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Night School

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We will begin shortly. Please standby.

**Modern Methods for Learning the Basics of
Structural Stability: From Behavior to Practice**

Session 1: Behavior of Compression Members – The Fundamentals
October 6, 2020




**Smarter.
Stronger.
Steel.**

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Course Description

Behavior of Compression Members – The Fundamentals
October 6, 2020

This session will begin with a brief overview of the 8-lecture course, and its unique format. The behavior of compression members will then be covered. The assumptions in the solution to the Euler column problem will be used as a basis for systematically moving from the theoretical solution presented in 1757 to the modern day methods of design and analysis of compression members. Emphasis will be placed on the effects of material yielding accentuated by the presence of residual stresses, initial imperfections, and end conditions. The flexural buckling strength of members without slender elements will be covered and ultimately presented in the form of column curves. The speakers will conclude by introducing the first learning module.



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Learning Objectives

- List the assumptions in the Euler column solution.
- Describe how bending is produced on a column.
- Describe the aspects that are taken into account to define a column's strength in the AISC Specification's column curve.
- Explain how column end restraint affects the behavior of a column.



Modern Methods for Learning The Basics of Structural Stability: From Behavior to Practice

Session 1: Behavior of Compression Members – The Fundamentals
October 6, 2019



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Modern Methods for Learning The Basics of Structural Stability: From Behavior to Practice

Course Introduction

Compression Members

Flexural Members

Beam-Columns

Systems



Course Overview

- Topics
 - Compression Members (Weeks 1 & 2)
 - Flexural Members (Weeks 3 & 4)
 - Beam-Columns (Weeks 5 & 6)
 - Systems (Weeks 7 & 8)
- “Active” learning! Weekly virtual lab experiences...
- Case studies from the real world...

3

Course Overview (2)



Course Overview (3)

- Focus of the course is on fundamentals!
- Better understanding of behavior will result in improved design
- Key Definitions
 - **Stability:** Under load, component returns to current state after applying a small disturbance such as a deflection
 - **Bifurcation (critical load):** Theoretical point at which loading a component results in an instantaneous change from current state to significant deflection – two options: not buckled or buckled
 - **Instability:** Loading a component results in a realistic transition from small deflection to significant deflection – buckling preceded by deflection

5

Course Overview (4)

“Buckling” Design Methods:

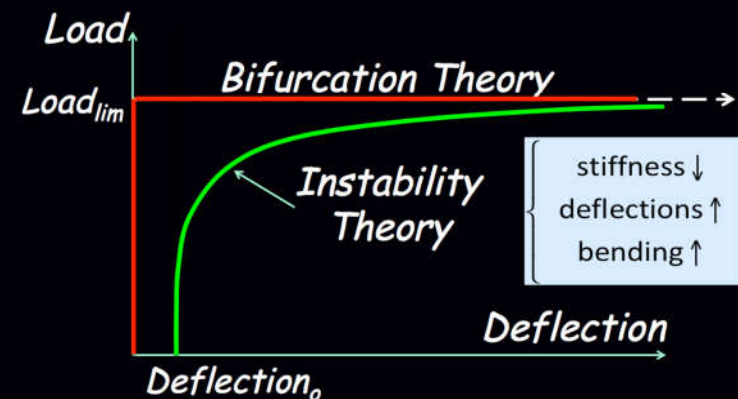


Figure applicable to system, member,
and cross-section behavior

6

Course Overview (5)

Analysis acronyms:

LBA: linear buckling analysis; **elastic critical load analysis**; elastic eigenvalue analysis; assumes bifurcation theory

GNA: geometric nonlinear analysis; **2nd-order elastic analysis**; assumes equilibrium on the deformed shape and linear elastic material, with no initial imperfections

GNIA: same as GNA, but **includes initial imperfections**

MNA: material nonlinear analysis; **1st-order inelastic analysis**; assumes equilibrium on the undeformed shape and accounts for yielding, with no initial imperfections

GMNIA: geometric and material nonlinear analysis; **2nd-order inelastic analysis**; assumes equilibrium on the deformed shape, accounts for yielding, and **includes initial imperfections**

7

**Modern Methods for Learning The Basics of
 Structural Stability: From Behavior to Practice**


Course Introduction

Compression Members

Flexural Members

Beam-Columns

Systems



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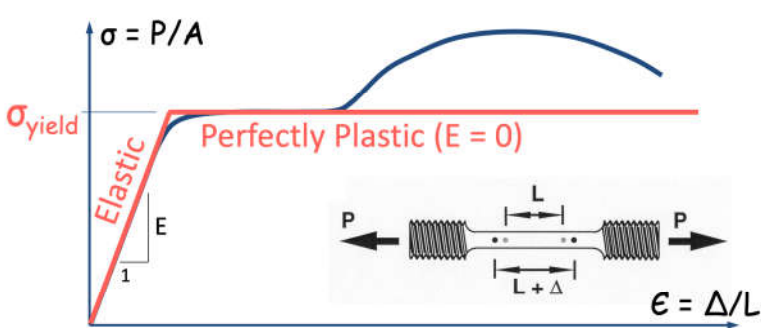
Limit States of Compression Members

- Full yielding (**today**)
- Instability
 - Along the member length
 - Flexural buckling (**today's emphasis!**)
 - Torsional buckling
 - Flexural-torsional buckling
 - At the cross section
 - local buckling

9

Full Yielding

- Tensile test



The graph plots stress $\sigma = P/A$ on the vertical axis against strain $\epsilon = \Delta/L$ on the horizontal axis. The initial linear portion is labeled 'Elastic' with a slope of E . The subsequent horizontal portion is labeled 'Perfectly Plastic ($E = 0$)' and reaches a yield stress σ_{yield} . A diagram below shows a tensile specimen of length L under load P , with an elongation Δ resulting in a total length of $L + \Delta$.

- Assume same response for compression
 - $\sigma_{y,compression} = \sigma_{y,tension} = \sigma_{yield}$
 - Neglect strain hardening (assume elastic-plastic)

10



Full Yielding (2)

- Column Curve – Take 1

$\sigma = P_n / A$

Limit State: Full yield

Acceptable?

- What about:
 - member instability ??? (today!)
 - cross section instability (local buckling) ???

11

Types of Member Instability

Flexural Buckling

(centroid = shear center)

Torsional Buckling

Flexural-torsional Buckling

(centroid ≠ shear center)

12

Flexural Buckling

- Euler's column
 - solution
 - assumptions
- Undoing Euler's assumptions (approaching reality)
 - bending before bifurcation
 - not fully elastic (partial yielding)
 - support conditions
- Column curves
 - AISC
 - others

13

Euler Buckling

- Leonhard Euler, 1744 and 1757
- Assumptions!
 - prismatic member ($I = \text{constant}$)
 - small deflections after buckling
 - no bending prior to bifurcation
 - perfectly straight
 - concentrically loaded
 - linear elastic behavior ($E = \text{constant}$)
 - pinned-roller supports (frictionless)

14

Euler Buckling (3)

Equilibrium on deformed shape:
 $\Sigma M_* = 0$
 $M(x) + P_E v(x) = 0$

Moment-curvature:
 $M(x) = EI \frac{d^2 v(x)}{dx^2}$

Solution:
 $EI \frac{d^2 v}{dx^2} + P_E v = 0 \Rightarrow v(x) = C_1 \cos\left(\sqrt{\frac{P_E}{EI}} x\right) + C_2 \sin\left(\sqrt{\frac{P_E}{EI}} x\right)$

wolframalpha.com
 $a2*y''(x)+a1*y(x)=0$

15

Euler Buckling (5)

Boundary Conditions!
 $v(x=0) = 0 \Rightarrow v(x) = C_2 \sin\left(\sqrt{\frac{P_E}{EI}} x\right)$
 $v(x=L) = 0 \Rightarrow v(x=L) = 0 = C_2 \sin\left(\sqrt{\frac{P_E}{EI}} L\right)$

1) $C_2 = 0$ "trivial solution"

2) $\sin\left(\sqrt{\frac{P_E}{EI}} L\right) = 0 \Rightarrow \sqrt{\frac{P_E}{EI}} L = n\pi \Rightarrow P_E = \frac{n^2 \pi^2 EI}{L^2}$
 $n = 1, 2, 3, \dots$

16

Euler Buckling (6)

$P_E = \frac{n^2 \pi^2 EI}{L^2} \quad n = 1, 2, 3, \dots$

Thoughts:

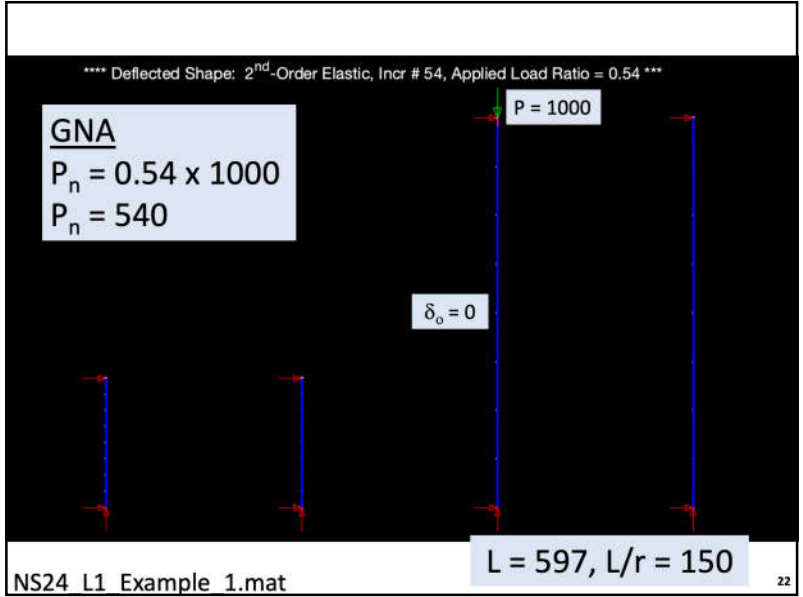
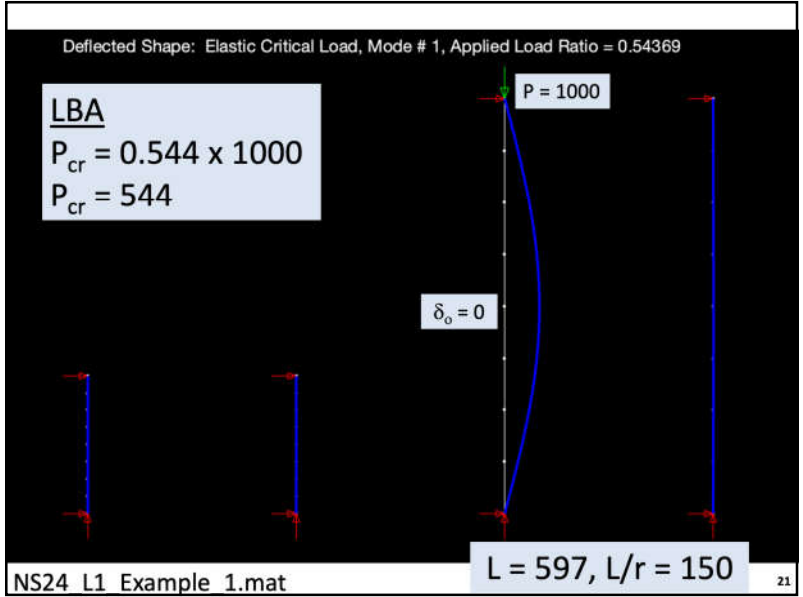
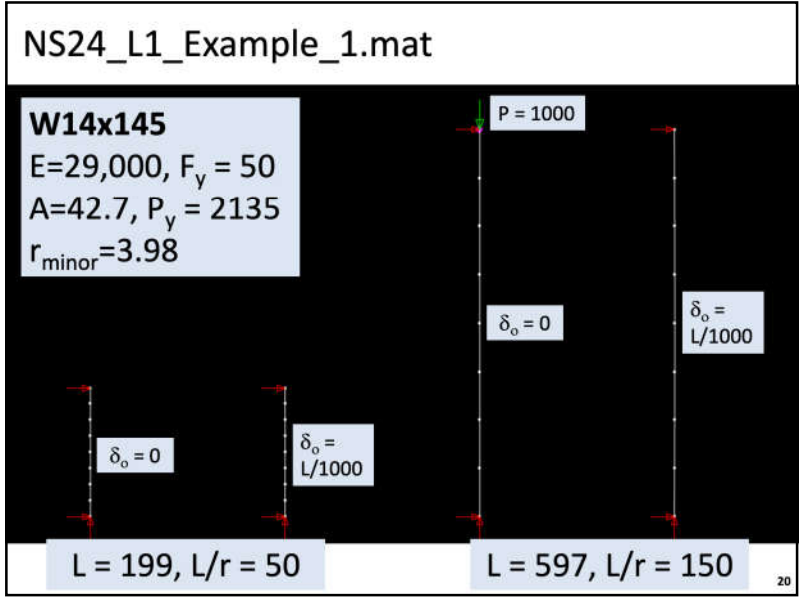
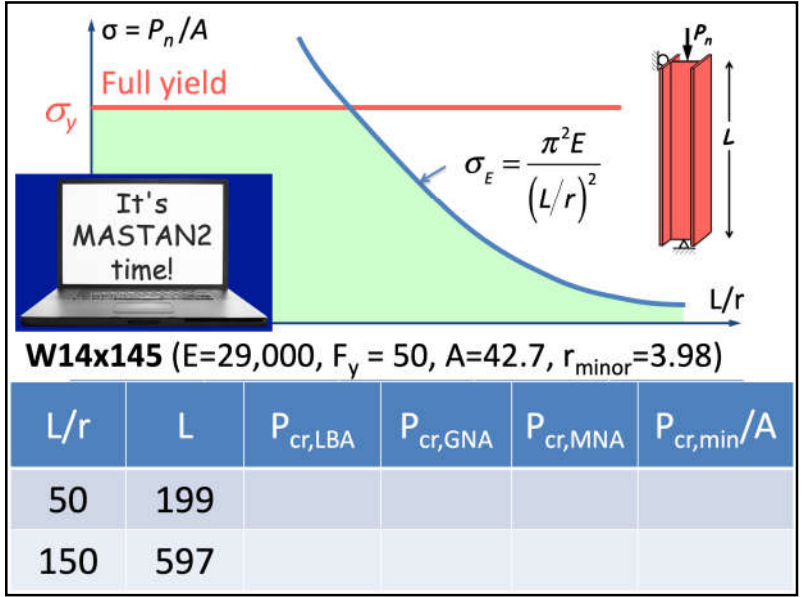
- Bifurcation
- $\delta = 0 \rightarrow \delta = \text{unbounded}$
- 1st mode ($n = 1$) controls!
- Interest in higher modes? Think bracing!

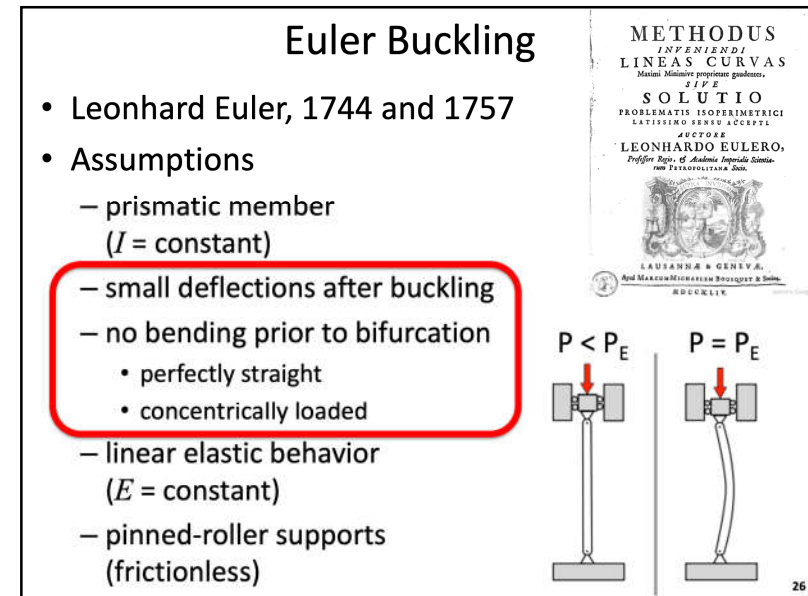
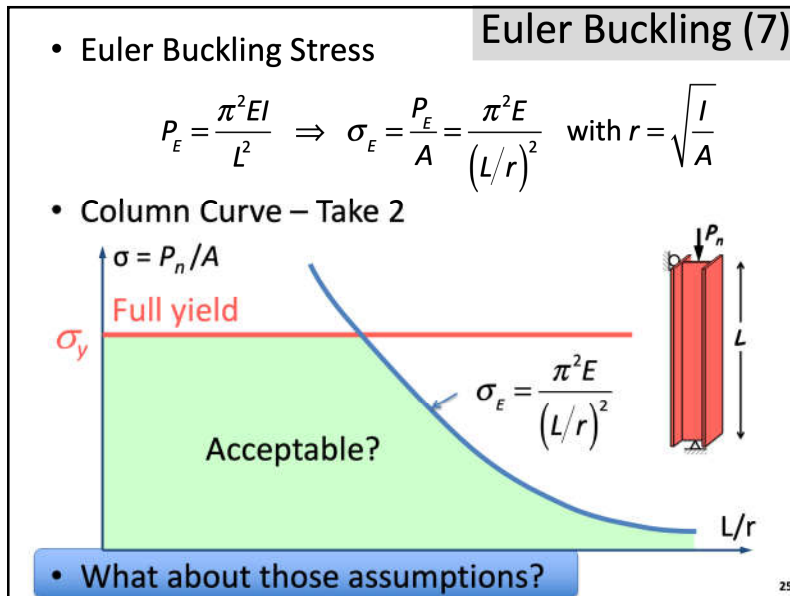
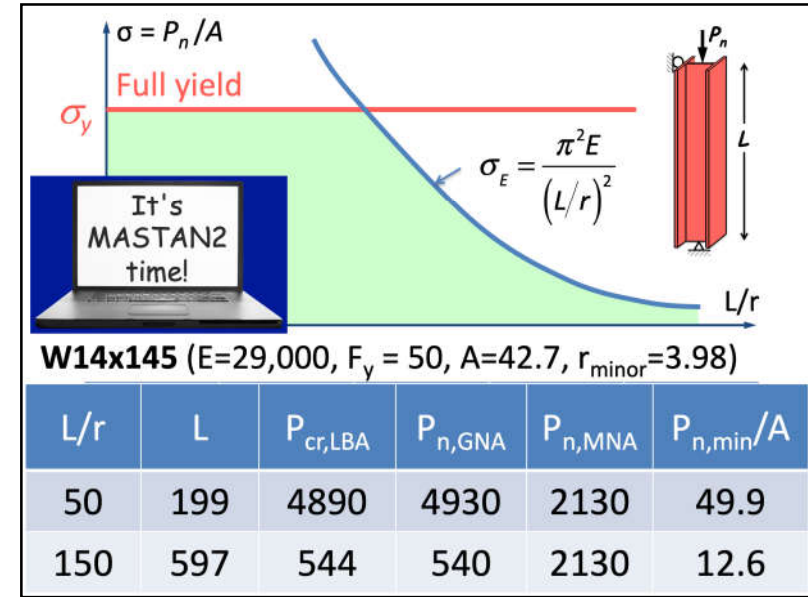
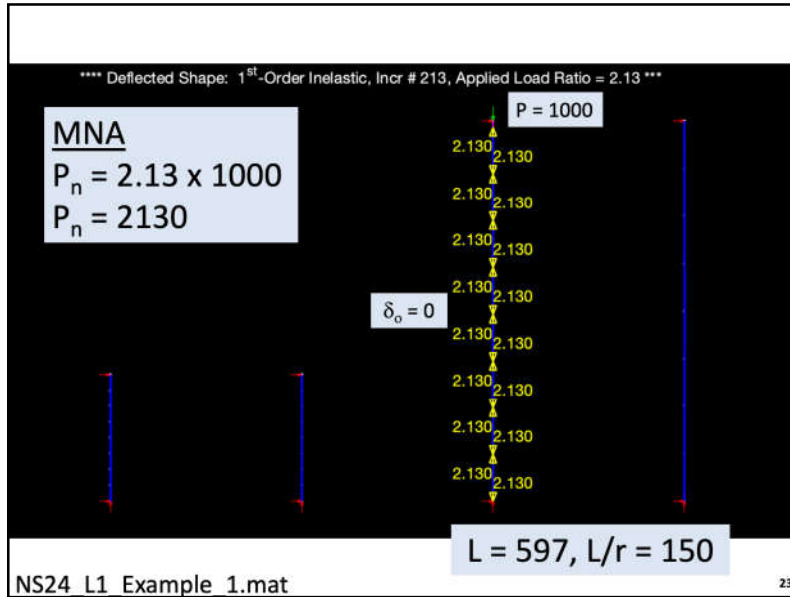
17

Euler Buckling (7)

- Euler Buckling Stress
 $P_E = \frac{\pi^2 EI}{L^2} \Rightarrow \sigma_E = \frac{P_E}{A} = \frac{\pi^2 E}{(L/r)^2}$ with $r = \sqrt{\frac{I}{A}}$
- Column Curve – Take 2

18





Bending

- Bending can be produced by:
 - Prior to loading, column is not perfectly straight
 - Axial load not concentrically applied (e_o is small, but not zero!)

Reality: Some combination of above exists...

Bending (2)

Let's consider a column with initial out-of-straightness:

$v_o(x) = \delta_o \sin \frac{\pi x}{L}$

Initial imperfection at mid-length
 e.g. $\delta_o = L/1000$

Bending (3)

Column with initial out-of-straightness:

$v_o(x) = \delta_o \sin \frac{\pi x}{L}$

$v(x) = v_o(x) + v_p(x)$

Equilibrium \rightarrow Differential Equation:

$$M(x, P) + Pv(x) = 0$$

$$EI \frac{d^2 v_p}{dx^2} + P(v_o(x) + v_p(x)) = 0$$

$$EI \frac{d^2 v_p}{dx^2} + Pv_p(x) = -Pv_o(x) = -P\delta_o \sin \frac{\pi x}{L}$$

Bending (4)

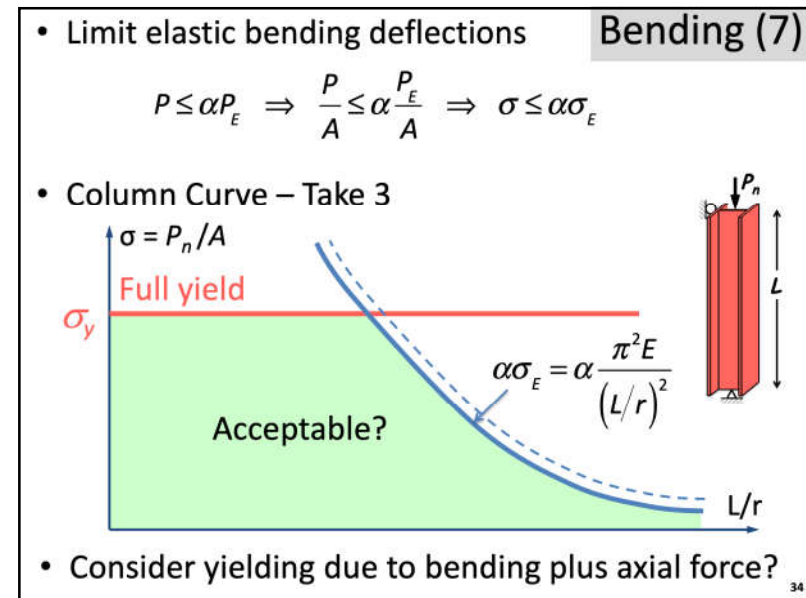
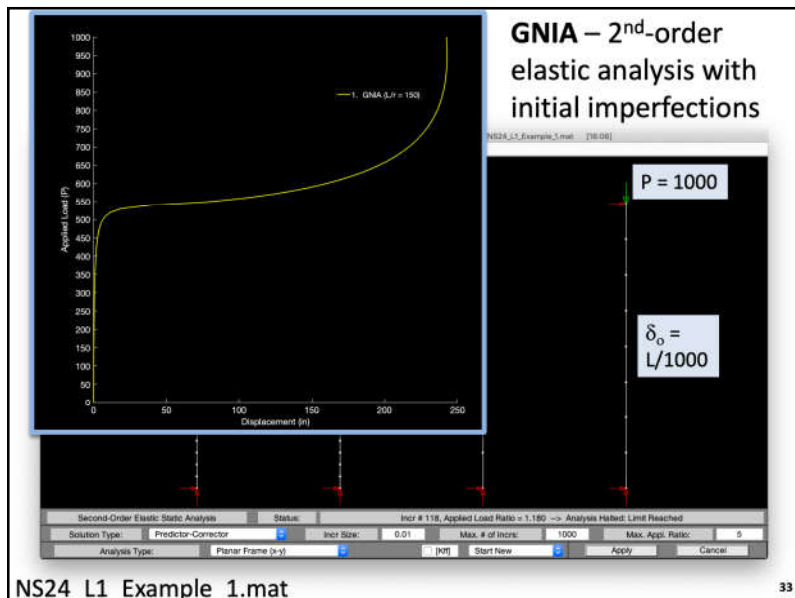
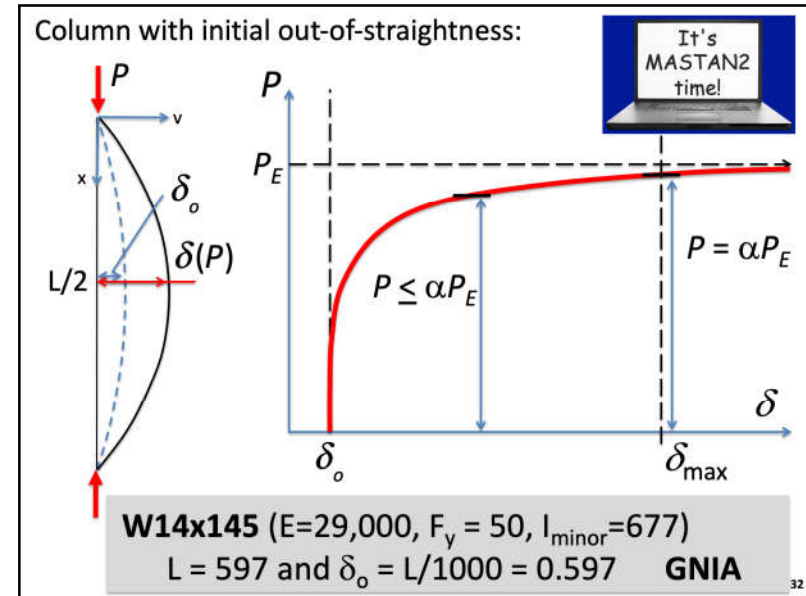
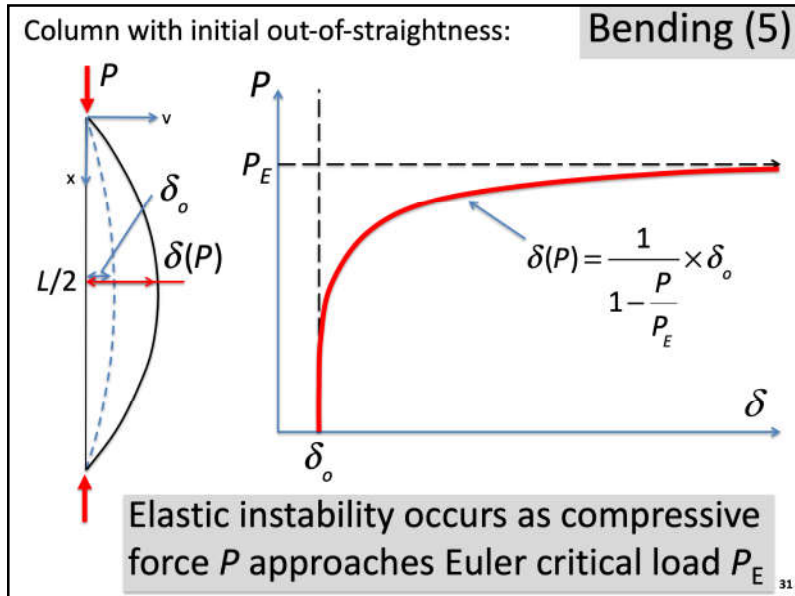
Column with initial out-of-straightness:

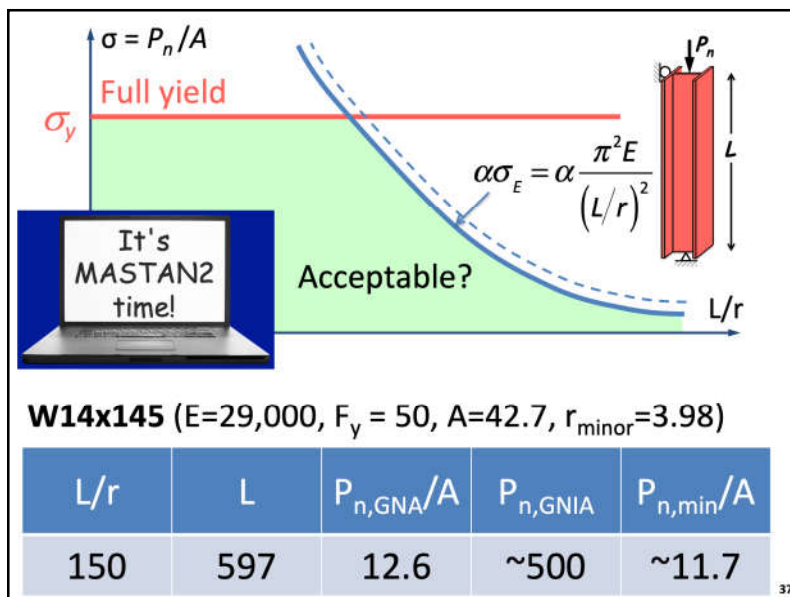
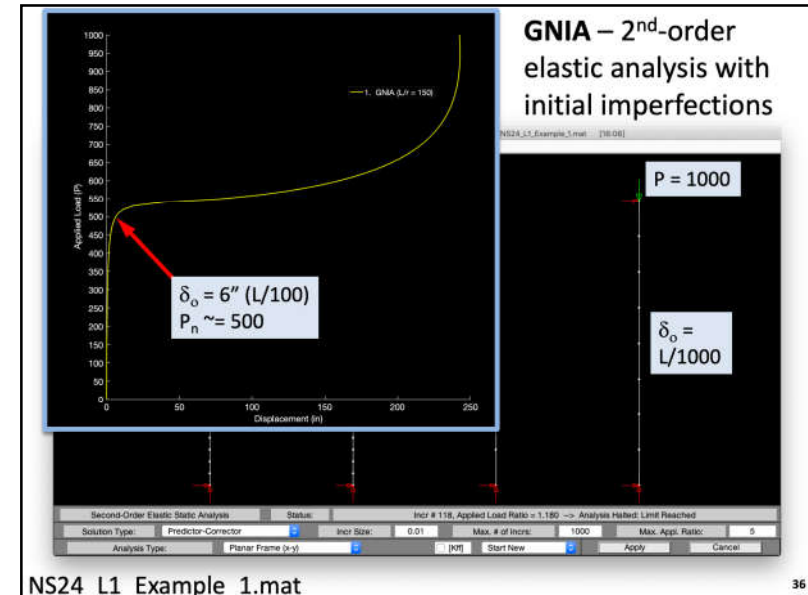
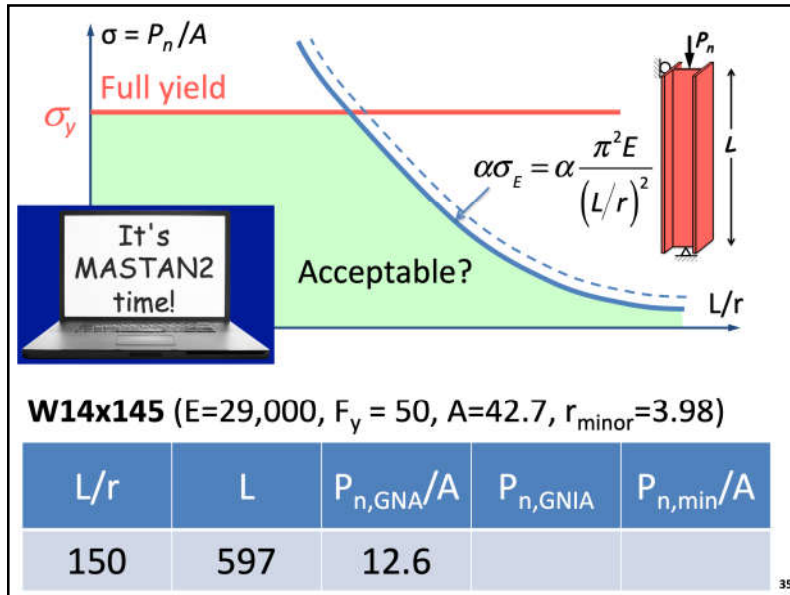
$v_o(x=L/2) = \delta_o$

$v(x=L/2) = \delta(P)$

$$v(x) = \frac{1}{1 - \frac{P}{P_E}} v_o(x)$$

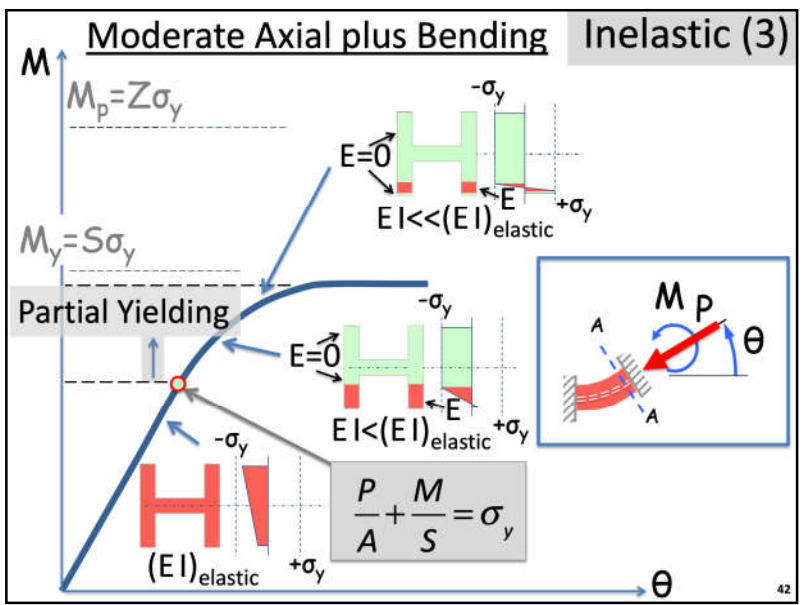
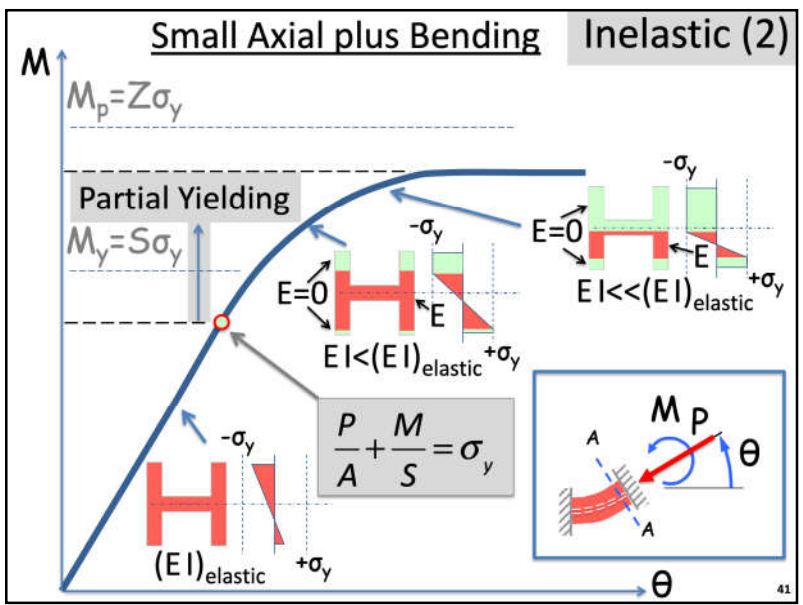
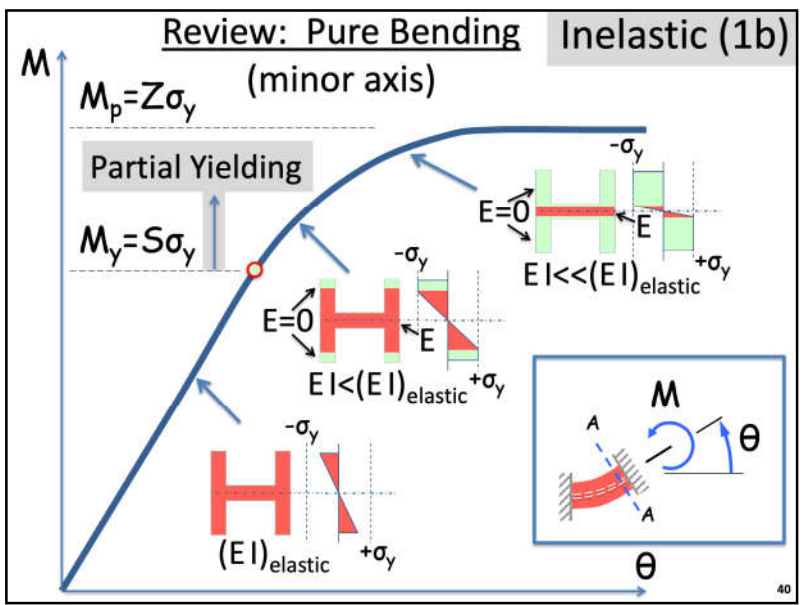
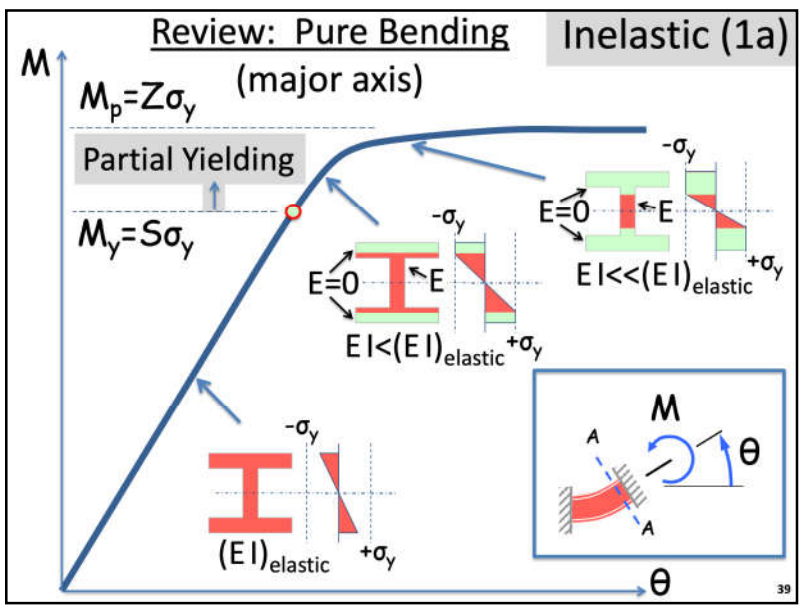
$$\delta(P) = \frac{1}{1 - \frac{P}{P_E}} \times \delta_o$$

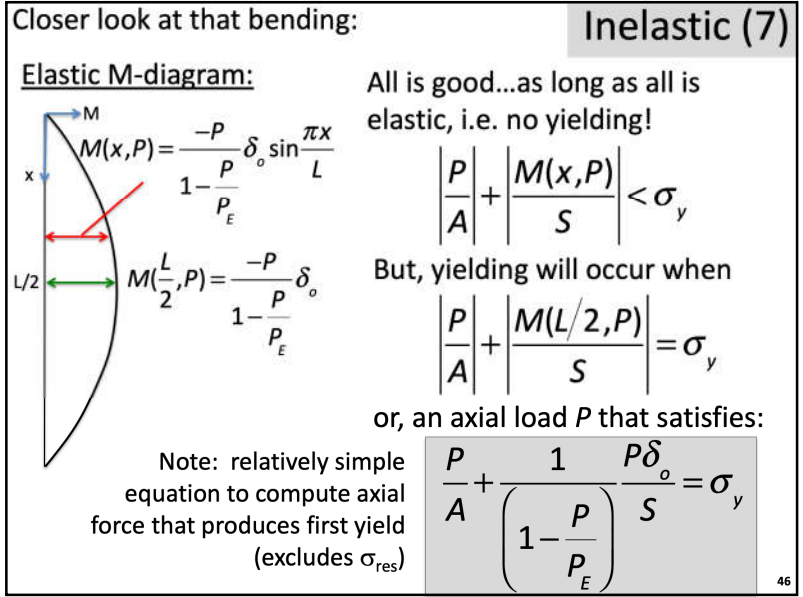
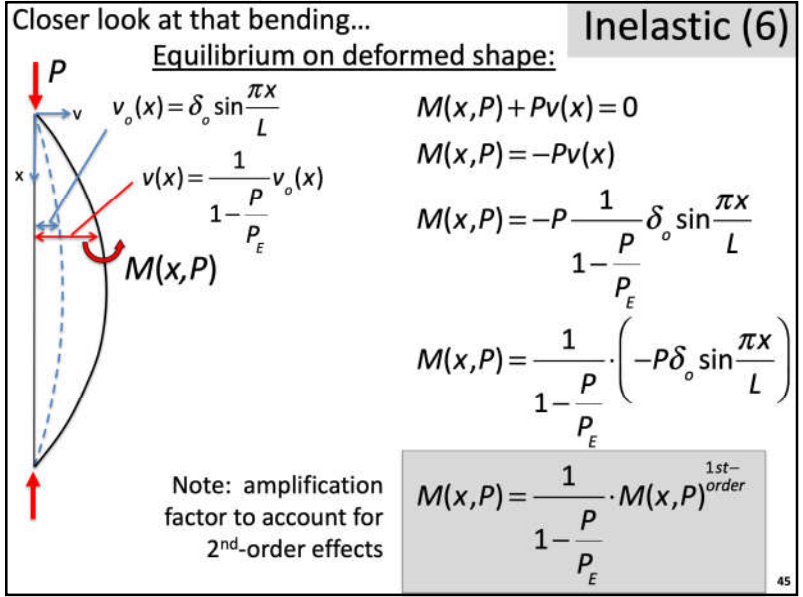
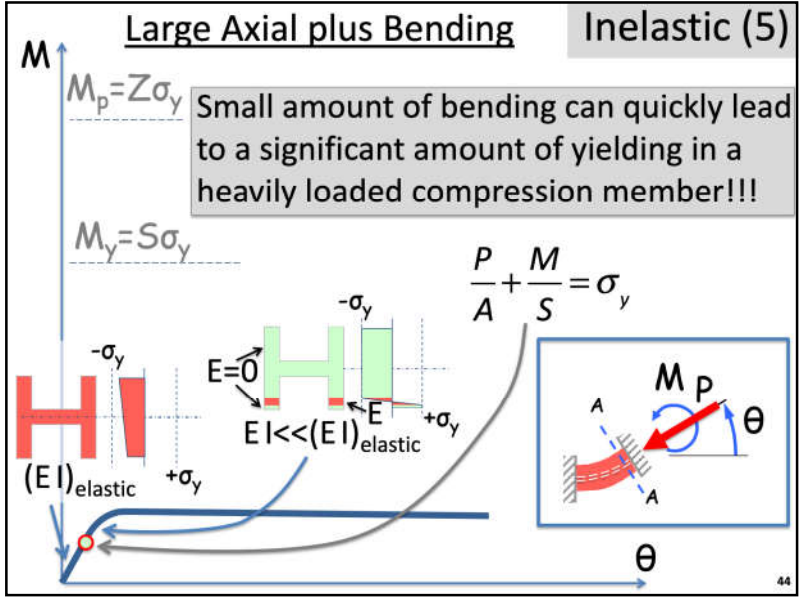
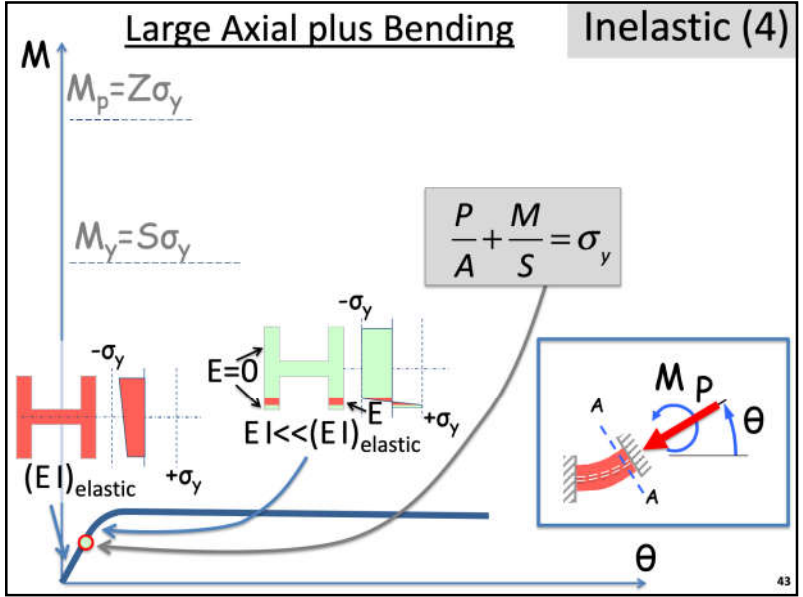





Euler Buckling

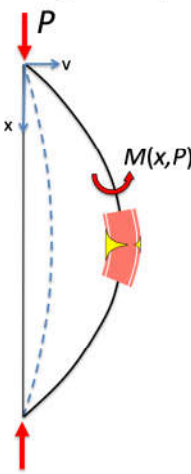
- Leonhard Euler, 1744 and 1757
- Assumptions!
 - prismatic member ($I = \text{constant}$)
 - small deflections after buckling
 - no bending prior to bifurcation
 - perfectly straight
 - centrically loaded
 - linear elastic behavior ($E = \text{constant}$)
 - pinned-roller supports (frictionless)





Inelastic (8)

And, once yielding occurs (ouch!):

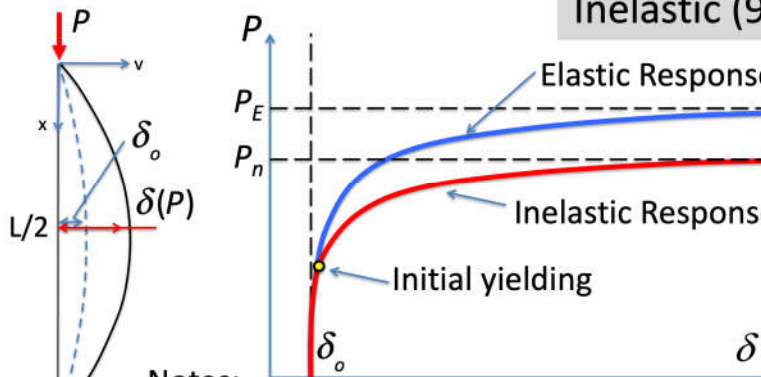


1. Yielded portion loses stiffness, $EI \downarrow$
2. Increases in deflection, $v(x) \uparrow$
3. Increases moment, $M(x) = P \cdot v(x) \uparrow$
4. Resulting in more yielding...

5. If equilibrium, apply more P
6. Repeat above steps 1 to 4
7. Apply more P repeating steps 1 to 6 until instability!

47

Inelastic (9)



Notes:

1. Inelastic instability occurs below the Euler critical load, i.e. $P_n < P_E$
2. The smaller the column slenderness L/r , the further P_n is below P_E ($L/r \downarrow \rightarrow P_n \uparrow$)

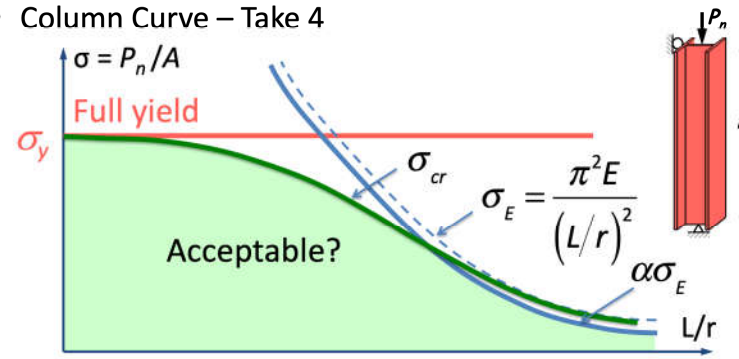
48

Inelastic (10)

- Axial plus bending may cause yielding

$$\sigma_{cr} = \frac{P_n}{A}$$

$$L/r \rightarrow 0, \sigma_{cr} = \sigma_y$$

$$L/r \uparrow, \sigma_{cr} < \sigma_y \text{ and } \sigma_{cr} < \sigma_E$$
- Column Curve – Take 4
 
- What about residual stresses?

49

Residual Stresses

- Occurs in structural shapes
 - Uneven cooling of hot-rolled shape after rolling
 - Welding of plates for fabricated or built-up shapes
 - Cold bending during fabrication
- Magnitude and distribution of residual stresses depend on the cross-sectional shape and dimensions
- Residual stresses are usually independent of F_y
- Thermal residual stresses occur in rolled wide flange shapes because locations with high surface area (e.g., flange tips) cool well before locations with smaller surface area (flange-to-web intersections)
- But, what about the impact of rotary straightening?
 And, today's production via near net sections?

50



Residual Stresses (2)

51

Residual Stresses (3)

Because areas with large surface area cool first and stiffen, the push-me pull-me begins...

Closer to actual distribution

52

Residual Stresses (4)

Shape	Flange pattern	Web pattern
W 4 x 13		
W 8 x 31		
W 8 x 67		
W 12 x 65		
W 14 x 426		

Approx = $0.3\sigma_y$

Mild Steel Rolled Shape

Approx = $0.5\sigma_y$

Approx σ_y

Mild Steel Welded Shape

53

Residual Stresses (5)

$P_y = A\sigma_y$

Partial Yielding

$E=0$

$EA \ll (EA)_{elastic}$

$E=0$

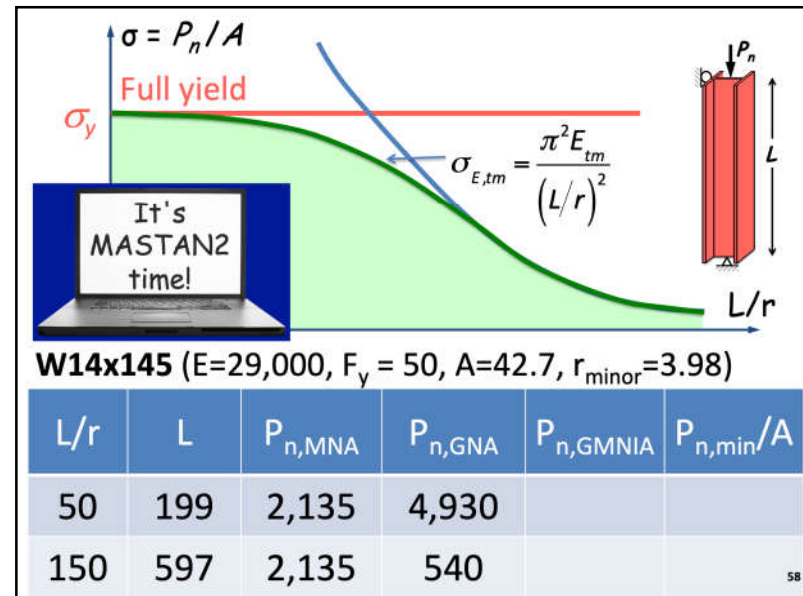
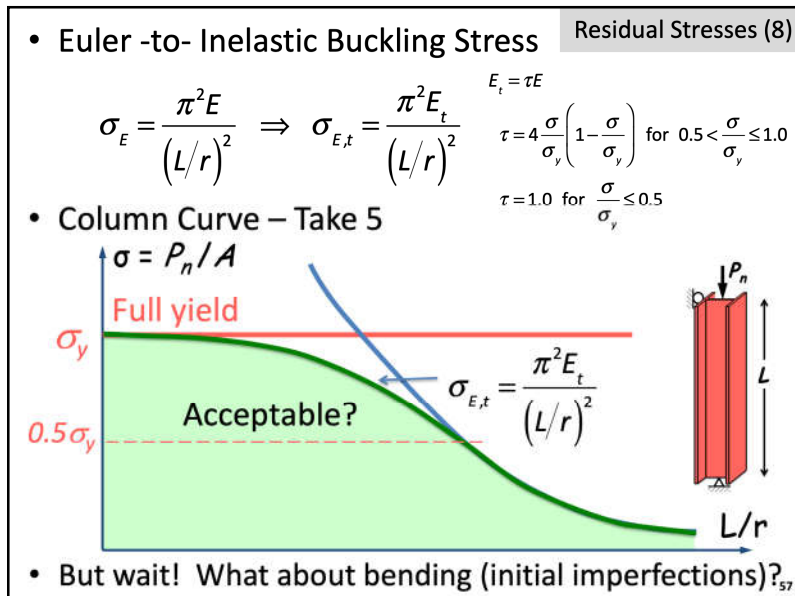
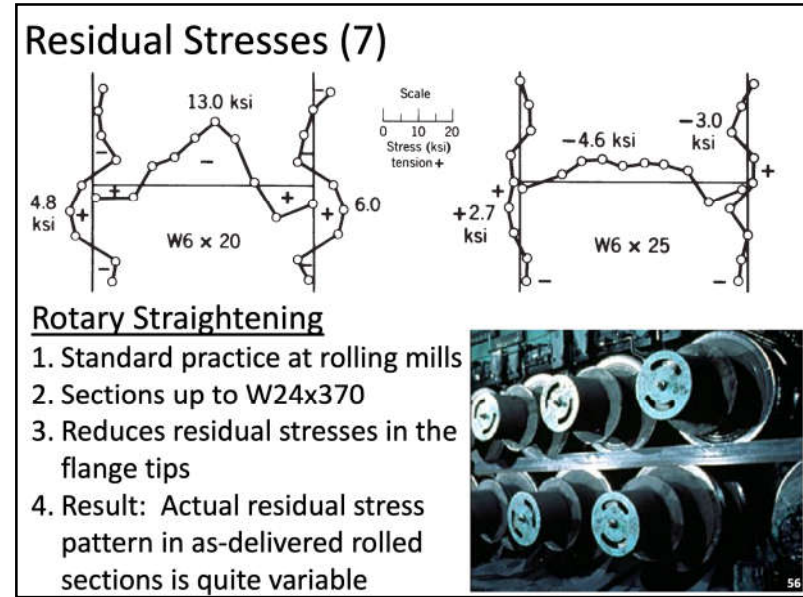
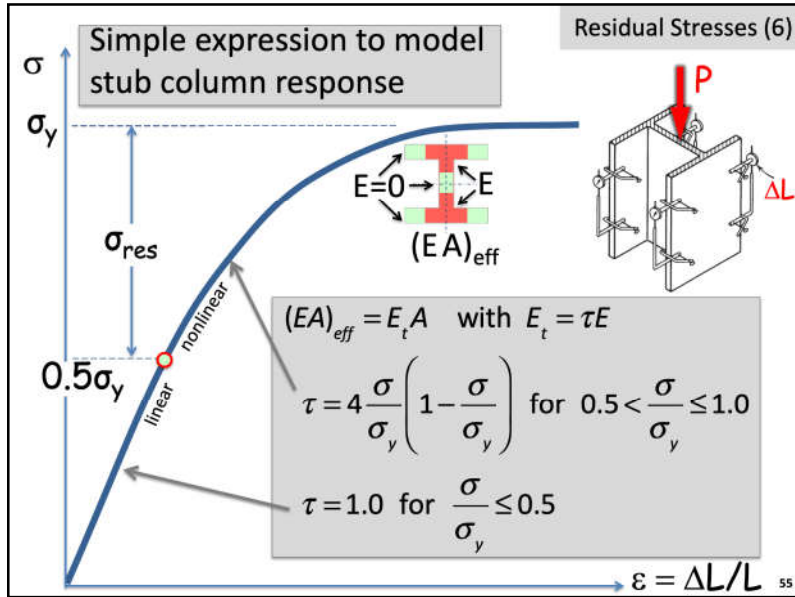
$EA < (EA)_{elastic}$

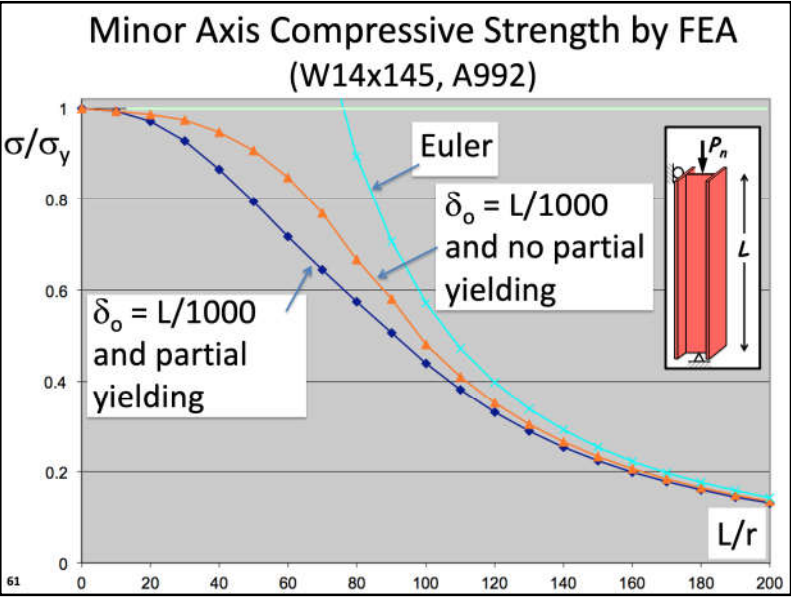
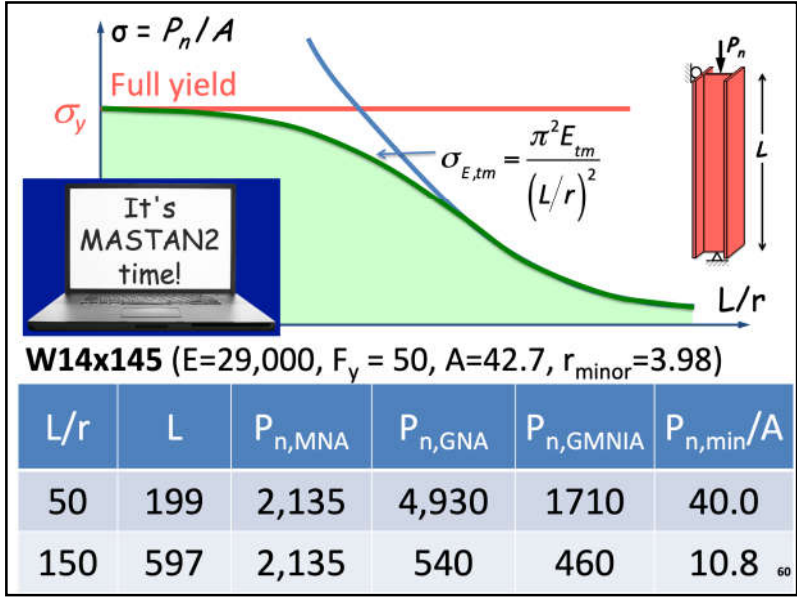
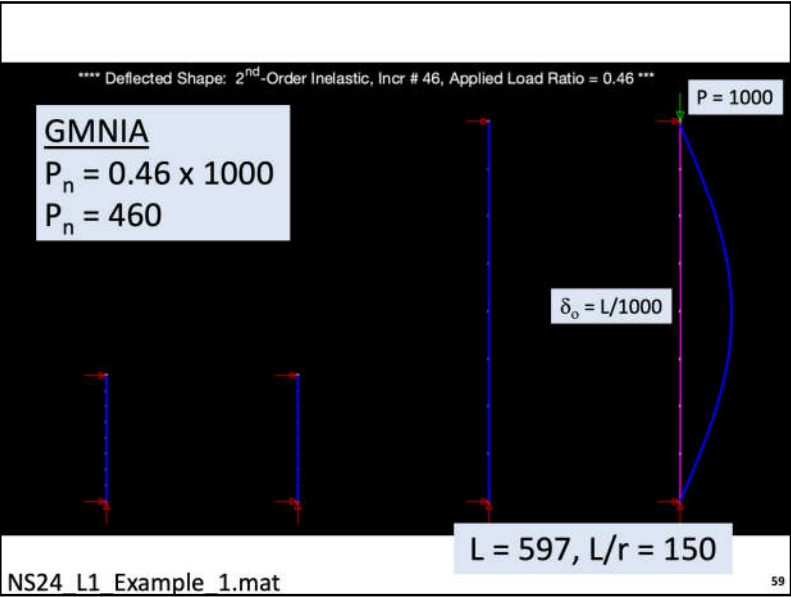
$(EA)_{elastic}$

$\sigma_{res} + P_{l:n}/A = \sigma_y$

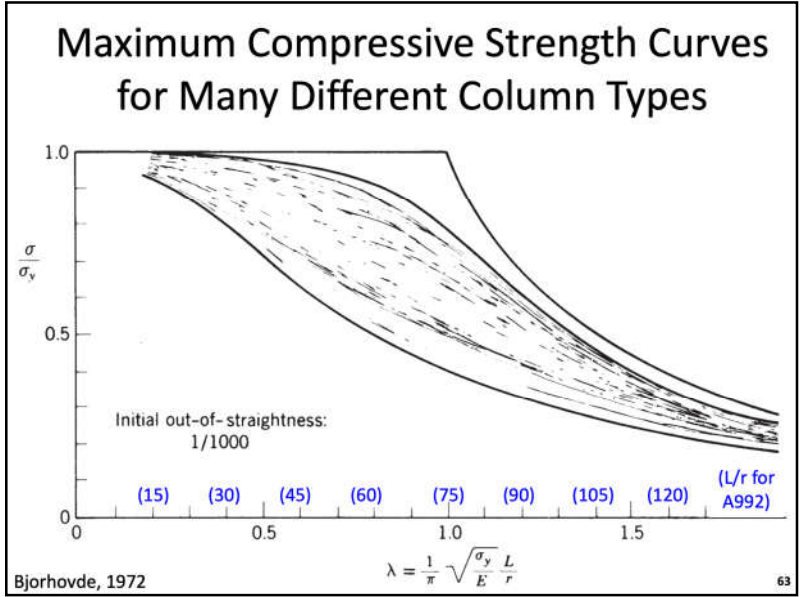
$\sigma_{res} = \sigma_y - P_{n:l}/A$

54

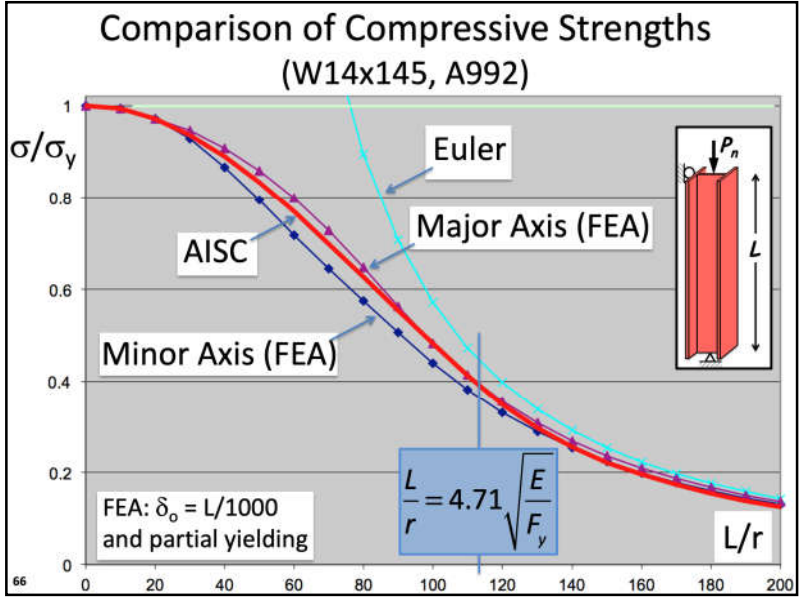
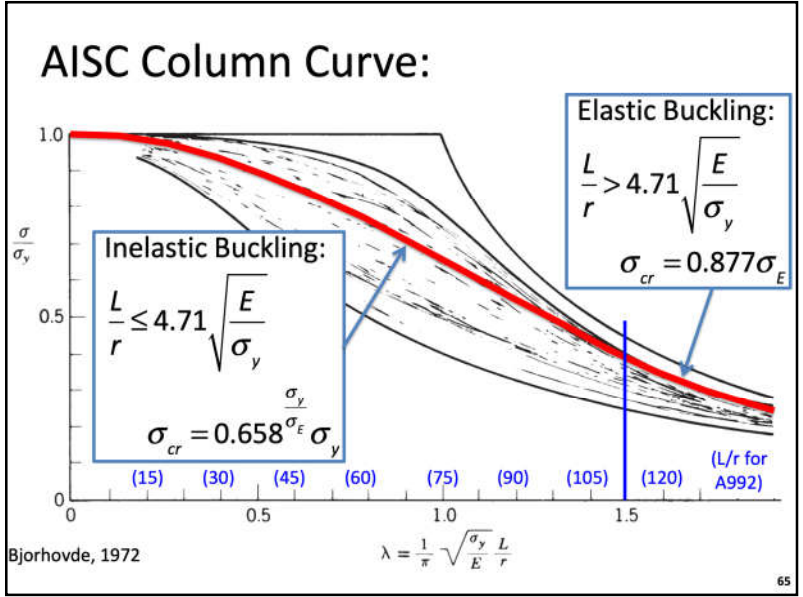


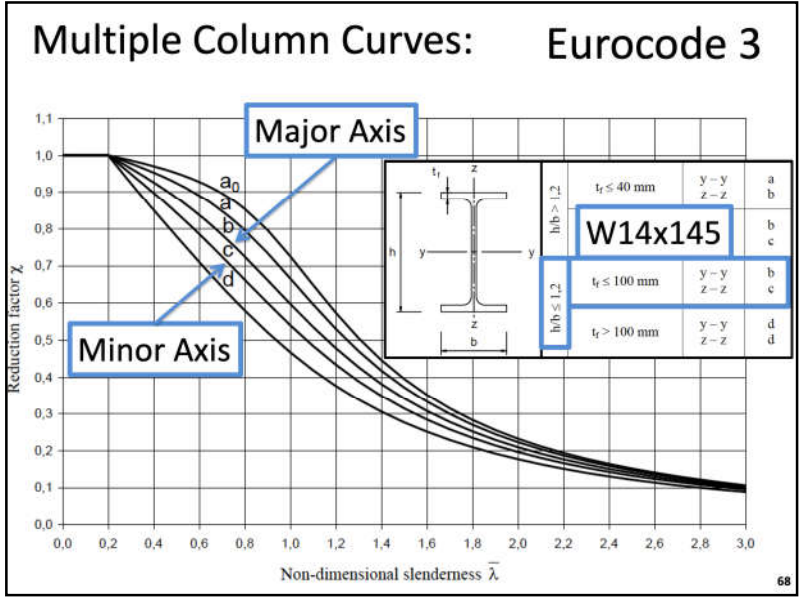
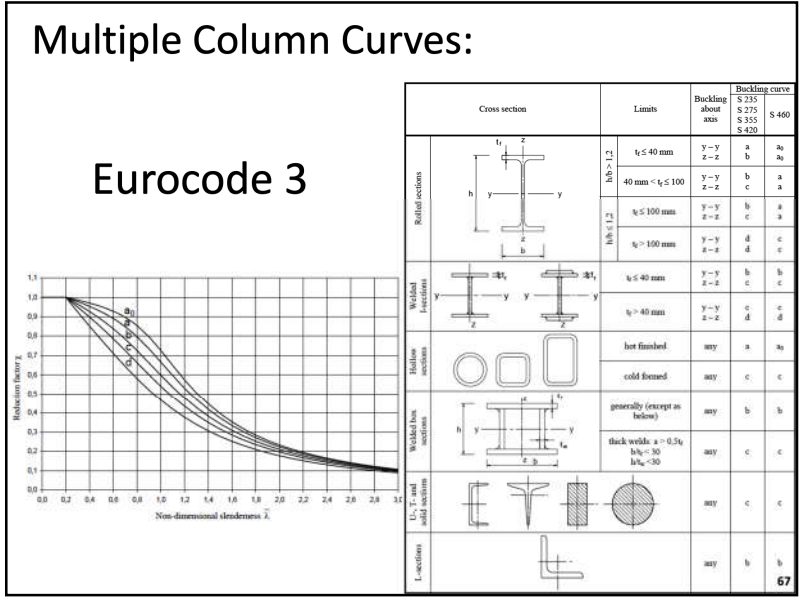


- ### Compressive Strength Curves
- Key observations from FEA
 - Strength reduced for initial imperfection and further reduced for residual stresses
 - All curves approach Euler, but are slightly below
 - Partial yielding accentuated by residual stresses impact minor axis strength more than major axis strength
 - Different strength curves for major and minor axis bending
 - Additional thoughts
 - Strength curves for W-shapes are function of dimensions, and thus will vary depending on W-shape
 - Other shapes (e.g., HSS, C's, and built-up shapes) will also have different compressive strength curves
- 62



- ### Column Curves for Design
- AISC employs a single curve “fit” to experimental and analytical data. Other codes use multiple curves.
 - Background to AISC curve:
 - Bjorhovde, R. (1972), “Deterministic and Probabilistic Approaches to the Strength of Steel Columns,” Ph.D. Dissertation, Lehigh University, Bethlehem, PA.
 - Tide, R.H.R. (2001), “A Technical Note: Derivation of the LRFD Column Design Equations,” Engineering Journal, AISC, Vol. 38, No. 3, 3rd Quarter, pp. 137–139.
 - Ziemian, R.D. (ed.) (2010), *Guide to Stability Design Criteria for Metal Structures*, 6th Ed., John Wiley & Sons, Inc., Hoboken, NJ.
- 64





Euler Buckling

- Leonhard Euler, 1744 and 1757
- Assumptions
 - prismatic member ($I = \text{constant}$)
 - small deflections after buckling
 - no bending prior to bifurcation
 - perfectly straight
 - centrically loaded
 - linear elastic behavior ($E = \text{constant}$)
 - pinned-roller supports (frictionless)**

Support Conditions

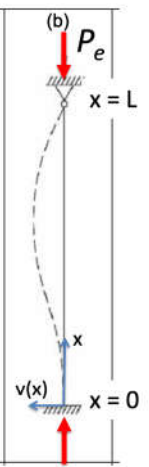
TABLE C-A-7.1

Euler Buckling

What about the others?



Support Conditions (2)



Equilibrium \rightarrow Differential Equation:
 $M(x=0) = M_o \Rightarrow EI \frac{d^2v}{dx^2} + P_e v = \frac{M_o x}{L}$

Solution:
 $v(x) = C_1 \cos\left(\sqrt{\frac{P_e}{EI}} x\right) + C_2 \sin\left(\sqrt{\frac{P_e}{EI}} x\right) + \frac{M_o x}{P_e L}$

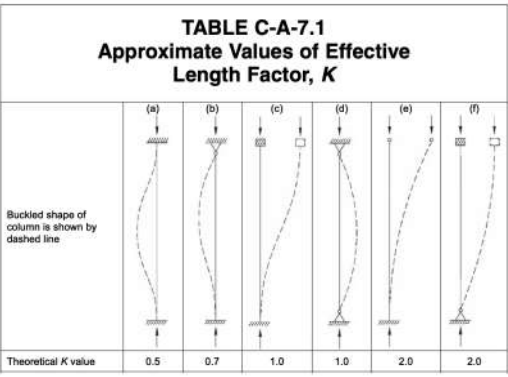
Boundary Conditions:
 $v(x=0) = 0, v'(x=0) = 0, v(x=L) = 0$

$$P_e = \frac{\pi^2 EI}{(0.70L)^2} \Rightarrow \sigma_e = \frac{P_e}{A} = \frac{\pi^2 E}{(KL/r)^2} \text{ with } K = 0.70$$

71

Support Conditions (3)

TABLE C-A-7.1
 Approximate Values of Effective Length Factor, K



Support Condition	Theoretical K value
(a)	0.5
(b)	0.7
(c)	1.0
(d)	1.0
(e)	2.0
(f)	2.0

Buckled shape of column is shown by dashed line

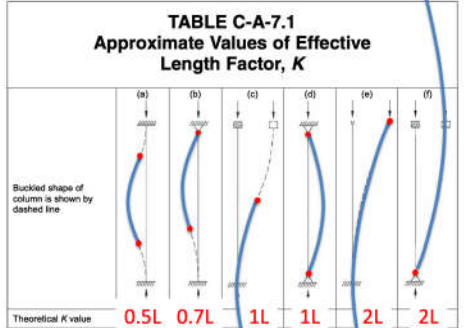
Elastic Buckling Stress:

$$\sigma_e = \frac{\pi^2 E}{(KL/r)^2}$$

72

Support Conditions (4)

TABLE C-A-7.1
 Approximate Values of Effective Length Factor, K



Support Condition	Theoretical K value
(a)	0.5L
(b)	0.7L
(c)	1L
(d)	1L
(e)	2L
(f)	2L

Buckled shape of column is shown by dashed line

Elastic Buckling Stress:

$$\sigma_e = \frac{\pi^2 E}{(KL/r)^2}$$

Notes on "effective length" KL :

- Find the Euler column?!
- Distance between inflection points ($M=0$)

73

Overview of Learning Modules

✓ Objectives

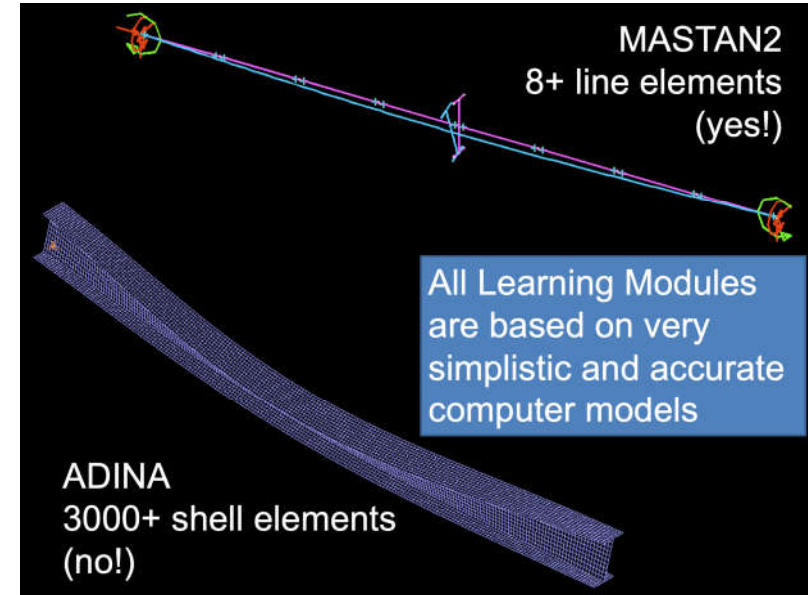
- Have "fun" focusing on the stability of members and systems
- Alternative to experimental laboratory
- Hands-on ("active learning"); what if scenarios?
- Software independent

• Consistent format

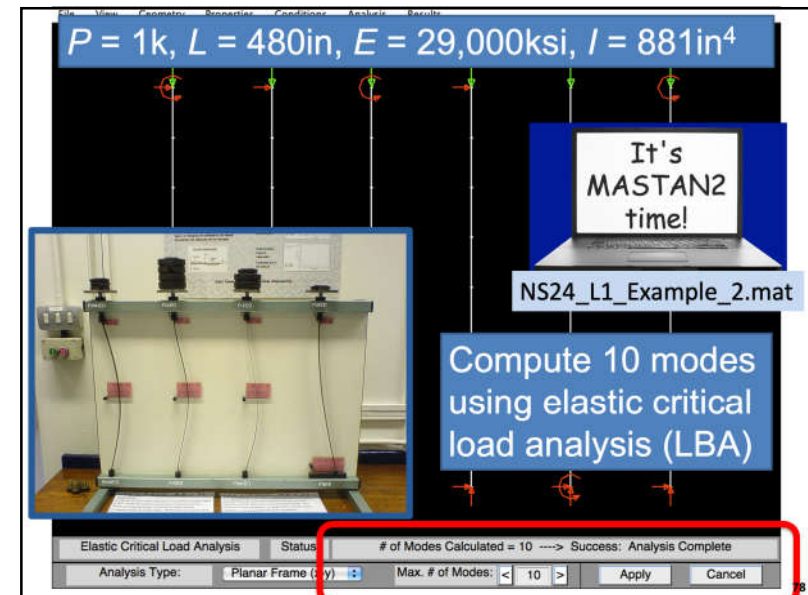
- Overview
- Learning Objectives
- Method
- Hints
- Questions

- MASTAN2 details
- More fun!
- Resources:
 - spreadsheets
 - tutorial videos (~140 min)

74



- ### Available Learning Modules
1. Elastic Column Buckling and the Effect of End Restraint (**Now!**)
 2. Factors Influencing the Flexural Buckling Strength of Compression Members ([Your virtual laboratory assignment!](#))
 3. Effective Length K -factors for Frame Members
 4. Factors Influencing the Strength of Flexural Members
 5. Lateral-Torsional Buckling of Beams with Moment Gradient
 6. Beam Design by Elastic and Inelastic Analyses
 7. Second-order ($P-\Delta$ and $P-\delta$) Effects
 8. Strength of Beam-Columns
 9. Design by the Direct Analysis Method



Deflected Shape: Elastic Critical Load, Mode # 1, Applied Load Ratio = 273.6101

Mode 1:

$$P_{cr} = 273.6$$

$$K = \frac{\pi}{L} \sqrt{\frac{EI}{P_{cr}}} = 2.0$$

TABLE C-A-7.1
Approximate Values of Effective Length Factor, K

Def Line Type: Solid Scale: 75 # of pts: 10

79

Deflected Shape: Elastic Critical Load, Mode # 2, Applied Load Ratio = 273.6101

Mode 2:

$$P_{cr} = 273.6$$

$$K = \frac{\pi}{L} \sqrt{\frac{EI}{P_{cr}}} = 2.0$$

TABLE C-A-7.1
Approximate Values of Effective Length Factor, K

Def Line Type: Solid Scale: 75 # of pts: 10

80

Deflected Shape: Elastic Critical Load, Mode # 3, Applied Load Ratio = 1094.4739

Mode 3:

$$P_{cr} = 1094.5$$

$$K = \frac{\pi}{L} \sqrt{\frac{EI}{P_{cr}}} = 1.0$$

TABLE C-A-7.1
Approximate Values of Effective Length Factor, K

Def Line Type: Solid Scale: 75 # of pts: 10

81

Deflected Shape: Elastic Critical Load, Mode # 4, Applied Load Ratio = 1094.4739

Mode 4:

$$P_{cr} = 1094.5$$

$$K = \frac{\pi}{L} \sqrt{\frac{EI}{P_{cr}}} = 1.0$$

TABLE C-A-7.1
Approximate Values of Effective Length Factor, K

Def Line Type: Solid Scale: 75 # of pts: 10

82

Deflected Shape: Elastic Critical Load, Mode # 5, Applied Load Ratio = 2239.2487

Mode 5:
 $P_{cr} = 2239.2$
 $K = \frac{\pi}{L} \sqrt{\frac{EI}{P_{cr}}} = 0.7$

TABLE C-A-7.1
 Approximate Values of Effective Length Factor, K

OH	O1	O2	O3	O4	O5	O6
0.5	0.7	1.0	1.0	1.0	1.0	2.0

Theoretical K value: 0.5 0.7 1.0 1.0 1.0 1.0 2.0

Def Line Type: Solid Scale: 75 # of pts: 10 Animate: 5 Apply Cancel

Deflected Shape: Elastic Critical Load, Mode # 6, Applied Load Ratio = 2462.89

TABLE C-A-7.1
 Approximate Values of Effective Length Factor, K

OH	O1	O2	O3	O4	O5	O6
0.5	0.7	1.0	1.0	1.0	1.0	2.0

Theoretical K value: 0.5 0.7 1.0 1.0 1.0 1.0 2.0

Def Line Type: Solid Scale: 75 # of pts: 10 Animate: 6 Apply Cancel

Deflected Shape: Elastic Critical Load, Mode # 7, Applied Load Ratio = 2462.89

TABLE C-A-7.1
 Approximate Values of Effective Length Factor, K

OH	O1	O2	O3	O4	O5	O6
0.5	0.7	1.0	1.0	1.0	1.0	2.0

Theoretical K value: 0.5 0.7 1.0 1.0 1.0 1.0 2.0

Def Line Type: Solid Scale: 75 # of pts: 10 Animate: 7 Apply Cancel

Deflected Shape: Elastic Critical Load, Mode # 8, Applied Load Ratio = 4379.9942

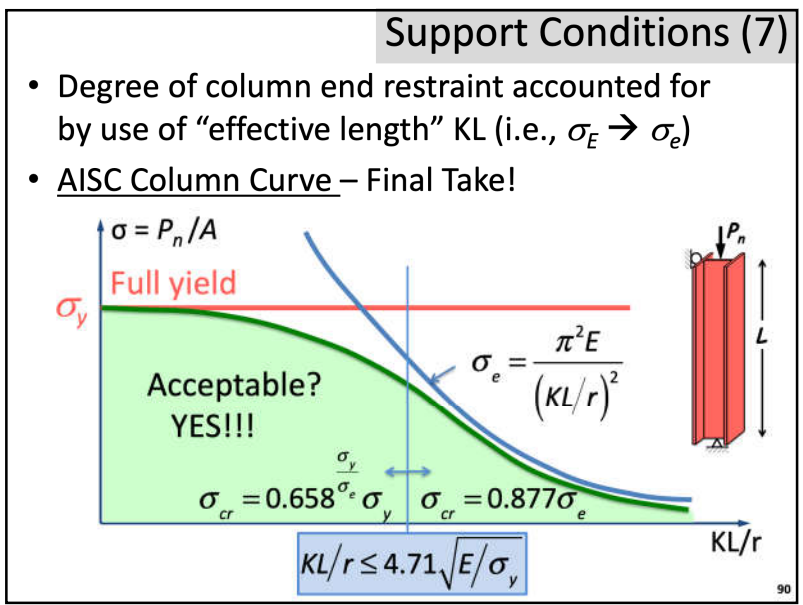
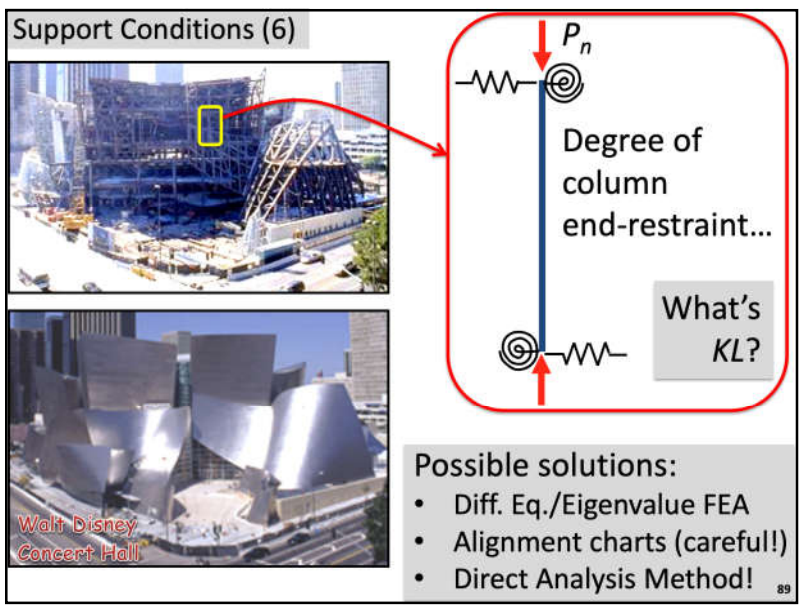
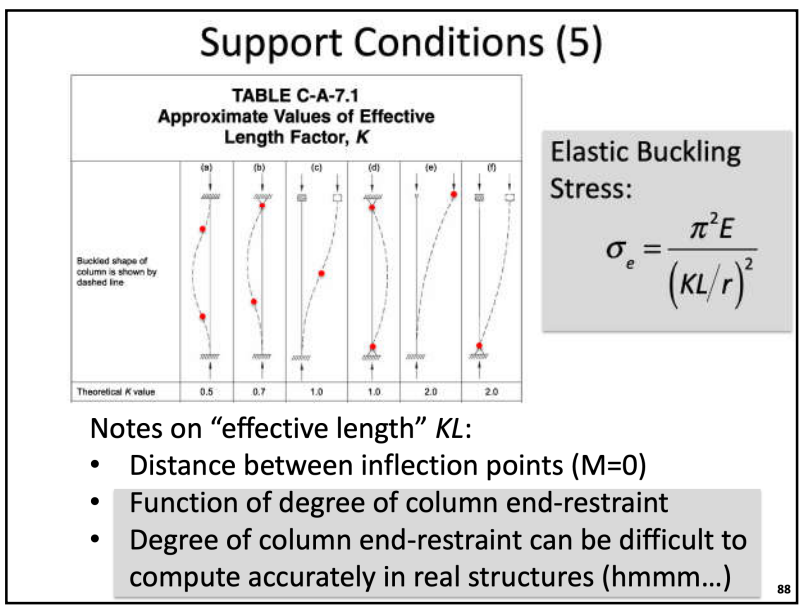
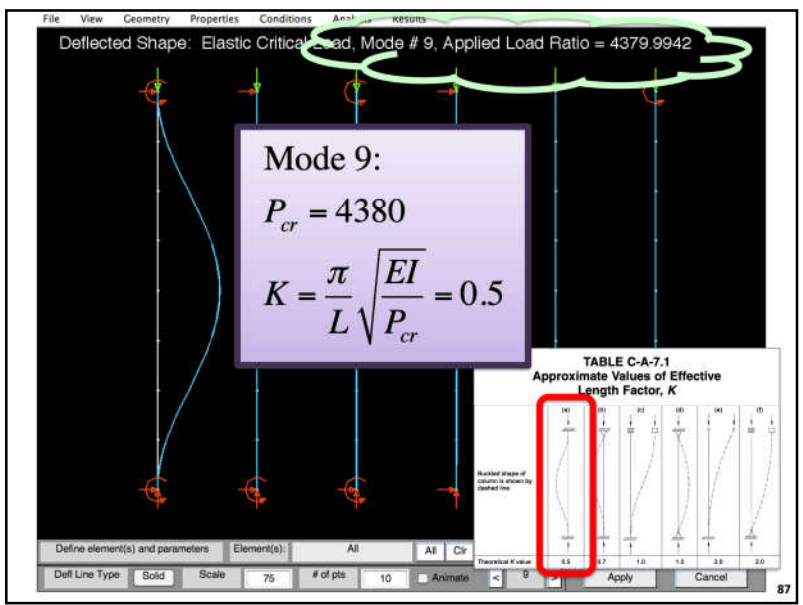
TABLE C-A-7.1
 Approximate Values of Effective Length Factor, K

OH	O1	O2	O3	O4	O5	O6
0.5	0.7	1.0	1.0	1.0	1.0	2.0

Theoretical K value: 0.5 0.7 1.0 1.0 1.0 1.0 2.0

Def Line Type: Solid Scale: 75 # of pts: 10 Animate: 8 Apply Cancel





Euler Buckling

- Leonhard Euler, 1744 and 1757
- Assumptions!
 - prismatic member
 ($I = \text{constant}$)
 - small deflections after buckling
 - no bending prior to bifurcation
 - perfectly straight
 - concentrically loaded
 - linear elastic behavior
 ($E = \text{constant}$)
 - pinned-roller supports
 (frictionless)

METHODUS
 INVENIENDI
 LINEAS CURVAS
 Maximi Minime propinque gradibus,
 SIVE
 SOLUTIO
 PROBLEMATIS ISOPERIMETRICI
 LATISSIMO SENSU ACCEPTI
 AUCTOR
 LEONHARDO EULERO,
 Professore Regio. et Academiae Imperialis Comite.
 PARS PATAVOLOGITANA Dicitur.
 LAUSANNÆ & GENEVÆ.
 Apud Marcum-Michaelem Bousquet & Coles.
 MDCCCLIV.

$P < P_E$ $P = P_E$

91

Summary – Compression

- Course introduction and stability concepts
- Limit states of compression members with focus on flexural buckling
- Euler Buckling → Maximum Compressive Strength Column Curve
- Column curve accounts for:
 - full yielding
 - bending due to initial imperfection (out-of-straightness)
 - partial yielding accentuated by presence of residual stresses
 - degree of end restraint

92

Summary – Compression (cont.)

- AISC and other column curves
- Other ideas introduced, including
 - moment amplification factor (2nd-order effects)
 - stiffness reduction τ -factor
 - Difficulty in computing K-factors...
- Your virtual laboratory assignment...
 - Try to recreate examples from this lecture
 - Checkout Learning Module 1 (look familiar?)
 - Try to complete a portion of Learning Module 2

93

Sideways leaning, we sideways darter; every ropeyarn tingling like a wire; the two tall masts buckling like Indian canes in land tornadoes.


Moby Dick
 H. Melville
 1851

Questions?

94

Thank You!

Hope you enjoyed this lecture!



95

AISC | Questions?





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Single-Session Registrants

CEU / PDH Certificates

- You will receive an email on how to report attendance from:
registration@aisc.org.
- Be on the lookout: Check your spam filter! Check your junk folder!
- Completely fill out online form. Don't forget to check the boxes next to each attendee's name!





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Single-Session Registrants

CEU / PDH Certificates

- Reporting site (URL will be provided in the forthcoming email).
- Username: Same as AISC website username.
- Password: Same as AISC website password.



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8-Session Registrants

CEU / PDH Certificates

One certificate will be issued at the conclusion of the course.



8-Session Registrants

Attendance and PDH Certificates

- You have two options to receive credit for a given session.
 - Option 1: Watch the live session. Credit for live attendance will be displayed on the Course Resources table within two days of the session.
 - Option 2: Watch the recording and pass the associated quiz.

Videos and Quizzes

- For each session, find access within two business days after the live air date. (An email will be sent from nightschool@aisc.org.)
- Reasons for quiz:
 - EEU – You must take all quizzes and the final exam to receive EEU.
 - PDHs – If you watch a recorded session, you must pass quiz for PDHs.
 - Reinforce what you learn in the lectures and get more out of the course!

Distribution of Certificates

All certificates will be issued after the course is completed. Only the registrant will receive a certificate for the course.



8-Session Registrants

Course Resources

Find all your handouts, quizzes and quiz scores, recording access, and attendance information in one place!



8-Session Registrants

Course Resources

Go to www.aisc.org and sign in.

8-Session Registrants

Course Resources

Go to www.aisc.org and sign in.

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Course Resources






Course Resources

Event	Start Date
Seismic Design of Steel	1/17/2001 13:00:00 AM
8-Session Package-Night School 11 - Fundamentals of Fabrication	5/6/2014 1:00:00 PM
101-20-8-Session Package-Night School 11 - Fundamentals of Connection Design	10/19/2017 7:00:00 PM
101-20-8-Session Package-Night School 14 - Seismic Design of Steel	10/19/2018 7:00:00 PM
101-27-4-Session Package-Night School 11 - Design of Fabrication	7/24/2018 7:00:00 PM
101-18-8-Session Package-Night School 18 - Steel Construction: M & T Topics Q&A	10/15/2018 7:00:00 PM
101-13-8-Session Package-Night School 18 - Connection Design	2/4/2019 7:00:00 PM
101-20-8-Session Package-Night School 20 - General Methods of Structural Analysis	6/9/2019 7:00:00 PM
8-Session Package-Session Design of Steel - Corrosion & Fatigue	7/10/2019 1:00:00 PM

8-Session Registrants

Course Resources

Night School 24: Modern Methods for Learning Structural Stability

8-SESSION PACKAGE RESOURCES

Event	Date	Platform	Video	Quiz	Attendance
NS24-1 - Compression Members - The Fundamentals	Oct 6, 2020 7:00PM EDT	CanvasLMS	Available 10/06/2020 5:00PM EDT	Available 10/06/2020 5:00PM EDT	Pending
NS24-2 - Compression Members - Practical Considerations	Oct 13, 2020 7:00PM EDT	CanvasLMS	Available 10/13/2020 5:00PM EDT	Available 10/13/2020 5:00PM EDT	Pending
NS24-3 - Behavior of Residual Members - The Fundamentals	Oct 20, 2020 7:00PM EDT	CanvasLMS	Available 10/20/2020 5:00PM EDT	Available 10/20/2020 5:00PM EDT	Pending
NS24-4 - Residual Members - Practical Considerations	Oct 27, 2020 7:00PM EDT	CanvasLMS	Available 10/27/2020 5:00PM EDT	Available 10/27/2020 5:00PM EDT	Pending
NS24-5 - Stability of Beam-Columns - The Fundamentals	Nov 3, 2020 7:00PM EDT	CanvasLMS	Available 11/03/2020 5:00PM EDT	No longer available	Pending
NS24-6 - Stability of Beam-Columns - Practical Considerations	Nov 11, 2020 7:00PM EDT	CanvasLMS	Available 11/11/2020 5:00PM EDT	No longer available	Pending
NS24-7 - Behavior of Structural Systems - The Fundamentals	Nov 17, 2020 7:00PM EDT	CanvasLMS	Available 12/03/2020 5:00PM EDT	No longer available	Pending
NS24-8 - Structural Systems - Practical Considerations	Dec 8, 2020 7:00PM EDT	CanvasLMS	Available 12/08/2020 5:00PM EDT	No longer available	Pending
NS24 - Final Exam	NS24			No longer available	



AISC | Thank you.



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