effective as deeper sections.

Method May Lead to Inefficient Sections: Another limitation of the current method of selecting a trial section is that, in the process of selecting a trial section, one loses sight of the relative contributions of the three potential components that make up P_{ueq} in Equation 1. In other words, numerous combinations of axial load and bending moments about both the x- and y-axes can produce the same P_{ueq} and therefore lead to the selection of the same trial section from the Column Tables. This point is illustrated in the four numerical cases cited in Table 1.

In the examples included in Table 1, although $P_{ueq} = 1,000$ kips for all four cases, clearly the same section can not be the most effective in all those situations. For instance, in Case 1, the member has a significantly large bending moment applied about its strong axis, with a relatively small axial load and no bending about the minor axis. This member acts more like a beam. In Case 2, on the other hand, the member is subjected to a large axial load and a relatively small bending moment about its x-axis and no bending about the y-axis. This member acts much like a column. Cases 3 and 4 illustrate members with other relative magnitudes of axial load and bending moments. Yet, in all four cases, $P_{ueq} = 1,000$ kips and the designer will be directed to the same section in the Column Load Tables to choose a trial section for the beam-column. It is surely desirable to be able to utilize the efficiency of different sections and nominal depths to select a more appropriate section for each case.

DEVELOPMENT OF THE PROPOSED DESIGN AIDS

The only criterion for adequacy of a section as a beam-column is compliance with AISC Equations H1-1a or H1-1b (Equation 2 or 3 in this paper). Therefore, it seems appropriate to base the process of selection of trial sections directly on the AISC Specifications as well. Further, as the reader is aware, the AISC LRFD Manual contains numerous design aids in the form of tables and charts for the design of beams and columns. Often the designer can select a section from these resources

and be certain that the selection is adequate and indeed the lightest section possible. There are no such aids for design of beam-columns. Following is a discussion on the development of one such set of design aids. These aids avoid the limitations of the current practice as stated earlier.

The proposed design aids are developed assuming that Equation 2 applies. Later, a discussion will address the procedural differences that apply if Equation 3 is applicable.

We begin by separating P_u , M_{ux} , and M_{uy} terms in Equation 2 as follows.

$$\left(\frac{1}{\phi P_n}\right)P_u + \left(\frac{8}{9(\phi_b M_{nx})}\right)M_{ux} + \left(\frac{8}{9(\phi_b M_{ny})}\right)M_{uy} \leq 1.0 \quad (5)$$

Then, name the three coefficients in Equation 5 as follows.

$$b = \frac{1}{\phi P_n} \quad (6)$$

$$m = \frac{8}{9(\phi_b M_{nx})} \quad (7)$$

$$n = \frac{8}{9(\phi_b M_{ny})} \quad (8)$$

Therefore, Equation 5 may now be written as follows.

$$bP_u + mM_{ux} + nM_{uy} \leq 1.0 \quad (9)$$

So far, no assumptions or exceptions to the AISC Specifications have been made. In fact, Equation 9, along with its coefficients, as defined in Equations 6 through 8, is exactly the same as Equation H1-1a of the AISC Specifications. Therefore, if one selects a section that satisfies Equation 9, the selection does indeed satisfy the AISC Specifications, provided that:

$$\frac{P_u}{\phi P_n} = bP_u \geq 0.2 \quad (10)$$

As indicated in Equations 6 through 8, coefficients b , m , and n , are dependent on the member material and cross sectional properties and dimensions, as well as other factors such as KL , L_b , and C_b . Thus values of b , m , and n may be tabulated for different sections and for more common conditions. The designer may then obtain values of b , m , and n from such tables in order to check member compliance with Equation 2. In addition, design aids may be developed to assist the designer with looking up reasonable initial values for these coefficients for the purpose of selecting a trial section.

Table 2 includes values of b , m , and n , for a large number of sections for a range of KL 's and L_b 's for A36 and A572 Gr. 50 steels. In developing these tables, such considerations as compactness, L_b versus L_p and L_r , etc. have been taken into account. Therefore, the designer may proceed with using the values listed without having to check those conditions. The

steps involved in using these aids will be presented later. Tables 3 through 5 are design aids, which may be used to obtain initial values for b , m , and n , to select a trial section.

In Table 2, the length L_a listed at the top of the table refers to values of $(KL)_y$ for use with b . For the purposes of looking up m , L_a represents L_b . Due to the relatively small intervals between KL and L_b values listed in Table 2, one may interpolate between these values.

The reader is reminded that regardless of the method of selecting a trial section, the designer still needs to determine such factors as the moment magnification factors, critical buckling direction, and C_b . The proposed method and design aids will only address the selection of a trial section and checking the selection for compliance with the AISC specifications once the above variables have been determined.

Note: Values of b , m , and n listed in Tables 2 through 5 are 1,000 times their actual values, to avoid large numbers of decimal places. Therefore, all values of b , m , and n listed in those tables must be multiplied by 10^{-3} before use. Section properties were obtained from the AISC database of shapes.

ASSUMPTIONS MADE IN THE DEVELOPMENT OF THE NEW DESIGN AIDS

In developing the proposed design aids discussed above and presented in Tables 2 through 5, the following conditions and assumptions were considered.

Column Action: The only coefficient in Equation 9, which depends on column action, is b . Values of b listed in Table 2 are calculated for effective lengths of eight through twenty feet at one-foot increments. For all sections listed, width thickness ratios of the web and flange elements were checked. Only b -values for sections with flange and web width-thickness ratios meeting requirements of Chapter E of the AISC

Specifications, that is $\left(\frac{b}{t}\right) < \lambda_r$, are listed in Table 2. Blank cells for b in Table 2 indicate sections with $\left(\frac{b}{t}\right) \geq \lambda_r$.

Values of b listed in Table 2 are based on $(KL)_y$, the effective length with respect to the least radius of gyration, just as they are in the Column Load Tables of the AISC Manual. In cases where $(KL)_x$ is critical, the designer may use its equivalent, $(KL)_y'$, instead to look up b . The value of $(KL)_y'$ is found as follows.

$$(KL)_y' = \frac{(KL)_x}{(r_x/r_y)} = \frac{(KL)_x(r_y)}{r_x} \quad (11)$$

Beam Action – Bending About the x-axis: The coefficient m in Equation 9, as defined in Equation 7, is a function of the member design flexural strength about the x-axis. The applicable limit states are yielding, lateral-torsional buckling, local flange buckling, and local web buckling. In the development of the m values listed in Table 2, it was assumed that C_b is

unity. The case when this is not true will be discussed later in an example.

Following is the procedure used in determining values of m . Recall that

$$m = \frac{8}{9(\phi_b M_{nx})} \quad (\text{Eq. 7 — repeated})$$

In turn, values of ϕM_n are determined as follows.

Compact Sections;

If $L_b \leq L_p$,

$$\phi M_{nx} = \phi M_{px} = \phi Z_x F_y \leq 1.5\phi M_y = 1.5\phi S_x F_y \quad (12)$$

If $L_p < L_b \leq L_r$,

$$\phi M_{nx} = \phi M_{px} - (\phi M_{px} - \phi M_{rx}) \left(\frac{L_b - L_p}{L_r - L_p} \right) \quad (13)$$

Non-Compact Sections;

If $L_b \leq L_p'$,

$$\phi M_{nx}' = \phi M_{px} - (\phi M_{px} - \phi M_{rx}) \left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p} \right) \quad (14)$$

If $L_p' < L_b \leq L_r$,

$$\phi M_{nx} = \phi M_{px} - (\phi M_{px} - \phi M_{rx}) \left(\frac{L_b - L_p}{L_r - L_p} \right) \quad (15)$$

Values of m for all compact and non-compact sections with $L_b \leq L_r$ are listed in Table 2. Cases where $L_b > L_r$ are left blank due to the member's low structural effectiveness. As noted earlier, L_a values listed in Table 2 represent L_b for the purpose of looking up m .

Formulas for calculation of variables such as L_p and L_r used in Equations 13 through 17 are presented in Chapter F of the AISC Specifications as well as in Part 4 of the AISC Manual and are therefore not repeated here. Only the formulas for ϕM_p were given here to emphasize use of the appropriate plastic section modulus for determining the plastic moment for bending about the x- or y-axis.

Beam Action – Bending About the y-axis: As indicated in Equation 8, the coefficient n is a function of the member design flexural strength about its weak axis. Three limit states apply to W-sections bent about their minor axis — yielding, local web buckling, and local flange buckling. The design flexural strength used in calculation of values of n listed in Table 2 is determined as follows. The web width-thickness ratio of all W-sections are below the corresponding λ_p .

Recall that

$$n = \frac{8}{9(\phi_b M_{ny})} \quad (\text{Eq. 8 — repeated})$$

where ϕM_{ny} is determined as follows.

Compact Sections:

$$\phi M_{ny} = \phi M_{py} = \phi Z_y F_y \leq 1.5\phi M_y = 1.5\phi S_y F_y \quad (16)$$

Non-Compact Sections:

$$\phi M_{ny}' = \phi M_{py} - (\phi M_{py} - \phi M_{ry}) \left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p} \right) \quad (17)$$

Chapter F of the AISC Specifications offers an upper limit for M_p of $1.5M_y = 1.5SF_y$, as indicated in Equations 12 and 16. This condition is imposed to limit potential significant inelastic deformation at service load of sections with shape factors (M_p/M_y) larger than 1.5 and permitted to reach M_p at factored load. This condition is satisfied for all W-sections listed in Table 2 and bent about their x-axis. However, for all sections listed, $M_{py} > 1.5S_y F_y$ for both 36 and 50 ksi steel. Therefore, the limiting value of $1.5M_y$ is used instead of M_{py} in calculating the n -values. Some authors, such as Charles Salmon and John Johnson, believe as stated in their textbook *Steel Structures Design and Behavior*, that this limiting value is intended for unsymmetrical sections such as T-sections and should not be applied to W, M, or S-sections.

Finally, in determining the values of n_{avg} listed in Table 5, often a few of the values which appeared to skew the average within each nominal depth were dropped to obtain more realistic averages for the majority of sections. Such values typically belong to a few of the lightest sections within each nominal depth.

BEAM-COLUMNS WITH RELATIVELY SMALL AXIAL LOAD

In cases when a beam-column is subjected to relatively small

axial loads, we may have $\frac{P_u}{\phi P_n} < 0.2$, in which case Equation

3 applies rather than Equation 2. Equation 3 accounts for the low axial load ratio and allows for larger applied moments about both the x- and y-axes. Figure 1, presented earlier, illustrates the interaction between the axial load and bending moment about the x-axis for a given beam-column for normal and low axial loads.

Equation 3 may be written in terms of coefficients b , m , and n as follows.

$$0.5bP_u + (9/8)(mM_{ux} + nM_{uy}) \leq 1.0 \quad (18)$$

The condition for Equation 3 (or its equivalent, Equation 18) to be applicable instead of Equation 2 (or its equivalent, Equation 9) may be stated as follows.

$$\frac{P_u}{\phi P_n} = bP_u < 0.20 \quad (19)$$

Therefore, if $\frac{P_u}{\phi P_n} = bP_u \geq 0.2$, Equation 9 should be used

to check the beam-column. Similarly, if $\frac{P_u}{\phi P_n} = bP_u < 0.20$, Equation 18 should be used.

RECOMMENDED PROCEDURE FOR USE OF THE PROPOSED DESIGN AIDS

The following procedure applies to beam-columns with

$$\frac{P_u}{\phi P_n} = bP_u \geq 0.2. \text{ For } \frac{P_u}{\phi P_n} = bP_u < 0.20, \text{ replace Equation 9}$$

with Equation 18 in the following procedure.

1. If bending about the x-axis appears to be more dominant than the axial load, select an initial value for b_{avg} from Table 3 for the desired nominal depth. Otherwise, select an initial value for m_{avg} from Table 4. If bending about the y-axis is present, also select a value for n_{avg} from Table 5.
2. Use Equation 9 and b or m (and n if applicable) found in Step 1 to solve for m or b .
3. From Table 2, select a section with the approximate values of b , m , and n found in Step 2.
4. Use b , m , and n for the section selected in Step 3 to check Equation 9.
5. Repeat Steps 3 and 4 for different sections until b , m , and n stabilize and the value of the interaction Equation 9 is equal to or close to unity.

Note 1: A feature of Table 2 is that the values of b , m , and n will converge quickly in Steps 2 and 3, even if the designer starts with poor estimates for the coefficients.

Note 2: Recall that the values listed for b , m , and n in Tables 2 through 5 are 1,000 times their actual values and should be multiplied by 10^{-3} before use.

EXAMPLES

The following examples are variations of problems in the well-respected textbook *Steel Structures, Design and Behavior, 4th Edition*, by Salmon and Johnson (1996) as well as the *AISC LRFD Manual (1994)*. They are re-worked using the current method as well as the method and design aids proposed in this paper. Only the problem information is repeated here, not the exact solutions in the references. Specifically, parts of the solutions that are not affected by the method of design, such as calculation of B_1 or C_m are either skipped, approximated, or values are used from the appropriate reference book. All pertinent parts are shown for both methods for comparison of the methods. The AISC Specifications requirement for limiting the width-thickness ratio of webs in combined flexural and axial compression is left out in all examples.

Example 1 — Beam-Column with bending about x-axis only (variation of example 12.13.3 of the Salmon and Johnson textbook):

Given: $P_u = 179$ kips, $M_{ux} = 47.6$ ft-kips, braced frame, $(KL)_x = 16$ ft, $(KL)_y = L_b = 8$ ft. Let $C_b = 1.0$.

Find: Lightest W-section of A36 steel for this beam-column.

Solution using the current method of practice:

Assume $(KL)_y$ is critical, from Table 3-2 of the AISC Manual, $m = 2.1$ (by extrapolation)

$$P_{ueq} = 179 + 47.6(2.1) = 279 \text{ kips}$$

From the Column Load Tables consider a W10×39 ($\phi P_n = 311$ kips). A W12×40 and a W14×43 may also be considered if a W10×39 is no good. W12×35 and W14×38 are also possibilities, though these shapes are not listed in the Column Load Tables.

For W10×39; Use $m = 2.2$, $P_{ueq} = 179 + 47.6(2.2) = 284$ kips, value of m stabilized.

$$\frac{(KL)_x}{(KL)_y} = \frac{16}{8} = 2.0 < \frac{r_x}{r_y} = 2.16 \rightarrow \text{y-dir. critical, as assumed}$$

$\rightarrow \phi P_n = 311$ kips (From AISC Column Load Tables)

$$\frac{P_u}{\phi P_n} = \frac{179}{311} = 0.58 > 0.2 \rightarrow \text{use AISC Equation H1-1a}$$

$$\left. \begin{aligned} \frac{b_f}{2t_f} &= 7.5 < \frac{65}{\sqrt{36}} = 10.8 \rightarrow \text{OK} \\ \frac{h}{t_w} &= 25.0 < \frac{640}{\sqrt{36}} = 107 \rightarrow \text{OK} \end{aligned} \right\} \rightarrow \text{compact section}$$

$$L_b = 8.0 \text{ ft} < L_p = 8.3 \text{ ft (from Column Load Tables)}$$

$$\phi M_n = \phi M_p = \frac{0.9Z_x F_y}{12} = \frac{0.9(46.8)(36)}{12} = 126 \text{ ft-kips}$$

$C_m = 1.0$ and $B_1 = 1.12$ (calculations not shown), braced frame, B_2 not needed.

$$M_{ux} = B_1 M_{ux} = (1.12)(47.6) = 53.3 \text{ ft-kips}$$

AISC Equation H1-1a yields;

$$\begin{aligned} \frac{P_u}{\phi P_n} + \frac{8}{9} \left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) &= \frac{179}{311} + \frac{8}{9} \left(\frac{53.3}{126} \right) \\ &= 0.58 + 0.38 = 0.96 < 1.0 \end{aligned}$$

\rightarrow Section is adequate.

Try W12×35. The referenced textbook states that a check of W12×35 shows that it is not adequate, but does not show the work involved. However, this section is checked here to illustrate the difference in length of complete solutions using the two methods under consideration.

Note that a W12×35 is not listed in the AISC Column Load Tables. Therefore, ϕP_n can not be looked up.

Calculate ϕP_n for a W12×35.

$$\frac{(KL)_x}{(KL)_y} = \frac{16}{8} = 2.0 < \frac{r_x}{r_y} = \frac{5.25}{1.54} = 3.41 \rightarrow y\text{-dir. critical.}$$

$$\lambda_c = \frac{(8)(12)}{\pi(1.54)} \sqrt{\frac{36}{29,000}} = 0.70 < 1.5 \rightarrow \text{use AISC}$$

Equation E2-2.

$$\phi P_n = (0.85) \left[0.658^{(0.70)^2} \right] (36) (10.3) = 257 \text{ kips}$$

$$\frac{P_u}{\phi P_n} = \frac{179}{257} = 0.70 > 0.2 \rightarrow \text{use AISC Equation H1-1a}$$

$$\left. \begin{aligned} \frac{b_f}{2t_f} &= 6.3 < \frac{65}{\sqrt{36}} = 10.8 \rightarrow \text{OK} \\ \frac{h}{t_w} &= 36.2 < \frac{640}{\sqrt{36}} = 107 \rightarrow \text{OK} \end{aligned} \right\} \rightarrow \text{compact section}$$

$$L_p = \frac{300(1.54)}{\sqrt{36}} = 77 \text{ in.} \approx 6.4 \text{ ft} > L_b = 8 \text{ ft} \rightarrow \text{find } L_r$$

$$L_r = \frac{(1.54)(2,420)}{(36 - 10)} \sqrt{1 + \sqrt{1 + (0.004340)(36 - 10)^2}}$$

$$= 248 \text{ in.} \approx 20.6 \text{ ft}$$

$$L_p < L_b < L_r \rightarrow \text{find } \phi M_p \text{ and } \phi M_r$$

$$\phi M_p = \frac{0.9Z_x F_y}{12} = \frac{0.9(51.2)(36)}{12} = 138 \text{ ft-kips}$$

$$\phi M_r = \frac{0.9S_x(F_y - 10)}{12} = \frac{0.9(45.6)(36 - 10)}{12} = 88.9 \text{ ft-kips}$$

$$\phi M_n = 138 - (138 - 88.9) \left(\frac{8.0 - 6.4}{20.6 - 6.4} \right) = 132 \text{ ft-kips}$$

$C_m = 1.0$ and $B_1 = 1.10$ (calculations not shown), braced frame, B_2 not needed.

$$M_{ux} = B_1 M_{nt} = (1.10)(47.6) = 52.4 \text{ ft-kips}$$

Equation 3 (AISC H1-1a) yields;

$$\frac{P_u}{\phi P_n} + \frac{8}{9} \left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) = \frac{179}{257} + \frac{8}{9} \left(\frac{52.4}{132} \right)$$

$$= 0.70 + 0.35 = 1.05 > 1.0$$

\rightarrow Section is not adequate.

Use W10x39 A36 steel.

Solution using the method and design aids proposed here:

Consider W10's. Since the axial load is relatively large look

up m_{avg} .

$$\text{From Table 4 obtain } m_{avg} = 10.61 \times 10^{-3}$$

$$\text{Equation 9 yields; } b(179) + (10.61 \times 10^{-3})(47.6) = 1.0$$

$$\rightarrow b_{req} = 2.77 \times 10^{-3}$$

From Table 2, try W10x39. Note that W10x45 has b and m values that are equal or smaller than those initially used and will work.

$C_m = 1.0$ and $B_1 = 1.12$ (calculations not shown), braced frame, B_2 not needed.

$$M_{ux} = B_1 M_{nt} = (1.12)(47.6) = 53.3 \text{ ft-kips}$$

$$(KL)_y' = \frac{16}{2.16} = 7.41 < (KL)_y = 8.0$$

\rightarrow use $L_a = (KL)_y = 8.0 \text{ ft}$ to look up b from Table 2.

$$bP_u = (3.22 \times 10^{-3})(179) = 0.58 > 0.20 \rightarrow \text{use Equation 9}$$

$$0.58 + (7.03 \times 10^{-3})(53.3) = 0.58 + 0.37 = 0.95 < 1.0$$

\rightarrow section is adequate

Try W12x35.

$C_m = 1.0$ and $B_1 = 1.10$ (calculations not shown), braced frame, B_2 not needed.

$$M_{ux} = B_1 M_{nt} = (1.10)(47.6) = 52.4 \text{ ft-kips}$$

$$(KL)_y' = \frac{(16)(1.54)}{(5.25)} = 4.7 < (KL)_y = 8.0$$

\rightarrow use $L_a = (KL)_y = 8.0 \text{ ft}$ to look up b from Table 2.

$$bP_u = (3.89 \times 10^{-3})(179) = 0.70 > 0.20 \rightarrow \text{use Equation 9}$$

$$0.70 + (6.70 \times 10^{-3})(52.4) = 0.70 + 0.35 = 1.05 > 1.0$$

\rightarrow section is not adequate.

Use W10x39 A36 steel.

Note that the amount of work to check W12x35 using the proposed method is significantly less than that of the current method of practice.

Example 2 — Beam-Column with bending about both axes (variation of Example 3-4 of the AISC Manual):

Given: $P_u = 400 \text{ kips}$, $M_{ux} = 250 \text{ ft-kips}$, $M_{uy} = 80 \text{ ft-kips}$, braced frame, $(KL)_x = (KL)_y = L_b = 14 \text{ ft}$, $C_m = 0.85$. Let $C_b = 1.0$.

Find: Select the lightest W14 section of $F_y = 50 \text{ ksi}$ steel for this beam-column.

Solution using the current method of practice:

For $KL = 14 \text{ ft}$, from Table 3-2 of the AISC Manual obtain $m = 1.4$. Let $u = 2$.

$$P_{ueq} = 400 + 250(1.4) + 80(1.4)(2) = 974 \text{ kips}$$

From the Column Load Tables consider W14x90, $\phi P_n = 969 \text{ kips}$

Calculate P_{ueq} using $m = 1.4$ and (from Column Load Tables): $u = 1.94$

$$P_{ueq} = 400 + 250(1.4) + 80(1.4)(1.94) = 967 \text{ kips, } m \text{ and } u \text{ have stabilized.}$$

Check W14x90 for compliance with the AISC Specifications.

$(KL)_x = (KL)_y = 14 \text{ ft} \rightarrow \text{y-dir. critical}$
 From Column Load Tables; $\phi P_n = 969 \text{ kips}$

$$\left. \begin{array}{l} P_{ex} = 10,123 \text{ kips} \\ P_{ey} = 3,684 \text{ kips} \\ B_{1x} = 1.0 \\ B_{1y} = 1.0 \end{array} \right\} \text{from Example 3-4 of the AISC Manual}$$

$$M_{ux} = 1.0 \times 250 = 250 \text{ ft-kips}$$

$$M_{uy} = 1.0 \times 80 = 80 \text{ ft-kips}$$

$$\left. \begin{array}{l} \lambda_p = \frac{65}{\sqrt{50}} = 9.2 < \frac{b_f}{2t_f} = 10.2 \\ < \lambda_r = \frac{141}{\sqrt{50-10}} = 22.3 \\ \frac{h}{t_w} = 25.9 < \frac{640}{\sqrt{50}} = 90.5 \rightarrow \text{OK} \end{array} \right\} \rightarrow \text{noncompact section}$$

Note: Although properties of this noncompact section are listed in the Z_x -Tables of the AISC Manual, those properties are calculated here again to illustrate the difference between the two methods as applied to a noncompact section. Recall that not all sections are included in the Column Load Tables.

$$\phi M_{px} = \frac{0.9Z_x F_y}{12} = \frac{0.9(157)(50)}{12} = 589 \text{ ft-kips}$$

$$\phi M_{rx} = \frac{0.9(143)(50-10)}{12} = 429 \text{ ft-kips}$$

$$\phi M_{nx} = \phi M_{nx}' = \phi M_{px} - (\phi M_{px} - \phi M_{rx}) \left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p} \right)$$

$$= 589 - (589 - 429) \left(\frac{10.2 - 9.2}{22.3 - 9.2} \right) = 577 \text{ ft-kips}$$

$$L_p = \frac{(300)(3.70)}{\sqrt{50}} = 157 \text{ in.} \equiv 13.1 \text{ ft}$$

$$L_r = \frac{(3.70)(2,900)}{(50-10)} \sqrt{1 + \sqrt{1 + (0.001750)(50-10)^2}}$$

$$= 461 \text{ in.} \equiv 38.4 \text{ ft}$$

$$L_p' = 13.1 + (38.4 - 13.1) \left(\frac{589 - 577}{589 - 429} \right) = 15.0 \text{ ft}$$

$$L_b = 14.0 \text{ ft} < L_p' = 15.0 \text{ ft} \rightarrow \phi M_n = \phi M_n' = 577 \text{ ft-kips}$$

In Example 3-4 of the AISC Manual, it is stated that $\phi M_{ny} = \phi M_{py} = 284$ which is incorrect for this noncompact section. Calculation of ϕM_{ny} follows.

$$\phi M_{py} = \frac{0.9Z_y F_y}{12} = \frac{0.9(75.6)(50)}{12} = 284 \text{ ft-kips}$$

$$\phi M_{ry} = \phi S_y (F_y - 10) = 0.9(49.9)(50 - 10) = 1,796 \text{ in.-kips}$$

$$\equiv 150 \text{ ft-kips}$$

$$\phi M_{ny} = \phi M_{ny}' = \phi M_{py} - (\phi M_{py} - \phi M_{ry}) \left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p} \right)$$

$$= 284 - (284 - 150) \left(\frac{10.2 - 9.2}{22.3 - 9.2} \right) = 274 \text{ ft-kips}$$

$$\frac{P_u}{\phi P_n} = \frac{400}{969} = 0.41 > 0.2 \rightarrow \text{use AISC Equation H1-1a}$$

$$\frac{P_u}{\phi P_n} + \frac{8}{9} \left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) = \frac{400}{969} + \frac{8}{9} \left(\frac{250}{577} + \frac{80}{274} \right)$$

$$= 0.41 + 0.39 + 0.26 = 1.06 > 1.0 \rightarrow \text{N.G.}$$

At this point the AISC Manual simply says to use W14×99. However, this section is checked here for compliance with the AISC Specifications.

Try W14×99.

$(KL)_x = (KL)_y = 14 \text{ ft} \rightarrow \text{y-dir. critical}$

From Column Load Tables; $\phi P_n = 1,060 \text{ kips}$

$$\left. \begin{array}{l} P_{ex} = 11,260 \text{ kips} \\ P_{ey} = 4,055 \text{ kips} \\ B_{1x} = 1.0 \\ B_{1y} = 1.0 \end{array} \right\} \text{calculations not shown}$$

$$M_{ux} = 1.0 \times 250 = 250 \text{ ft-kips}$$

$$M_{uy} = 1.0 \times 80 = 80 \text{ ft-kips}$$

$$\left. \begin{array}{l} \lambda_p = \frac{65}{\sqrt{50}} = 9.2 < \frac{b_f}{2t_f} = 9.3 \\ < \lambda_r = \frac{141}{\sqrt{50-10}} = 22.3 \\ \frac{h}{t_w} = 23.5 < \frac{640}{\sqrt{F_y}} = 90.5 \rightarrow \text{OK} \end{array} \right\} \rightarrow \text{noncompact section}$$

$$\phi M_{px} = \frac{0.9Z_x F_y}{12} = \frac{0.9(173)(50)}{12} = 649 \text{ ft-kips}$$

$$\phi M_{rx} = \frac{0.9(157)(50-10)}{12} = 471 \text{ ft-kips}$$

$$\phi M_{nx} = \phi M_{nx}' = \phi M_{px} - (\phi M_{px} - \phi M_{rx}) \left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p} \right)$$

$$= 649 - (649 - 471) \left(\frac{9.3 - 9.2}{22.3 - 9.2} \right) = 648 \text{ ft-kips}$$

$$L_p = \frac{(300)(3.71)}{\sqrt{50}} = 157 \text{ in.} \equiv 13.1 \text{ ft}$$

$$L_r = \frac{(3.71)(3,190)}{(50-10)} \sqrt{1 + \sqrt{1 + (0.001220)(50-10)^2}}$$

$$= 488 \text{ in.} \equiv 40.6 \text{ ft}$$

$$L_p' = 13.1 + (40.6 - 13.1) \left(\frac{649 - 648}{649 - 471} \right) = 13.3 \text{ ft}$$

$$L_p' = 13.3 \text{ ft} < L_b = 14.0 \text{ ft} < L_r = 40.6 \text{ ft}$$

$$\phi M_{nx} = 648 - (648 - 471) \left(\frac{14.0 - 13.3}{40.6 - 13.3} \right) = 644 \text{ ft-kips}$$

$$\phi M_{py} = \frac{0.9Z_y F_y}{12} = \frac{0.9(83.6)(50)}{12} = 314 \text{ ft-kips}$$

$$\phi M_{ry} = \phi S_y (F_y - 10) = 0.9(55.2)(50 - 10) = 1,987 \text{ in.-kips} \\ \equiv 166 \text{ ft-kips}$$

$$\phi M_{ny} = \phi M_{ny}' = \phi M_{py} - (\phi M_{py} - \phi M_{ry}) \left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p} \right) \\ = 314 - (314 - 166) \left(\frac{9.3 - 9.2}{22.3 - 9.2} \right) = 313 \text{ ft-kips}$$

$$\frac{P_u}{\phi P_n} = \frac{400}{1,060} = 0.38 > 0.2 \rightarrow \text{use AISC Equation H1-1a}$$

$$\frac{P_u}{\phi P_n} + \frac{8}{9} \left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) = \frac{400}{1,060} + \frac{8}{9} \left(\frac{250}{648} + \frac{80}{313} \right)$$

$$= 0.38 + 0.34 + 0.23 = 0.95 < 1.0 \rightarrow \text{OK}$$

Select W14x99 A572 Grade 50 steel.

Note: It is obvious that, though W14x99 is a noncompact section, its width-thickness ratios are very close to the limiting factors. Therefore, design flexural strengths about the x- and y-axes will be very close to the corresponding ϕM_n 's. However, these values were calculated here to illustrate the work ordinarily involved in checking a noncompact section.

Solution using the method and design aids proposed here:

Consider W14's. From Table 4, use $m_{avg} = 1.37$, and from Table 5 let $n = 3.5$.

Use Equation 9 to find b ; $b(400) + (1.37 \times 10^{-3})(250) + (3.5 \times 10^{-3})(80) = 1.0 \rightarrow b = 0.94 \times 10^{-3}$

From Table 2 find a W14 section with b , m , and n values roughly less than or equal to the above numbers.

Consider W14x99, $b = 0.94 \times 10^{-3}$, $m = 1.38 \times 10^{-3}$, $n = 2.87 \times 10^{-3}$

$$(KL)_x = (KL)_y = 14 \text{ ft} \rightarrow \text{y-dir. critical}$$

From Column Load Tables; $\phi P_n = 1,060$ kips

$$\left. \begin{array}{l} P_{ex} = 11,260 \text{ kips} \\ P_{ey} = 4,055 \text{ kips} \\ B_{1x} = 1.0 \\ B_{1y} = 1.0 \end{array} \right\} \text{calculations not shown}$$

$$M_{ux} = 1.0 \times 250 = 250 \text{ ft-kips}$$

$$M_{uy} = 1.0 \times 80 = 80 \text{ ft-kips}$$

$$bP_u = (0.94 \times 10^{-3})(400) = 0.38 > 0.2 \rightarrow \text{use Equation 9} \\ (0.94 \times 10^{-3})(400) + (1.38 \times 10^{-3})(250) + (2.87 \times 10^{-3})(80) \\ = 0.38 + 0.35 + 0.23 = 0.95 < 1.0 \rightarrow \text{Section OK.}$$

Consider W14x90, $b = 1.03 \times 10^{-3}$, $m = 1.54 \times 10^{-3}$, $n = 3.28 \times 10^{-3}$

$$(KL)_x = (KL)_y = 14 \text{ ft} \rightarrow \text{y-dir. critical}$$

From Column Load Tables; $\phi P_n = 969$ kips

$$\left. \begin{array}{l} P_{ex} = 10,123 \text{ kips} \\ P_{ey} = 3,684 \text{ kips} \\ B_{1x} = 1.0 \\ B_{1y} = 1.0 \end{array} \right\} \text{from Example 3-4 of the AISC Manual}$$

$$M_{ux} = 1.0 \times 250 = 250 \text{ ft-kips}$$

$$M_{uy} = 1.0 \times 80 = 80 \text{ ft-kips}$$

$$bP_u = (1.03 \times 10^{-3})(400) = 0.41 > 0.2 \rightarrow \text{use Equation 9} \\ (1.03 \times 10^{-3})(400) + (1.54 \times 10^{-3})(250) + (3.28 \times 10^{-3})(80) \\ = 0.41 + 0.39 + 0.26 = 1.06 > 1.0 \rightarrow \text{N.G.}$$

Use W14x99 A572 Grade 50 steel.

Example 3—Beam-Column with relatively small axial load (variation of example 12.13.1 of the Salmon and Johnson textbook):

Given: $P_u = 159$ kips, $M_{nt} = 560$ ft-kips, constant moment, braced frame, $(KL)_x = (KL)_y = L_b = 14$ ft.

Find: Determine if a W14x132 section of A36 steel is adequate.

Solution using the current method of practice:

$B_1 = 1.01$ (see example 12.13.1 in Salmon and Johnson textbook), braced frame, B_2 not needed.

$$\rightarrow M_{ux} = B_1 M_{nt} = (1.01)(560) = 566 \text{ ft-kips}$$

$$(KL)_x = (KL)_y = 14 \text{ ft}, \rightarrow \phi P_n = 1,070 \text{ kips (from Column Load Tables)}$$

$$\frac{P_u}{\phi P_n} = \frac{159}{1,070} = 0.149 < 0.2 \rightarrow \text{use AISC Equation H1-1b}$$

$$\left. \begin{array}{l} \frac{b_f}{2t_f} = 7.1 < \frac{65}{\sqrt{36}} = 10.8 \rightarrow \text{OK} \\ \frac{h}{t_w} = 17.7 < \frac{640}{\sqrt{36}} = 107 \rightarrow \text{OK} \end{array} \right\} \rightarrow \text{compact section}$$

$L_b = 14 \text{ ft} < L_p = 15.7 \text{ ft}$ (from Column Load Tables) $\rightarrow C_b$ need not be considered and

$$\phi M_n = \phi M_p = \frac{0.9Z_x F_y}{12} = \frac{0.9(234)(36)}{12} = 632 \text{ ft-kips}$$

Equation 3 (AISC H1-1b) yields;

$$\frac{P_u}{2\phi P_n} + \left(\frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) = \frac{159}{2(971)} + \frac{566}{632}$$

$$= 0.08 + 0.90 + 0.98 \leq 1.0 \rightarrow \text{Section is adequate.}$$

Solution using the method and design aids proposed here:

$B_1 = 1.01$ (see example 12.13.1 in Salmon and Johnson textbook), braced frame, B_2 not needed.

$$\rightarrow M_{ux} = B_1 M_{nt} = (1.01)(560) = 566 \text{ ft-kips}$$

From Table 2, $b = 0.94 \times 10^{-3}$, $m = 1.41 \times 10^{-3}$,
 $bP_u = (0.94 \times 10^{-3})(159) = 0.15 < 0.2 \rightarrow$ use Equation 18;
 $L_b = 14.0 \text{ ft} < L_p = 15.7 \text{ ft}$ (from Table 2) $\rightarrow C_b$ need not be considered

$$0.5bP_u + (9/8)(mM_{ux} + nM_{uy}) = 0.5(0.15)$$

$$+ (9/8)(1.41 \times 10^{-3})(566) = 0.08 + 0.90 = 0.98 < 1.0$$

W14x132 is adequate.

Note 1: From Table 2, W18x119 and W21x101 also work, but are deeper than W14x132. These sections are more effective in bending due to smaller m -values.

Note 2: As expected, the values of the components of the interaction equations in all examples illustrated here (e.g. 0.08 and 0.90 in example 3) are equal for a given section under consideration, regardless of the method of design. Any differences between these values are minor and due to rounding of numbers.

USING THE PROPOSED DESIGN AIDS FOR BETTER DESIGN

According to the AISC Specifications, the three components that make up Equations 9 and 18 should add up to one or less for the member to be acceptable. For a set of given conditions, and assuming no changes in P_u , M_{ux} , and M_{uy} , smaller values of b , m , and n result in smaller components and lower total for the left hand side of the interaction equation and consequently a more efficient section. Therefore, when selecting sections, it is desirable to choose those with smaller values of b , m , and n .

Table 2 also allows designers to select sections that are more efficient for a given set of conditions. For example, if a beam-column is subjected to relatively large axial load, the designer may select a section with a smaller b value, though m and n may be slightly larger than those of another section. Due to the dominating role of the first term in Equation 9, in such a case, this combination may still lead to a smaller total.

A similar idea can be extended to members with a large bending moment about their x- and/or y-axes.

OTHER BENEFITS OF THE PROPOSED DESIGN AIDS

Table 2 offers additional benefits to the designer than the applications discussed thus far. In particular, one may determine the design axial strength as well as the design flexural strength (about both axes) of a section under a set of conditions using the coefficients listed in this table.

As presented earlier, Equations 6 through 8 show the relationship between the coefficients b , m , and n and the design axial strength, design bending strength about the x-axis, and the design bending strength about the y-axis, respectively. Therefore, in order to determine the design strength of a particular section under certain conditions, one may look up the appropriate coefficient from Table 2 and find the desired property through a short and simple calculation.

It should be noted that, although the design strengths of many sections are listed in numerous design aids available in the AISC Manual, Table 2 covers many more sections than any of those aids alone. Further, most design aids currently available in the AISC Manual, understandably, provide either the design axial strength or the design bending strength about the x-axis only. Table 2 allows easy calculation of ϕP_n , ϕM_{nx} , and ϕM_{ny} for many sections and for a range of conditions such as a variety of KL 's and L_b 's.

The author wishes to emphasize that he does not claim that Table 2 is a comprehensive design aid for calculation of the design strengths under all conditions. Nor does he claim that Table 2 should be used in lieu of the existing aids for design of beams and columns in the AISC Manual. It is simply suggested that Table 2 offers certain additional information, which may benefit the designer in certain cases. Several examples of such applications of Table 2 follow. It is noted that in none of these examples is it necessary to check width-thickness ratio, L_p , L_r , etc.

Another benefit of the new design aids is that one can select more efficient sections for a given set of axial load and bending moments. For example, a section with a b -value half of that of another section is twice as effective in carrying axial loads and is more effective for cases with larger axial loads. This type of information allows designers to select more efficient sections for the particular axial load and moments given.

Example 4:

Given: W24x117, $(KL)_x = (KL)_y = 14 \text{ ft}$, and A36 steel, determine ϕP_n .

Solution: $(KL)_x = (KL)_y \rightarrow$ From Table 2, $b = 1.13 \times 10^{-3}$
 $\rightarrow \phi P_n = \frac{1}{b} = \frac{1}{1.13 \times 10^{-3}} = 885 \text{ kips}$

Example 5:

Given: W16×67, $(KL)_x = 25$ ft, $(KL)_y = 5$ ft, and A36 steel, determine ϕP_n .

Solution:

$$(KL)_y' = \frac{(KL)_x(r_y)}{r_x} = \frac{(25)(2.46)}{6.96} = 8.8 > (KL)_y \rightarrow \text{use } (KL)_y'$$

From Table 2, $b = 1.83 \times 10^{-3}$ for $(KL)_y' = 8.8$ (by interpolation)

$$\rightarrow \phi P_n = \frac{1}{b} = \frac{1}{1.83 \times 10^{-3}} = 546 \text{ kips}$$

Example 6:

Given: W12×65, $L_b = 16$ ft, $C_b = 1.0$, Grade 50 steel, determine ϕM_{nx} and ϕM_{ny} .

Solution: for $L_a = 16$ ft, $m = 2.63 \times 10^{-3}$

$$\rightarrow \phi M_{nx} = \frac{8}{9m} = \frac{8}{9(2.63 \times 10^{-3})} = 3.38 \text{ ft-kips}$$

Similarly, From Table 2, $n = 5.57 \times 10^{-3}$

$$\rightarrow \phi M_{ny} = \frac{8}{9n} = \frac{8}{9(5.57 \times 10^{-3})} = 160 \text{ ft-kips}$$

Note that W12×65 is noncompact in Grade 50 steel and that $L_b = 16$ ft $>$ $L_p' = 11.8$ ft. However, it is not necessary to check any of that information when using Table 2.

Example 7:

Given: W24×131, $L_b = 16$ ft, $C_b = 1.3$, A36 steel, determine ϕM_{nx} .

Solution: $L_b = 16$ ft $>$ $L_p = 12.4$ ft (from Table 2) \rightarrow consider C_b

From Table 2, $m = 0.93 \times 10^{-3}$

$$\rightarrow \phi M_{nx} = \frac{8}{9n} = \frac{8}{9(0.93 \times 10^{-3})} = 956 \text{ ft-kips for } C_b = 1.0$$

For $C_b = 1.3$, $\phi M_{nx} = (1.3)(956) = 1,243$ ft-kips $\leq \phi M_p = 999$ ft-kips (from Table 2), $\rightarrow \phi M_{nx} = \phi M_p = 999$ ft-kips.

Example 8:

Given: $M_u = 500$ ft-kips, $L_b = 12$ ft, $C_b = 1.0$, A36 steel, select the lightest W24 section.

Solution: Let $M_u = \phi M_{nx} = \frac{8}{9m}$ or

$$m_{req} = \frac{8}{9M_u} = \frac{8}{9(500)} = 1.8 \times 10^{-3}$$

From Table 2, look under $L_a = 12$ ft, for a section with $m = 1.8 \times 10^{-3}$ or smaller. Use W24×84.

SUMMARY OF ADVANTAGES OF THE NEW DESIGN AIDS

The new design aids developed and presented in this paper offer the following advantages:

1. Save time in design — compactness, L_b versus L_p and L_r , already accounted for,
2. KL and L_b need not be equal, tables cover a range of KL 's and L_b 's,
3. Can select more efficient sections with appropriate b , m , and n coefficients depending on the relative magnitude of the applied axial load and bending moments,
4. Can choose from a wide range of sections — selection not limited to “column” sections,
5. Designer can easily judge efficiency of a section by observing its values of b , m , and n coefficients,
6. Tables provide additional helpful information such as ϕP_n , ϕM_{nx} , ϕM_{ny} , ϕM_p , and L_p for a large number of sections,

DISCLAIMER

The findings and opinions presented in this paper are those of the author. The designer is expected to use his/her own knowledge and engineering judgement in accepting or rejecting any or all contents of this paper, as (s)he is solely responsible for the final design. While the author has presented here what he believes to be true and accurate, he can not accept any responsibility for any errors in what is presented in this paper, nor for any undesirable consequences of its use.

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Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi															
L_p				8		9		10		11		12		13	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W40X328	17.3	4077	1.19	0.35	0.22	0.35	0.22	0.35	0.22	0.36	0.22	0.36	0.22	0.37	0.22
W40X298	17.2	3699	1.31	0.38	0.24	0.39	0.24	0.39	0.24	0.39	0.24	0.40	0.24	0.40	0.24
W40X268	17.0	3294	1.47		0.27		0.27		0.27		0.27		0.27		0.27
W40X244	16.8	2970	1.66		0.30		0.30		0.30		0.30		0.30		0.30
W40X221	16.3	2611	1.96		0.34		0.34		0.34		0.34		0.34		0.34
W40X192	15.4	2179	2.52		0.41		0.41		0.41		0.41		0.41		0.41
W40X655	16.1	8262	0.65	0.18	0.11	0.18	0.11	0.18	0.11	0.18	0.11	0.18	0.11	0.19	0.11
W40X593	15.9	7425	0.73	0.19	0.12	0.20	0.12	0.20	0.12	0.20	0.12	0.20	0.12	0.21	0.12
W40X531	15.6	6615	0.83	0.22	0.13	0.22	0.13	0.22	0.13	0.22	0.13	0.23	0.13	0.23	0.13
W40X480	15.5	5886	0.93	0.24	0.15	0.24	0.15	0.25	0.15	0.25	0.15	0.25	0.15	0.26	0.15
W40X436	15.3	5346	1.04	0.28	0.17	0.27	0.17	0.27	0.17	0.27	0.17	0.28	0.17	0.28	0.17
W40X397	15.2	4833	1.15	0.29	0.18	0.30	0.18	0.30	0.18	0.30	0.18	0.31	0.18	0.31	0.18
W40X362	15.0	4401	1.27	0.32	0.20	0.32	0.20	0.33	0.20	0.33	0.20	0.34	0.20	0.34	0.20
W40X324	14.9	3942	1.43	0.36	0.23	0.36	0.23	0.36	0.23	0.37	0.23	0.37	0.23	0.38	0.23
W40X297	14.8	3591	1.59	0.39	0.25	0.39	0.25	0.40	0.25	0.40	0.25	0.41	0.25	0.41	0.25
W40X277	14.9	3375	1.66	0.42	0.26	0.42	0.26	0.43	0.26	0.43	0.26	0.44	0.26	0.44	0.26
W40X249	14.8	3024	1.86		0.29		0.29		0.29		0.29		0.29		0.29
W40X215	14.8	2600	2.17		0.34		0.34		0.34		0.34		0.34		0.34
W40X199	14.4	2344	2.49		0.38		0.38		0.38		0.38		0.38		0.38
W40X183	10.4	2109	3.86		0.42		0.42		0.42		0.43		0.43		0.44
W40X167	10.0	1868	4.58		0.48		0.48		0.48		0.48		0.49		0.50
W40X149	9.5	1612	5.66		0.55		0.55		0.56		0.57		0.58		0.59
W36X848	17.8	10341	0.44	0.13	0.09	0.14	0.09	0.14	0.09	0.14	0.09	0.14	0.09	0.14	0.09
W36X798	17.7	9639	0.47	0.14	0.09	0.14	0.09	0.15	0.09	0.15	0.09	0.15	0.09	0.15	0.09
W36X720	17.4	8613	0.53	0.16	0.10	0.18	0.10	0.18	0.10	0.18	0.10	0.18	0.10	0.17	0.10
W36X650	17.2	7668	0.60	0.18	0.12	0.18	0.12	0.18	0.12	0.18	0.12	0.18	0.12	0.19	0.12
W36X588	17.0	6885	0.67	0.20	0.13	0.20	0.13	0.20	0.13	0.20	0.13	0.20	0.13	0.21	0.13
W36X527	16.8	6129	0.76	0.22	0.15	0.22	0.15	0.22	0.15	0.22	0.15	0.23	0.15	0.23	0.15
W36X485	16.6	5589	0.83	0.24	0.16	0.24	0.16	0.24	0.16	0.24	0.16	0.25	0.16	0.25	0.16
W36X439	16.5	5022	0.93	0.26	0.18	0.27	0.18	0.27	0.18	0.27	0.18	0.27	0.18	0.28	0.18
W36X393	16.3	4482	1.06	0.29	0.20	0.30	0.20	0.30	0.20	0.30	0.20	0.31	0.20	0.31	0.20
W36X359	16.1	4077	1.17	0.32	0.22	0.32	0.22	0.33	0.22	0.33	0.22	0.33	0.22	0.34	0.22
W36X328	16.0	3726	1.28	0.35	0.24	0.35	0.24	0.36	0.24	0.36	0.24	0.37	0.24	0.37	0.24
W36X300	16.0	3402	1.41	0.38	0.26	0.39	0.26	0.39	0.26	0.39	0.26	0.40	0.26	0.40	0.26
W36X280	15.9	3159	1.52	0.41	0.28	0.41	0.28	0.42	0.28	0.42	0.28	0.43	0.28	0.43	0.28
W36X260	15.8	2916	1.66	0.44	0.30	0.45	0.30	0.45	0.30	0.46	0.30	0.46	0.30	0.47	0.30
W36X245	15.6	2727	1.78	0.47	0.33	0.47	0.33	0.48	0.33	0.48	0.33	0.49	0.33	0.50	0.33
W36X230	15.5	2546	1.93	0.50	0.35	0.51	0.35	0.51	0.35	0.52	0.35	0.52	0.35	0.53	0.35
W36X256	11.0	2808	2.54	0.46	0.32	0.47	0.32	0.48	0.32	0.49	0.32	0.51	0.32	0.52	0.32
W36X232	10.9	2527	2.84	0.52	0.35	0.52	0.35	0.54	0.35	0.55	0.35	0.56	0.36	0.58	0.36
W36X210	10.8	2249	3.25	0.57	0.40	0.58	0.40	0.59	0.40	0.61	0.40	0.62	0.40	0.64	0.41
W36X194	10.7	2071	3.55		0.43		0.43		0.43		0.43		0.44		0.45
W36X182	10.6	1939	3.81		0.46		0.46		0.46		0.46		0.47		0.48
W36X170	10.5	1804	4.13		0.49		0.49		0.49		0.50		0.51		0.51
W36X160	10.4	1685	4.47		0.53		0.53		0.53		0.53		0.54		0.55
W36X150	10.3	1569	4.87		0.57		0.57		0.57		0.57		0.59		0.60
W36X135	9.9	1374	5.82		0.65		0.65		0.65		0.66		0.67		0.69
W33X619	16.6	6912	0.65	0.19	0.13	0.19	0.13	0.19	0.13	0.19	0.13	0.19	0.13	0.20	0.13
W33X567	16.4	6291	0.71	0.20	0.14	0.20	0.14	0.21	0.14	0.21	0.14	0.21	0.14	0.21	0.14
W33X515	16.2	5697	0.80	0.22	0.16	0.23	0.16	0.23	0.16	0.23	0.16	0.23	0.16	0.24	0.16
W33X468	16.0	5103	0.89	0.25	0.17	0.25	0.17	0.25	0.17	0.25	0.17	0.26	0.17	0.26	0.17
W33X424	15.9	4590	0.99	0.27	0.19	0.27	0.19	0.28	0.19	0.28	0.19	0.28	0.19	0.29	0.19
W33X387	15.8	4185	1.10	0.30	0.21	0.30	0.21	0.30	0.21	0.31	0.21	0.31	0.21	0.32	0.21
W33X354	15.6	3834	1.21	0.33	0.23	0.33	0.23	0.33	0.23	0.34	0.23	0.34	0.23	0.34	0.23
W33X318	15.5	3429	1.36	0.36	0.26	0.37	0.26	0.37	0.26	0.37	0.26	0.38	0.26	0.38	0.26
W33X291	15.4	3105	1.50	0.40	0.29	0.40	0.29	0.40	0.29	0.41	0.29	0.41	0.29	0.42	0.29
W33X263	15.3	2808	1.68	0.44	0.32	0.44	0.32	0.45	0.32	0.45	0.32	0.46	0.32	0.46	0.32
W33X241	15.1	2535	1.86	0.48	0.35	0.48	0.35	0.49	0.35	0.49	0.35	0.50	0.35	0.51	0.35
W33X221	15.0	2309	2.07	0.52	0.39	0.53	0.39	0.53	0.39	0.54	0.39	0.55	0.39	0.56	0.39

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_b for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 (F_y = 36 ksi)

F _y = 36 ksi																	
L _p				14		15		16		17		18		19		20	
Shape	L _p	φM _p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W40X328	17.3	4077	1.19	0.37	0.22	0.37	0.22	0.38	0.22	0.38	0.22	0.39	0.22	0.40	0.22	0.40	0.22
W40X298	17.2	3699	1.31	0.41	0.24	0.41	0.24	0.42	0.24	0.42	0.24	0.43	0.24	0.44	0.24	0.45	0.25
W40X268	17.0	3294	1.47		0.27		0.27		0.27		0.27		0.27		0.28		0.28
W40X244	16.8	2970	1.66		0.30		0.30		0.30		0.30		0.30		0.31		0.31
W40X221	16.3	2611	1.96		0.34		0.34		0.34		0.34		0.35		0.35		0.36
W40X192	15.4	2179	2.52		0.41		0.41		0.41		0.42		0.42		0.43		0.43
W40X655	16.1	8262	0.65	0.19	0.11	0.19	0.11	0.19	0.11	0.20	0.11	0.20	0.11	0.20	0.11	0.21	0.11
W40X593	15.9	7425	0.73	0.21	0.12	0.21	0.12	0.21	0.12	0.22	0.12	0.22	0.12	0.23	0.12	0.23	0.12
W40X531	15.6	6615	0.83	0.23	0.13	0.24	0.13	0.24	0.13	0.24	0.14	0.25	0.14	0.25	0.14	0.26	0.14
W40X480	15.5	5866	0.93	0.26	0.15	0.26	0.15	0.27	0.15	0.27	0.15	0.28	0.15	0.28	0.15	0.29	0.16
W40X436	15.3	5346	1.04	0.29	0.17	0.29	0.17	0.29	0.17	0.30	0.17	0.31	0.17	0.31	0.17	0.32	0.17
W40X397	15.2	4833	1.15	0.31	0.18	0.32	0.18	0.33	0.19	0.33	0.19	0.34	0.19	0.35	0.19	0.35	0.19
W40X362	15.0	4401	1.27	0.35	0.20	0.35	0.20	0.36	0.20	0.36	0.21	0.37	0.21	0.38	0.21	0.39	0.21
W40X324	14.9	3942	1.43	0.39	0.23	0.39	0.23	0.40	0.23	0.41	0.23	0.42	0.23	0.43	0.24	0.44	0.24
W40X297	14.8	3591	1.59	0.42	0.25	0.43	0.25	0.44	0.25	0.45	0.25	0.46	0.26	0.47	0.26	0.48	0.26
W40X277	14.9	3375	1.66	0.45	0.26	0.46	0.26	0.47	0.27	0.48	0.27	0.49	0.27	0.50	0.28	0.51	0.28
W40X249	14.8	3024	1.86		0.29		0.29		0.30		0.30		0.31		0.31		0.31
W40X215	14.8	2600	2.17		0.34		0.34		0.35		0.35		0.36		0.36		0.37
W40X199	14.4	2344	2.49		0.38		0.38		0.39		0.39		0.40		0.40		0.41
W40X183	10.4	2109	3.86		0.45		0.46		0.47		0.48		0.49		0.50		0.51
W40X167	10.0	1868	4.58		0.52		0.53		0.54		0.55		0.56		0.57		0.59
W40X149	9.5	1612	5.66		0.61		0.62		0.63		0.65		0.67		0.68		0.70
W36X848	17.8	10341	0.44	0.14	0.09	0.14	0.09	0.15	0.09	0.15	0.09	0.15	0.09	0.15	0.09	0.15	0.09
W36X798	17.7	9639	0.47	0.15	0.09	0.15	0.09	0.16	0.09	0.16	0.09	0.16	0.09	0.16	0.09	0.17	0.09
W36X720	17.4	8613	0.53	0.17	0.10	0.17	0.10	0.17	0.10	0.18	0.10	0.18	0.10	0.18	0.10	0.18	0.10
W36X650	17.2	7668	0.60	0.19	0.12	0.19	0.12	0.19	0.12	0.20	0.12	0.20	0.12	0.20	0.12	0.21	0.12
W36X588	17.0	6885	0.67	0.21	0.13	0.21	0.13	0.21	0.13	0.22	0.13	0.22	0.13	0.22	0.13	0.23	0.13
W36X527	16.8	6129	0.76	0.23	0.15	0.24	0.15	0.24	0.15	0.24	0.15	0.25	0.15	0.25	0.15	0.26	0.15
W36X486	16.6	5589	0.83	0.25	0.16	0.26	0.16	0.26	0.16	0.26	0.16	0.27	0.16	0.27	0.16	0.28	0.16
W36X439	16.5	5022	0.93	0.28	0.18	0.28	0.18	0.29	0.18	0.29	0.18	0.30	0.18	0.30	0.18	0.31	0.18
W36X393	16.3	4482	1.06	0.31	0.20	0.32	0.20	0.32	0.20	0.33	0.20	0.33	0.20	0.34	0.20	0.35	0.20
W36X359	16.1	4077	1.17	0.34	0.22	0.35	0.22	0.35	0.22	0.36	0.22	0.37	0.22	0.37	0.22	0.38	0.22
W36X328	16.0	3729	1.28	0.37	0.24	0.39	0.24	0.39	0.24	0.39	0.24	0.40	0.24	0.41	0.24	0.42	0.25
W36X300	16.0	3402	1.41	0.41	0.26	0.42	0.26	0.42	0.26	0.43	0.26	0.44	0.27	0.45	0.27	0.46	0.27
W36X290	15.9	3159	1.52	0.44	0.28	0.45	0.28	0.45	0.28	0.46	0.28	0.47	0.29	0.48	0.29	0.49	0.29
W36X260	15.8	2916	1.66	0.47	0.30	0.48	0.30	0.49	0.31	0.50	0.31	0.51	0.31	0.52	0.32	0.53	0.32
W36X245	15.6	2727	1.78	0.50	0.33	0.51	0.33	0.52	0.33	0.53	0.33	0.54	0.33	0.55	0.34	0.56	0.34
W36X230	15.5	2546	1.93	0.54	0.35	0.55	0.35	0.56	0.35	0.57	0.35	0.58	0.36	0.59	0.36	0.60	0.37
W36X256	11.0	2808	2.84	0.54	0.33	0.55	0.33	0.57	0.34	0.59	0.34	0.61	0.35	0.64	0.35	0.67	0.36
W36X232	10.9	2527	2.84	0.60	0.37	0.62	0.37	0.64	0.38	0.66	0.39	0.69	0.39	0.71	0.40	0.75	0.40
W36X210	10.8	2249	3.25	0.68	0.42	0.68	0.42	0.71	0.43	0.73	0.44	0.76	0.45	0.80	0.45	0.83	0.46
W36X194	10.7	2071	3.55		0.45		0.46		0.47		0.48		0.49		0.50		0.51
W36X182	10.6	1939	3.81		0.49		0.50		0.50		0.51		0.52		0.53		0.54
W36X170	10.5	1804	4.13		0.52		0.53		0.54		0.56		0.57		0.58		0.59
W36X160	10.4	1685	4.47		0.56		0.58		0.59		0.60		0.61		0.63		0.64
W36X150	10.3	1569	4.87		0.61		0.62		0.63		0.65		0.66		0.68		0.69
W36X135	9.9	1374	5.82		0.70		0.72		0.74		0.75		0.77		0.79		0.81
W33X619	16.6	6912	0.65	0.20	0.13	0.20	0.13	0.20	0.13	0.21	0.13	0.21	0.13	0.21	0.13	0.22	0.13
W33X567	16.4	6291	0.71	0.22	0.14	0.22	0.14	0.22	0.14	0.23	0.14	0.23	0.14	0.23	0.14	0.24	0.14
W33X515	16.2	5697	0.80	0.24	0.16	0.24	0.16	0.25	0.16	0.25	0.16	0.25	0.16	0.26	0.16	0.26	0.16
W33X468	16.0	5103	0.89	0.26	0.17	0.27	0.17	0.27	0.17	0.28	0.18	0.28	0.18	0.29	0.18	0.29	0.18
W33X424	15.9	4590	0.99	0.29	0.19	0.30	0.19	0.30	0.19	0.31	0.20	0.31	0.20	0.32	0.20	0.32	0.20
W33X387	15.8	4185	1.10	0.32	0.21	0.33	0.21	0.33	0.21	0.34	0.21	0.34	0.22	0.35	0.22	0.36	0.22
W33X354	15.6	3834	1.21	0.35	0.23	0.35	0.23	0.36	0.23	0.37	0.23	0.37	0.24	0.38	0.24	0.39	0.24
W33X319	15.5	3429	1.36	0.39	0.25	0.40	0.25	0.40	0.25	0.41	0.26	0.42	0.26	0.43	0.27	0.44	0.27
W33X291	15.4	3105	1.50	0.43	0.29	0.43	0.29	0.44	0.29	0.45	0.29	0.46	0.29	0.47	0.30	0.48	0.30
W33X263	15.3	2806	1.68	0.47	0.32	0.46	0.32	0.49	0.32	0.50	0.32	0.51	0.33	0.52	0.33	0.53	0.33
W33X241	15.1	2535	1.86	0.52	0.35	0.52	0.35	0.53	0.35	0.54	0.36	0.56	0.36	0.57	0.37	0.58	0.37
W33X221	15.0	2306	2.07	0.56	0.39	0.57	0.39	0.58	0.39	0.60	0.39	0.61	0.40	0.62	0.40	0.64	0.41

L_p = (KL)_y or (KL)_x for "b", and L_p for "m". Blank cells indicate slender element section or L_p > L_r.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi															
Shape	L_p			8		9		10		11		12		13	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W33X201	14.8	2084	2.31	0.57	0.43	0.58	0.43	0.59	0.43	0.59	0.43	0.60	0.43	0.61	0.43
W33X168	10.4	1696	4.07		0.62		0.52		0.52		0.53		0.54		0.55
W33X152	10.3	1509	4.65		0.59		0.59		0.59		0.60		0.61		0.62
W33X141	10.1	1388	5.14		0.64		0.64		0.64		0.65		0.66		0.68
W33X130	10.0	1261	5.79		0.70		0.70		0.71		0.72		0.73		0.75
W33X118	9.7	1121	6.73		0.79		0.79		0.80		0.82		0.83		0.85
W30X581	16.1	5967	0.70	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15	0.21	0.15	0.21	0.15
W30X526	15.8	5373	0.79	0.22	0.17	0.22	0.17	0.22	0.17	0.23	0.17	0.23	0.17	0.23	0.17
W30X477	15.6	4833	0.88	0.24	0.18	0.24	0.18	0.25	0.18	0.25	0.18	0.25	0.18	0.26	0.18
W30X433	15.5	4347	0.99	0.27	0.20	0.27	0.20	0.27	0.20	0.28	0.20	0.28	0.20	0.28	0.20
W30X391	15.3	3861	1.11	0.30	0.23	0.30	0.23	0.30	0.23	0.31	0.23	0.31	0.23	0.32	0.23
W30X367	15.2	3610	1.23	0.33	0.25	0.33	0.25	0.33	0.25	0.34	0.25	0.34	0.25	0.35	0.25
W30X326	15.0	3213	1.35	0.35	0.28	0.36	0.28	0.36	0.28	0.37	0.28	0.37	0.28	0.38	0.28
W30X292	14.9	2862	1.52	0.40	0.31	0.40	0.31	0.40	0.31	0.41	0.31	0.42	0.31	0.42	0.31
W30X261	14.8	2541	1.73	0.44	0.35	0.45	0.35	0.45	0.35	0.46	0.35	0.46	0.35	0.47	0.35
W30X235	14.7	2282	1.93	0.48	0.39	0.50	0.39	0.50	0.39	0.51	0.39	0.52	0.39	0.53	0.39
W30X211	14.5	2022	2.19	0.55	0.44	0.55	0.44	0.56	0.44	0.57	0.44	0.58	0.44	0.59	0.44
W30X191	14.4	1817	2.45	0.61	0.49	0.61	0.49	0.62	0.49	0.63	0.49	0.64	0.49	0.65	0.49
W30X173	14.3	1634	2.75	0.67	0.54	0.68	0.54	0.69	0.54	0.70	0.54	0.71	0.54	0.72	0.54
W30X148	9.5	1350	5.07	0.82	0.66	0.85	0.66	0.87	0.66	0.90	0.68	0.93	0.69	0.96	0.70
W30X132	9.4	1180	5.90		0.75		0.75		0.76		0.78		0.79		0.81
W30X124	9.3	1102	6.38		0.81		0.81		0.82		0.83		0.85		0.87
W30X116	9.1	1021	7.01		0.87		0.87		0.89		0.91		0.93		0.95
W30X108	9.0	894	7.87		0.95		0.95		0.97		1.00		1.02		1.04
W30X99	8.8	842	8.96		1.06		1.06		1.09		1.11		1.14		1.17
W30X90	8.7	764	9.93		1.16		1.17		1.20		1.23		1.26		1.29
W27X539	15.3	5076	0.79	0.21	0.18	0.22	0.18	0.22	0.18	0.22	0.18	0.22	0.18	0.23	0.18
W27X494	15.0	4617	0.88	0.23	0.19	0.24	0.19	0.24	0.19	0.24	0.19	0.25	0.19	0.25	0.19
W27X448	14.9	4131	0.98	0.26	0.22	0.26	0.22	0.26	0.22	0.27	0.22	0.27	0.22	0.28	0.22
W27X408	14.7	3726	1.10	0.29	0.24	0.29	0.24	0.29	0.24	0.30	0.24	0.30	0.24	0.30	0.24
W27X368	14.5	3348	1.23	0.31	0.27	0.32	0.27	0.32	0.27	0.33	0.27	0.33	0.27	0.34	0.27
W27X336	14.4	3051	1.36	0.34	0.29	0.35	0.29	0.35	0.29	0.36	0.29	0.36	0.29	0.37	0.29
W27X307	14.3	2754	1.50	0.38	0.32	0.38	0.32	0.39	0.32	0.39	0.32	0.40	0.32	0.40	0.32
W27X281	14.2	2519	1.65	0.41	0.35	0.42	0.35	0.42	0.35	0.43	0.35	0.43	0.35	0.44	0.35
W27X258	14.0	2295	1.83	0.45	0.39	0.46	0.39	0.46	0.39	0.47	0.39	0.48	0.39	0.48	0.39
W27X235	13.9	2076	2.03	0.49	0.43	0.50	0.43	0.51	0.43	0.51	0.43	0.52	0.43	0.53	0.43
W27X217	13.8	1912	2.20	0.54	0.46	0.54	0.46	0.55	0.46	0.56	0.46	0.57	0.46	0.58	0.46
W27X194	13.7	1896	2.49	0.60	0.52	0.61	0.52	0.61	0.52	0.62	0.52	0.63	0.52	0.65	0.52
W27X178	13.6	1531	2.79	0.65	0.58	0.66	0.58	0.67	0.58	0.68	0.58	0.69	0.58	0.70	0.58
W27X181	13.5	1382	3.10	0.72	0.64	0.73	0.64	0.74	0.64	0.75	0.64	0.77	0.64	0.78	0.64
W27X146	13.4	1245	3.46	0.80	0.71	0.81	0.71	0.82	0.71	0.83	0.71	0.85	0.71	0.86	0.71
W27X129	9.2	1047	5.96	0.95	0.83	0.96	0.83	1.01	0.85	1.04	0.86	1.08	0.88	1.12	0.89
W27X114	9.1	926	6.97		0.96		0.96		0.98		1.00		1.02		1.04
W27X102	9.0	824	7.89		1.08		1.08		1.10		1.13		1.15		1.18
W27X94	8.8	751	8.85		1.18		1.19		1.21		1.24		1.27		1.30
W27X84	8.6	658	10.35		1.35		1.36		1.39		1.43		1.46		1.50
W24X492	14.2	4185	0.93	0.24	0.21	0.24	0.21	0.24	0.21	0.25	0.21	0.25	0.21	0.25	0.21
W24X450	14.0	3897	1.03	0.26	0.23	0.26	0.23	0.26	0.23	0.27	0.23	0.27	0.23	0.28	0.23
W24X408	13.9	3375	1.15	0.29	0.26	0.29	0.26	0.29	0.26	0.30	0.26	0.30	0.26	0.31	0.26
W24X370	13.7	3024	1.29	0.32	0.29	0.32	0.29	0.32	0.29	0.33	0.29	0.33	0.29	0.34	0.29
W24X335	13.5	2754	1.44	0.35	0.32	0.35	0.32	0.36	0.32	0.36	0.32	0.37	0.32	0.38	0.32
W24X306	13.3	2489	1.60	0.38	0.36	0.39	0.36	0.39	0.36	0.40	0.36	0.40	0.36	0.41	0.36
W24X279	13.2	2255	1.77	0.42	0.39	0.42	0.39	0.43	0.39	0.44	0.39	0.44	0.39	0.45	0.39
W24X256	13.1	2099	2.00	0.47	0.44	0.47	0.44	0.48	0.44	0.49	0.44	0.50	0.44	0.51	0.44
W24X229	13.0	1825	2.21	0.51	0.49	0.52	0.49	0.53	0.49	0.53	0.49	0.54	0.49	0.56	0.49
W24X207	12.8	1636	2.47	0.57	0.54	0.57	0.54	0.58	0.54	0.59	0.54	0.60	0.54	0.62	0.54
W24X192	12.8	1509	2.68	0.61	0.59	0.62	0.59	0.63	0.59	0.64	0.59	0.65	0.59	0.66	0.59
W24X176	12.7	1380	2.95	0.67	0.64	0.68	0.64	0.69	0.64	0.70	0.64	0.71	0.64	0.73	0.65
W24X162	12.7	1264	3.21	0.72	0.70	0.73	0.70	0.74	0.70	0.76	0.70	0.77	0.70	0.79	0.71

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi																	
Shape	L_p	ϕM_p	n	14		15		16		17		18		19		20	
				b	m	b	m	b	m	b	m	b	m	b	m		
W33X201	14.8	2084	2.31	0.62	0.43	0.63	0.43	0.64	0.43	0.66	0.44	0.67	0.44	0.69	0.45	0.70	0.45
W33X199	10.4	1698	4.07		0.56		0.57		0.58		0.59		0.60		0.61		0.62
W33X152	10.3	1509	4.65		0.63		0.64		0.66		0.67		0.68		0.70		0.71
W33X141	10.1	1388	5.14		0.69		0.70		0.72		0.73		0.75		0.77		0.78
W33X130	10.0	1261	5.79		0.77		0.78		0.80		0.82		0.84		0.86		0.88
W33X118	9.7	1121	6.73		0.87		0.89		0.91		0.93		0.96		0.96		1.01
W30X581	16.1	5967	0.70	0.21	0.15	0.22	0.15	0.22	0.15	0.22	0.15	0.23	0.15	0.23	0.15	0.24	0.15
W30X526	15.8	5373	0.79	0.24	0.17	0.24	0.17	0.24	0.17	0.25	0.17	0.25	0.17	0.26	0.17	0.26	0.17
W30X477	15.6	4833	0.88	0.26	0.18	0.26	0.18	0.27	0.18	0.27	0.19	0.28	0.19	0.28	0.19	0.29	0.19
W30X433	15.5	4347	0.99	0.29	0.20	0.29	0.20	0.30	0.21	0.30	0.21	0.31	0.21	0.31	0.21	0.32	0.21
W30X391	15.3	3861	1.11	0.32	0.23	0.33	0.23	0.33	0.23	0.34	0.23	0.34	0.23	0.35	0.24	0.36	0.24
W30X357	15.2	3510	1.23	0.35	0.25	0.36	0.25	0.36	0.25	0.37	0.26	0.38	0.26	0.39	0.26	0.39	0.28
W30X326	15.0	3213	1.35	0.38	0.28	0.39	0.28	0.40	0.28	0.40	0.28	0.41	0.28	0.42	0.28	0.43	0.29
W30X292	14.9	2862	1.52	0.43	0.31	0.44	0.31	0.44	0.31	0.45	0.32	0.46	0.32	0.47	0.32	0.48	0.32
W30X261	14.8	2541	1.73	0.48	0.35	0.49	0.35	0.50	0.35	0.51	0.36	0.52	0.36	0.53	0.36	0.54	0.37
W30X235	14.7	2282	1.93	0.53	0.39	0.54	0.39	0.55	0.40	0.57	0.40	0.58	0.40	0.59	0.41	0.60	0.41
W30X211	14.5	2022	2.19	0.60	0.44	0.61	0.44	0.62	0.45	0.63	0.45	0.64	0.46	0.66	0.46	0.68	0.47
W30X191	14.4	1817	2.45	0.68	0.49	0.67	0.49	0.69	0.50	0.70	0.50	0.72	0.51	0.73	0.52	0.75	0.52
W30X173	14.3	1634	2.75	0.73	0.54	0.74	0.55	0.76	0.56	0.77	0.56	0.79	0.57	0.81	0.58	0.83	0.59
W30X148	9.5	1350	5.07	1.00	0.72	1.04	0.73	1.09	0.74	1.15	0.76	1.21	0.77	1.27	0.79	1.35	0.81
W30X132	9.4	1180	5.90		0.83		0.84		0.86		0.88		0.90		0.92		0.94
W30X124	9.3	1102	6.36		0.89		0.91		0.93		0.95		0.97		1.00		1.02
W30X116	9.1	1021	7.01		0.97		0.99		1.02		1.04		1.07		1.09		1.12
W30X108	9.0	994	7.87		1.07		1.09		1.12		1.15		1.18		1.22		1.25
W30X99	8.8	842	8.96		1.20		1.23		1.26		1.30		1.33		1.37		1.41
W30X90	8.7	784	9.93		1.33		1.36		1.40		1.44		1.48		1.53		1.58
W27X539	15.3	5076	0.79	0.23	0.18	0.23	0.18	0.24	0.18	0.24	0.18	0.25	0.18	0.25	0.18	0.26	0.18
W27X494	15.0	4617	0.88	0.25	0.19	0.26	0.19	0.26	0.19	0.27	0.19	0.27	0.19	0.28	0.20	0.28	0.20
W27X448	14.9	4131	0.98	0.28	0.22	0.29	0.22	0.29	0.22	0.30	0.22	0.30	0.22	0.31	0.22	0.32	0.22
W27X408	14.7	3726	1.10	0.31	0.24	0.32	0.24	0.32	0.24	0.33	0.24	0.33	0.24	0.34	0.24	0.35	0.25
W27X368	14.5	3348	1.23	0.34	0.27	0.35	0.27	0.36	0.27	0.36	0.27	0.37	0.27	0.38	0.27	0.39	0.27
W27X336	14.4	3051	1.36	0.38	0.29	0.38	0.29	0.39	0.29	0.40	0.30	0.41	0.30	0.42	0.30	0.43	0.30
W27X307	14.3	2754	1.50	0.41	0.32	0.42	0.32	0.43	0.33	0.44	0.33	0.45	0.33	0.46	0.33	0.47	0.34
W27X281	14.2	2519	1.65	0.45	0.35	0.46	0.36	0.47	0.36	0.48	0.36	0.49	0.36	0.50	0.37	0.51	0.37
W27X258	14.0	2295	1.83	0.49	0.39	0.50	0.39	0.51	0.39	0.52	0.40	0.54	0.40	0.55	0.40	0.56	0.41
W27X235	13.9	2076	2.03	0.54	0.43	0.55	0.43	0.56	0.44	0.58	0.44	0.59	0.44	0.61	0.45	0.62	0.45
W27X217	13.8	1912	2.20	0.59	0.47	0.60	0.47	0.61	0.47	0.62	0.48	0.64	0.48	0.66	0.49	0.67	0.49
W27X194	13.7	1696	2.49	0.66	0.53	0.67	0.53	0.69	0.54	0.70	0.54	0.72	0.55	0.74	0.56	0.76	0.56
W27X178	13.6	1531	2.79	0.72	0.58	0.73	0.59	0.75	0.60	0.77	0.60	0.79	0.61	0.81	0.62	0.83	0.63
W27X161	13.5	1382	3.10	0.79	0.65	0.81	0.66	0.83	0.66	0.85	0.67	0.87	0.68	0.89	0.69	0.92	0.70
W27X146	13.4	1245	3.46	0.88	0.72	0.90	0.73	0.92	0.74	0.94	0.75	0.97	0.76	0.99	0.77	1.02	0.78
W27X129	9.2	1067	5.96	1.17	0.91	1.23	0.93	1.29	0.95	1.35	0.97	1.43	0.99	1.51	1.01	1.61	1.03
W27X114	9.1	926	6.97		1.06		1.08		1.11		1.13		1.16		1.19		1.22
W27X102	9.0	824	7.89		1.20		1.23		1.26		1.29		1.33		1.36		1.40
W27X94	8.8	751	8.85		1.33		1.37		1.40		1.44		1.48		1.52		1.56
W27X84	8.6	659	10.35		1.54		1.58		1.62		1.67		1.72		1.77		1.82
W24X492	14.2	4185	0.93	0.26	0.21	0.26	0.21	0.27	0.21	0.27	0.21	0.28	0.22	0.29	0.22	0.29	0.22
W24X450	14.0	3807	1.03	0.28	0.23	0.29	0.23	0.29	0.24	0.30	0.24	0.31	0.24	0.32	0.24	0.32	0.24
W24X408	13.9	3375	1.15	0.31	0.26	0.32	0.26	0.33	0.27	0.33	0.27	0.34	0.27	0.35	0.27	0.36	0.27
W24X370	13.7	3024	1.29	0.35	0.29	0.35	0.30	0.36	0.30	0.37	0.30	0.38	0.30	0.39	0.30	0.40	0.30
W24X335	13.5	2754	1.44	0.38	0.32	0.39	0.33	0.40	0.33	0.41	0.33	0.42	0.33	0.43	0.33	0.44	0.33
W24X306	13.3	2489	1.60	0.42	0.36	0.43	0.36	0.44	0.36	0.45	0.37	0.46	0.37	0.48	0.37	0.49	0.37
W24X279	13.2	2255	1.77	0.46	0.40	0.47	0.40	0.48	0.40	0.50	0.40	0.51	0.41	0.52	0.41	0.54	0.41
W24X250	13.1	2009	2.00	0.52	0.45	0.53	0.45	0.54	0.45	0.56	0.46	0.57	0.48	0.59	0.46	0.60	0.47
W24X229	13.0	1825	2.21	0.57	0.49	0.58	0.50	0.59	0.50	0.61	0.50	0.63	0.51	0.65	0.51	0.67	0.52
W24X207	12.8	1636	2.47	0.63	0.55	0.64	0.55	0.66	0.56	0.68	0.56	0.70	0.57	0.72	0.57	0.74	0.58
W24X192	12.8	1509	2.68	0.68	0.60	0.70	0.60	0.71	0.61	0.73	0.61	0.75	0.62	0.78	0.63	0.80	0.63
W24X176	12.7	1380	2.95	0.74	0.65	0.76	0.66	0.78	0.67	0.80	0.67	0.82	0.68	0.85	0.69	0.88	0.70
W24X162	12.7	1264	3.21	0.80	0.71	0.82	0.72	0.84	0.73	0.87	0.74	0.89	0.75	0.92	0.76	0.95	0.77

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi															
Shape	L_p			8		9		10		11		12		13	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W24X146	12.5	1129	3.63	0.80	0.79	0.81	0.79	0.83	0.79	0.84	0.79	0.86	0.79	0.88	0.79
W24X131	12.4	999	4.14	0.90	0.89	0.91	0.89	0.92	0.89	0.94	0.89	0.96	0.89	0.98	0.90
W24X117	12.3	883	4.72	1.00	1.01	1.02	1.01	1.04	1.01	1.06	1.01	1.08	1.01	1.10	1.02
W24X104	12.1	780	5.39		1.14		1.14		1.14		1.14		1.14		1.15
W24X103	8.3	756	8.28	1.22	1.18	1.26	1.19	1.31	1.22	1.36	1.24	1.42	1.27	1.49	1.30
W24X94	8.3	686	9.14	1.34	1.30	1.38	1.32	1.43	1.35	1.49	1.38	1.56	1.41	1.64	1.44
W24X84	8.1	605	10.50		1.47		1.50		1.53		1.57		1.61		1.65
W24X76	8.0	540	11.93		1.65		1.69		1.73		1.77		1.82		1.87
W24X68	7.8	478	13.98		1.87		1.92		1.97		2.02		2.06		2.14
W24X62	5.8	413	22.40		2.33		2.41		2.51		2.61		2.72		2.84
W24X55	5.6	362	26.44		2.68		2.79		2.91		3.03		3.17		3.32
W21X402	13.6	3051	1.16	0.29	0.29	0.29	0.29	0.30	0.29	0.30	0.29	0.31	0.29	0.31	0.29
W21X364	13.5	2727	1.31	0.32	0.33	0.32	0.33	0.33	0.33	0.33	0.33	0.34	0.33	0.35	0.33
W21X333	13.3	2471	1.45	0.35	0.36	0.35	0.36	0.36	0.36	0.37	0.36	0.37	0.36	0.38	0.36
W21X300	13.1	2203	1.64	0.39	0.40	0.39	0.40	0.40	0.40	0.41	0.40	0.41	0.40	0.42	0.40
W21X275	13.0	2001	1.80	0.43	0.44	0.43	0.44	0.44	0.44	0.44	0.44	0.45	0.44	0.46	0.44
W21X248	12.9	1790	2.01	0.47	0.50	0.48	0.50	0.49	0.50	0.49	0.50	0.50	0.50	0.51	0.50
W21X223	12.7	1590	2.28	0.53	0.56	0.53	0.56	0.54	0.56	0.55	0.56	0.56	0.56	0.57	0.56
W21X201	12.6	1431	2.55	0.58	0.62	0.59	0.62	0.60	0.62	0.61	0.62	0.62	0.62	0.64	0.62
W21X182	12.5	1285	2.84	0.64	0.69	0.65	0.69	0.66	0.69	0.68	0.69	0.69	0.69	0.70	0.69
W21X166	12.4	1186	3.13	0.71	0.78	0.72	0.76	0.73	0.76	0.74	0.76	0.76	0.76	0.77	0.77
W21X147	12.3	1007	3.65	0.80	0.88	0.81	0.88	0.83	0.88	0.84	0.88	0.86	0.88	0.88	0.89
W21X132	12.2	899	4.10	0.89	0.99	0.90	0.99	0.92	0.98	0.94	0.99	0.96	0.99	0.98	1.00
W21X122	12.2	829	4.46	0.96	1.07	0.98	1.07	0.99	1.07	1.01	1.07	1.03	1.07	1.06	1.08
W21X111	12.1	753	4.93	1.06	1.18	1.08	1.18	1.09	1.18	1.11	1.18	1.14	1.18	1.16	1.19
W21X101	12.0	683	5.45	1.16	1.30	1.18	1.30	1.20	1.30	1.22	1.30	1.25	1.30	1.28	1.32
W21X93	7.7	597	9.93	1.38	1.50	1.44	1.53	1.50	1.56	1.57	1.59	1.65	1.63	1.75	1.66
W21X83	7.6	529	11.26	1.55	1.69	1.62	1.73	1.69	1.77	1.77	1.81	1.86	1.85	1.97	1.90
W21X73	7.5	464	12.91	1.76	1.93	1.83	1.98	1.92	2.03	2.01	2.08	2.12	2.13	2.25	2.19
W21X68	7.5	432	13.98		2.08		2.13		2.19		2.25		2.31		2.37
W21X62	7.4	389	15.79		2.32		2.38		2.45		2.52		2.59		2.67
W21X57	5.6	348	23.47		2.77		2.87		2.98		3.09		3.22		3.36
W21X50	5.4	297	28.73		3.29		3.43		3.57		3.73		3.90		4.09
W21X44	5.3	258	34.51		3.85		4.02		4.20		4.40		4.62		4.87
W18X311	12.3	2033	1.66	0.38	0.44	0.38	0.44	0.39	0.44	0.40	0.44	0.40	0.44	0.41	0.44
W18X283	12.1	1825	1.86	0.42	0.49	0.42	0.49	0.43	0.49	0.44	0.49	0.45	0.49	0.46	0.49
W18X258	12.0	1650	2.05	0.46	0.54	0.46	0.54	0.47	0.54	0.48	0.54	0.49	0.54	0.50	0.54
W18X234	11.9	1482	2.29	0.50	0.60	0.51	0.60	0.52	0.60	0.53	0.60	0.54	0.60	0.56	0.60
W18X211	11.8	1323	2.57	0.56	0.67	0.57	0.67	0.58	0.67	0.59	0.67	0.60	0.67	0.62	0.68
W18X192	11.6	1193	2.86	0.62	0.74	0.63	0.74	0.64	0.74	0.65	0.74	0.67	0.75	0.68	0.75
W18X175	11.5	1075	3.19	0.66	0.83	0.69	0.83	0.70	0.83	0.72	0.83	0.74	0.83	0.75	0.84
W18X158	11.4	961	3.57	0.75	0.92	0.77	0.92	0.78	0.92	0.80	0.92	0.82	0.93	0.84	0.94
W18X143	11.3	869	3.95	0.83	1.02	0.84	1.02	0.86	1.02	0.88	1.02	0.90	1.03	0.92	1.04
W18X130	11.3	786	4.40	0.91	1.13	0.93	1.13	0.95	1.13	0.97	1.13	0.99	1.14	1.02	1.15
W18X119	11.2	705	4.89	1.00	1.26	1.01	1.26	1.03	1.26	1.06	1.26	1.08	1.27	1.11	1.29
W18X106	11.1	621	5.57	1.13	1.43	1.15	1.43	1.17	1.43	1.20	1.43	1.23	1.45	1.26	1.47
W18X97	11.0	570	6.08	1.23	1.56	1.25	1.56	1.28	1.56	1.31	1.56	1.34	1.58	1.38	1.60
W18X86	11.0	502	6.95	1.39	1.77	1.41	1.77	1.44	1.77	1.47	1.77	1.51	1.80	1.55	1.82
W18X76	10.9	440	7.95	1.57	2.02	1.60	2.02	1.64	2.02	1.68	2.02	1.72	2.06	1.77	2.09
W18X71	7.1	392	13.89	1.86	2.32	1.94	2.37	2.04	2.42	2.16	2.48	2.29	2.53	2.45	2.60
W18X65	7.0	359	15.24	2.03	2.53	2.12	2.59	2.23	2.65	2.36	2.72	2.51	2.79	2.68	2.85
W18X60	7.0	332	16.50	2.20	2.74	2.30	2.81	2.42	2.88	2.56	2.96	2.72	3.04	2.91	3.12
W18X55	7.0	302	18.44	2.40	3.02	2.51	3.10	2.65	3.18	2.80	3.27	2.98	3.37	3.19	3.47
W18X50	6.9	273	20.51		3.36		3.46		3.56		3.66		3.78		3.90
W18X46	5.4	245	29.54		3.98		4.13		4.29		4.46		4.65		4.86
W18X40	5.3	212	34.56		4.65		4.84		5.04		5.27		5.51		5.78
W18X35	5.1	180	42.87		5.58		5.84		6.11		6.42		6.76		7.14
W16X100	10.5	535	6.15	1.20	1.66	1.23	1.66	1.25	1.66	1.29	1.67	1.32	1.69	1.36	1.71
W16X89	10.4	473	6.99	1.35	1.88	1.38	1.88	1.41	1.88	1.45	1.90	1.49	1.92	1.53	1.95

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi																	
L_p				14		15		16		17		18		19		20	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W24X146	12.5	1129	3.63	0.90	0.80	0.92	0.81	0.84	0.82	0.97	0.83	1.00	0.84	1.03	0.85	1.06	0.87
W24X131	12.4	999	4.14	1.00	0.91	1.03	0.92	1.06	0.93	1.09	0.95	1.12	0.96	1.16	0.98	1.20	0.99
W24X117	12.3	883	4.72	1.13	1.03	1.16	1.05	1.19	1.06	1.22	1.08	1.26	1.10	1.30	1.11	1.35	1.13
W24X104	12.1	780	5.39		1.17		1.19		1.21		1.23		1.25		1.27		1.30
W24X103	8.3	756	6.28	1.57	1.32	1.66	1.35	1.76	1.38	1.88	1.42	2.01	1.45	2.15	1.49	2.32	1.52
W24X94	8.3	686	9.14	1.72	1.47	1.82	1.51	1.94	1.55	2.06	1.59	2.21	1.63	2.37	1.67	2.56	1.72
W24X84	8.1	605	10.50		1.69		1.74		1.79		1.84		1.89		1.95		2.00
W24X76	8.0	540	11.93		1.92		1.97		2.03		2.09		2.15		2.22		2.30
W24X68	7.8	478	13.98		2.21		2.28		2.35		2.43		2.51		2.60		2.70
W24X62	5.8	413	22.40		2.97		3.11		3.27		3.44						
W24X55	5.6	362	26.44		3.49		3.67		3.87								
W21X402	13.6	3051	1.16	0.32	0.29	0.32	0.29	0.33	0.29	0.34	0.30	0.35	0.30	0.36	0.30	0.37	0.30
W21X364	13.5	2727	1.31	0.35	0.33	0.36	0.33	0.37	0.33	0.38	0.33	0.39	0.33	0.40	0.33	0.41	0.34
W21X333	13.3	2471	1.45	0.39	0.36	0.39	0.36	0.40	0.36	0.41	0.37	0.42	0.37	0.44	0.37	0.45	0.37
W21X300	13.1	2203	1.64	0.43	0.41	0.44	0.41	0.45	0.41	0.46	0.41	0.47	0.41	0.49	0.42	0.50	0.42
W21X275	13.0	2001	1.80	0.47	0.45	0.48	0.45	0.49	0.45	0.51	0.45	0.52	0.46	0.54	0.46	0.55	0.46
W21X248	12.9	1790	2.01	0.52	0.50	0.54	0.50	0.55	0.51	0.56	0.51	0.58	0.51	0.60	0.52	0.62	0.52
W21X223	12.7	1590	2.28	0.59	0.56	0.60	0.57	0.62	0.57	0.63	0.58	0.65	0.58	0.67	0.58	0.69	0.59
W21X201	12.6	1431	2.55	0.65	0.63	0.67	0.63	0.68	0.64	0.70	0.64	0.72	0.65	0.75	0.65	0.77	0.66
W21X182	12.5	1285	2.84	0.72	0.70	0.74	0.71	0.76	0.71	0.78	0.72	0.80	0.73	0.83	0.73	0.85	0.74
W21X166	12.4	1166	3.13	0.79	0.77	0.81	0.78	0.83	0.79	0.86	0.80	0.88	0.80	0.91	0.81	0.94	0.82
W21X147	12.3	1007	3.65	0.90	0.90	0.92	0.91	0.95	0.92	0.97	0.93	1.00	0.94	1.04	0.95	1.07	0.96
W21X132	12.2	899	4.10	1.00	1.01	1.03	1.02	1.06	1.03	1.09	1.05	1.12	1.06	1.16	1.07	1.20	1.09
W21X122	12.2	829	4.46	1.08	1.10	1.11	1.11	1.14	1.13	1.18	1.14	1.21	1.16	1.25	1.17	1.30	1.19
W21X111	12.1	753	4.93	1.19	1.21	1.22	1.23	1.26	1.25	1.30	1.26	1.34	1.28	1.38	1.30	1.43	1.32
W21X101	12.0	683	5.45	1.31	1.34	1.35	1.36	1.38	1.38	1.43	1.40	1.47	1.42	1.52	1.44	1.56	1.47
W21X89	7.7	597	9.93	1.86	1.70	1.99	1.74	2.12	1.76	2.29	1.83	2.47	1.87	2.69	1.92	2.93	1.97
W21X83	7.6	529	11.26	2.10	1.94	2.24	1.99	2.40	2.05	2.59	2.10	2.80	2.16	3.04	2.22	3.33	2.28
W21X73	7.5	464	12.91	2.39	2.25	2.56	2.31	2.75	2.37	2.97	2.44	3.22	2.52	3.50	2.60	3.84	2.68
W21X68	7.5	432	13.98		2.44		2.51		2.59		2.67		2.76		2.85		2.95
W21X62	7.4	389	15.79		2.75		2.83		2.92		3.02		3.13		3.24		3.36
W21X57	5.6	348	23.47		3.51		3.67		3.85		4.05						
W21X50	5.4	287	28.73		4.29		4.52		4.78								
W21X44	5.3	258	34.51		5.14		5.45										
W18X311	12.3	2033	1.86	0.42	0.44	0.43	0.44	0.45	0.44	0.46	0.45	0.47	0.45	0.49	0.45	0.51	0.45
W18X283	12.1	1825	1.86	0.47	0.49	0.48	0.49	0.49	0.50	0.51	0.50	0.52	0.50	0.54	0.50	0.56	0.51
W18X258	12.0	1650	2.05	0.52	0.54	0.53	0.55	0.54	0.55	0.56	0.55	0.58	0.56	0.60	0.56	0.62	0.56
W18X234	11.9	1482	2.29	0.57	0.61	0.59	0.61	0.60	0.61	0.62	0.62	0.64	0.62	0.67	0.62	0.69	0.63
W18X211	11.8	1323	2.57	0.63	0.68	0.65	0.69	0.67	0.69	0.69	0.69	0.72	0.70	0.74	0.70	0.77	0.71
W18X192	11.6	1193	2.86	0.70	0.76	0.72	0.76	0.74	0.77	0.77	0.77	0.79	0.78	0.82	0.78	0.86	0.79
W18X175	11.5	1075	3.19	0.77	0.84	0.80	0.85	0.82	0.85	0.85	0.85	0.88	0.87	0.91	0.88	0.95	0.88
W18X158	11.4	961	3.57	0.86	0.94	0.89	0.95	0.91	0.96	0.95	0.97	0.98	0.98	1.02	0.99	1.06	0.99
W18X143	11.3	869	3.95	0.95	1.05	0.96	1.06	1.01	1.07	1.04	1.08	1.08	1.08	1.12	1.10	1.17	1.11
W18X130	11.3	786	4.40	1.05	1.16	1.08	1.18	1.12	1.19	1.16	1.20	1.20	1.21	1.25	1.23	1.30	1.24
W18X119	11.2	705	4.89	1.14	1.30	1.18	1.32	1.22	1.33	1.28	1.35	1.31	1.36	1.36	1.38	1.42	1.40
W18X106	11.1	621	5.57	1.30	1.48	1.34	1.50	1.38	1.52	1.43	1.54	1.49	1.56	1.55	1.59	1.61	1.61
W18X97	11.0	570	6.08	1.42	1.62	1.46	1.65	1.51	1.67	1.57	1.69	1.63	1.72	1.69	1.74	1.77	1.77
W18X86	11.0	502	6.95	1.60	1.85	1.65	1.88	1.71	1.91	1.77	1.94	1.84	1.97	1.92	2.00	2.00	2.04
W18X76	10.9	440	7.95	1.82	2.12	1.88	2.16	1.95	2.20	2.02	2.24	2.10	2.28	2.19	2.32	2.29	2.36
W18X71	7.1	392	13.89	2.63	2.66	2.83	2.73	3.08	2.80	3.35	2.87	3.68	2.95	4.05	3.04	4.49	3.13
W18X65	7.0	359	15.24	2.88	2.94	3.11	3.02	3.38	3.10	3.68	3.19	4.04	3.29	4.47	3.39	4.95	3.49
W18X60	7.0	332	16.50	3.12	3.21	3.37	3.30	3.66	3.40	4.00	3.51	4.39	3.62	4.85	3.74	5.37	3.87
W18X55	7.0	302	18.44	3.44	3.58	3.72	3.69	4.05	3.81	4.43	3.94	4.87	4.06	5.39	4.23	5.88	4.38
W18X50	6.9	273	20.51		4.03		4.17		4.31		4.47		4.64		4.83		5.03
W18X46	5.4	245	29.54		5.09		5.33		5.61								
W18X40	5.3	212	34.56		6.08		6.40										
W18X35	5.1	180	42.87		7.56												
W16X100	10.5	535	6.15	1.41	1.73	1.46	1.75	1.51	1.78	1.57	1.80	1.64	1.82	1.72	1.84	1.80	1.87
W16X89	10.4	473	6.99	1.59	1.97	1.64	2.00	1.71	2.03	1.78	2.06	1.85	2.08	1.94	2.11	2.03	2.14

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 (F_y = 36 ksi)

F _y = 36 ksi															
Shape	L _p			8		9		10		11		12		13	
	L _p	φM _p	n	b	m	b	m	b	m	b	m	b	m	b	m
W16X77	10.3	405	8.16	1.57	2.19	1.60	2.19	1.64	2.19	1.68	2.22	1.73	2.25	1.78	2.28
W16X67	10.3	351	9.46	1.80	2.53	1.84	2.53	1.88	2.53	1.93	2.56	1.99	2.60	2.05	2.65
W16X57	6.7	284	18.14	2.35	3.23	2.47	3.31	2.62	3.39	2.78	3.48	2.98	3.57	3.21	3.66
W16X50	6.6	248	20.90	2.69	3.71	2.83	3.80	3.00	3.91	3.20	4.02	3.42	4.13	3.69	4.25
W16X45	6.5	222	23.50	2.99	4.16	3.15	4.28	3.34	4.41	3.56	4.54	3.83	4.68	4.13	4.83
W16X40	6.5	197	26.80		4.71		4.85		5.00		5.16		5.34		5.52
W16X36	6.3	173	31.35		5.42		5.60		5.79		5.99		6.21		6.45
W16X31	4.9	146	48.86		6.94		7.27		7.62		8.01		8.45		8.93
W16X26	4.7	119	62.89		8.70		9.16		9.68		10.25		10.90		11.63
W14X730	19.5	4482	0.42	0.16	0.20	0.16	0.20	0.16	0.20	0.16	0.20	0.16	0.20	0.16	0.20
W14X665	19.3	3996	0.46	0.17	0.22	0.17	0.22	0.17	0.22	0.17	0.22	0.17	0.22	0.17	0.22
W14X605	19.0	3564	0.52	0.19	0.25	0.19	0.25	0.19	0.25	0.19	0.25	0.19	0.25	0.20	0.25
W14X550	18.7	3186	0.58	0.21	0.28	0.21	0.28	0.21	0.28	0.21	0.28	0.21	0.28	0.21	0.28
W14X500	18.5	2835	0.65	0.23	0.31	0.23	0.31	0.23	0.31	0.23	0.31	0.24	0.31	0.24	0.31
W14X455	18.3	2527	0.72	0.25	0.35	0.25	0.35	0.25	0.35	0.26	0.35	0.26	0.35	0.26	0.35
W14X426	18.1	2346	0.76	0.27	0.38	0.27	0.38	0.27	0.38	0.27	0.38	0.28	0.38	0.28	0.38
W14X398	18.0	2163	0.84	0.29	0.41	0.29	0.41	0.29	0.41	0.29	0.41	0.30	0.41	0.30	0.41
W14X370	17.8	1987	0.91	0.31	0.45	0.31	0.45	0.31	0.45	0.32	0.45	0.32	0.45	0.32	0.45
W14X342	17.7	1814	0.99	0.33	0.49	0.33	0.49	0.34	0.49	0.34	0.49	0.34	0.49	0.35	0.49
W14X311	17.5	1628	1.10	0.37	0.55	0.37	0.55	0.37	0.55	0.38	0.55	0.38	0.55	0.38	0.55
W14X283	17.4	1463	1.23	0.40	0.61	0.41	0.61	0.41	0.61	0.41	0.61	0.42	0.61	0.42	0.61
W14X257	17.2	1315	1.36	0.44	0.68	0.45	0.68	0.45	0.68	0.46	0.68	0.46	0.68	0.47	0.68
W14X233	17.1	1177	1.51	0.49	0.76	0.49	0.76	0.50	0.76	0.50	0.76	0.51	0.76	0.51	0.76
W14X211	17.0	1053	1.69	0.54	0.84	0.55	0.84	0.55	0.84	0.56	0.84	0.56	0.84	0.57	0.84
W14X193	16.9	959	1.84	0.59	0.93	0.60	0.93	0.60	0.93	0.61	0.93	0.61	0.93	0.62	0.93
W14X176	16.8	864	2.05	0.65	1.03	0.66	1.03	0.66	1.03	0.67	1.03	0.67	1.03	0.68	1.03
W14X159	16.7	775	2.28	0.72	1.15	0.73	1.15	0.73	1.15	0.74	1.15	0.75	1.15	0.76	1.15
W14X145	16.6	702	2.51	0.79	1.27	0.80	1.27	0.80	1.27	0.81	1.27	0.82	1.27	0.83	1.27
W14X132	15.7	632	2.95	0.87	1.41	0.88	1.41	0.89	1.41	0.90	1.41	0.91	1.41	0.92	1.41
W14X120	15.6	572	3.25	0.96	1.55	0.97	1.55	0.98	1.55	0.99	1.55	1.00	1.55	1.01	1.55
W14X109	15.5	518	3.59	1.06	1.71	1.07	1.71	1.08	1.71	1.09	1.71	1.10	1.71	1.12	1.71
W14X99	15.5	467	3.98	1.16	1.90	1.17	1.90	1.19	1.90	1.20	1.90	1.22	1.90	1.23	1.90
W14X90	15.4	424	4.40	1.28	2.10	1.29	2.10	1.30	2.10	1.32	2.10	1.34	2.10	1.35	2.10
W14X82	10.3	375	7.49	1.47	2.37	1.50	2.37	1.53	2.37	1.57	2.39	1.62	2.41	1.67	2.44
W14X74	10.3	340	8.25	1.62	2.61	1.66	2.61	1.70	2.61	1.74	2.63	1.79	2.67	1.85	2.70
W14X68	10.3	311	9.07	1.77	2.86	1.81	2.86	1.85	2.86	1.90	2.89	1.96	2.93	2.02	2.97
W14X61	10.2	275	10.21	1.98	3.23	2.02	3.23	2.07	3.23	2.13	3.26	2.19	3.31	2.26	3.36
W14X53	8.0	235	15.35	2.39	3.78	2.47	3.85	2.57	3.92	2.69	3.99	2.82	4.07	2.97	4.15
W14X48	8.0	212	17.15	2.65	4.20	2.74	4.28	2.85	4.37	2.98	4.46	3.13	4.55	3.29	4.65
W14X43	7.9	188	19.42	2.97	4.74	3.08	4.84	3.21	4.95	3.35	5.06	3.52	5.17	3.71	5.30
W14X38	6.5	166	27.85	3.57	5.58	3.77	5.74	4.00	5.91	4.27	6.09	4.60	6.28	4.97	6.48
W14X34	6.4	147	31.76		6.32		6.51		6.72		6.94		7.17		7.42
W14X30	6.2	128	37.71		7.36		7.61		7.88		8.16		8.46		8.79
W14X26	4.5	108	62.00		9.56		10.04		10.57		11.15		11.81		12.56
W14X22	4.3	90	78.39		11.89		12.57		13.34		14.21		15.19		
W12X396	14.5	1628	1.24	0.34	0.55	0.35	0.55	0.35	0.55	0.36	0.55	0.36	0.55	0.37	0.55
W12X305	14.3	1450	1.38	0.38	0.61	0.38	0.61	0.39	0.61	0.39	0.61	0.40	0.61	0.41	0.61
W12X279	14.1	1289	1.53	0.42	0.68	0.42	0.68	0.43	0.68	0.43	0.68	0.44	0.68	0.45	0.68
W12X252	13.9	1156	1.73	0.46	0.77	0.47	0.77	0.47	0.77	0.48	0.77	0.49	0.77	0.49	0.77
W12X230	13.8	1042	1.91	0.50	0.85	0.51	0.85	0.52	0.85	0.52	0.85	0.53	0.85	0.54	0.85
W12X210	13.7	940	2.11	0.55	0.95	0.56	0.95	0.57	0.95	0.58	0.95	0.59	0.95	0.60	0.95
W12X190	13.5	840	2.36	0.61	1.06	0.62	1.06	0.63	1.06	0.64	1.06	0.65	1.06	0.66	1.06
W12X170	13.4	743	2.67	0.68	1.20	0.69	1.20	0.70	1.20	0.71	1.20	0.73	1.20	0.74	1.20
W12X152	13.3	656	3.01	0.77	1.35	0.78	1.35	0.79	1.35	0.80	1.35	0.81	1.35	0.83	1.35
W12X136	13.2	578	3.42	0.86	1.54	0.87	1.54	0.88	1.54	0.90	1.54	0.91	1.54	0.93	1.54
W12X120	13.0	502	3.92	0.97	1.77	0.99	1.77	1.00	1.77	1.02	1.77	1.03	1.77	1.06	1.77
W12X106	13.0	443	4.45	1.10	2.01	1.12	2.01	1.13	2.01	1.15	2.01	1.17	2.01	1.20	2.01
W12X96	12.9	397	4.94	1.22	2.24	1.24	2.24	1.25	2.24	1.26	2.24	1.30	2.24	1.33	2.24
W12X87	12.8	356	5.53	1.34	2.49	1.36	2.49	1.38	2.49	1.41	2.49	1.43	2.49	1.46	2.50

L_p = (KL)_y or (KL)_x for "b", and L_b for "m". Blank cells indicate slender element section or L_p > L_b.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi																	
Shape	L_p			14		15		16		17		18		19		20	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W16X77	10.3	405	8.16	1.84	2.32	1.91	2.35	1.99	2.39	2.07	2.43	2.16	2.47	2.26	2.51	2.38	2.55
W16X67	10.3	351	9.46	2.12	2.69	2.20	2.74	2.29	2.79	2.38	2.84	2.49	2.89	2.61	2.94	2.74	3.00
W16X57	6.7	284	18.14	3.48	3.76	3.79	3.87	4.15	3.98	4.58	4.09	5.08	4.22	5.67	4.35	6.28	4.49
W16X50	6.6	248	20.90	4.00	4.38	4.36	4.52	4.79	4.67	5.29	4.82	5.88	4.99	6.56	5.17	7.26	5.36
W16X45	6.5	222	23.50	4.49	4.99	4.91	5.16	5.40	5.34	5.98	5.54	6.67	5.75	7.43	5.98	8.23	6.23
W16X40	6.5	197	26.60		5.72		5.93		6.15		6.40		6.67		6.95		
W16X36	6.3	173	31.35		6.70		6.98		7.27		7.60		7.96				
W16X31	4.9	146	48.88		9.46												
W16X26	4.7	119	62.89														
W14X730	19.5	4482	0.42	0.16	0.20	0.16	0.20	0.17	0.20	0.17	0.20	0.17	0.20	0.17	0.20	0.17	0.20
W14X665	19.3	3996	0.46	0.18	0.22	0.18	0.22	0.18	0.22	0.18	0.22	0.19	0.22	0.19	0.22	0.19	0.22
W14X605	19.0	3564	0.52	0.20	0.25	0.20	0.25	0.20	0.25	0.20	0.25	0.21	0.25	0.21	0.25	0.21	0.25
W14X550	18.7	3186	0.58	0.22	0.28	0.22	0.28	0.22	0.28	0.22	0.28	0.23	0.28	0.23	0.28	0.23	0.28
W14X500	18.5	2835	0.65	0.24	0.31	0.24	0.31	0.25	0.31	0.25	0.31	0.25	0.31	0.26	0.31	0.26	0.31
W14X455	18.3	2527	0.72	0.26	0.35	0.27	0.35	0.27	0.35	0.27	0.35	0.28	0.35	0.28	0.35	0.29	0.35
W14X426	18.1	2346	0.78	0.28	0.38	0.29	0.38	0.29	0.38	0.29	0.38	0.30	0.38	0.30	0.38	0.31	0.38
W14X398	18.0	2163	0.84	0.30	0.41	0.31	0.41	0.31	0.41	0.31	0.41	0.32	0.41	0.32	0.41	0.33	0.41
W14X370	17.8	1987	0.91	0.33	0.45	0.33	0.45	0.33	0.45	0.34	0.45	0.34	0.45	0.35	0.45	0.35	0.45
W14X342	17.7	1814	0.99	0.35	0.49	0.36	0.49	0.36	0.49	0.37	0.49	0.37	0.49	0.38	0.49	0.38	0.49
W14X311	17.5	1628	1.10	0.39	0.55	0.39	0.55	0.40	0.55	0.40	0.55	0.41	0.55	0.42	0.55	0.42	0.55
W14X283	17.4	1463	1.23	0.43	0.61	0.43	0.61	0.44	0.61	0.44	0.61	0.45	0.61	0.46	0.61	0.47	0.61
W14X257	17.2	1315	1.36	0.47	0.68	0.46	0.68	0.48	0.68	0.49	0.68	0.50	0.68	0.51	0.68	0.52	0.68
W14X233	17.1	1177	1.51	0.52	0.76	0.53	0.76	0.54	0.76	0.54	0.76	0.55	0.76	0.56	0.76	0.57	0.76
W14X211	17.0	1053	1.69	0.58	0.84	0.58	0.84	0.59	0.84	0.60	0.84	0.61	0.85	0.62	0.85	0.63	0.85
W14X193	16.9	959	1.84	0.63	0.93	0.64	0.93	0.65	0.93	0.66	0.93	0.67	0.93	0.68	0.94	0.69	0.94
W14X176	16.8	884	2.05	0.69	1.03	0.70	1.03	0.71	1.03	0.72	1.03	0.73	1.03	0.75	1.04	0.76	1.04
W14X159	16.7	775	2.28	0.77	1.15	0.78	1.15	0.79	1.15	0.80	1.15	0.82	1.15	0.83	1.16	0.85	1.17
W14X145	16.6	702	2.51	0.84	1.27	0.85	1.27	0.87	1.27	0.88	1.27	0.89	1.28	0.91	1.28	0.93	1.29
W14X132	16.7	632	2.95	0.94	1.41	0.95	1.41	0.97	1.41	0.98	1.42	1.00	1.43	1.02	1.44	1.04	1.45
W14X120	16.6	572	3.25	1.03	1.55	1.05	1.55	1.06	1.56	1.08	1.57	1.10	1.58	1.13	1.59	1.15	1.60
W14X109	15.5	518	3.59	1.14	1.71	1.15	1.71	1.17	1.72	1.20	1.73	1.22	1.75	1.24	1.76	1.27	1.77
W14X99	15.5	467	3.98	1.25	1.90	1.27	1.90	1.29	1.91	1.32	1.93	1.34	1.94	1.37	1.96	1.40	1.98
W14X90	15.4	424	4.40	1.37	2.10	1.40	2.10	1.42	2.11	1.45	2.13	1.48	2.15	1.51	2.17	1.54	2.19
W14X82	10.3	375	7.49	1.73	2.47	1.79	2.50	1.86	2.53	1.94	2.56	2.02	2.59	2.12	2.62	2.22	2.65
W14X74	10.3	340	8.25	1.91	2.73	1.98	2.77	2.06	2.80	2.14	2.84	2.23	2.88	2.34	2.92	2.45	2.96
W14X68	10.3	311	9.07	2.09	3.01	2.17	3.05	2.25	3.10	2.35	3.14	2.45	3.18	2.57	3.23	2.70	3.28
W14X61	10.2	275	10.21	2.34	3.41	2.43	3.46	2.52	3.52	2.63	3.57	2.75	3.63	2.88	3.69	3.03	3.75
W14X53	8.0	235	15.35	3.13	4.23	3.33	4.32	3.55	4.40	3.80	4.50	4.08	4.59	4.40	4.70	4.77	4.80
W14X48	8.0	212	17.15	3.48	4.75	3.70	4.85	3.95	4.96	4.23	5.08	4.54	5.20	4.91	5.33	5.32	5.46
W14X43	7.9	188	19.42	3.93	5.42	4.18	5.55	4.47	5.69	4.79	5.84	5.16	5.99	5.58	6.16	6.06	6.33
W14X38	6.5	166	27.85	5.42	6.69	5.93	6.92	6.54	7.17	7.26	7.43	8.13	7.72	9.05	8.02	10.03	
W14X34	6.4	147	31.76		7.69		7.96		8.29		8.63		8.99				
W14X30	6.2	128	37.71		9.14		9.53		9.95		10.40						
W14X26	4.5	109	62.00														
W14X22	4.3	90	78.39														
W12X336	14.5	1628	1.24	0.37	0.55	0.38	0.55	0.39	0.55	0.40	0.55	0.41	0.55	0.42	0.55	0.43	0.55
W12X305	14.3	1450	1.38	0.41	0.61	0.42	0.61	0.43	0.62	0.44	0.62	0.45	0.62	0.46	0.62	0.47	0.62
W12X279	14.1	1299	1.53	0.45	0.68	0.46	0.69	0.47	0.69	0.48	0.69	0.49	0.69	0.51	0.69	0.52	0.70
W12X252	13.9	1156	1.73	0.50	0.77	0.51	0.77	0.52	0.77	0.54	0.78	0.55	0.78	0.56	0.78	0.58	0.78
W12X230	13.8	1042	1.91	0.55	0.85	0.56	0.86	0.58	0.86	0.59	0.86	0.60	0.86	0.62	0.87	0.64	0.87
W12X210	13.7	940	2.11	0.61	0.95	0.62	0.95	0.63	0.95	0.65	0.96	0.66	0.96	0.68	0.96	0.70	0.97
W12X190	13.5	840	2.36	0.67	1.06	0.69	1.06	0.70	1.07	0.72	1.07	0.74	1.08	0.76	1.08	0.78	1.08
W12X170	13.4	743	2.67	0.75	1.20	0.77	1.21	0.79	1.21	0.81	1.22	0.83	1.22	0.85	1.23	0.88	1.23
W12X152	13.3	656	3.01	0.85	1.36	0.86	1.37	0.88	1.37	0.91	1.38	0.93	1.38	0.96	1.39	0.98	1.40
W12X136	13.2	578	3.42	0.95	1.55	0.97	1.55	0.99	1.56	1.02	1.57	1.05	1.58	1.08	1.59	1.11	1.60
W12X120	13.0	502	3.92	1.06	1.78	1.10	1.79	1.13	1.80	1.16	1.81	1.19	1.82	1.22	1.83	1.26	1.85
W12X106	13.0	443	4.45	1.22	2.02	1.25	2.04	1.28	2.05	1.31	2.06	1.35	2.08	1.39	2.09	1.43	2.11
W12X96	12.9	397	4.94	1.35	2.26	1.39	2.28	1.42	2.29	1.46	2.31	1.50	2.33	1.54	2.35	1.59	2.36
W12X87	12.8	356	5.53	1.49	2.52	1.53	2.54	1.57	2.56	1.61	2.58	1.66	2.60	1.71	2.63	1.76	2.65

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_b for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi															
Shape	L_p			8		9		10		11		12		13	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W12X79	12.7	321	6.13	1.48	2.77	1.50	2.77	1.53	2.77	1.55	2.77	1.58	2.77	1.62	2.77
W12X72	12.7	292	6.77	1.63	3.05	1.66	3.05	1.68	3.05	1.71	3.05	1.74	3.05	1.78	3.06
W12X65	12.6	261	7.54	1.80	3.40	1.83	3.40	1.86	3.40	1.89	3.40	1.93	3.40	1.97	3.42
W12X58	10.5	233	10.26	2.08	3.81	2.12	3.81	2.17	3.81	2.22	3.84	2.29	3.89	2.36	3.94
W12X53	10.3	210	11.43	2.27	4.23	2.31	4.23	2.37	4.23	2.43	4.26	2.50	4.32	2.58	4.38
W12X50	8.2	195	15.79	2.52	4.55	2.61	4.61	2.71	4.68	2.82	4.76	2.95	4.84	3.10	4.92
W12X45	8.1	175	17.70	2.82	5.09	2.91	5.17	3.03	5.26	3.16	5.36	3.31	5.46	3.48	5.56
W12X40	8.0	155	19.95	3.15	5.73	3.27	5.83	3.39	5.94	3.54	6.06	3.71	6.19	3.91	6.32
W12X36	6.4	138	29.38	3.89	6.70	4.11	6.88	4.37	7.07	4.67	7.27	5.03	7.48	5.45	7.70
W12X30	6.3	116	35.17	4.59	8.01	4.85	8.25	5.16	8.50	5.53	8.77	5.96	9.06	6.47	9.36
W12X26	6.3	100	41.10		9.32		9.63		9.95		10.29		10.66		11.06
W12X22	3.5	79	95.01	9.87	14.37	11.80	15.33	14.42	16.42	17.44	17.69	20.76		24.36	
W12X19	3.4	67	116.74		17.75		19.13		20.75						
W12X16	3.2	54	155.66		23.14		25.32								
W12X14	3.1	47	184.44		27.41		30.19								
W10X112	11.2	397	4.85	1.06	2.24	1.08	2.24	1.10	2.24	1.13	2.24	1.16	2.25	1.19	2.26
W10X100	11.0	361	5.48	1.19	2.53	1.21	2.53	1.24	2.53	1.27	2.53	1.30	2.55	1.33	2.56
W10X88	11.0	305	6.31	1.35	2.91	1.38	2.91	1.41	2.91	1.44	2.91	1.48	2.93	1.52	2.95
W10X77	10.8	264	7.29	1.55	3.37	1.58	3.37	1.62	3.37	1.66	3.38	1.70	3.40	1.75	3.43
W10X68	10.8	230	8.31	1.76	3.86	1.79	3.86	1.83	3.86	1.87	3.87	1.92	3.90	1.98	3.93
W10X60	10.7	201	9.54	2.00	4.41	2.04	4.41	2.08	4.41	2.13	4.43	2.19	4.47	2.25	4.51
W10X54	10.7	180	10.65	2.23	4.94	2.27	4.94	2.32	4.94	2.38	4.96	2.44	5.01	2.51	5.07
W10X49	10.6	163	11.74	2.45	5.45	2.50	5.45	2.55	5.45	2.62	5.48	2.69	5.54	2.77	5.61
W10X45	8.4	148	16.50	2.77	6.00	2.86	6.05	2.96	6.13	3.08	6.21	3.22	6.30	3.37	6.39
W10X39	6.3	126	19.42	3.22	7.03	3.32	7.12	3.45	7.23	3.59	7.34	3.75	7.46	3.94	7.59
W10X33	8.1	105	23.86	3.83	8.49	3.96	8.63	4.12	8.79	4.29	8.96	4.50	9.13	4.73	9.31
W10X30	5.7	99	38.17	4.79	9.53	5.13	9.79	5.54	10.06	6.03	10.34	6.61	10.65	7.32	10.97
W10X26	5.7	86	44.88	5.58	11.25	5.99	11.59	6.47	11.95	7.05	12.34	7.75	12.76	8.58	13.20
W10X22	5.5	70	55.28	6.62	13.71	7.13	14.19	7.73	14.71	8.46	15.26	9.33	15.86	10.39	16.50
W10X19	3.6	58	102.56	11.04	18.96	13.09	20.07	15.87	21.33	19.20	22.76	22.85		26.81	
W10X17	3.5	50	123.30	13.03	22.58	15.64	24.10	19.17	25.83	23.19	27.83	27.60		32.39	
W10X15	3.4	43	151.36	15.52	27.44	18.89	29.57	23.33	32.06	28.22		33.59		39.42	
W10X12	3.3	34	199.53		36.27		39.54								
W8X67	8.8	190	10.26	1.85	4.69	1.90	4.70	1.96	4.73	2.03	4.76	2.11	4.79	2.21	4.83
W8X58	8.8	161	11.99	2.13	5.51	2.20	5.52	2.27	5.56	2.35	5.60	2.45	5.65	2.56	5.70
W8X48	8.7	132	14.63	2.59	6.72	2.67	6.74	2.76	6.81	2.87	6.87	2.98	6.94	3.12	7.01
W8X40	8.5	107	17.99	3.14	8.27	3.24	8.32	3.35	8.42	3.48	8.52	3.63	8.62	3.80	8.73
W8X35	8.5	94	20.71	3.57	9.49	3.68	9.56	3.81	9.68	3.96	9.82	4.14	9.95	4.33	10.09
W8X31	8.4	82	23.68	4.03	10.83	4.16	10.92	4.31	11.09	4.48	11.26	4.68	11.43	4.90	11.61
W8X28	6.8	73	33.10	4.77	12.37	5.01	12.59	5.29	12.82	5.62	13.06	6.00	13.31	6.45	13.57
W8X24	6.7	63	36.98	5.57	14.58	5.85	14.86	6.18	15.16	6.58	15.51	7.03	15.85	7.57	16.21
W8X21	5.3	55	59.16	7.20	17.41	7.81	17.92	8.55	18.47	9.45	19.04	10.55	19.66	11.89	20.32
W8X18	5.1	46	72.20	8.56	21.23	9.32	21.96	10.25	22.75	11.39	23.60	12.78	24.51	14.49	25.49
W8X15	3.7	37	129.11	13.77	29.52	16.27	31.10	19.63	32.85	23.75	34.81	28.27	37.02	33.17	
W8X13	3.5	31	160.20	16.93	36.60	20.32	38.91	24.91	41.53	30.14	44.53	35.87		42.10	
W8X10	3.5	24	207.06	21.96	49.17	26.36	52.99	32.31	57.46	39.10		46.53		54.61	
W6X25	6.3	51	39.12	5.49	17.85	5.81	18.12	6.18	18.40	6.62	18.68	7.14	18.98	7.75	19.28
W6X20	6.3	40	49.77	6.91	22.82	7.31	23.25	7.80	23.70	8.37	24.17	9.04	24.66	9.84	25.17
W6X15	6.7	29	72.05	9.26	31.94	9.84	32.75	10.53	33.61	11.34	34.52	12.31	35.47	13.46	36.48
W6X12	4.0	32	99.76	11.55	31.33	13.24	32.26	15.43	33.24	18.31	34.28	21.79	35.39	25.57	36.58
W6X12	3.8	22	146.32	16.33	46.32	19.02	48.27	22.54	50.38	27.18	52.69	32.34	55.23	37.96	58.01
W6X9	3.8	17	197.73	21.91	64.45	25.60	68.00	30.46	71.96	36.80	76.41	43.79	81.45	51.39	
W5X19	5.3	31	60.46	7.93	29.53	8.58	29.99	9.37	30.46	10.33	30.95	11.49	31.45	12.89	31.98
W5X16	5.3	26	73.16	9.43	36.00	10.22	36.66	11.17	37.34	12.33	38.05	13.74	38.79	15.45	39.55
W4X13	4.2	17	115.52	13.86	56.18	15.77	57.24	18.21	58.35	21.35	59.51	25.38	60.71	29.78	61.96

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_c$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 36$ ksi)

$F_y = 36$ ksi																	
L_p				14		15		16		17		18		19		20	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W12X79	12.7	321	6.13	1.65	2.60	1.69	2.82	1.74	2.85	1.78	2.88	1.83	2.90	1.89	2.93	1.95	2.96
W12X72	12.7	292	6.77	1.82	3.09	1.86	3.12	1.91	3.15	1.96	3.18	2.02	3.22	2.08	3.25	2.15	3.29
W12X65	12.6	261	7.54	2.01	3.45	2.06	3.49	2.12	3.53	2.18	3.57	2.24	3.61	2.31	3.65	2.39	3.69
W12X58	10.5	233	10.26	2.43	3.99	2.52	4.04	2.62	4.09	2.72	4.15	2.84	4.21	2.97	4.26	3.11	4.33
W12X53	10.3	210	11.43	2.67	4.45	2.76	4.51	2.87	4.58	2.99	4.65	3.12	4.72	3.27	4.79	3.43	4.86
W12X50	8.2	195	15.79	3.27	5.00	3.47	5.09	3.68	5.18	3.93	5.28	4.21	5.37	4.53	5.48	4.90	5.58
W12X45	8.1	175	17.70	3.67	5.67	3.90	5.78	4.15	5.89	4.43	6.01	4.75	6.14	5.12	6.27	5.54	6.40
W12X40	8.0	155	19.95	4.13	6.45	4.38	6.59	4.66	6.74	4.99	6.89	5.36	7.05	5.77	7.21	6.25	7.39
W12X36	6.4	138	20.38	5.04	7.04	5.51	7.20	5.99	7.39	6.56	7.60	7.16	7.37	7.95	8.18	8.86	9.10
W12X30	6.3	116	35.17	7.07	9.69	7.78	10.04	8.61	10.42	9.60	10.83	11.27	12.00	11.75	13.29		
W12X26	6.3	100	41.10		11.48		11.95		12.45		12.99		13.58				
W12X22	3.5	79	95.01	28.25		32.44		36.90		41.66		46.71		52.04		57.66	
W12X19	3.4	67	116.74														
W12X16	3.2	54	155.66														
W12X14	3.1	47	184.44														
W10X112	11.2	397	4.85	1.22	2.27	1.26	2.28	1.30	2.30	1.35	2.31	1.40	2.32	1.45	2.33	1.52	2.34
W10X100	11.0	351	5.49	1.37	2.58	1.42	2.59	1.47	2.61	1.52	2.62	1.58	2.64	1.64	2.65	1.71	2.67
W10X88	11.0	305	6.31	1.56	2.97	1.61	2.99	1.67	3.01	1.73	3.03	1.80	3.05	1.87	3.07	1.96	3.09
W10X77	10.6	264	7.29	1.80	3.45	1.86	3.48	1.93	3.51	2.00	3.53	2.08	3.56	2.17	3.59	2.26	3.62
W10X68	10.8	230	8.31	2.04	3.97	2.11	4.00	2.18	4.04	2.27	4.07	2.36	4.11	2.46	4.14	2.57	4.18
W10X60	10.7	201	9.54	2.33	4.56	2.40	4.60	2.49	4.65	2.59	4.69	2.69	4.74	2.81	4.79	2.94	4.84
W10X54	10.7	180	10.65	2.59	5.12	2.68	5.18	2.78	5.24	2.89	5.30	3.01	5.36	3.14	5.42	3.29	5.48
W10X49	10.6	163	11.74	2.86	5.67	2.96	5.74	3.07	5.81	3.19	5.89	3.32	5.96	3.47	6.04	3.63	6.12
W10X45	8.4	148	16.50	3.55	6.48	3.75	6.57	3.97	6.67	4.23	6.77	4.51	6.87	4.84	6.98	5.20	7.09
W10X39	8.3	126	19.42	4.15	7.71	4.39	7.84	4.66	7.98	4.97	8.12	5.32	8.27	5.71	8.42	6.16	8.57
W10X33	8.1	105	23.86	4.99	9.50	5.30	9.70	5.64	9.90	6.02	10.11	6.46	10.34	6.96	10.57	7.53	10.81
W10X30	5.7	99	38.17	8.16	11.31	8.17	11.67	10.41	12.05	11.76	12.48	13.18	12.91	14.68	13.38	16.27	13.89
W10X26	5.7	85	44.88	9.59	13.68	10.80	14.19	12.28	14.74	13.86	15.34	15.54	15.98	17.31		19.18	
W10X22	5.5	70	55.28	11.66	17.20	13.23	17.96	15.05	18.79	16.99		19.05		21.22		23.52	
W10X19	3.6	58	102.56	31.10		35.70		40.62		45.85		51.41		57.28		63.46	
W10X17	3.5	50	123.30	37.57		43.13		49.07		55.40		62.11		69.20		76.87	
W10X15	3.4	43	151.36	45.72		52.48		59.71		67.41		75.58		84.21		93.30	
W10X12	3.3	34	199.53														
W8X67	8.8	190	10.26	2.31	4.86	2.42	4.90	2.55	4.93	2.70	4.97	2.87	5.00	3.05	5.04	3.26	5.08
W8X58	8.8	161	11.99	2.68	5.74	2.81	5.79	2.97	5.84	3.14	5.89	3.34	5.94	3.55	5.99	3.80	6.04
W8X48	8.7	132	14.63	3.27	7.08	3.44	7.15	3.63	7.22	3.85	7.30	4.09	7.37	4.36	7.45	4.67	7.53
W8X40	8.5	107	17.99	3.99	8.84	4.21	8.95	4.45	9.06	4.73	9.18	5.04	9.30	5.39	9.42	5.79	9.55
W8X35	8.5	94	20.71	4.55	10.23	4.80	10.38	5.08	10.53	5.40	10.69	5.76	10.85	6.16	11.02	6.62	11.19
W8X31	8.4	82	23.68	5.15	11.80	5.44	11.99	5.76	12.19	6.12	12.39	6.53	12.61	7.00	12.83	7.53	13.05
W8X28	6.8	73	33.10	6.98	13.84	7.59	14.12	8.30	14.41	9.13	14.71	10.10	15.03	11.25	15.36	12.47	15.70
W8X24	6.7	63	38.98	8.19	16.58	8.91	16.97	9.76	17.39	10.75	17.82	11.92	18.27	13.28	18.75	14.71	19.25
W8X21	5.3	55	59.16	13.53	21.02	15.53	21.77	17.67	22.58	19.94	23.45	22.36	24.39	24.91		27.60	
W8X18	5.1	46	72.20	16.62	26.66	19.06	27.72	21.71	28.99	24.51		27.48		30.62		33.92	
W8X15	3.7	37	129.11	38.47		44.17		50.25		56.73		63.60		70.86		78.52	
W8X13	3.5	31	160.20	48.82		56.05		63.77		71.99		80.71		89.92		99.64	
W8X10	3.5	24	207.06	63.34		72.71		82.72		93.39		104.70		116.65		129.26	
W6X25	6.3	51	38.12	8.47	19.60	9.32	19.93	10.31	20.26	11.50	20.61	12.69	20.97	14.37	21.34	15.92	21.73
W6X20	6.3	40	49.77	10.78	25.70	11.88	26.25	13.19	26.83	14.77	27.43	16.56	28.06	18.45	28.72	20.44	29.41
W6X15	6.7	26	72.05	14.81	37.55	16.42	38.68	18.33	39.88	20.66	41.16	23.16	42.53	25.80	43.99	28.59	45.55
W6X16	4.0	32	99.76	29.66	37.85	34.05	39.20	38.74	40.66	43.73	42.24	49.03	43.94	54.63		60.53	
W6X12	3.8	22	146.32	44.02	61.09	50.54		57.50		64.91		72.78		81.09		89.85	
W6X9	3.8	17	197.73	59.61		68.42		77.85		87.89		98.53		109.78		121.64	
W5X19	5.3	31	60.46	14.61	32.50	16.73	33.05	19.04	33.63	21.49	34.22	24.08	34.83	26.84	35.47	29.74	36.13
W5X16	5.3	26	73.16	17.54	40.35	20.12	41.18	22.89	42.04	25.84	42.94	28.97	43.88	32.28	44.86	35.76	45.89
W4X13	4.2	17	115.52	34.54	63.26	38.85	64.82	45.11	66.04	60.90	67.52	67.09	69.07	63.61	70.70	76.46	72.40

$L_p = (KL)_x$ or $(KL)_y$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi															
L_p				8		9		10		11		12		13	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W40X328	14.67	5662.50	0.85		0.16		0.16		0.16		0.16		0.16		0.16
W40X298	14.57	5137.50	0.95		0.17		0.17		0.17		0.17		0.17		0.17
W40X268	14.46	4575.00	1.06		0.19		0.19		0.19		0.19		0.19		0.19
W40X244	14.28	4125.00	1.20		0.22		0.22		0.22		0.22		0.22		0.22
W40X221	13.79	3626.25	1.41		0.25		0.25		0.25		0.25		0.25		0.25
W40X192	15.46	2922.43	1.92		0.30		0.30		0.30		0.30		0.30		0.30
W40X655	13.65	11475.00	0.47	0.13	0.08	0.13	0.08	0.13	0.08	0.14	0.08	0.14	0.08	0.14	0.08
W40X593	13.47	10312.50	0.52	0.14	0.09	0.15	0.09	0.15	0.09	0.15	0.09	0.15	0.09	0.16	0.09
W40X531	13.26	9187.50	0.59	0.16	0.10	0.16	0.10	0.16	0.10	0.17	0.10	0.17	0.10	0.17	0.10
W40X480	13.15	8175.00	0.67	0.18	0.11	0.18	0.11	0.18	0.11	0.19	0.11	0.19	0.11	0.20	0.11
W40X436	12.98	7425.00	0.75	0.19	0.12	0.20	0.12	0.20	0.12	0.21	0.12	0.21	0.12	0.21	0.12
W40X397	12.90	6712.50	0.83	0.21	0.13	0.22	0.13	0.22	0.13	0.23	0.13	0.23	0.13	0.24	0.13
W40X362	12.76	6112.50	0.91	0.23	0.15	0.24	0.15	0.24	0.15	0.25	0.15	0.25	0.15	0.26	0.15
W40X324	12.62	5475.00	1.03	0.26	0.16	0.27	0.16	0.27	0.16	0.28	0.16	0.28	0.16	0.29	0.17
W40X297	12.52	4987.50	1.16		0.18		0.18		0.18		0.18		0.18		0.18
W40X277	12.66	4687.50	1.20		0.19		0.19		0.19		0.19		0.19		0.19
W40X249	12.59	4200.00	1.34		0.21		0.21		0.21		0.21		0.21		0.22
W40X215	12.52	3611.25	1.56		0.25		0.25		0.25		0.25		0.25		0.25
W40X199	12.20	3255.00	1.79		0.27		0.27		0.27		0.27		0.27		0.28
W40X183	8.84	2928.75	2.78		0.30		0.31		0.31		0.32		0.32		0.34
W40X167	8.49	2595.00	3.30		0.34		0.35		0.35		0.37		0.37		0.39
W40X149	8.10	2238.75	4.07		0.40		0.41		0.41		0.44		0.44		0.46
W36X848	15.10	14362.50	0.32	0.10	0.06	0.10	0.06	0.10	0.06	0.10	0.06	0.10	0.06	0.11	0.06
W36X798	14.99	13387.50	0.34	0.10	0.07	0.11	0.07	0.11	0.07	0.11	0.07	0.11	0.07	0.11	0.07
W36X720	14.78	11962.50	0.36	0.12	0.07	0.12	0.07	0.12	0.07	0.12	0.07	0.12	0.07	0.13	0.07
W36X650	14.57	10650.00	0.43	0.13	0.08	0.13	0.08	0.13	0.08	0.14	0.08	0.14	0.08	0.14	0.08
W36X588	14.39	9562.50	0.48	0.14	0.09	0.15	0.09	0.15	0.09	0.15	0.09	0.15	0.09	0.15	0.09
W36X527	14.21	8512.50	0.55	0.16	0.10	0.16	0.10	0.16	0.10	0.17	0.10	0.17	0.10	0.17	0.10
W36X485	14.07	7762.50	0.60	0.17	0.11	0.18	0.11	0.18	0.11	0.18	0.11	0.18	0.11	0.19	0.11
W36X439	13.97	6975.00	0.67	0.19	0.13	0.20	0.13	0.20	0.13	0.20	0.13	0.20	0.13	0.21	0.13
W36X393	13.79	6225.00	0.76	0.21	0.14	0.22	0.14	0.22	0.14	0.23	0.14	0.23	0.14	0.23	0.14
W36X359	13.68	5662.50	0.84	0.23	0.16	0.24	0.16	0.24	0.16	0.25	0.16	0.25	0.16	0.26	0.16
W36X326	13.58	5175.00	0.92	0.26	0.17	0.26	0.17	0.26	0.17	0.27	0.17	0.27	0.17	0.28	0.17
W36X300	13.54	4725.00	1.01	0.28	0.19	0.29	0.19	0.29	0.19	0.30	0.19	0.30	0.19	0.31	0.19
W36X280	13.47	4387.50	1.10	0.30	0.20	0.31	0.20	0.31	0.20	0.32	0.20	0.32	0.20	0.33	0.20
W36X260	13.36	4050.00	1.20		0.22		0.22		0.22		0.22		0.22		0.22
W36X245	13.26	3787.50	1.28		0.23		0.23		0.23		0.23		0.23		0.24
W36X230	13.19	3536.25	1.39		0.25		0.25		0.25		0.25		0.25		0.25
W36X216	13.12	3287.50	1.49		0.26		0.26		0.26		0.26		0.26		0.26
W36X210	13.12	3123.75	1.54		0.28		0.28		0.28		0.30		0.30		0.31
W36X194	9.05	2876.25	2.55		0.31		0.31		0.31		0.33		0.33		0.34
W36X182	9.02	2692.50	2.74		0.33		0.34		0.34		0.36		0.36		0.37
W36X170	8.94	2505.00	2.97		0.35		0.36		0.36		0.38		0.38		0.39
W36X160	8.84	2340.00	3.22		0.38		0.39		0.39		0.41		0.41		0.42
W36X150	8.73	2178.75	3.50		0.41		0.42		0.42		0.44		0.44		0.46
W36X135	8.41	1908.75	4.19		0.47		0.48		0.48		0.51		0.51		0.53
W33X619	14.07	9600.00	0.46	0.14	0.09	0.14	0.09	0.14	0.09	0.14	0.09	0.14	0.09	0.15	0.09
W33X567	13.93	8797.50	0.51	0.15	0.10	0.15	0.10	0.15	0.10	0.16	0.10	0.16	0.10	0.16	0.10
W33X515	13.75	7912.50	0.57	0.16	0.11	0.17	0.11	0.17	0.11	0.17	0.11	0.17	0.11	0.18	0.11
W33X468	13.61	7087.50	0.64	0.18	0.13	0.18	0.13	0.18	0.13	0.19	0.13	0.19	0.13	0.20	0.13
W33X424	13.47	6375.00	0.72	0.20	0.14	0.20	0.14	0.20	0.14	0.21	0.14	0.21	0.14	0.22	0.14
W33X387	13.40	5812.50	0.79	0.22	0.15	0.22	0.15	0.22	0.15	0.23	0.15	0.23	0.15	0.24	0.15
W33X354	13.22	5325.00	0.87	0.24	0.17	0.24	0.17	0.24	0.17	0.25	0.17	0.25	0.17	0.26	0.17
W33X318	13.12	4762.50	0.98	0.26	0.19	0.27	0.19	0.27	0.19	0.28	0.19	0.28	0.19	0.29	0.18
W33X291	13.05	4312.50	1.08	0.29	0.21	0.30	0.21	0.30	0.21	0.31	0.21	0.31	0.21	0.32	0.21
W33X263	12.94	3900.00	1.21	0.32	0.23	0.33	0.23	0.33	0.23	0.34	0.23	0.34	0.23	0.35	0.23
W33X241	12.83	3521.25	1.34		0.25		0.25		0.25		0.25		0.25		0.26
W33X221	12.69	3206.25	1.49		0.28		0.28		0.28		0.28		0.28		0.28

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi																	
L_p				14		15		16		17		18		19		20	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W40X328	14.87	5662.50	0.85		0.16		0.16		0.16		0.16		0.16		0.17		0.17
W40X298	14.57	5137.50	0.95		0.17		0.18		0.18		0.18		0.18		0.18		0.18
W40X268	14.46	4575.00	1.06		0.19		0.20		0.20		0.20		0.20		0.21		0.21
W40X244	14.28	4125.00	1.20		0.22		0.22		0.22		0.23		0.23		0.23		0.23
W40X221	13.79	3626.25	1.41		0.25		0.25		0.25		0.26		0.26		0.27		0.27
W40X192	15.46	2922.43	1.92		0.30		0.31		0.31		0.32		0.32		0.33		0.33
W40X165	13.85	11475.00	0.47	0.14	0.08	0.15	0.06	0.15	0.06	0.15	0.08	0.15	0.06	0.16	0.08	0.16	0.06
W40X159	13.47	10312.50	0.52	0.16	0.09	0.16	0.09	0.16	0.09	0.17	0.09	0.17	0.09	0.18	0.09	0.18	0.09
W40X151	13.26	9187.50	0.59	0.17	0.10	0.18	0.10	0.18	0.10	0.19	0.10	0.19	0.10	0.20	0.10	0.20	0.10
W40X148	13.15	8175.00	0.67	0.20	0.11	0.20	0.11	0.20	0.11	0.22	0.11	0.22	0.11	0.23	0.12	0.23	0.12
W40X146	12.98	7425.00	0.75	0.21	0.12	0.22	0.12	0.22	0.12	0.24	0.13	0.24	0.13	0.25	0.13	0.25	0.13
W40X139	12.90	6712.50	0.83	0.24	0.13	0.25	0.14	0.25	0.14	0.26	0.14	0.26	0.14	0.28	0.14	0.28	0.14
W40X136	12.76	6112.50	0.91	0.26	0.15	0.27	0.15	0.27	0.15	0.29	0.15	0.29	0.15	0.31	0.16	0.31	0.16
W40X132	12.62	5475.00	1.03	0.29	0.17	0.31	0.17	0.31	0.17	0.32	0.17	0.32	0.17	0.34	0.18	0.34	0.18
W40X127	12.52	4987.50	1.15		0.18		0.19		0.19		0.19		0.19		0.20		0.20
W40X127	12.66	4687.50	1.20		0.19		0.20		0.20		0.20		0.20		0.21		0.21
W40X124	12.59	4200.00	1.34		0.22		0.22		0.22		0.23		0.23		0.24		0.24
W40X121	12.52	3611.25	1.56		0.25		0.26		0.26		0.27		0.27		0.28		0.28
W40X119	12.20	3255.00	1.79		0.28		0.29		0.29		0.30		0.30		0.31		0.31
W40X118	8.84	2928.75	2.78		0.34		0.35		0.35		0.37		0.37		0.39		0.39
W40X117	8.49	2595.00	3.30		0.39		0.41		0.41		0.43		0.43		0.45		0.45
W40X119	8.10	2238.75	4.07		0.46		0.48		0.48		0.51		0.51		0.54		0.54
W36X848	15.10	14362.50	0.32	0.11	0.06	0.11	0.06	0.11	0.06	0.11	0.06	0.11	0.06	0.12	0.06	0.12	0.06
W36X798	14.99	13387.50	0.34	0.11	0.07	0.12	0.07	0.12	0.07	0.12	0.07	0.12	0.07	0.13	0.07	0.13	0.07
W36X720	14.78	11962.50	0.38	0.13	0.07	0.13	0.07	0.13	0.07	0.14	0.08	0.14	0.08	0.14	0.08	0.14	0.08
W36X650	14.57	10650.00	0.43	0.14	0.08	0.15	0.08	0.15	0.08	0.15	0.09	0.15	0.09	0.16	0.09	0.16	0.09
W36X588	14.39	9562.50	0.48	0.15	0.09	0.16	0.09	0.16	0.09	0.17	0.10	0.17	0.10	0.18	0.10	0.18	0.10
W36X527	14.21	8512.50	0.55	0.17	0.10	0.18	0.11	0.18	0.11	0.19	0.11	0.19	0.11	0.20	0.11	0.20	0.11
W36X486	14.07	7762.50	0.60	0.19	0.11	0.20	0.12	0.20	0.12	0.21	0.12	0.21	0.12	0.22	0.12	0.22	0.12
W36X439	13.97	6975.00	0.67	0.21	0.13	0.22	0.13	0.22	0.13	0.23	0.13	0.23	0.13	0.24	0.13	0.24	0.13
W36X393	13.79	6225.00	0.76	0.23	0.14	0.24	0.15	0.24	0.15	0.26	0.15	0.26	0.15	0.27	0.15	0.27	0.15
W36X359	13.68	5662.50	0.84	0.26	0.16	0.27	0.16	0.27	0.16	0.28	0.16	0.28	0.16	0.30	0.17	0.30	0.17
W36X328	13.58	5175.00	0.92	0.28	0.17	0.29	0.18	0.29	0.18	0.31	0.18	0.31	0.18	0.32	0.18	0.32	0.18
W36X300	13.54	4725.00	1.01	0.31	0.19	0.32	0.19	0.32	0.19	0.34	0.20	0.34	0.20	0.36	0.20	0.36	0.20
W36X280	13.47	4387.50	1.10	0.33	0.20	0.34	0.21	0.34	0.21	0.36	0.21	0.36	0.21	0.38	0.22	0.38	0.22
W36X260	13.36	4050.00	1.20		0.22		0.23		0.23		0.23		0.23		0.24		0.24
W36X245	13.26	3787.50	1.28		0.24		0.24		0.24		0.25		0.25		0.26		0.26
W36X230	13.19	3536.25	1.39		0.25		0.26		0.26		0.27		0.27		0.28		0.28
W36X256	9.37	3900.00	1.83	0.42	0.25	0.46	0.26	0.46	0.26	0.51	0.26	0.51	0.26	0.57	0.27	0.57	0.27
W36X232	9.26	3510.00	2.05		0.28		0.29		0.29		0.30		0.30		0.31		0.31
W36X210	9.12	3123.75	2.34		0.31		0.33		0.33		0.34		0.34		0.35		0.35
W36X194	9.05	2876.25	2.55		0.34		0.36		0.36		0.37		0.37		0.39		0.39
W36X182	9.02	2692.50	2.74		0.37		0.38		0.38		0.40		0.40		0.42		0.42
W36X170	8.94	2505.00	2.97		0.39		0.41		0.41		0.43		0.43		0.45		0.45
W36X160	8.84	2340.00	3.22		0.42		0.45		0.45		0.47		0.47		0.49		0.49
W36X150	8.73	2178.75	3.50		0.46		0.48		0.48		0.51		0.51		0.53		0.53
W36X135	8.41	1908.75	4.19		0.53		0.56		0.56		0.59		0.59		0.63		0.63
W33X619	14.07	9600.00	0.46	0.15	0.09	0.15	0.09	0.15	0.09	0.16	0.09	0.16	0.09	0.17	0.10	0.17	0.10
W33X567	13.93	8737.50	0.51	0.16	0.10	0.17	0.10	0.17	0.10	0.18	0.10	0.18	0.10	0.19	0.11	0.19	0.11
W33X515	13.75	7912.50	0.57	0.18	0.11	0.19	0.11	0.19	0.11	0.20	0.12	0.20	0.12	0.21	0.12	0.21	0.12
W33X468	13.61	7087.50	0.64	0.20	0.13	0.21	0.13	0.21	0.13	0.22	0.13	0.22	0.13	0.23	0.13	0.23	0.13
W33X424	13.47	6375.00	0.72	0.22	0.14	0.23	0.14	0.23	0.14	0.24	0.14	0.24	0.14	0.25	0.15	0.25	0.15
W33X387	13.40	5812.50	0.79	0.24	0.15	0.25	0.16	0.25	0.16	0.26	0.16	0.26	0.16	0.28	0.16	0.28	0.16
W33X354	13.22	5325.00	0.87	0.26	0.17	0.27	0.17	0.27	0.17	0.29	0.18	0.29	0.18	0.31	0.18	0.31	0.18
W33X310	13.12	4762.50	0.90	0.29	0.19	0.31	0.19	0.31	0.19	0.32	0.20	0.32	0.20	0.34	0.20	0.34	0.20
W33X291	13.05	4312.50	1.08	0.32	0.21	0.34	0.21	0.34	0.21	0.35	0.22	0.35	0.22	0.37	0.22	0.37	0.22
W33X283	12.94	3900.00	1.21	0.35	0.23	0.37	0.24	0.37	0.24	0.39	0.24	0.39	0.24	0.42	0.25	0.42	0.25
W33X241	12.83	3521.25	1.34		0.26		0.26		0.26		0.27		0.27		0.28		0.28
W33X221	12.69	3206.25	1.49		0.28		0.29		0.29		0.30		0.30		0.31		0.31

$L_p = (KL)_p$, or $(KL)_p$, for "b", and L_m for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi															
Shape	L_p			8		9		10		11		12		13	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W33X201	12.59	2895.00	1.66		0.31		0.31		0.31		0.31		0.31		0.31
W33X189	8.84	2368.75	2.93		0.39		0.39		0.39		0.40		0.40		0.42
W33X152	8.73	2096.25	3.35		0.42		0.44		0.44		0.45		0.45		0.47
W33X141	8.59	1927.50	3.70		0.46		0.48		0.48		0.50		0.50		0.52
W33X130	8.45	1751.25	4.17		0.51		0.53		0.53		0.55		0.55		0.58
W33X118	8.20	1556.25	4.85		0.57		0.60		0.60		0.63		0.63		0.66
W30X581	13.65	8287.50	0.51	0.14	0.11	0.15	0.11	0.15	0.11	0.15	0.11	0.15	0.11	0.16	0.11
W30X526	13.44	7462.50	0.67	0.16	0.12	0.16	0.12	0.16	0.12	0.17	0.12	0.17	0.12	0.18	0.12
W30X477	13.26	6712.50	0.63	0.18	0.13	0.18	0.13	0.18	0.13	0.19	0.13	0.19	0.13	0.19	0.13
W30X433	13.12	6037.50	0.71	0.19	0.15	0.20	0.15	0.20	0.15	0.21	0.15	0.21	0.15	0.22	0.15
W30X391	13.01	5362.50	0.80	0.22	0.17	0.22	0.17	0.22	0.17	0.23	0.17	0.23	0.17	0.24	0.17
W30X357	12.90	4875.00	0.86	0.24	0.18	0.24	0.18	0.24	0.18	0.25	0.18	0.25	0.18	0.26	0.18
W30X326	12.76	4462.50	0.98	0.26	0.20	0.27	0.20	0.27	0.20	0.28	0.20	0.28	0.20	0.29	0.20
W30X292	12.66	3975.00	1.10	0.29	0.22	0.30	0.22	0.30	0.22	0.31	0.22	0.31	0.22	0.32	0.23
W30X261	12.52	3528.75	1.24	0.32	0.25	0.33	0.25	0.33	0.25	0.35	0.25	0.35	0.25	0.36	0.26
W30X235	12.45	3168.75	1.39	0.36	0.28	0.37	0.28	0.37	0.28	0.39	0.28	0.39	0.28	0.40	0.29
W30X211	12.34	2808.75	1.58	0.40	0.32	0.41	0.32	0.41	0.32	0.43	0.32	0.43	0.32	0.45	0.32
W30X191	12.23	2523.75	1.77		0.35		0.35		0.35		0.35		0.35		0.36
W30X173	12.13	2268.75	1.98		0.39		0.39		0.39		0.39		0.39		0.40
W30X148	8.06	1875.00	3.65		0.47		0.49		0.49		0.52		0.52		0.54
W30X132	7.95	1638.75	4.25		0.54		0.57		0.57		0.59		0.59		0.62
W30X124	7.88	1530.00	4.59		0.58		0.61		0.61		0.64		0.64		0.67
W30X116	7.74	1417.50	5.05		0.63		0.66		0.66		0.70		0.70		0.73
W30X108	7.60	1297.50	5.66		0.69		0.73		0.73		0.77		0.77		0.81
W30X99	7.42	1170.00	6.45		0.77		0.81		0.81		0.86		0.86		0.91
W30X90	7.39	1061.25	7.15		0.85		0.90		0.90		0.95		0.95		1.01
W27X539	12.94	7050.00	0.57	0.16	0.13	0.16	0.13	0.16	0.13	0.17	0.13	0.17	0.13	0.17	0.13
W27X494	12.76	6412.50	0.63	0.17	0.14	0.18	0.14	0.18	0.14	0.18	0.14	0.18	0.14	0.19	0.14
W27X448	12.62	5737.50	0.71	0.19	0.15	0.20	0.15	0.20	0.15	0.20	0.15	0.20	0.15	0.21	0.16
W27X408	12.45	5175.00	0.79	0.21	0.17	0.22	0.17	0.22	0.17	0.22	0.17	0.22	0.17	0.23	0.17
W27X368	12.30	4650.00	0.88	0.23	0.19	0.24	0.19	0.24	0.19	0.25	0.19	0.25	0.19	0.26	0.19
W27X336	12.20	4237.50	0.98	0.25	0.21	0.26	0.21	0.26	0.21	0.27	0.21	0.27	0.21	0.28	0.21
W27X307	12.09	3825.00	1.08	0.28	0.23	0.29	0.23	0.29	0.23	0.30	0.23	0.30	0.23	0.31	0.24
W27X281	12.02	3496.75	1.19	0.30	0.25	0.31	0.25	0.31	0.25	0.32	0.25	0.32	0.25	0.34	0.26
W27X258	11.91	3187.50	1.32	0.33	0.28	0.34	0.28	0.34	0.28	0.36	0.28	0.36	0.28	0.37	0.29
W27X235	11.77	2883.75	1.46	0.36	0.31	0.37	0.31	0.37	0.31	0.39	0.31	0.39	0.31	0.41	0.32
W27X217	11.74	2655.00	1.58	0.39	0.33	0.41	0.33	0.41	0.33	0.42	0.34	0.42	0.34	0.44	0.34
W27X194	11.63	2385.00	1.79	0.44	0.38	0.45	0.38	0.45	0.38	0.47	0.38	0.47	0.38	0.50	0.39
W27X178	11.53	2126.25	2.01	0.48	0.42	0.50	0.42	0.50	0.42	0.52	0.42	0.52	0.42	0.55	0.43
W27X161	11.46	1920.00	2.23		0.46		0.46		0.46		0.47		0.47		0.48
W27X146	11.35	1728.75	2.49		0.51		0.51		0.51		0.52		0.52		0.54
W27X129	7.81	1481.25	4.29		0.60		0.63		0.63		0.66		0.66		0.69
W27X114	7.71	1286.25	5.02		0.70		0.73		0.73		0.76		0.76		0.80
W27X102	7.60	1143.75	5.88		0.78		0.82		0.82		0.87		0.87		0.91
W27X94	7.50	1042.50	6.37		0.86		0.91		0.91		0.96		0.96		1.01
W27X84	7.32	915.00	7.45		0.99		1.04		1.04		1.10		1.10		1.17
W24X492	12.06	5812.50	0.67	0.17	0.15	0.18	0.15	0.18	0.15	0.19	0.15	0.19	0.15	0.20	0.15
W24X450	11.88	5287.50	0.74	0.19	0.17	0.20	0.17	0.20	0.17	0.20	0.17	0.20	0.17	0.21	0.17
W24X408	11.77	4687.50	0.83	0.21	0.19	0.22	0.19	0.22	0.19	0.23	0.19	0.23	0.19	0.24	0.19
W24X370	11.60	4200.00	0.93	0.23	0.21	0.24	0.21	0.24	0.21	0.25	0.21	0.25	0.21	0.26	0.21
W24X335	11.42	3825.00	1.04	0.26	0.23	0.26	0.23	0.26	0.23	0.28	0.23	0.28	0.23	0.29	0.24
W24X306	11.31	3457.50	1.15	0.28	0.26	0.29	0.26	0.29	0.26	0.30	0.26	0.30	0.26	0.32	0.26
W24X279	11.21	3131.25	1.27	0.31	0.28	0.32	0.28	0.32	0.28	0.33	0.29	0.33	0.29	0.35	0.29
W24X250	11.10	2790.00	1.44	0.34	0.32	0.36	0.32	0.36	0.32	0.37	0.32	0.37	0.32	0.39	0.33
W24X229	11.00	2535.00	1.59	0.38	0.35	0.39	0.35	0.39	0.35	0.41	0.35	0.41	0.35	0.43	0.36
W24X207	10.89	2272.50	1.78	0.42	0.39	0.43	0.39	0.43	0.39	0.45	0.40	0.45	0.40	0.48	0.41
W24X192	10.85	2096.25	1.93	0.45	0.42	0.47	0.42	0.47	0.42	0.49	0.43	0.49	0.43	0.52	0.44
W24X176	10.75	1916.25	2.13	0.49	0.46	0.51	0.46	0.51	0.46	0.54	0.47	0.54	0.47	0.57	0.48
W24X162	10.78	1755.00	2.31	0.53	0.51	0.55	0.51	0.55	0.51	0.58	0.51	0.58	0.51	0.62	0.53

$L_a = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi																	
L_p				14		15		16		17		18		19		20	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W33X201	12.59	2895.00	1.66		0.31		0.32		0.32		0.33		0.33		0.34		0.34
W33X169	8.84	2358.75	2.93		0.42		0.44		0.44		0.46		0.46		0.48		0.48
W33X152	8.73	2096.25	3.35		0.47		0.50		0.50		0.52		0.52		0.55		0.55
W33X141	8.59	1927.50	3.70		0.52		0.55		0.55		0.57		0.57		0.61		0.61
W33X130	8.45	1751.25	4.17		0.58		0.61		0.61		0.64		0.64		0.68		0.68
W33X118	8.20	1556.25	4.85		0.66		0.69		0.69		0.74		0.74		0.78		0.78
W30X581	13.65	8287.50	0.51	0.16	0.11	0.17	0.11	0.17	0.11	0.17	0.11	0.17	0.11	0.18	0.11	0.18	0.11
W30X528	13.44	7462.50	0.57	0.18	0.12	0.18	0.12	0.18	0.12	0.19	0.12	0.19	0.12	0.20	0.12	0.20	0.12
W30X477	13.26	6712.50	0.63	0.19	0.13	0.20	0.13	0.20	0.13	0.21	0.14	0.21	0.14	0.23	0.14	0.23	0.14
W30X433	13.12	6037.50	0.71	0.22	0.15	0.23	0.15	0.23	0.15	0.24	0.15	0.24	0.15	0.25	0.15	0.25	0.15
W30X391	13.01	5362.50	0.80	0.24	0.17	0.25	0.17	0.25	0.17	0.27	0.17	0.27	0.17	0.28	0.18	0.28	0.18
W30X357	12.90	4875.00	0.88	0.26	0.18	0.28	0.19	0.28	0.19	0.29	0.19	0.29	0.19	0.31	0.19	0.31	0.19
W30X326	12.76	4462.50	0.98	0.29	0.20	0.30	0.21	0.30	0.21	0.32	0.21	0.32	0.21	0.34	0.21	0.34	0.21
W30X292	12.66	3975.00	1.10	0.32	0.23	0.34	0.23	0.34	0.23	0.36	0.24	0.36	0.24	0.38	0.24	0.38	0.24
W30X261	12.52	3528.75	1.24	0.36	0.26	0.38	0.26	0.38	0.26	0.40	0.27	0.40	0.27	0.43	0.27	0.43	0.27
W30X235	12.45	3168.75	1.39	0.40	0.29	0.42	0.29	0.42	0.29	0.45	0.30	0.45	0.30	0.48	0.31	0.48	0.31
W30X211	12.34	2808.75	1.58	0.45	0.32	0.47	0.33	0.47	0.33	0.50	0.34	0.50	0.34	0.54	0.35	0.54	0.35
W30X191	12.23	2523.75	1.77		0.36		0.37		0.37		0.38		0.38		0.39		0.39
W30X173	12.13	2268.75	1.98		0.40		0.41		0.41		0.43		0.43		0.44		0.44
W30X148	8.06	1875.00	3.65		0.54		0.57		0.57		0.60		0.60		0.63		0.63
W30X132	7.95	1638.75	4.25		0.62		0.66		0.66		0.69		0.69		0.73		0.73
W30X124	7.86	1530.00	4.59		0.67		0.71		0.71		0.75		0.75		0.80		0.80
W30X116	7.74	1417.50	5.05		0.73		0.78		0.78		0.82		0.82		0.88		0.88
W30X108	7.60	1297.50	5.66		0.81		0.86		0.86		0.92		0.92		0.96		0.96
W30X99	7.42	1170.00	6.45		0.91		0.97		0.97		1.03		1.03				
W30X90	7.39	1061.25	7.15		1.01		1.07		1.07		1.15		1.15				
W27X539	12.94	7050.00	0.57	0.17	0.13	0.18	0.13	0.18	0.13	0.19	0.13	0.19	0.13	0.20	0.13	0.20	0.13
W27X494	12.76	6412.50	0.63	0.19	0.14	0.20	0.14	0.20	0.14	0.21	0.14	0.21	0.14	0.22	0.14	0.22	0.14
W27X448	12.62	5737.50	0.71	0.21	0.16	0.22	0.16	0.22	0.16	0.23	0.16	0.23	0.16	0.25	0.16	0.25	0.16
W27X406	12.45	5175.00	0.79	0.23	0.17	0.25	0.18	0.25	0.18	0.26	0.18	0.26	0.18	0.28	0.18	0.28	0.18
W27X368	12.30	4650.00	0.88	0.26	0.19	0.27	0.20	0.27	0.20	0.29	0.20	0.29	0.20	0.31	0.20	0.31	0.20
W27X336	12.20	4237.50	0.98	0.28	0.21	0.30	0.22	0.30	0.22	0.32	0.22	0.32	0.22	0.34	0.22	0.34	0.22
W27X307	12.09	3825.00	1.08	0.31	0.24	0.33	0.24	0.33	0.24	0.35	0.25	0.35	0.25	0.37	0.25	0.37	0.25
W27X281	12.02	3498.75	1.19	0.34	0.26	0.36	0.26	0.36	0.26	0.38	0.27	0.38	0.27	0.41	0.28	0.41	0.28
W27X258	11.91	3187.50	1.32	0.37	0.29	0.39	0.29	0.39	0.29	0.42	0.30	0.42	0.30	0.45	0.30	0.45	0.30
W27X235	11.77	2883.75	1.46	0.41	0.32	0.43	0.32	0.43	0.32	0.46	0.33	0.46	0.33	0.50	0.34	0.50	0.34
W27X217	11.74	2655.00	1.58	0.44	0.34	0.47	0.35	0.47	0.35	0.50	0.36	0.50	0.36	0.54	0.37	0.54	0.37
W27X194	11.63	2355.00	1.79	0.50	0.39	0.53	0.40	0.53	0.40	0.57	0.41	0.57	0.41	0.61	0.42	0.61	0.42
W27X178	11.53	2126.25	2.01	0.55	0.43	0.58	0.45	0.58	0.45	0.62	0.46	0.62	0.46	0.67	0.47	0.67	0.47
W27X161	11.46	1920.00	2.23		0.48		0.50		0.50		0.51		0.51		0.53		0.53
W27X146	11.35	1728.75	2.49		0.54		0.55		0.55		0.57		0.57		0.59		0.59
W27X129	7.81	1481.25	4.29		0.69		0.72		0.72		0.76		0.76		0.80		0.80
W27X114	7.71	1286.25	5.02		0.80		0.85		0.85		0.90		0.90		0.95		0.95
W27X102	7.60	1143.75	5.68		0.91		0.97		0.97		1.03		1.03		1.09		1.09
W27X94	7.50	1042.50	6.37		1.01		1.07		1.07		1.14		1.14				
W27X84	7.32	915.00	7.45		1.17		1.24		1.24		1.33		1.33				
W24X492	12.06	5812.50	0.67	0.20	0.15	0.21	0.16	0.21	0.16	0.22	0.16	0.22	0.16	0.23	0.16	0.23	0.16
W24X450	11.88	5287.50	0.74	0.21	0.17	0.23	0.17	0.23	0.17	0.24	0.17	0.24	0.17	0.26	0.18	0.26	0.18
W24X408	11.77	4687.50	0.83	0.24	0.19	0.25	0.19	0.25	0.19	0.27	0.20	0.27	0.20	0.29	0.20	0.29	0.20
W24X370	11.60	4200.00	0.93	0.26	0.21	0.28	0.22	0.28	0.22	0.30	0.22	0.30	0.22	0.32	0.22	0.32	0.22
W24X335	11.42	3825.00	1.04	0.29	0.24	0.31	0.24	0.31	0.24	0.33	0.24	0.33	0.24	0.36	0.25	0.36	0.25
W24X308	11.31	3457.50	1.15	0.32	0.26	0.34	0.27	0.34	0.27	0.37	0.27	0.37	0.27	0.40	0.28	0.40	0.28
W24X279	11.21	3131.25	1.27	0.35	0.29	0.38	0.30	0.38	0.30	0.40	0.30	0.40	0.30	0.44	0.31	0.44	0.31
W24X250	11.10	2790.00	1.44	0.39	0.33	0.42	0.33	0.42	0.33	0.45	0.34	0.45	0.34	0.49	0.35	0.49	0.35
W24X229	11.00	2536.00	1.69	0.43	0.36	0.46	0.37	0.46	0.37	0.50	0.38	0.50	0.38	0.54	0.39	0.54	0.39
W24X207	10.89	2272.50	1.78	0.46	0.41	0.52	0.42	0.52	0.42	0.56	0.43	0.56	0.43	0.60	0.44	0.60	0.44
W24X192	10.85	2096.25	1.93	0.52	0.44	0.56	0.45	0.56	0.45	0.60	0.46	0.60	0.46	0.65	0.48	0.65	0.48
W24X176	10.75	1916.25	2.13	0.57	0.48	0.61	0.50	0.61	0.50	0.66	0.51	0.66	0.51	0.72	0.53	0.72	0.53
W24X162	10.78	1755.00	2.31	0.62	0.53	0.66	0.55	0.66	0.55	0.71	0.56	0.71	0.56	0.78	0.58	0.78	0.58

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_r for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi															
Shape	L_p			8		9		10		11		12		13	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W24X146	10.64	1567.50	2.61	0.59	0.57	0.61	0.57	0.61	0.57	0.65	0.58	0.65	0.58	0.69	0.60
W24X131	10.50	1387.50	2.98	0.66	0.64	0.69	0.64	0.69	0.64	0.73	0.66	0.73	0.66	0.77	0.68
W24X117	10.39	1226.25	3.40		0.72		0.72		0.72		0.74		0.74		0.77
W24X104	10.29	1083.75	3.88		0.82		0.82		0.82		0.85		0.85		0.88
W24X103	7.04	1050.00	5.96		0.87		0.91		0.91		0.96		0.96		1.01
W24X94	7.00	952.50	6.58		0.96		1.01		1.01		1.06		1.06		1.12
W24X84	6.89	840.00	7.56		1.09		1.15		1.15		1.22		1.22		1.29
W24X76	6.79	750.00	8.59		1.22		1.29		1.29		1.37		1.37		1.46
W24X68	6.61	663.75	10.07		1.39		1.48		1.48		1.58		1.58		1.69
W24X62	4.88	573.75	16.12		1.75		1.92		1.92		2.11		2.11		
W24X55	4.74	502.50	18.04		2.03		2.23		2.23		2.47		2.47		
W21X402	11.56	4237.50	0.84	0.21	0.21	0.22	0.21	0.22	0.21	0.23	0.21	0.23	0.21	0.24	0.21
W21X364	11.42	3787.50	0.84	0.23	0.23	0.24	0.23	0.24	0.23	0.25	0.24	0.25	0.24	0.27	0.24
W21X333	11.28	3431.25	1.05	0.26	0.26	0.27	0.26	0.27	0.26	0.28	0.26	0.28	0.26	0.29	0.26
W21X300	11.14	3060.00	1.18	0.29	0.29	0.30	0.29	0.30	0.29	0.31	0.29	0.31	0.29	0.33	0.30
W21X275	11.03	2778.75	1.30	0.31	0.32	0.32	0.32	0.32	0.32	0.34	0.32	0.34	0.32	0.36	0.33
W21X248	10.92	2486.25	1.45	0.35	0.36	0.36	0.36	0.36	0.36	0.38	0.36	0.38	0.36	0.40	0.37
W21X223	10.78	2208.75	1.64	0.39	0.40	0.40	0.40	0.40	0.40	0.42	0.41	0.42	0.41	0.45	0.41
W21X201	10.66	1987.50	1.84	0.43	0.45	0.45	0.45	0.45	0.45	0.47	0.45	0.47	0.45	0.50	0.46
W21X182	10.61	1785.00	2.05	0.47	0.50	0.49	0.50	0.49	0.50	0.52	0.51	0.52	0.51	0.55	0.52
W21X166	10.54	1620.00	2.25	0.52	0.55	0.54	0.55	0.54	0.55	0.57	0.56	0.57	0.56	0.61	0.57
W21X147	10.43	1398.75	2.63	0.59	0.64	0.61	0.64	0.61	0.64	0.65	0.65	0.65	0.65	0.69	0.67
W21X132	10.36	1248.75	2.96	0.66	0.71	0.69	0.71	0.69	0.71	0.72	0.73	0.72	0.73	0.77	0.75
W21X122	10.32	1151.25	3.21	0.71	0.77	0.74	0.77	0.74	0.77	0.78	0.79	0.78	0.79	0.83	0.82
W21X111	10.25	1048.25	3.55	0.78	0.85	0.82	0.85	0.82	0.85	0.86	0.87	0.86	0.87	0.92	0.90
W21X101	10.22	948.75	3.92		0.94		0.94		0.94		0.96		0.96		1.00
W21X93	6.51	828.75	7.15	1.05	1.11	1.18	1.17	1.18	1.17	1.35	1.23	1.35	1.23	1.59	1.30
W21X83	6.47	735.00	8.10		1.26		1.33		1.33		1.41		1.41		1.49
W21X73	6.40	645.00	9.30		1.44		1.52		1.52		1.62		1.62		1.72
W21X68	6.36	600.00	10.07		1.55		1.65		1.65		1.75		1.75		1.88
W21X62	6.26	540.00	11.37		1.73		1.84		1.84		1.97		1.97		2.11
W21X57	4.77	483.75	16.90		2.09		2.28		2.28		2.51		2.51		
W21X50	4.60	412.50	20.66		2.49		2.74		2.74		3.05		3.05		
W21X44	4.45	357.75	24.85		2.92		3.23		3.23		3.63		3.63		
W18X311	10.43	2823.75	1.20	0.28	0.31	0.29	0.31	0.29	0.31	0.31	0.32	0.31	0.32	0.33	0.32
W18X283	10.29	2535.00	1.34	0.31	0.35	0.32	0.35	0.32	0.35	0.34	0.35	0.34	0.35	0.36	0.36
W18X268	10.18	2291.25	1.48	0.34	0.39	0.35	0.39	0.35	0.39	0.37	0.39	0.37	0.39	0.40	0.40
W18X234	10.08	2058.75	1.65	0.37	0.43	0.39	0.43	0.39	0.43	0.41	0.44	0.41	0.44	0.44	0.44
W18X211	9.97	1837.50	1.85	0.41	0.48	0.43	0.48	0.43	0.48	0.46	0.49	0.46	0.49	0.49	0.50
W18X192	9.86	1657.50	2.06	0.45	0.54	0.48	0.54	0.48	0.54	0.51	0.55	0.51	0.55	0.54	0.56
W18X175	9.76	1492.50	2.30	0.50	0.60	0.53	0.60	0.53	0.60	0.56	0.61	0.56	0.61	0.60	0.62
W18X158	9.69	1335.00	2.57	0.56	0.67	0.58	0.67	0.58	0.67	0.62	0.68	0.62	0.68	0.67	0.70
W18X143	9.62	1207.50	2.85	0.61	0.74	0.64	0.74	0.64	0.74	0.69	0.76	0.69	0.76	0.74	0.78
W18X130	9.55	1091.25	3.17	0.68	0.81	0.71	0.82	0.71	0.82	0.76	0.84	0.76	0.84	0.82	0.86
W18X119	9.51	978.75	3.52	0.74	0.91	0.78	0.91	0.78	0.91	0.83	0.94	0.83	0.94	0.89	0.97
W18X106	9.40	862.50	4.01	0.83	1.03	0.88	1.04	0.88	1.04	0.94	1.07	0.94	1.07	1.01	1.11
W18X97	9.37	791.25	4.38	0.91	1.12	0.96	1.13	0.96	1.13	1.02	1.17	1.02	1.17	1.11	1.21
W18X86	9.30	697.50	5.00	1.03	1.27	1.08	1.29	1.08	1.29	1.16	1.34	1.16	1.34	1.25	1.39
W18X76	9.23	611.25	5.73		1.45		1.47		1.47		1.53		1.53		1.69
W18X71	6.01	543.75	10.00	1.43	1.72	1.63	1.82	1.63	1.82	1.91	1.93	1.91	1.93	2.31	2.05
W18X65	5.98	498.75	10.97	1.56	1.88	1.78	2.00	1.78	2.00	2.09	2.12	2.09	2.12	2.54	2.27
W18X60	5.98	461.25	11.88		2.04		2.17		2.17		2.32		2.32		2.48
W18X55	5.90	420.00	13.28		2.25		2.40		2.40		2.57		2.57		2.77
W18X50	5.83	378.75	14.77		2.51		2.69		2.69		2.89		2.89		3.12
W18X46	4.56	340.13	21.27		3.01		3.30		3.30		3.65		3.65		
W18X40	4.49	294.00	24.89		3.52		3.88		3.88		4.32		4.32		
W18X35	4.31	249.38	30.86		4.24		4.72		4.72						
W16X100	8.87	742.50	4.43	0.89	1.20	0.95	1.22	0.95	1.22	1.02	1.25	1.02	1.25	1.11	1.29
W16X89	8.80	656.25	5.03	1.00	1.35	1.06	1.38	1.06	1.38	1.15	1.43	1.15	1.43	1.25	1.48

$L_a = (KL)_y$ or $(KL)_x$ for "b", and L_b for "m". Blank cells indicate slender element section or $L_b > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi																	
Shape	L_p			14		15		16		17		18		19		20	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W24X148	10.64	1567.50	2.61	0.99	0.80	0.74	0.62	0.74	0.62	0.80	0.64	0.60	0.64	0.87	0.68	0.87	0.66
W24X131	10.50	1387.50	2.98	0.77	0.68	0.83	0.70	0.83	0.70	0.90	0.72	0.90	0.72	0.99	0.75	0.99	0.75
W24X117	10.39	1228.25	3.40		0.77		0.80		0.80		0.83		0.83		0.86		0.86
W24X104	10.29	1083.75	3.88		0.88		0.91		0.91		0.95		0.95		0.99		0.99
W24X103	7.04	1050.00	5.96		1.01		1.07		1.07		1.13		1.13		1.21		1.21
W24X94	7.00	952.50	6.58		1.12		1.19		1.19		1.27		1.27				
W24X84	6.89	840.00	7.56		1.29		1.38		1.38		1.48		1.48				
W24X76	6.79	750.00	8.59		1.46		1.57		1.57		1.68		1.68				
W24X66	6.61	663.75	10.07		1.69		1.82		1.82								
W24X62	4.88	573.75	16.12														
W24X55	4.74	502.50	19.04														
W21X402	11.56	4237.50	0.84	0.24	0.21	0.26	0.21	0.26	0.21	0.27	0.22	0.27	0.22	0.30	0.22	0.30	0.22
W21X364	11.42	3787.50	0.94	0.27	0.24	0.28	0.24	0.28	0.24	0.30	0.24	0.30	0.24	0.33	0.25	0.33	0.25
W21X333	11.28	3431.25	1.05	0.29	0.26	0.31	0.27	0.31	0.27	0.34	0.27	0.34	0.27	0.36	0.27	0.36	0.27
W21X300	11.14	3060.00	1.18	0.33	0.30	0.36	0.30	0.36	0.30	0.38	0.30	0.38	0.30	0.41	0.31	0.41	0.31
W21X275	11.03	2778.75	1.30	0.36	0.33	0.38	0.33	0.38	0.33	0.41	0.34	0.41	0.34	0.45	0.34	0.45	0.34
W21X248	10.92	2486.25	1.45	0.40	0.37	0.43	0.37	0.43	0.37	0.46	0.38	0.46	0.38	0.50	0.39	0.50	0.39
W21X223	10.78	2208.75	1.64	0.45	0.41	0.48	0.42	0.48	0.42	0.52	0.43	0.52	0.43	0.57	0.44	0.57	0.44
W21X201	10.68	1987.50	1.84	0.50	0.46	0.53	0.47	0.53	0.47	0.58	0.48	0.58	0.48	0.63	0.49	0.63	0.49
W21X182	10.61	1785.00	2.05	0.55	0.52	0.59	0.53	0.59	0.53	0.64	0.54	0.64	0.54	0.70	0.55	0.70	0.55
W21X166	10.54	1620.00	2.25	0.61	0.57	0.65	0.59	0.65	0.59	0.71	0.60	0.71	0.60	0.77	0.62	0.77	0.62
W21X147	10.43	1398.75	2.63	0.69	0.67	0.74	0.69	0.74	0.69	0.81	0.71	0.81	0.71	0.88	0.73	0.88	0.73
W21X132	10.36	1248.75	2.95	0.77	0.75	0.83	0.77	0.83	0.77	0.90	0.80	0.90	0.80	0.99	0.82	0.99	0.82
W21X122	10.32	1151.25	3.21	0.83	0.82	0.90	0.84	0.90	0.84	0.98	0.87	0.98	0.87	1.07	0.90	1.07	0.90
W21X111	10.25	1046.25	3.55	0.92	0.90	0.99	0.93	0.99	0.93	1.08	0.97	1.08	0.97	1.19	1.00	1.19	1.00
W21X101	10.22	948.75	3.92		1.00		1.03		1.03		1.07		1.07		1.11		1.11
W21X93	6.51	826.75	7.15	1.59	1.30	1.91	1.38	1.91	1.38	2.37	1.47	2.37	1.47	2.92		2.92	
W21X83	6.47	735.00	8.10		1.49		1.59		1.59		1.70		1.70				
W21X73	6.40	645.00	9.30		1.72		1.85		1.85								
W21X68	6.36	600.00	10.07		1.88		2.02		2.02								
W21X62	6.26	540.00	11.37		2.11		2.28		2.28								
W21X57	4.77	483.75	16.90														
W21X50	4.60	412.50	20.68														
W21X44	4.45	357.75	24.85														
W18X311	10.43	2823.75	1.20	0.33	0.32	0.35	0.32	0.35	0.32	0.35	0.33	0.38	0.33	0.42	0.33	0.42	0.33
W18X283	10.29	2535.00	1.34	0.36	0.36	0.39	0.36	0.39	0.36	0.42	0.37	0.42	0.37	0.47	0.37	0.47	0.37
W18X258	10.18	2291.25	1.48	0.40	0.40	0.43	0.40	0.43	0.40	0.47	0.41	0.47	0.41	0.52	0.41	0.52	0.41
W18X234	10.08	2058.75	1.65	0.44	0.44	0.48	0.45	0.48	0.45	0.52	0.46	0.52	0.46	0.57	0.47	0.57	0.47
W18X211	9.97	1837.50	1.85	0.49	0.50	0.53	0.51	0.53	0.51	0.58	0.52	0.58	0.52	0.64	0.53	0.64	0.53
W18X192	9.86	1657.50	2.06	0.54	0.56	0.59	0.57	0.59	0.57	0.65	0.58	0.65	0.58	0.72	0.59	0.72	0.59
W18X175	9.76	1492.50	2.30	0.60	0.62	0.65	0.63	0.65	0.63	0.72	0.65	0.72	0.65	0.80	0.66	0.80	0.66
W18X158	9.69	1335.00	2.57	0.67	0.70	0.73	0.71	0.73	0.71	0.80	0.73	0.80	0.73	0.89	0.75	0.89	0.75
W18X143	9.62	1207.50	2.85	0.74	0.78	0.80	0.79	0.80	0.79	0.89	0.82	0.89	0.82	0.99	0.84	0.99	0.84
W18X130	9.55	1091.25	3.17	0.82	0.86	0.89	0.89	0.89	0.89	0.98	0.91	0.98	0.91	1.10	0.94	1.10	0.94
W18X119	9.51	978.75	3.52	0.89	0.97	0.97	1.00	0.97	1.00	1.07	1.03	1.07	1.03	1.20	1.06	1.20	1.06
W18X106	9.40	862.50	4.01	1.01	1.11	1.11	1.14	1.11	1.14	1.23	1.18	1.23	1.18	1.37	1.23	1.37	1.23
W18X97	9.37	791.25	4.38	1.11	1.21	1.21	1.26	1.21	1.26	1.34	1.30	1.34	1.30	1.50	1.35	1.50	1.35
W18X86	9.30	697.50	5.00	1.25	1.39	1.37	1.44	1.37	1.44	1.52	1.50	1.52	1.50	1.71	1.56	1.71	1.56
W18X76	9.23	611.25	5.73		1.59		1.66		1.66		1.73		1.73		1.81		1.81
W18X71	6.01	543.75	10.00	2.31	2.05	2.87	2.19	2.87	2.19	3.64		3.64		4.49		4.49	
W18X65	5.98	498.75	10.97	2.54	2.27	3.17	2.43	3.17	2.43	4.01		4.01		4.95		4.95	
W18X60	5.98	461.25	11.88		2.48		2.67		2.67								
W18X55	5.90	420.00	13.28		2.77		3.00		3.00								
W18X50	5.83	378.75	14.77		3.12												
W18X46	4.56	340.19	21.27														
W18X40	4.49	294.00	24.89														
W18X35	4.31	249.36	30.66														
W16X100	8.87	742.50	4.43	1.11	1.29	1.23	1.33	1.23	1.33	1.38	1.38	1.38	1.38	1.56	1.42	1.56	1.42
W16X89	8.80	656.25	5.03	1.25	1.48	1.39	1.53	1.39	1.53	1.56	1.58	1.56	1.58	1.77	1.64	1.77	1.64

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_b for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi															
L_e				8		9		10		11		12		13	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W16X77	8.73	562.50	5.87	1.16	1.58	1.24	1.62	1.24	1.62	1.33	1.68	1.33	1.68	1.46	1.74
W16X87	8.70	487.50	6.61		1.82		1.87		1.87		1.94		1.94		2.02
W16X57	5.66	393.75	13.06	1.82	2.41	2.11	2.56	2.11	2.56	2.53	2.73	2.53	2.73	3.14	2.92
W16X50	5.62	345.00	15.05		2.77		2.95		2.95		3.16		3.16		3.41
W16X45	5.55	308.63	16.92		3.11		3.33		3.33		3.59		3.59		3.88
W16X40	5.55	273.38	19.15		3.53		3.79		3.79		4.09		4.09		4.44
W16X36	5.37	240.00	22.57		4.06		4.39		4.39		4.77		4.77		5.22
W16X31	4.14	202.50	35.19		5.28		5.90		5.90						
W16X26	3.96	165.75	45.28		6.64		7.52		7.52						
W14X730	16.58	6225.00	0.30	0.11	0.14	0.11	0.14	0.11	0.14	0.12	0.14	0.12	0.14	0.12	0.14
W14X665	16.33	5550.00	0.33	0.12	0.16	0.13	0.16	0.13	0.16	0.13	0.16	0.13	0.16	0.13	0.16
W14X605	16.09	4950.00	0.37	0.14	0.18	0.14	0.18	0.14	0.18	0.14	0.18	0.14	0.18	0.15	0.18
W14X550	15.87	4425.00	0.42	0.15	0.20	0.15	0.20	0.15	0.20	0.16	0.20	0.16	0.20	0.16	0.20
W14X500	15.66	3937.50	0.47	0.17	0.23	0.17	0.23	0.17	0.23	0.17	0.23	0.17	0.23	0.18	0.23
W14X455	15.49	3510.00	0.52	0.18	0.25	0.19	0.25	0.19	0.25	0.19	0.25	0.19	0.25	0.20	0.25
W14X426	15.34	3258.75	0.56	0.20	0.27	0.20	0.27	0.20	0.27	0.20	0.27	0.20	0.27	0.21	0.27
W14X398	15.24	3003.75	0.60	0.21	0.30	0.21	0.30	0.21	0.30	0.22	0.30	0.22	0.30	0.22	0.30
W14X370	15.10	2760.00	0.66	0.22	0.32	0.23	0.32	0.23	0.32	0.23	0.32	0.23	0.32	0.24	0.32
W14X342	14.99	2520.00	0.72	0.24	0.35	0.25	0.35	0.25	0.35	0.25	0.35	0.25	0.35	0.26	0.35
W14X311	14.85	2261.25	0.79	0.27	0.39	0.27	0.39	0.27	0.39	0.29	0.39	0.29	0.39	0.29	0.39
W14X283	14.74	2032.50	0.88	0.29	0.44	0.30	0.44	0.30	0.44	0.31	0.44	0.31	0.44	0.32	0.44
W14X257	14.60	1826.25	0.98	0.32	0.49	0.33	0.49	0.33	0.49	0.34	0.49	0.34	0.49	0.35	0.49
W14X233	14.50	1635.00	1.09	0.36	0.54	0.37	0.54	0.37	0.54	0.38	0.54	0.38	0.54	0.39	0.54
W14X211	14.39	1462.50	1.22	0.40	0.61	0.40	0.61	0.40	0.61	0.42	0.61	0.42	0.61	0.43	0.61
W14X193	14.32	1331.25	1.33	0.43	0.67	0.44	0.67	0.44	0.67	0.45	0.67	0.45	0.67	0.47	0.67
W14X176	14.21	1200.00	1.46	0.47	0.74	0.48	0.74	0.48	0.74	0.50	0.74	0.50	0.74	0.52	0.74
W14X159	14.14	1076.25	1.64	0.53	0.83	0.54	0.83	0.54	0.83	0.55	0.83	0.55	0.83	0.57	0.83
W14X145	14.07	975.00	1.81	0.57	0.91	0.59	0.91	0.59	0.91	0.61	0.91	0.61	0.91	0.63	0.91
W14X132	13.29	877.50	2.12	0.64	1.01	0.65	1.01	0.65	1.01	0.68	1.01	0.68	1.01	0.70	1.02
W14X120	13.22	795.00	2.34	0.70	1.12	0.72	1.12	0.72	1.12	0.74	1.12	0.74	1.12	0.77	1.13
W14X109	13.19	720.00	2.58	0.77	1.23	0.79	1.23	0.79	1.23	0.82	1.23	0.82	1.23	0.85	1.24
W14X99	13.34	647.25	2.87	0.85	1.37	0.87	1.37	0.87	1.37	0.90	1.37	0.90	1.37	0.94	1.38
W14X90	15.03	576.46	3.28	0.93	1.54	0.96	1.54	0.96	1.54	0.99	1.54	0.99	1.54	1.03	1.54
W14X82	8.77	521.25	5.39	1.09	1.71	1.16	1.74	1.16	1.74	1.25	1.79	1.25	1.79	1.37	1.84
W14X74	8.77	472.50	5.94	1.20	1.88	1.28	1.92	1.28	1.92	1.38	1.98	1.38	1.98	1.51	2.04
W14X68	8.70	431.25	6.53	1.32	2.06	1.40	2.11	1.40	2.11	1.51	2.18	1.51	2.18	1.65	2.25
W14X61	8.66	382.50	7.35	1.47	2.32	1.57	2.38	1.57	2.38	1.69	2.46	1.69	2.46	1.85	2.56
W14X53	6.79	326.63	11.05	1.81	2.79	2.01	2.92	2.01	2.92	2.28	3.06	2.28	3.06	2.64	3.22
W14X48	6.75	294.00	12.35	2.01	3.11	2.23	3.27	2.23	3.27	2.53	3.43	2.53	3.43	2.94	3.62
W14X43	6.88	261.00	13.98		3.52		3.70		3.70		3.91		3.91		4.14
W14X38	5.48	230.63	20.05		4.18		4.47		4.47		4.82		4.82		5.22
W14X34	5.41	204.75	22.87		4.74		5.09		5.09		5.51		5.51		6.00
W14X30	5.27	177.38	27.15		5.53		5.98		5.98		6.51		6.51		
W14X26	3.82	150.75	44.84		7.31		8.25		8.25						
W14X22	3.68	124.50	56.44		9.12										
W12X336	12.27	2281.25	0.89	0.25	0.39	0.26	0.39	0.26	0.39	0.27	0.39	0.27	0.39	0.28	0.40
W12X305	12.09	2013.75	0.99	0.28	0.44	0.29	0.44	0.29	0.44	0.30	0.44	0.30	0.44	0.31	0.44
W12X279	11.95	1803.75	1.11	0.30	0.49	0.32	0.49	0.32	0.49	0.33	0.49	0.33	0.49	0.34	0.50
W12X252	11.81	1605.00	1.24	0.34	0.55	0.35	0.55	0.35	0.55	0.36	0.55	0.36	0.55	0.38	0.56
W12X230	11.70	1447.50	1.37	0.37	0.61	0.38	0.61	0.38	0.61	0.40	0.61	0.40	0.61	0.42	0.62
W12X210	11.60	1305.00	1.52	0.41	0.68	0.42	0.68	0.42	0.68	0.44	0.68	0.44	0.68	0.46	0.69
W12X190	11.49	1166.25	1.70	0.45	0.76	0.47	0.76	0.47	0.76	0.49	0.76	0.49	0.76	0.51	0.77
W12X170	11.38	1031.25	1.92	0.50	0.86	0.52	0.86	0.52	0.86	0.54	0.86	0.54	0.86	0.57	0.87
W12X152	11.28	911.25	2.17	0.56	0.98	0.58	0.98	0.58	0.98	0.61	0.98	0.61	0.98	0.64	0.99
W12X136	11.17	802.50	2.46	0.63	1.11	0.66	1.11	0.66	1.11	0.69	1.11	0.69	1.11	0.73	1.13
W12X120	11.07	697.50	2.82	0.71	1.27	0.74	1.27	0.74	1.27	0.78	1.28	0.78	1.28	0.82	1.30
W12X106	11.00	615.00	3.21	0.81	1.45	0.84	1.45	0.84	1.45	0.88	1.46	0.88	1.46	0.93	1.48
W12X96	10.92	551.25	3.56	0.90	1.61	0.93	1.61	0.93	1.61	0.98	1.63	0.98	1.63	1.04	1.66
W12X87	10.85	495.00	3.98	0.99	1.80	1.03	1.80	1.03	1.80	1.08	1.82	1.08	1.82	1.14	1.86

$L_a = (KL)_y$ or $(KL)_x$ for "b", and L_b for "m". Blank cells indicate slender element section or $L_b > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi																	
Shape	L_p			14		15		16		17		18		19		20	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W16X77	8.73	562.50	5.87	1.46	1.74	1.62	1.81	1.62	1.81	1.82	1.88	1.82	1.88	2.08	1.96	2.08	1.96
W16X67	8.70	487.50	5.81		2.02		2.11		2.11		2.20		2.20		2.31		2.31
W16X57	5.66	393.75	13.06	3.14	2.92	4.02	3.14	4.02	3.14	5.08		5.08		6.28		6.28	
W16X50	5.62	345.00	15.05		3.41												
W16X45	5.55	308.63	16.92		3.88												
W16X40	5.55	273.38	19.15		4.44												
W16X36	5.37	240.00	22.57		5.22												
W16X31	4.14	202.50	35.19														
W16X26	3.96	165.75	45.28														
W14X730	16.58	6225.00	0.30	0.12	0.14	0.12	0.14	0.12	0.14	0.13	0.14	0.13	0.14	0.13	0.14	0.13	0.14
W14X665	16.33	5550.00	0.33	0.13	0.16	0.14	0.16	0.14	0.16	0.14	0.16	0.14	0.16	0.15	0.16	0.15	0.16
W14X605	16.09	4950.00	0.37	0.15	0.18	0.15	0.18	0.15	0.18	0.16	0.18	0.16	0.18	0.16	0.18	0.16	0.18
W14X550	15.87	4425.00	0.42	0.16	0.20	0.17	0.20	0.17	0.20	0.17	0.20	0.17	0.20	0.18	0.20	0.18	0.20
W14X500	15.66	3937.50	0.47	0.18	0.23	0.18	0.23	0.18	0.23	0.19	0.23	0.19	0.23	0.20	0.23	0.20	0.23
W14X455	15.49	3510.00	0.52	0.20	0.25	0.20	0.25	0.20	0.25	0.21	0.25	0.21	0.25	0.22	0.26	0.22	0.26
W14X426	15.34	3258.75	0.56	0.21	0.27	0.22	0.27	0.22	0.27	0.23	0.27	0.23	0.27	0.24	0.28	0.24	0.28
W14X398	15.24	3003.75	0.60	0.22	0.30	0.23	0.30	0.23	0.30	0.24	0.30	0.24	0.30	0.25	0.30	0.25	0.30
W14X370	15.10	2760.00	0.66	0.24	0.32	0.25	0.32	0.25	0.32	0.26	0.32	0.26	0.32	0.27	0.33	0.27	0.33
W14X342	14.99	2520.00	0.72	0.26	0.35	0.27	0.35	0.27	0.35	0.28	0.36	0.28	0.36	0.29	0.36	0.29	0.36
W14X311	14.85	2261.25	0.79	0.28	0.38	0.30	0.38	0.30	0.38	0.31	0.40	0.31	0.40	0.33	0.40	0.33	0.40
W14X283	14.74	2032.50	0.88	0.32	0.44	0.33	0.44	0.33	0.44	0.34	0.44	0.34	0.44	0.36	0.45	0.36	0.45
W14X257	14.60	1828.25	0.98	0.35	0.49	0.36	0.49	0.36	0.49	0.36	0.49	0.36	0.49	0.40	0.50	0.40	0.50
W14X233	14.50	1635.00	1.09	0.39	0.54	0.40	0.55	0.40	0.55	0.42	0.55	0.42	0.55	0.44	0.56	0.44	0.56
W14X211	14.39	1462.50	1.22	0.43	0.61	0.45	0.61	0.45	0.61	0.47	0.62	0.47	0.62	0.49	0.63	0.49	0.63
W14X193	14.32	1331.25	1.33	0.47	0.67	0.49	0.67	0.49	0.67	0.51	0.68	0.51	0.68	0.54	0.69	0.54	0.69
W14X176	14.21	1200.00	1.48	0.52	0.74	0.54	0.75	0.54	0.75	0.56	0.76	0.56	0.76	0.59	0.77	0.59	0.77
W14X159	14.14	1076.25	1.64	0.57	0.83	0.60	0.84	0.60	0.84	0.62	0.85	0.62	0.85	0.66	0.86	0.66	0.86
W14X145	14.07	975.00	1.81	0.63	0.91	0.65	0.92	0.65	0.92	0.68	0.94	0.68	0.94	0.72	0.95	0.72	0.95
W14X132	13.29	877.50	2.12	0.70	1.02	0.73	1.03	0.73	1.03	0.77	1.05	0.77	1.05	0.82	1.07	0.82	1.07
W14X120	13.22	795.00	2.34	0.77	1.13	0.81	1.15	0.81	1.15	0.85	1.17	0.85	1.17	0.90	1.19	0.90	1.19
W14X109	13.19	720.00	2.58	0.85	1.24	0.89	1.27	0.89	1.27	0.94	1.29	0.94	1.29	1.00	1.32	1.00	1.32
W14X99	13.34	647.29	2.87	0.94	1.38	0.98	1.41	0.98	1.41	1.04	1.44	1.04	1.44	1.10	1.47	1.10	1.47
W14X90	15.03	576.46	3.28	1.03	1.54	1.08	1.56	1.08	1.56	1.14	1.59	1.14	1.59	1.21	1.63	1.21	1.63
W14X82	8.77	521.25	5.39	1.37	1.84	1.51	1.90	1.51	1.90	1.70	1.96	1.70	1.96	1.94	2.02	1.94	2.02
W14X74	8.77	472.50	5.94	1.51	2.04	1.67	2.11	1.67	2.11	1.88	2.19	1.88	2.19	2.14	2.26	2.14	2.26
W14X68	8.70	431.25	6.53	1.65	2.25	1.84	2.33	1.84	2.33	2.07	2.42	2.07	2.42	2.36	2.52	2.36	2.52
W14X61	8.66	382.50	7.35	1.85	2.56	2.06	2.66	2.06	2.66	2.32	2.76	2.32	2.76	2.65	2.88	2.65	2.88
W14X53	6.79	326.63	11.05	2.64	3.22	3.13	3.39	3.13	3.39	3.81	3.58	3.81	3.58	4.69	3.80	4.69	3.80
W14X48	6.75	294.00	12.35	2.94	3.62	3.49	3.83	3.49	3.83	4.25	4.07	4.25	4.07	5.25		5.25	
W14X43	6.68	261.00	13.98		4.14		4.40		4.40		4.69		4.69				
W14X38	5.48	230.63	20.05		5.22												
W14X34	5.41	204.75	22.87		6.00												
W14X30	5.27	177.38	27.15														
W14X26	3.82	150.75	44.64														
W14X22	3.68	124.50	56.44														
W12X398	12.27	2261.25	0.89	0.28	0.40	0.30	0.40	0.30	0.40	0.32	0.40	0.32	0.40	0.34	0.40	0.34	0.40
W12X305	12.09	2013.75	0.99	0.31	0.44	0.33	0.45	0.33	0.45	0.35	0.45	0.35	0.45	0.38	0.45	0.38	0.45
W12X279	11.95	1803.75	1.11	0.34	0.50	0.36	0.50	0.36	0.50	0.39	0.50	0.39	0.50	0.42	0.51	0.42	0.51
W12X252	11.81	1605.00	1.24	0.38	0.56	0.40	0.56	0.40	0.56	0.43	0.57	0.43	0.57	0.46	0.57	0.46	0.57
W12X230	11.70	1447.50	1.37	0.42	0.62	0.44	0.63	0.44	0.63	0.47	0.63	0.47	0.63	0.51	0.64	0.51	0.64
W12X210	11.60	1305.00	1.52	0.46	0.69	0.49	0.69	0.49	0.69	0.52	0.70	0.52	0.70	0.56	0.71	0.56	0.71
W12X190	11.49	1166.25	1.70	0.51	0.77	0.54	0.78	0.54	0.78	0.58	0.79	0.58	0.79	0.63	0.80	0.63	0.80
W12X170	11.38	1031.25	1.92	0.57	0.87	0.61	0.88	0.61	0.88	0.65	0.89	0.65	0.89	0.71	0.90	0.71	0.90
W12X152	11.28	911.25	2.17	0.64	0.99	0.69	1.00	0.69	1.00	0.74	1.02	0.74	1.02	0.80	1.03	0.80	1.03
W12X136	11.17	802.50	2.46	0.73	1.13	0.77	1.15	0.77	1.15	0.83	1.16	0.83	1.16	0.90	1.18	0.90	1.18
W12X120	11.07	697.50	2.82	0.82	1.30	0.88	1.32	0.88	1.32	0.94	1.35	0.94	1.35	1.02	1.37	1.02	1.37
W12X106	11.00	615.00	3.21	0.93	1.48	1.00	1.51	1.00	1.51	1.07	1.54	1.07	1.54	1.17	1.57	1.17	1.57
W12X96	10.92	551.25	3.66	1.04	1.66	1.11	1.69	1.11	1.69	1.19	1.73	1.19	1.73	1.30	1.76	1.30	1.76
W12X87	10.85	495.00	3.98	1.14	1.86	1.22	1.90	1.22	1.90	1.32	1.94	1.32	1.94	1.44	1.98	1.44	1.98

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi															
Shape	L_p			8		9		10		11		12		13	
	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m
W12X70	10.78	446.25	4.41	1.09	1.99	1.14	1.99	1.14	1.99	1.19	2.02	1.19	2.02	1.27	2.07
W12X72	10.75	405.00	4.88	1.20	2.19	1.25	2.19	1.25	2.19	1.31	2.23	1.31	2.23	1.39	2.29
W12X65	11.81	357.64	5.57	1.33	2.49	1.38	2.49	1.38	2.49	1.45	2.49	1.45	2.49	1.54	2.56
W12X58	8.87	324.00	7.38	1.54	2.74	1.64	2.79	1.64	2.79	1.76	2.88	1.76	2.88	1.92	2.98
W12X53	8.77	292.13	8.23	1.68	3.04	1.79	3.11	1.79	3.11	1.92	3.21	1.93	3.21	2.11	3.33
W12X50	6.93	271.50	11.37	1.91	3.34	2.11	3.48	2.11	3.48	2.38	3.63	2.38	3.63	2.74	3.79
W12X45	6.86	242.83	12.74	2.13	3.75	2.36	3.92	2.36	3.92	2.67	4.10	2.67	4.10	3.08	4.31
W12X40	6.82	215.63	14.37	2.39	4.23	2.65	4.44	2.65	4.44	3.00	4.66	3.00	4.66	3.47	4.91
W12X35	5.44	192.00	21.15		5.01		5.35		5.35		5.74		5.74		6.20
W12X30	5.37	161.63	25.32		6.00		6.44		6.44		6.95		6.95		7.56
W12X26	5.94	139.50	29.69		6.99		7.54		7.54		8.16		8.16		
W12X22	3.01	109.88	68.41		11.28										
W12X19	2.90	92.63	84.06												
W12X16	2.72	75.38	112.07												
W12X14	2.65	65.25	132.79												
W10X112	9.48	551.25	3.49	0.79	1.61	0.83	1.62	0.83	1.62	0.88	1.64	0.88	1.64	0.95	1.66
W10X100	9.37	487.50	3.95	0.88	1.82	0.93	1.83	0.93	1.83	0.99	1.86	0.99	1.86	1.07	1.89
W10X88	9.30	423.75	4.54	1.00	2.10	1.06	2.11	1.06	2.11	1.13	2.15	1.13	2.15	1.22	2.18
W10X77	9.19	368.00	5.25	1.15	2.43	1.22	2.45	1.22	2.45	1.30	2.50	1.30	2.50	1.41	2.55
W10X68	9.16	319.88	5.99	1.30	2.78	1.38	2.80	1.38	2.80	1.47	2.87	1.47	2.87	1.60	2.93
W10X60	9.09	279.75	6.87	1.48	3.18	1.57	3.21	1.57	3.21	1.68	3.29	1.68	3.29	1.83	3.38
W10X54	9.05	249.75	7.67	1.65	3.56	1.75	3.60	1.75	3.60	1.88	3.70	1.88	3.70	2.04	3.81
W10X49	8.98	226.50	8.45	1.81	3.92	1.92	3.98	1.92	3.98	2.07	4.10	2.07	4.10	2.25	4.23
W10X45	7.11	205.88	11.88	2.09	4.38	2.30	4.54	2.30	4.54	2.57	4.70	2.57	4.70	2.95	4.88
W10X39	7.00	175.50	13.96	2.43	5.16	2.68	5.37	2.68	5.37	3.01	5.59	3.01	5.59	3.46	5.84
W10X33	6.86	145.50	17.18	2.90	6.26	3.21	6.56	3.21	6.56	3.63	6.87	3.63	6.87	4.19	7.23
W10X30	4.84	137.25	27.48	3.81	7.16	4.66	7.66	4.66	7.66	5.97	8.25	5.97	8.25	7.97	8.94
W10X26	4.81	117.38	32.32	4.45	8.46	5.46	9.13	5.46	9.13	7.02	9.91	7.02	9.91	9.40	
W10X22	4.70	97.50	39.80		10.34		11.26		11.26		12.35		12.35		
W10X19	3.08	81.00	73.84	10.20	14.84	15.87		15.87		22.85		22.85		31.10	
W10X17	2.97	70.13	88.78		17.75										
W10X15	2.86	60.00	108.98												
W10X12	2.87	47.02	144.73												
W8X67	7.50	263.25	7.38	1.39	3.39	1.51	3.45	1.51	3.45	1.67	3.52	1.67	3.52	1.69	3.59
W8X58	7.42	224.25	8.64	1.60	3.99	1.75	4.07	1.75	4.07	1.94	4.16	1.94	4.16	2.20	4.25
W8X48	7.35	183.75	10.53	1.95	4.88	2.13	5.00	2.13	5.00	2.37	5.13	2.37	5.13	2.69	5.27
W8X40	7.21	149.25	12.95	2.36	6.03	2.59	6.21	2.59	6.21	2.89	6.41	2.89	6.41	3.30	6.53
W8X35	7.18	130.13	14.91	2.69	6.93	2.95	7.17	2.95	7.17	3.30	7.43	3.30	7.43	3.77	7.70
W8X31	7.15	113.98	17.05	3.04	7.92	3.34	8.22	3.34	8.22	3.74	8.55	3.74	8.55	4.27	8.91
W8X28	5.73	102.00	23.83	3.69	9.17	4.26	9.61	4.26	9.61	5.08	10.09	5.08	10.09	6.26	10.62
W8X24	5.69	87.00	28.07	4.31	10.82	4.99	11.41	4.99	11.41	5.96	12.06	5.96	12.06	7.37	12.79
W8X21	4.45	76.50	42.59	5.84	13.12	7.41	14.15	7.41	14.15	9.94	15.36	9.94	15.36	13.53	
W8X18	4.35	63.75	51.98	6.98	16.05	8.97	17.51	8.97	17.51	12.21	19.25	12.21	19.25	16.82	
W8X15	3.11	51.00	92.96	12.65	23.07	19.63		19.63		28.27		28.27		38.47	
W8X13	2.97	42.75	115.35	15.94	28.76	24.91		24.91		35.87		35.87		48.82	
W8X10	3.12	32.96	151.28												
W6X25	5.37	70.88	28.17	4.25	13.19	5.06	13.73	5.06	13.73	6.18	14.32	6.18	14.32	7.83	14.96
W6X20	5.30	55.88	35.83	5.41	16.95	6.40	17.81	6.40	17.81	7.86	18.76	7.86	18.76	10.03	19.82
W6X15	6.89	38.50	55.36	7.29	23.88	8.70	25.47	8.70	25.47	10.82	27.27	10.82	27.27	14.01	29.36
W6X16	3.43	43.88	71.83	10.16	23.88	15.13	25.91	15.13	25.91	21.79	28.32	21.79	28.32	29.66	
W6X12	3.25	31.13	105.35	14.69	35.79	22.46	40.06	22.46	40.06	32.34		32.34		44.02	
W6X9	3.22	23.36	142.40	19.81	49.99	30.41		30.41		43.79		43.79		59.61	
W5X19	4.53	43.50	43.53	6.41	21.89	8.08	22.82	8.08	22.82	10.72	23.83	10.72	23.83	14.57	24.84
W5X16	4.49	35.96	52.67	7.63	26.80	9.66	28.15	9.66	28.15	12.87	29.64	12.87	29.64	17.52	31.30
W4X13	3.54	23.55	83.17	12.05	42.04	17.82	44.29	17.82	44.29	25.38	46.80	25.38	46.80	34.54	48.82

$L_p = (KL)_y$ or $(KL)_x$ for "b", and L_p for "m". Blank cells indicate slender element section or $L_p > L_r$.

Table 2. Values of "b", "m", and "n" Coefficients x 1000 ($F_y = 50$ ksi)

$F_y = 50$ ksi																	
L_b				14		15		16		17		18		19		20	
Shape	L_p	ϕM_p	n	b	m	b	m	b	m	b	m	b	m	b	m	b	m
W12X79	10.78	448.25	4.41	1.27	2.07	1.36	2.12	1.36	2.12	1.46	2.17	1.46	2.17	1.59	2.22	1.59	2.22
W12X72	10.75	405.00	4.88	1.39	2.29	1.49	2.34	1.49	2.34	1.61	2.41	1.61	2.41	1.76	2.47	1.76	2.47
W12X65	11.81	357.64	5.57	1.54	2.56	1.66	2.63	1.66	2.63	1.79	2.71	1.79	2.71	1.95	2.79	1.95	2.79
W12X58	8.87	324.00	7.38	1.92	2.98	2.12	3.08	2.12	3.08	2.38	3.19	2.38	3.19	2.70	3.31	2.70	3.31
W12X53	8.77	292.13	8.23	2.11	3.33	2.34	3.45	2.34	3.45	2.63	3.58	2.63	3.58	2.99	3.73	2.99	3.73
W12X50	6.93	271.50	11.37	2.74	3.79	3.23	3.97	3.23	3.97	3.89	4.17	3.89	4.17	4.78	4.38	4.78	4.38
W12X45	8.86	242.63	12.74	3.08	4.31	3.65	4.53	3.65	4.53	4.41	4.77	4.41	4.77	5.43	5.05	5.43	5.05
W12X40	6.82	215.63	14.37	3.47	4.91	4.11	5.19	4.11	5.19	4.98	5.50	4.98	5.50	6.14		6.14	
W12X35	5.44	192.00	21.15		6.20												
W12X30	5.37	161.63	25.32		7.56												
W12X26	5.34	139.50	29.59														
W12X22	3.01	109.88	68.41														
W12X19	2.90	92.63	84.06														
W12X16	2.72	75.38	112.07														
W12X14	2.65	65.25	132.79														
W10X112	9.48	551.25	3.49	0.95	1.66	1.04	1.69	1.04	1.69	1.15	1.71	1.15	1.71	1.29	1.73	1.29	1.73
W10X100	9.37	487.50	3.95	1.07	1.89	1.17	1.92	1.17	1.92	1.30	1.95	1.30	1.95	1.46	1.98	1.46	1.98
W10X88	9.30	423.75	4.54	1.22	2.18	1.34	2.22	1.34	2.22	1.49	2.26	1.49	2.26	1.67	2.31	1.67	2.31
W10X77	9.19	366.00	5.25	1.41	2.55	1.55	2.60	1.55	2.60	1.72	2.65	1.72	2.65	1.94	2.71	1.94	2.71
W10X68	9.16	319.88	5.99	1.60	2.93	1.76	3.00	1.76	3.00	1.96	3.07	1.96	3.07	2.20	3.15	2.20	3.15
W10X60	9.09	279.75	6.87	1.83	3.38	2.01	3.47	2.01	3.47	2.24	3.56	2.24	3.56	2.53	3.66	2.53	3.66
W10X54	9.05	249.75	7.67	2.04	3.81	2.25	3.92	2.25	3.92	2.51	4.04	2.51	4.04	2.83	4.16	2.83	4.16
W10X48	8.88	226.50	8.45	2.25	4.23	2.48	4.36	2.48	4.36	2.77	4.51	2.77	4.51	3.14	4.66	3.14	4.66
W10X45	7.11	205.88	11.88	2.95	4.88	3.45	5.07	3.45	5.07	4.12	5.28	4.12	5.28	5.02	5.51	5.02	5.51
W10X39	7.00	175.50	13.98	3.46	5.84	4.07	6.10	4.07	6.10	4.88	6.38	4.88	6.38	6.99	6.71	6.99	6.71
W10X33	6.86	145.50	17.18	4.19	7.23	4.96	7.62	4.96	7.62	6.00	8.05	6.00	8.05	7.39		7.39	
W10X30	4.84	137.25	27.48	7.97	8.94	10.41		10.41		13.18		13.18		16.27		16.27	
W10X26	4.81	117.38	32.32	9.40		12.28		12.28		15.54		15.54		19.18		19.18	
W10X22	4.70	97.50	39.80														
W10X19	3.08	81.00	73.84	31.10		40.62		40.62		51.41		51.41		63.46		63.46	
W10X17	2.97	70.13	88.78														
W10X15	2.86	60.00	108.98														
W10X12	2.87	47.02	144.73														
W8X67	7.50	263.25	7.38	1.89	3.59	2.18	3.66	2.18	3.66	2.55	3.73	2.55	3.73	3.05	3.81	3.05	3.81
W8X58	7.42	224.25	8.64	2.20	4.25	2.54	4.35	2.54	4.35	2.98	4.45	2.98	4.45	3.58	4.56	3.58	4.56
W8X48	7.35	183.75	10.53	2.69	5.27	3.11	5.42	3.11	5.42	3.67	5.57	3.67	5.57	4.43	5.73	4.43	5.73
W8X40	7.21	149.25	12.95	3.30	6.63	3.84	6.85	3.84	6.85	4.56	7.10	4.56	7.10	5.54	7.36	5.54	7.36
W8X35	7.18	130.13	14.91	3.77	7.70	4.39	8.00	4.39	8.00	5.23	8.33	5.23	8.33	6.36	8.68	6.36	8.68
W8X31	7.15	113.98	17.05	4.27	8.91	4.99	9.29	4.99	9.29	5.95	9.72	5.95	9.72	7.25	10.16	7.25	10.16
W8X28	5.73	102.00	23.83	6.26	10.62	7.98	11.22	7.98	11.22	10.10	11.88	10.10	11.88	12.47		12.47	
W8X24	5.69	87.00	28.07	7.37	12.79	9.41	13.62	9.41	13.62	11.92		11.92		14.71		14.71	
W8X21	4.45	76.50	42.59	13.53		17.67		17.67		22.36		22.36		27.60		27.60	
W8X18	4.35	63.75	51.88	16.62		21.71		21.71		27.48		27.48		33.92		33.92	
W8X15	3.11	51.00	92.96	38.47		50.25		50.25		63.60		63.60		78.52		78.52	
W8X13	2.97	42.75	115.35	48.82		63.77		63.77		80.71		80.71		99.64		99.64	
W8X10	3.12	32.96	151.28														
W6X25	5.37	70.88	28.17	7.89	14.96	10.19	15.66	10.19	15.66	12.89	16.43	12.89	16.43	15.92	17.28	15.92	17.28
W6X20	5.30	55.88	35.83	10.03	19.82	13.08	21.01	13.08	21.01	16.56		16.56		20.44		20.44	
W6X15	6.89	38.50	55.36	14.01	29.36	18.30		18.30		23.16		23.16		28.59		28.59	
W6X16	3.43	43.88	71.83	29.66		38.74		38.74		49.03		49.03		60.53		60.53	
W6X12	3.25	31.13	105.35	44.02		57.50		57.50		72.78		72.78		89.85		89.85	
W6X9	3.22	23.36	142.40	59.61		77.85		77.85		98.53		98.53		121.64		121.64	
W5X19	4.53	43.50	43.53	14.57	24.94	19.04	26.16	19.04	26.16	24.09	27.51	24.09	27.51	29.74	29.00	29.74	29.00
W5X16	4.49	35.96	52.67	17.52	31.30	22.89	33.16	22.89	33.16	28.97		28.97		35.76		35.76	
W4X13	3.54	23.55	83.17	34.54	49.62	45.11	52.79	45.11	52.79	57.09		57.09		70.49		70.49	

$L_b = (KL)_y$ or $(KL)_x$ for "b", and L_b for "m". Blank cells indicate slender element section or $L_b > L_r$.

Table 3. Average Values of the "b" Coefficient × 1000, $b_{avg} \times 1000$

KL	$F_y = 36 \text{ ksi}$							$F_y = 50 \text{ ksi}$						
	8	10	12	14	16	18	20	8	10	12	14	16	18	20
W40	0.30	0.31	0.31	0.32	0.33	0.35	0.36	0.19	0.19	0.20	0.21	0.22	0.23	0.24
W36	0.33	0.34	0.35	0.36	0.37	0.39	0.41	0.20	0.20	0.21	0.22	0.23	0.24	0.26
W33	0.35	0.36	0.36	0.37	0.39	0.40	0.42	0.22	0.22	0.23	0.24	0.25	0.26	0.28
W30	0.42	0.43	0.45	0.46	0.48	0.51	0.54	0.25	0.26	0.27	0.28	0.29	0.31	0.33
W27	0.48	0.49	0.51	0.53	0.56	0.59	0.63	0.29	0.30	0.31	0.33	0.35	0.37	0.40
W24	0.61	0.64	0.67	0.71	0.76	0.81	0.89	0.37	0.38	0.40	0.42	0.45	0.49	0.53
W21	0.79	0.83	0.88	0.95	1.03	1.14	1.27	0.48	0.51	0.54	0.59	0.64	0.72	0.81
W18	1.10	1.17	1.26	1.38	1.54	1.75	2.02	0.69	0.74	0.81	0.91	1.03	1.20	1.40
W16	1.99	2.16	2.39	2.70	3.12	3.68	4.39	1.22	1.34	1.51	1.74	2.06	2.46	2.92
W14	0.97	1.02	1.09	1.17	1.29	1.43	1.61	0.61	0.64	0.68	0.74	0.81	0.90	1.02
W12	1.85	2.13	2.50	2.97	3.53	4.21	4.99	0.94	1.00	1.08	1.19	1.32	1.50	1.73
W10	4.71	6.05	7.89	10.13	12.84	15.96	19.48	2.57	3.20	4.03	5.10	6.38	7.88	9.60
W8	7.39	9.66	12.85	16.76	21.43	26.81	32.91	5.20	7.04	9.44	12.43	15.99	20.09	24.76
W6	11.91	15.49	21.07	27.89	35.99	45.49	56.16	10.27	14.69	20.46	27.53	35.94	45.49	56.16
W5	8.68	10.27	12.61	16.08	20.96	26.53	32.75	7.02	8.87	11.79	16.05	20.96	26.53	32.75
W4	13.86	18.21	25.38	34.54	45.11	57.09	70.49	12.05	17.62	25.38	34.54	45.11	57.09	70.49

Table 4. Average Values of the "m" Coefficient × 1000, $m_{avg} \times 1000$

L_b	$F_y = 36 \text{ ksi}$							$F_y = 50 \text{ ksi}$						
	8	10	12	14	16	18	20	8	10	12	14	16	18	20
W40	0.27	0.27	0.28	0.28	0.28	0.29	0.30	0.20	0.20	0.20	0.21	0.21	0.22	0.23
W36	0.29	0.29	0.30	0.31	0.31	0.32	0.33	0.21	0.21	0.22	0.23	0.23	0.24	0.25
W33	0.36	0.36	0.37	0.38	0.39	0.40	0.41	0.26	0.26	0.27	0.28	0.29	0.30	0.31
W30	0.51	0.52	0.53	0.55	0.57	0.59	0.62	0.37	0.38	0.39	0.41	0.43	0.45	0.40
W27	0.56	0.57	0.58	0.59	0.61	0.63	0.66	0.41	0.42	0.43	0.44	0.46	0.48	0.41
W24	0.91	0.94	0.97	1.02	1.08	0.89	0.92	0.67	0.70	0.73	0.62	0.65	0.62	0.49
W21	1.30	1.35	1.42	1.50	1.41	1.17	1.22	0.96	1.01	1.08	0.82	0.86	0.67	0.56
W18	1.90	1.98	2.09	2.22	1.87	1.76	1.85	1.40	1.48	1.42	1.22	1.18	0.83	0.86
W16	4.10	4.37	4.70	4.37	4.04	4.32	3.66	3.07	3.32	2.74	2.93	1.98	1.76	1.83
W14	2.34	2.46	2.61	2.04	2.13	1.96	1.60	1.74	1.60	1.47	1.37	1.13	1.17	0.98
W12	5.43	4.22	3.17	3.29	3.43	3.59	2.91	2.54	2.27	2.37	2.22	1.85	1.92	1.80
W10	10.61	9.87	6.59	6.89	7.23	6.62	6.06	5.99	4.72	4.99	4.13	3.82	3.95	3.66
W8	17.41	19.03	14.34	12.66	13.31	12.09	10.92	11.18	8.68	9.20	7.47	7.80	7.25	6.72
W6	35.79	38.55	41.86	36.36	31.91	33.87	32.23	27.28	24.60	22.17	21.38	18.34	16.43	17.28
W5	32.77	33.90	35.12	36.42	37.83	39.36	41.01	24.34	25.48	26.74	28.12	29.66	27.51	29.00
W4	56.18	58.35	60.71	63.26	66.04	69.07	72.40	42.04	44.29	46.80	49.62	52.79		

$L_b = (KL)_x$ or $(KL)_y$ for "b," and L_b for "m." Blank cells indicate slender element section or $L_b > L_c$.

Table 5. Average Values of the "n" Coefficient × 1000, $n_{avg} \times 1000$

	$F_y = 36$	$F_y = 50$
W40	1.5	1.1
W36	1.6	1.1
W33	1.7	1.2
W30	2.3	1.7
W27	2.7	1.9
W24	3.9	2.8
W21	5.3	3.8
W18	7.2	4.7
W16	15.0	10.8
W14	4.9	3.5
W12	9.7	7.0
W10	18.7	13.5
W8	30.3	21.8
W6	135.5	47.8
W5	66.8	48.1
W4	115.5	83.2