5.4-1 For W-, M-, and S-shapes with $F_y = 60$ ksi:

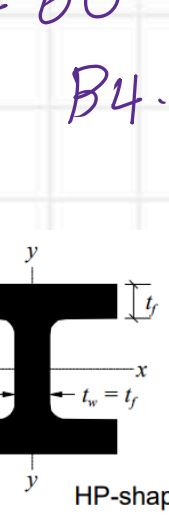
a. List the shapes in Part 1 of the *Manual* that are noncompact (when used as flexural members). State whether they are noncompact because of the flange, the web, or both.

b. List the shapes in Part 1 of the *Manual* that are slender. State whether they are slender because of the flange, the web, or both.

Solution

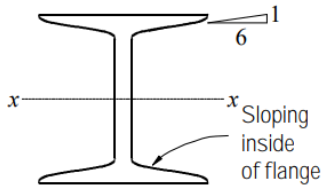
Fy = 60 ksi

item 10 Refer to B4.1b For Flange



W- and M-shapes

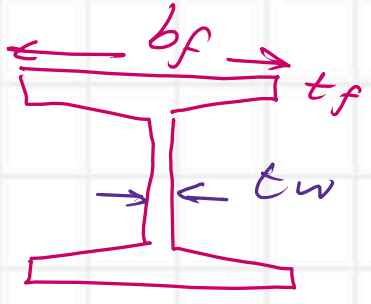
HP-shapes



S-shapes

I-shaped cross-sections

S has slopes

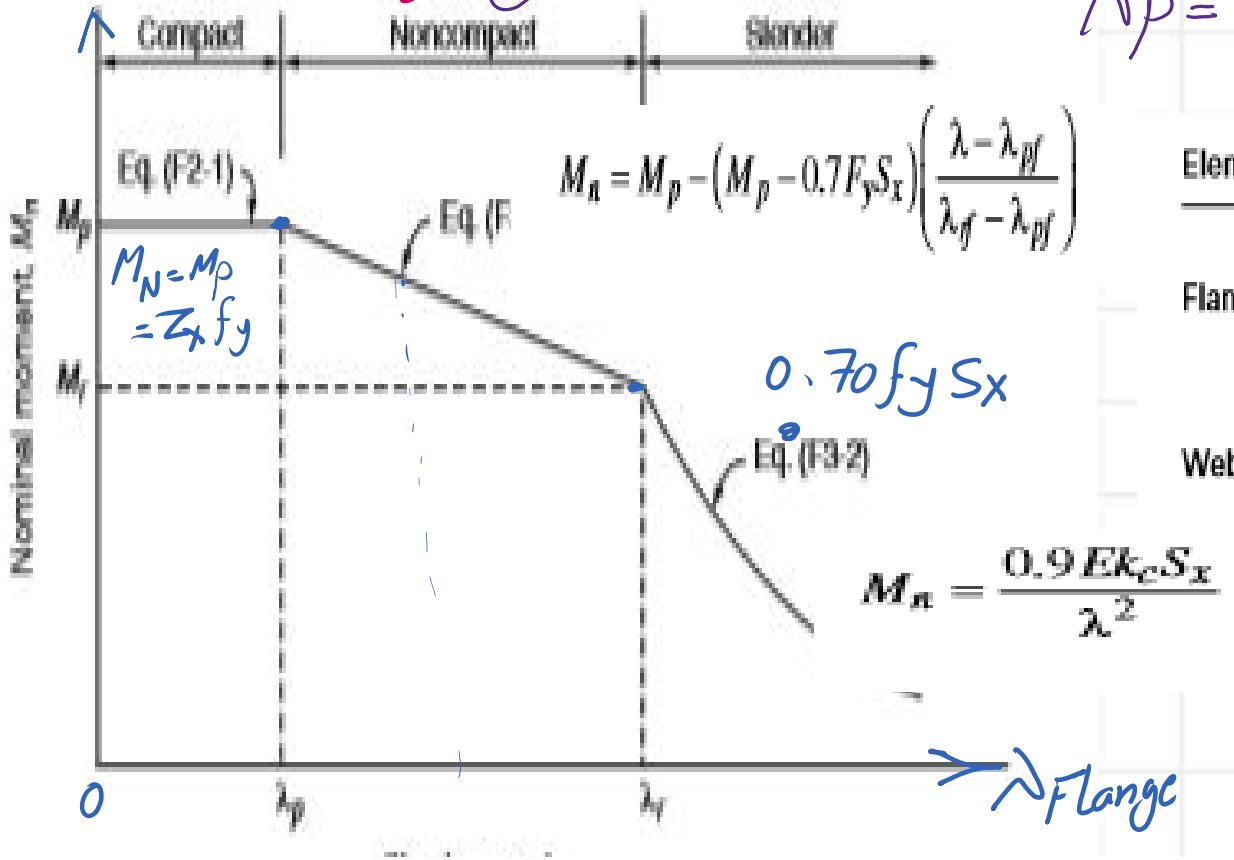


Typical Shapes

For W, M, S Shapes

item 15 For Webs in the Same Table

$E = 29000$ ksi & $F_y = 60$ ksi



$\lambda_p = 0.38\sqrt{\frac{29000}{60}} = 8.35$, $\lambda_r = 21.984$

Element	λ	λ_p	λ_r	
Flange	$\frac{b_f}{2t_f}$	$0.38\sqrt{\frac{E}{F_y}}$	$1.0\sqrt{\frac{E}{F_y}}$	item No. 10
Web	$\frac{h}{t_w}$	$3.76\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$	item No. 15

$3.76\sqrt{\frac{29000}{60}} = 82.66$

$5.7\sqrt{\frac{29000}{60}} \Rightarrow 125.31$

where

$k_c = \frac{4}{\sqrt{h/t_w}}$ and shall not be taken less than 0.35 nor greater than 0.76 for calculation purposes

h = distance as defined in Section B4.1b, in. (mm)

$\lambda = \frac{b_f}{2t_f}$

b_f = width of the flange, in. (mm)

t_f = thickness of the flange, in. (mm)

$\lambda_{pf} = \lambda_p$ is the limiting slenderness for a compact flange, defined in Table B4.1b

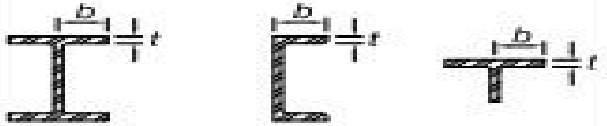
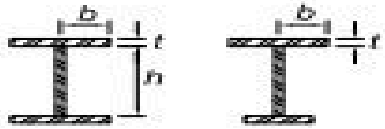
$\lambda_{rf} = \lambda_r$ is the limiting slenderness for a noncompact flange, defined in Table B4.1b

Unstiffened elements.

Item 10 for doubly symmetric

D.S

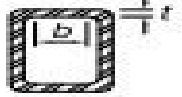
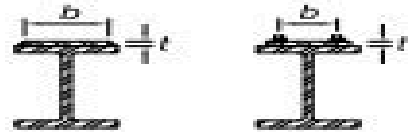
TABLE B4.1b
Width-to-Thickness Ratios: Compression Elements Members Subject to Flexure

	Case	Description of Element	Width-to-Thickness Ratio	Limiting Width-to-Thickness Ratio λ_p (compact/ noncompact)	Limiting Width-to-Thickness Ratio λ_r (noncompact/ slender)	Examples
Unstiffened Elements	10	Flanges of rolled I-shaped sections, channels, and tees	b/t	$0.38\sqrt{\frac{E}{F_y}}$	$1.0\sqrt{\frac{E}{F_y}}$	
	11	Flanges of doubly and singly symmetric I-shaped built-up sections	b/t	$0.38\sqrt{\frac{E}{F_y}}$	$0.95\sqrt{\frac{k_c E}{F_L}}$ [a] [b]	
	12	Legs of single angles	b/t	$0.54\sqrt{\frac{E}{F_y}}$	$0.91\sqrt{\frac{E}{F_y}}$	
	13	Flanges of all I-shaped sections and channels in flexure about the minor axis	b/t	$0.38\sqrt{\frac{E}{F_y}}$	$1.0\sqrt{\frac{E}{F_y}}$	
	14	Stems of tees	d/t	$0.84\sqrt{\frac{E}{F_y}}$	$1.52\sqrt{\frac{E}{F_y}}$	

Stiffened elements .

D-Symmetric

TABLE B4.1b (continued)
Width-to-Thickness Ratios: Compression Elements Members Subject to Flexure

	Case	Description of Element	Width-to-Thickness Ratio	Limiting Width-to-Thickness Ratio λ_p (compact/noncompact)	Limiting Width-to-Thickness Ratio λ_r (noncompact/slender)	Examples
Stiffened Elements	15	Webs of doubly symmetric I-shaped sections and channels	h/t_w	$3.76\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$	
	16	Webs of singly symmetric I-shaped sections	h_c/t_w	$\frac{\frac{h_c}{h_p}\sqrt{\frac{E}{F_y}}}{\left(0.54\frac{M_p}{M_y}-0.09\right)^2} \le \lambda_r$ [c]	$5.70\sqrt{\frac{E}{F_y}}$	
	17	Flanges of rectangular HSS	b/t	$1.12\sqrt{\frac{E}{F_y}}$	$1.40\sqrt{\frac{E}{F_y}}$	
	18	Flange cover plates and diaphragm plates between lines of fasteners or welds	b/t	$1.12\sqrt{\frac{E}{F_y}}$	$1.40\sqrt{\frac{E}{F_y}}$	
	19	Webs of rectangular HSS and box sections	h/t	$2.42\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$	

W - section $F_y = 60$ ksi

Type	Std_Nomen	$b_f/2$
W	W30X90	8.52
W	W24X104	8.50
W	W21X48	9.47
W	W14X109	8.49
W	W14X99	9.34
W	W14X90	10.2
W	W14X30	8.74
W	W12X72	8.99
W	W12X65	9.92
W	W12X53	8.69
W	W12X26	8.54
W	W12X14	8.82
W	W10X49	8.93
W	W10X33	9.15
W	W10X12	9.43
W	W8X31	9.19
W	W8X10	9.61
W	W6X15	11.5
W	W6X9	9.16
W	W6X8.5	10.1

W sections Flange Non-Compact

$\lambda_p = 8.35$ based on $F_y = 60$ ksi

$\frac{b_f}{2t_f} > 8.35$

$\frac{b_f}{2t_f} < 21.848$

20 sections are considered as non Compact sections

Tables for W & M and S Shapes

1-1
1-2
1-3

$F_y = 60$ ksi

Conclusion

No non compact sections for web

W → For section $F_y = 60$ ksi

W sections web - Non-Compact

$\lambda_{wp} = 82.66$

$\frac{h}{t_w}$ max $= 57.5$

For W30x90

5.4-1 For W-, M-, and S-shapes with $F_y = 60$ ksi:

a. List the shapes in Part 1 of the *Manual* that are noncompact (when used as flexural members). State whether they are noncompact because of the flange, the web, or both.

b. List the shapes in Part 1 of the *Manual* that are slender. State whether they are slender because of the flange, the web, or both.

EDI_Std_Nomenclatu	$b_f/2t_f$
M12X10	9.03
M4X6	11.9
M4X3.45	8.65
M4X3.2	8.65
M3X2.9	8.65

M_section

Non-Compact Flange

$\frac{b_f}{2t_f} > 8.35$

$\frac{b_f}{2t_f} < 21.848$

$F_y = 60$ ksi

5 sections

5.4-1 For W-, M-, and S-shapes with $F_y = 60$ ksi:

a. List the shapes in Part 1 of the *Manual* that are noncompact (when used as flexural members). State whether they are noncompact because of the flange, the web, or both.

b. List the shapes in Part 1 of the *Manual* that are slender. State whether they are slender because of the flange, the web, or both.

M_section

Non-Compact - Web

$\frac{h}{t_w} > 82.66$

< 125.31

$F_y = 60$ ksi

No M_section

non Compact

For web

5.4-1 For W-, M-, and S-shapes with $F_y = 60$ ksi:

a. List the shapes in Part 1 of the *Manual* that are noncompact (when used as flexural members). State whether they are noncompact because of the flange, the web, or both.

b. List the shapes in Part 1 of the *Manual* that are slender. State whether they are slender because of the flange, the web, or both.

We use V15 Data base For W-section

For which $\frac{bf}{tf} > 8.35$ $\frac{bf}{tf} \leq 21.98$ Non-Compact due to flange

No S Section is non Compact For Flange or web

Non Compact For Web

$\frac{h}{tw} > 82.66$

$\frac{h}{tw} \leq 125.31$

Part-a

5.4-1 For W-, M-, and S-shapes with $F_y = 60$ ksi:

a. List the shapes in Part 1 of the *Manual* that are noncompact (when used as flexural members). State whether they are noncompact because of the flange, the web, or both.

b. List the shapes in Part 1 of the *Manual* that are slender. State whether they are slender because of the flange, the web, or both.

For part b. No W, M and S shapes are slender For Fy = 60 ksi:

Prepared by Eng.Maged Kamel.