Topics

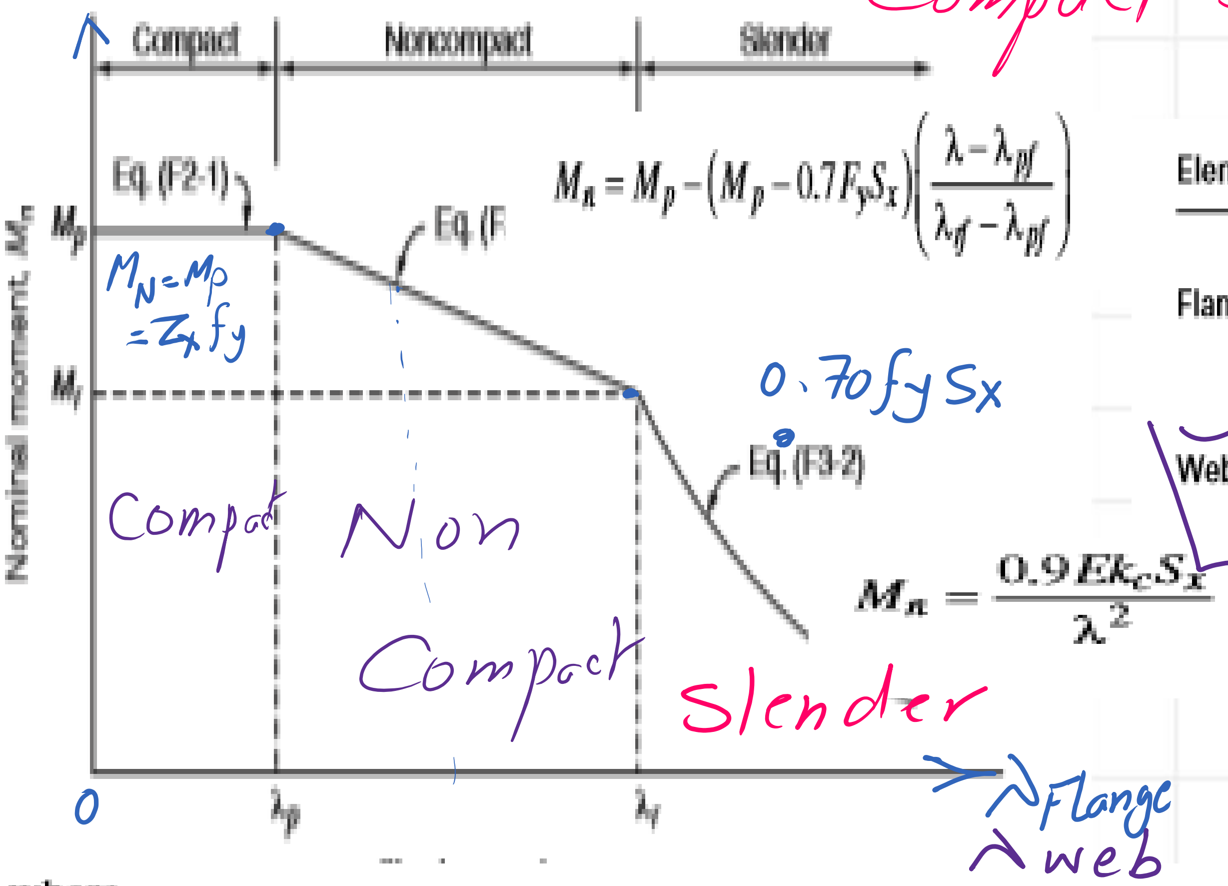
1. What is the difference between Compact and Non-Compact sections?

2. What are the Controling parameters?

Prepared by Eng.Maged Kamel.

Compact Sections $\frac{b_f}{2t_f} < 0.38\sqrt{\frac{E}{F_y}}$

$h/t_w < 3.76\sqrt{\frac{E}{F_y}}$



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

Non Compact or

$\frac{b_f}{2t_f} > 0.38\sqrt{\frac{E}{F_y}}$, $< 1.0\sqrt{\frac{E}{F_y}}$

$\frac{h}{t_w} > 3.76\sqrt{\frac{E}{F_y}}$, $< 5.7\sqrt{\frac{E}{F_y}}$

slender

$\frac{b_f}{2t_f} > 1.0\sqrt{\frac{E}{F_y}}$

$h/t_w > 5.70\sqrt{\frac{E}{F_y}}$

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)

λ = $\frac{b_f}{2t_f}$

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

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

λ_{pf} = λ_p is the limiting slenderness for a compact flange, defined in Table B4.1b

λ_{rf} = λ_r is the limiting slenderness for a noncompact flange, defined in Table B4.1b

What is b or bf definitions?

1a. Unstiffened Elements

For unstiffened elements supported along only one edge parallel to the direction of the compression force, the width shall be taken as follows:

(a) For flanges of I-shaped members and tees, the width, b, is one-half the full-flange width, b_f. I shaped

(b) For legs of angles and flanges of channels and zees, the width, b, is the full leg or flange width. L

(c) For plates, the width, b, is the distance from the free edge to the first row of fasteners or line of welds.

(d) For stems of tees, d is the full depth of the section. T

User Note: Refer to Table B4.1 for the graphic representation of unstiffened element dimensions.

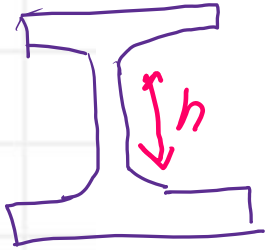
Prepared by Eng.Maged Kamel.

B4-1b. 16.1-16

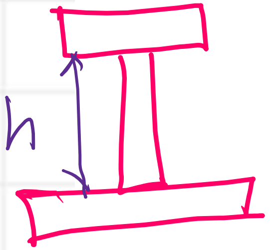
1b. Stiffened Elements

How to estimate h?

For stiffened elements supported along two edges parallel to the direction of the compression force, the width shall be taken as follows:



(a) For webs of rolled sections, h is the clear distance between flanges less the fillet at each flange; h_c is twice the distance from the centroid to the inside face of the compression flange less the fillet or corner radius.



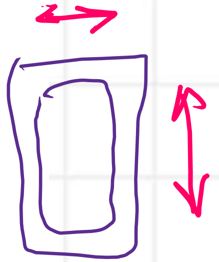
(b) For webs of built-up sections, h is the distance between adjacent lines of fasteners or the clear distance between flanges when welds are used, and h_c is twice the distance from the centroid to the nearest line of fasteners at the compression flange or the inside face of the compression flange when welds are used; h_p is twice the distance from the plastic neutral axis to the nearest line of fasteners at the compression flange or the inside face of the compression flange when welds are used.

B4-1-b

HSS

(c) For flange or diaphragm plates in built-up sections, the width, *b*, is the distance between adjacent lines of fasteners or lines of welds.

(d) For flanges of rectangular hollow structural sections (HSS), the width, *b*, is the clear distance between webs less the inside corner radius on each side. For webs of rectangular HSS, *h* is the clear distance between the flanges less the inside corner radius on each side. If the corner radius is not known, *b* and *h* shall be taken as the corresponding outside dimension minus three times the thickness. The thickness, *t*, shall be taken as the design wall thickness, per Section B4.2.



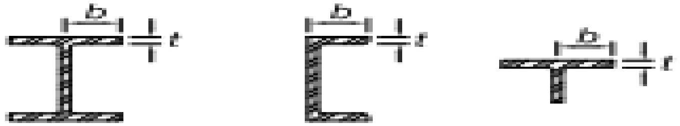
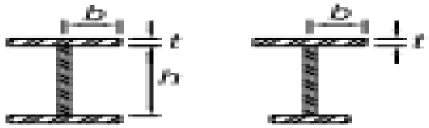
(e) For flanges or webs of box sections and other stiffened elements, the width, *b*, is the clear distance between the elements providing stiffening.

(f) For perforated cover plates, *b* is the transverse distance between the nearest line of fasteners, and the net area of the plate is taken at the widest hole.

Subject to Flexure

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

Flange

	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	$0.38\sqrt{\frac{E}{F_y}}$	[a] [b] $0.95\sqrt{\frac{k_c E}{F_L}}$	
	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	$0.84\sqrt{\frac{E}{F_y}}$	$1.52\sqrt{\frac{E}{F_y}}$	

Prepared by Eng.Maged Kamel.

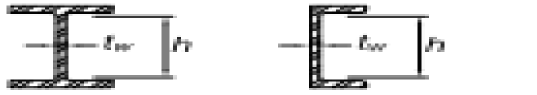
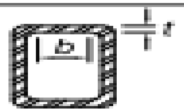
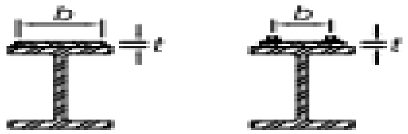
STIFFened Elements

web

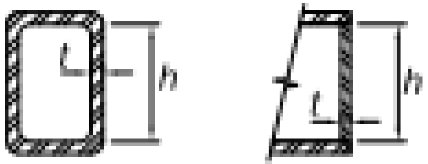
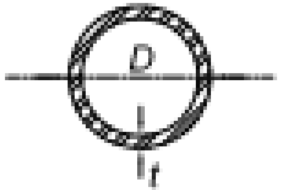
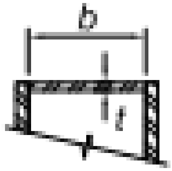
item 15 ←

singly 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	$\dfrac{\frac{h_c}{h_p}\sqrt{\frac{E}{F_y}}}{\left(0.54\frac{M_p}{M_y}-0.09\right)^2} \le \lambda_r$ [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	$2.42\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$	

Prepared by Eng.Maged Kamel.

	19	Webs of rectangular HSS and box sections	h/t	$2.42\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$	
	20	Round HSS	D/t	$0.07\frac{E}{F_y}$	$0.31\frac{E}{F_y}$	
	21	Flanges of box sections	b/t	$1.12\sqrt{\frac{E}{F_y}}$	$1.49\sqrt{\frac{E}{F_y}}$	

[a] $k_c = 4/\sqrt{h/t_w}$, shall not be taken less than 0.35 nor greater than 0.76 for calculation purposes.

[b] $F_L = 0.7F_y$ for slender web I-shaped members and major-axis bending of compact and noncompact web built-up I-shaped members with $S_{xt}/S_{xc} \geq 0.7$; $F_L = F_yS_{xt}/S_{xc} \geq 0.5F_y$ for major-axis bending of compact and noncompact web built-up I-shaped members with $S_{xt}/S_{xc} < 0.7$, where S_{xc}, S_{xt} = elastic section modulus referred to compression and tension flanges, respectively, in.^{3} (mm^3).

[c] M_y is the moment at yielding of the extreme fiber. $M_p = F_yZ_x$, plastic bending moment, kip-in. (N-mm), where Z_x = plastic section modulus taken about x-axis, in.^{3} (mm^3).

E = modulus of elasticity of steel = 29,000 ksi (200 000 MPa)

F_y= specified minimum yield stress, ksi (MPa)

ENA = elastic neutral axis

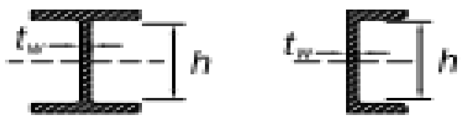
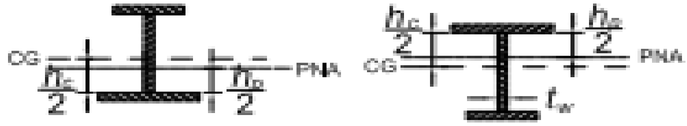
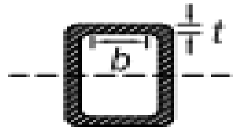
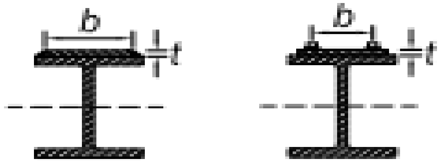
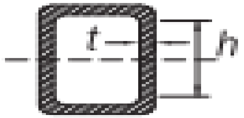
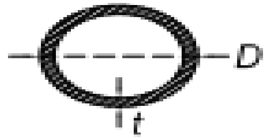
PNA = plastic neutral axis

21 items

AisC-360-16

Prepared by Eng.Maged Kamel.

AISC-360-10 No. of items =20

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 and boxes of uniform thickness	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 boxes	h/t	$2.42\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$	
	20	Round HSS	D/t	$0.07\frac{E}{F_y}$	$0.31\frac{E}{F_y}$	

[a] $k_c = 4/\sqrt{h/t_w}$ but shall not be taken less than 0.35 nor greater than 0.76 for calculation purposes.
[b] $F_L = 0.7F_y$ for major axis bending of compact and noncompact web built-up I-shaped members with $S_{xt}/S_{xc} \ge 0.7$;
$F_L = F_yS_{xt}/S_{xc} \ge 0.5F_y$ for major-axis bending of compact and noncompact web built-up I-shaped members with $S_{xt}/S_{xc} < 0.7$.
[c] M_y is the moment at yielding of the extreme fiber. M_p = plastic bending moment, kip-in. (N-mm)
E = modulus of elasticity of steel = 29,000 ksi (200 000 MPa)
F_y = specified minimum yield stress, ksi (MPa)

Prepared by Eng.Maged Kamel.

Prepared by Eng.Maged Kamel.