The flexural design strength of noncompact I or C rolled shapes bent about the major axis is determined by:

$$\phi_b M_n = \phi_b M_p - \phi_b(M_p - M_r)\left(\frac{L_b - L_p}{L_r - L_p}\right) \le \phi_b M_n'$$

In the Load Factor Design Selection Table, in the case of the noncompact shapes, the values of $\phi_b M_n'$ and L_p' are tabulated as $\phi_b M_p$ and L_p. The formula above may be used with the tabulated values.

Flexural Design Strength for $C_b > 1.0$

C_b is a factor which varies with the moment gradient between bracing points (L_b). For C_b greater than 1.0, the design flexural strength is equal to the tabulated value of the design flexural strength (with $C_b = 1.0$) multiplied by the calculated C_b value. The maximum value is $\phi_b M_p$ for compact shapes or $\phi_b M_n'$ for noncompact shapes. The maximum unbraced lengths associated with the maximum flexural design strengths $\phi_b M_p$ and $\phi_b M_n'$ are L_m and L_m' (see Figure 4-1).

A new expression for C_b is given in the LRFD Specification. (It is more accurate than the one previously shown.)

$$C_b = \frac{12.5M_{max}}{2.5M_{max} + 3M_A + 4M_B + 3M_c} \quad \text{(F1-3)}$$

where M is the absolute value of a moment in the unbraced beam segment as follows:

M_{max}, the maximum
M_A, at the quarter point
M_B, at the centerline
M_c, at the three-quarter point

Values for C_b for some typical loading conditions are given in Table 4-1.

Compact Sections ($C_b > 1.0$)
When $L_b \le L_m$

The flexural design strength for rolled I and C shapes is:

$$\phi_b M_n = \phi_b M_p$$

A condition for Lb<=Lm

But you have to find Lm from the formula A or B shown below.

When $L_b > L_m$

A condition for Lb>Lm

But you have to find Lm from the formula A or B shown below.

The flexural design strength is:

$$\phi_b M_n = C_b[\phi_b M_n \text{ (for } C_b = 1.0)] \le \phi_b M_p$$

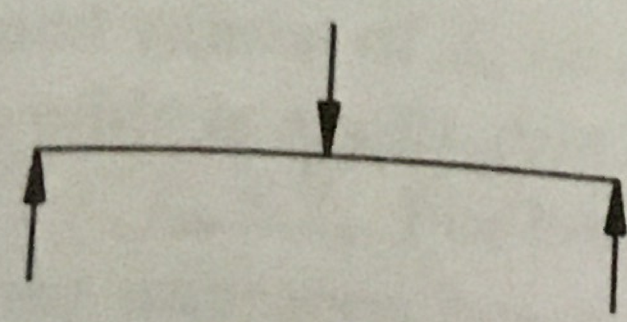
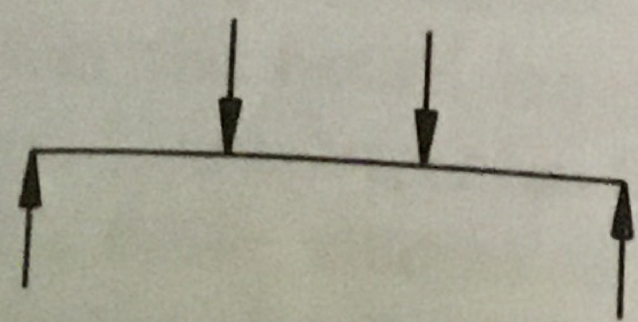
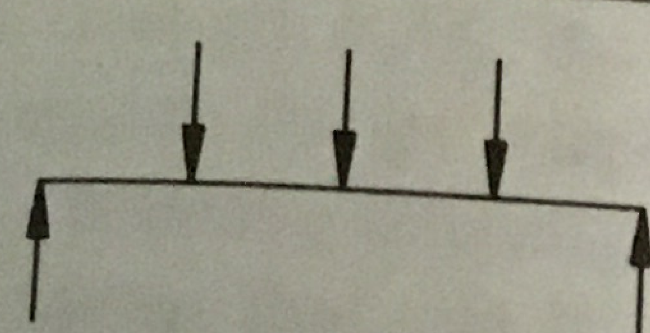
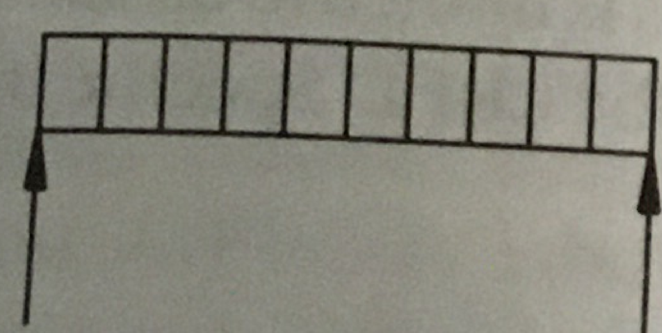
For $L_m \le L_r$

How do you know formula to use? You don't know it Lm <Lr unless you plug into the Formula A, or do you plug into Formula B?

Formula A

$$L_m = L_p + \frac{(C_b M_p - M_p)(L_r - L_p)}{C_b(M_p - M_r)}$$

Table 4-1.
Values of C_b for Simply Supported Beams

Load	Lateral Bracing Along Span	C_b
	None	1.32
	At load points	1.67 1.67
	None	1.14
	At load points	1.67 1.00 1.67
	None	1.14
	At load points	1.67 1.11 1.11 1.67
	None	1.14
	At centerline	1.30 1.30

For $L_m > L_r$

$$L_m = \frac{C_b \pi}{M_p}\sqrt{\frac{EI_yGJ}{2}}\sqrt{1+\sqrt{1+\frac{4C_wM_p^2}{I_yC_b^2G^2J^2}}}$$

Formula B

The value of C_b for which L_m or L_m' equals L_r for any rolled shape is:

$$C_b = \frac{F_yZ_x}{(F_y - 10)S_x}$$

Noncompact Sections ($C_b > 1.0$)
When $L_b \le L_m'$

The flexural design strength for rolled I and C shapes is:

$$\phi_bM_n = \phi_bM_n' < \phi_bM_p$$

When $L_b > L_m'$

The flexural design strength is:

$$\phi_bM_n = C_b[\phi_bM_n \text{ (for } C_b = 1.0)] \le \phi_bM_n'$$