CE 415: Design of Steel Structures

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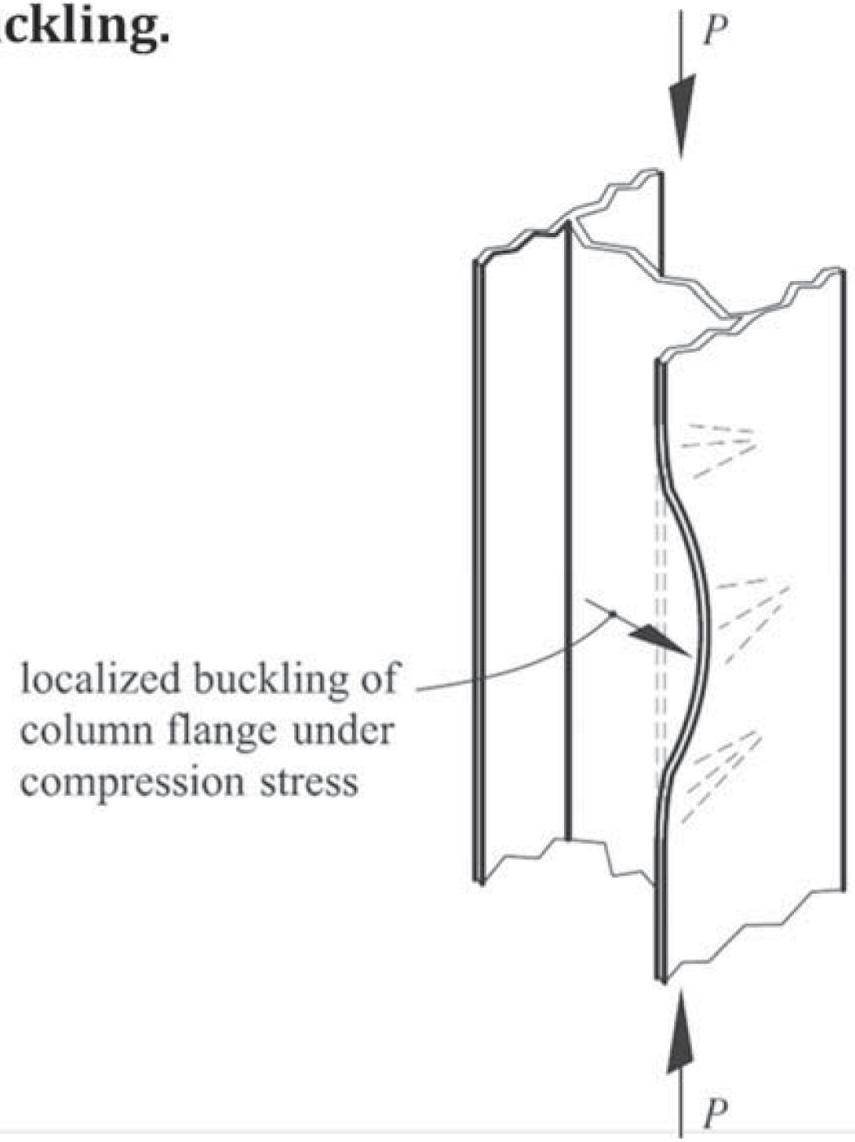
LOCAL BUCKLING

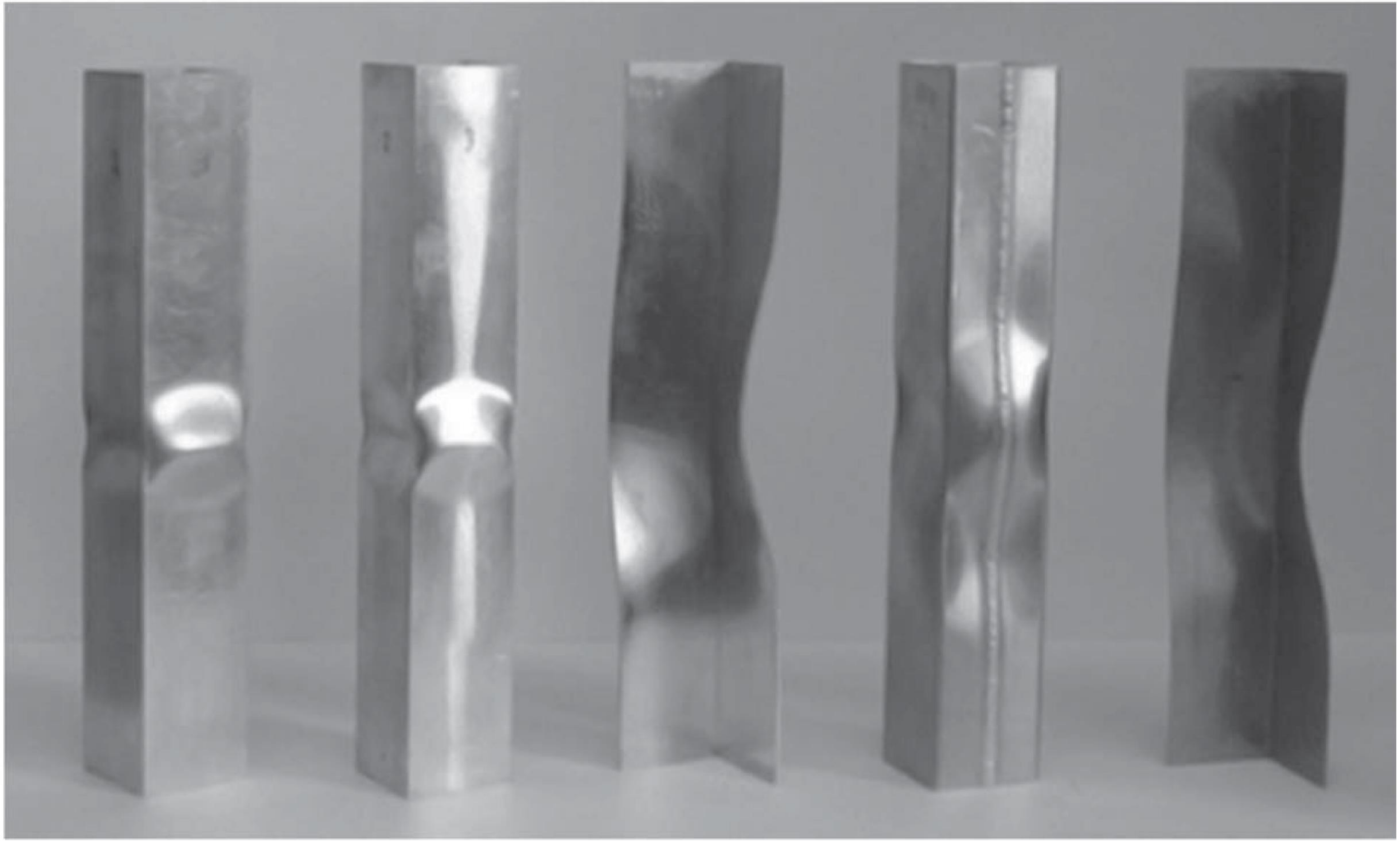
Local buckling is a phenomenon by which a portion of the section of a column or beam buckles instead of overall buckling.

Local buckling leads to a reduction in the strength of a compression member and prevents the member from reaching its overall compression capacity.

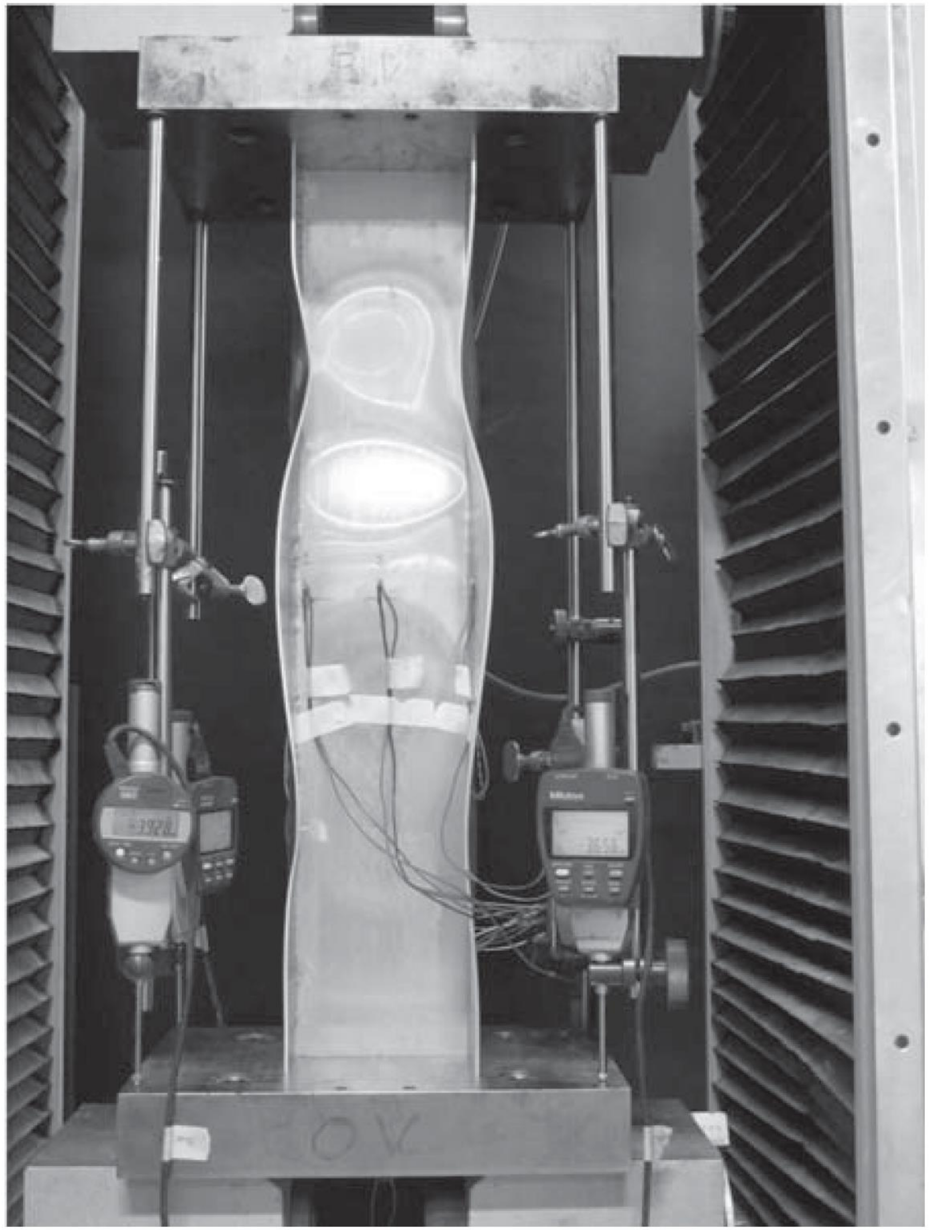
To avoid or prevent local buckling, the AISC specification prescribes limits to the width-to-thickness ratios of the plate components that make up the structural member.



LOCAL BUCKLING



LOCAL BUCKLING



Local buckling primarily depends on the ratio, *b/t*, of the width (*b*) and thickness (*t*) of the plate elements that builds up a section.

LOCAL BUCKLING

Based on the width/thickness ratio steel sections are defined as

Compact: A compact section reaches its cross-sectional material strength, or capacity, before local buckling occurs.

Non-Compact: In a non-compact section, only a portion of the cross-section reaches its yield strength before local buckling occurs.

Slender: In a slender section, the cross-section does not yield and the strength of the member is governed by local buckling.

The use of slender sections as compression members is not efficient or economical; therefore, the use of slender section in design practice is not recommended.

LOCAL BUCKLING

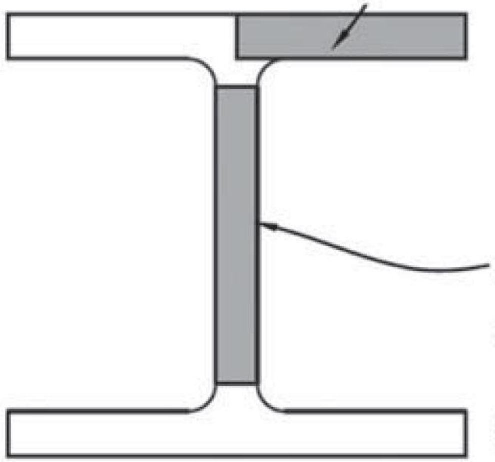
There are also two type of elements of a column section :

Stiffened:

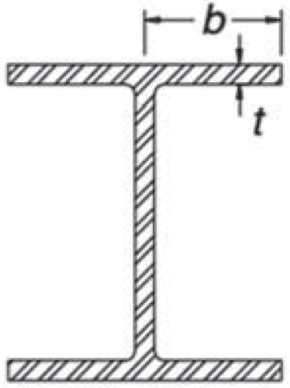
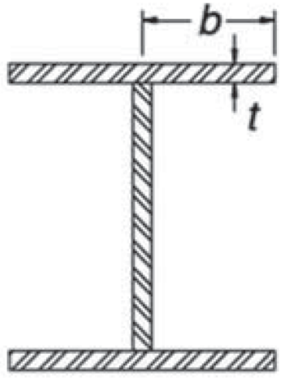
Stiffened elements are supported along both edges parallel to the applied axial load. An example of this is the web of an I-shaped column where the flanges are connected on either end of the web.

Unstiffened:

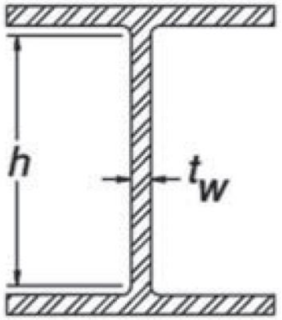
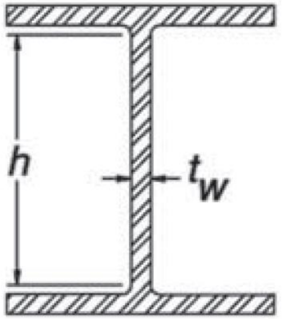
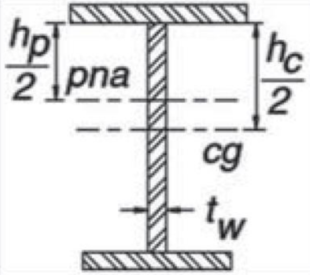
An unstiffened element has only one unsupported edge parallel to the axial load—for example, the outstanding flange of an I-shaped column that is connected to the web on one edge and free along the other edge.



LOCAL BUCKLING: AISC Specification for limiting b/t ratio
Unstiffened Elements

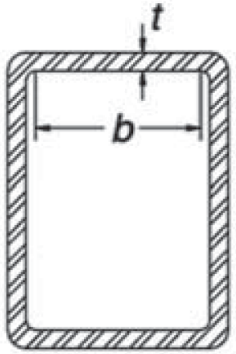
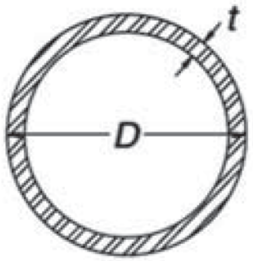
Case	Description of Element	Width-Thickness Ratio	Limiting Width-Thickness Ratios		Example
			λ_p (compact)	λ_r (noncompact)	
1	Flexure in flanges of rolled I-shaped sections and channels	b/t	$0.38\sqrt{E/F_y}$	$1.0\sqrt{E/F_y}$	
2	Flexure in flanges of doubly and singly symmetric I-shaped built-up sections	b/t	$0.38\sqrt{E/F_y}$	$0.95\sqrt{k_c E/F_L}$ [a],[b]	

LOCAL BUCKLING: AISC Specification for limiting *b/t* ratio
Stiffened Elements

	Case	Description of Element	Width Thickness Ratio	Limiting Width-Thickness Ratios λ_p (compact)	Limiting Width-Thickness Ratios λ_r (noncompact)	Example
Stiffened Elements	9	Flexure in webs of doubly symmetric I-shaped sections and channels	h/t_w	$3.76\sqrt{E/F_y}$	$5.70\sqrt{E/F_y}$	
	10	Uniform compression in webs of doubly symmetric I-shaped sections	h/t_w	NA	$1.49\sqrt{E/F_y}$	
	11	Flexure in webs of singly-symmetric I-shaped sections	h_c/t_w	$\dfrac{\dfrac{h_c}{h_p}\sqrt{\dfrac{E}{F_y}}}{\left(0.54\dfrac{M_p}{M_y}-0.09\right)^2} \le \lambda_r$	$5.70\sqrt{E/F_y}$	

LOCAL BUCKLING: AISC Specification for limiting *b/t* ratio

Stiffened Elements

Case	Description of Element	Width Thick-ness Ratio	Limiting Width-Thickness Ratios		Example
			λ_p (compact)	λ_r (noncompact)	
12	Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression; flange cover plates and diaphragm plates between lines of fasteners or welds	b/t	$1.12\sqrt{E/F_y}$	$1.40\sqrt{E/F_y}$	
15	Circular hollow sections				
	In uniform compression	D/t	NA	$0.11E/F_y$	
	In flexure	D/t	$0.07E/F_y$	$0.31E/F_y$	