



AISC Night School

Thank you for joining our live webinar today.
We will begin shortly. Please standby.

Modern Methods for Learning the Basics of Structural Stability: From Behavior to Practice
Session 5: Behavior of Beam-Columns – The Fundamentals
November 10, 2020



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AISC Live Webinars

Today's live webinar will begin shortly. Please stand by.

Today's audio will be broadcast through the internet. Please be sure to turn up the volume on your speakers.

Please type any questions or comments through the chat feature in the left portion of your screen.

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Course Description

Behavior of Beam-Columns – The Fundamentals
November 10, 2020

This lecture will begin with a review of basic concepts related to the stability of beam-columns. Using thoughts from the lectures on compression members and flexural members, an understanding of the basics of beam-columns will be gained. The speakers will conclude by introducing the third learning module.



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Learning Objectives

- Explain the development of the AISC interaction equation for beam-columns.
- Describe how the theoretical minor axis interaction curve and the theoretical major axis interaction curve compare to the AISC interaction curve.
- List the five effects that must be considered for stability design per the AISC *Specification*.
- Explain how to derive the P- δ moment amplification factor, B_1 . Explain how it changes based on the moment gradient of a member.



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

Session 5: Behavior of Beam-Columns – The Fundamentals
November 10, 2020



Ronald D. Ziemian, PE, PhD
Professor
Bucknell University



Craig Quadrato, PE, PhD
Senior Associate
Wiss, Janney, Elstner Associates, Inc.



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...

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Course Overview (2)

Strength/Weight

Stiffness/Weight

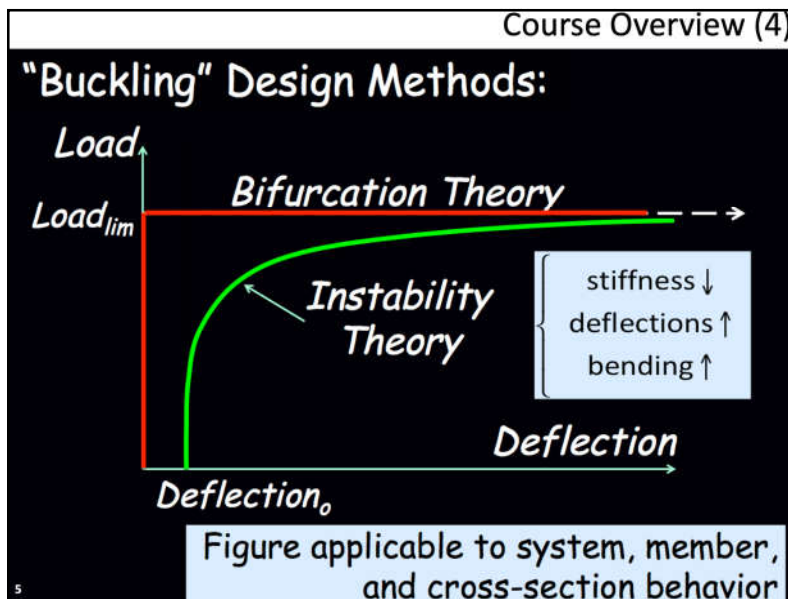
Competitive \$

Slender Systems, Members, and Cross-sections

Design for Stability!

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



Course Overview (4)

"Buckling" Design Methods:

Load

Load_{lim}

Bifurcation Theory

At first glance it would seem that such a force (P), no matter how large, would never cause the column to bend; because there would be no reason why it should bend in either one sense or another. But (at the bifurcation load P_{cr}) the slightest variation in the dimension of the column or the slightest (horizontal) force applied no matter from what side, would furnish sufficient cause to induce buckling in a special direction.

Leonard Euler (1759)



Course Overview (4)

"Buckling" Design Methods:

Bifurcation Theory

Clearly, the column can remain straight at or above the bifurcation load only if it was initially ideally straight, ideally concentrically loaded, and free from even the minutest lateral load. This means that any real column, with inevitable slight imperfections, such as initial crookedness, load eccentricity, etc., will not fail to buckle and collapse at, or even somewhat below its bifurcation load.

William McGuire (*Steel Structures* 1968)

Course Overview (4)

"Buckling" Design Methods:

Bifurcation Theory

If there always exists some form of imperfection, which in turns causes bending, then all columns are really beam-columns...*so, let's get started!*

Ron and Craig (*NS24-2020*)

Deflection

Deflection_o

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

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

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 Beam-Columns

- Full yielding (**today!**)
- Instability
 - Along the member length
 - Lateral-torsional buckling (slides on flexure)
 - Flexural buckling (slides on compression)
 - Torsional-flexural buckling (**today!**)
 - At the cross section
 - local buckling

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From Section Strength to Member Strength:

Development of AISC Interaction Equation for beam-columns (sort of!)

Limit the P - M strength to initial yield:

$$\left| \sigma_{res} + \frac{P}{A} + \frac{M}{S} \right| \leq \sigma_y \Rightarrow \left| \frac{\sigma_{res}}{\sigma_y} + \frac{P}{A\sigma_y} + \frac{M}{S\sigma_y} \right| \leq 1.0$$

Important Notes!

- For simplicity, not showing both M 's
- No factors of safety (ϕ 's or Ω 's) are included in today's lecture...learn behavior based on nominal strengths

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From Section Strength to Member Strength:

Development of AISC Interaction Equation for beam-columns (sort of!)

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Cross section strength (full yield):

$$\begin{array}{ll} \frac{P}{P_y} \geq 0.2 & \frac{P}{P_y} + \frac{8M}{9M_p} \leq 1.0 \\ \frac{P}{P_y} < 0.2 & \frac{1P}{2P_y} + \frac{M}{M_p} \leq 1.0 \end{array}$$

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From Section Strength to Member Strength:

Development of AISC Interaction Equation for beam-columns (sort of!)

Limit the strength to initial yield:

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Member strength:

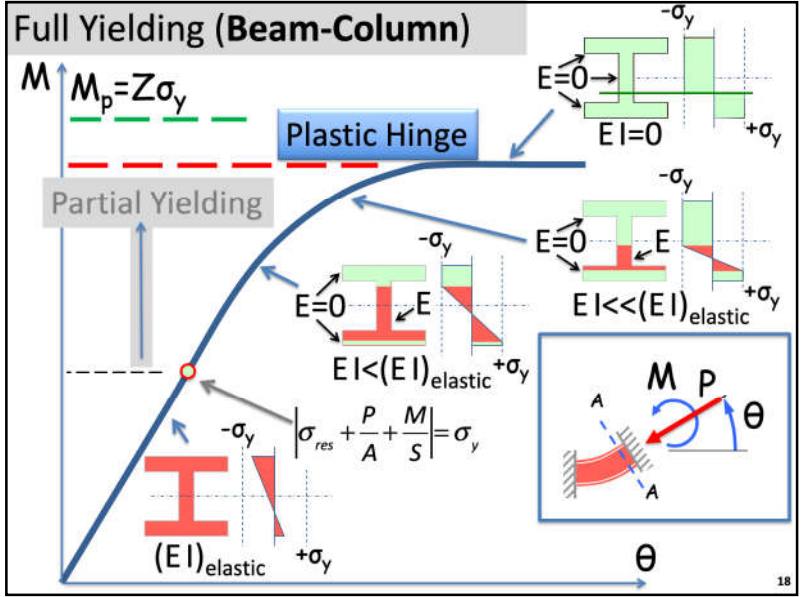
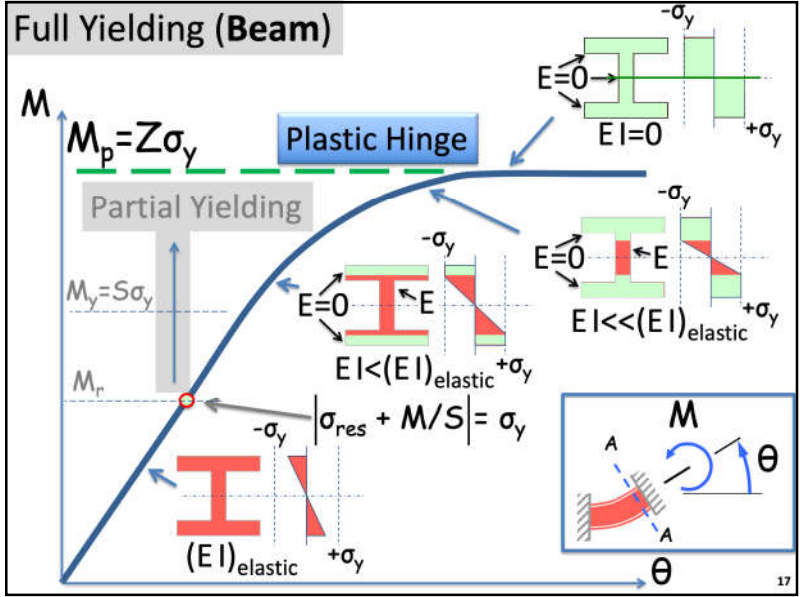
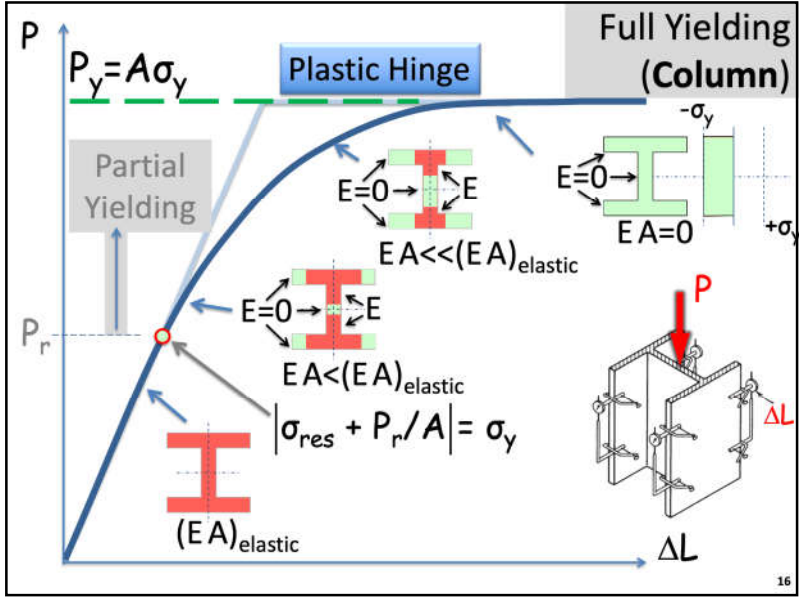
$$\begin{array}{ll} \frac{P}{P_n} + \frac{8M}{9M_n} \leq 1.0 \\ \frac{1P}{2P_n} + \frac{M}{M_n} \leq 1.0 \end{array}$$

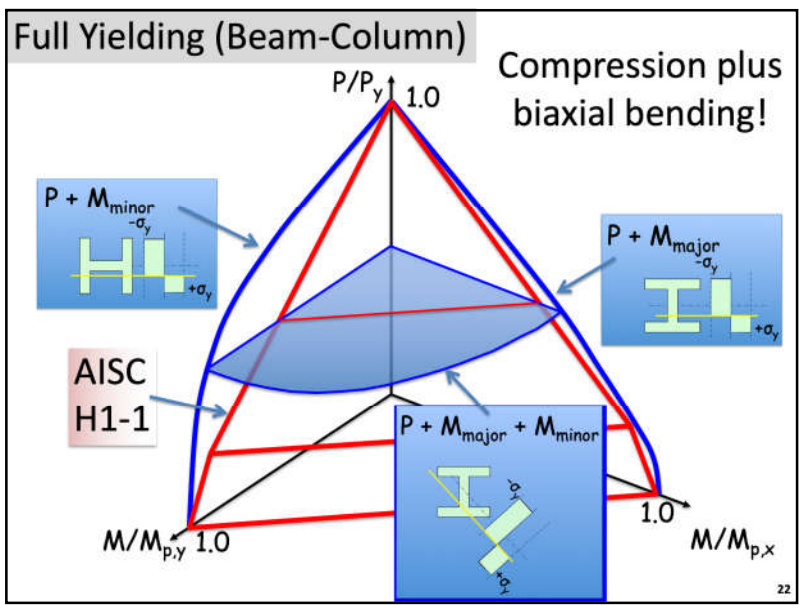
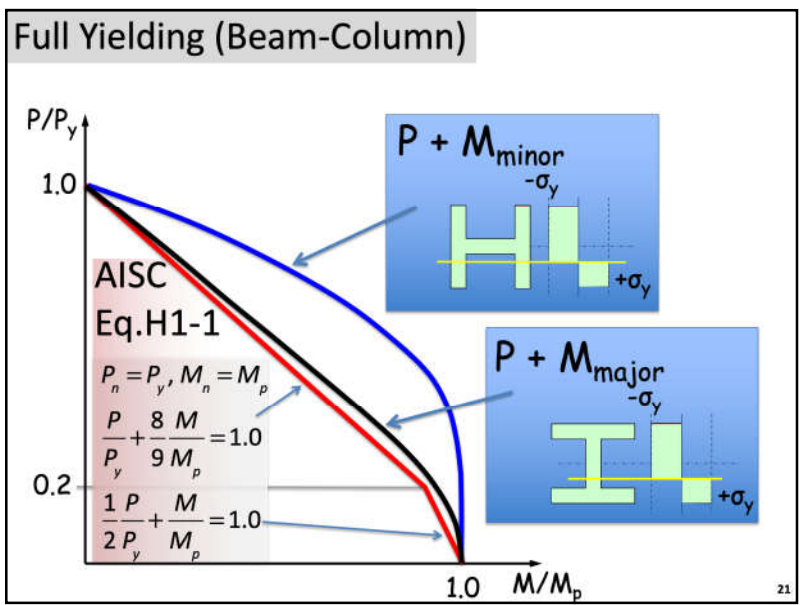
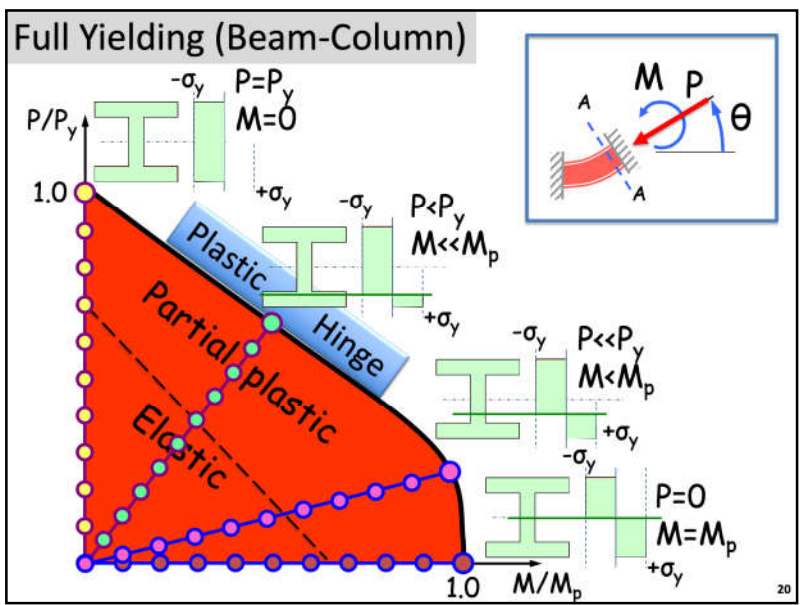
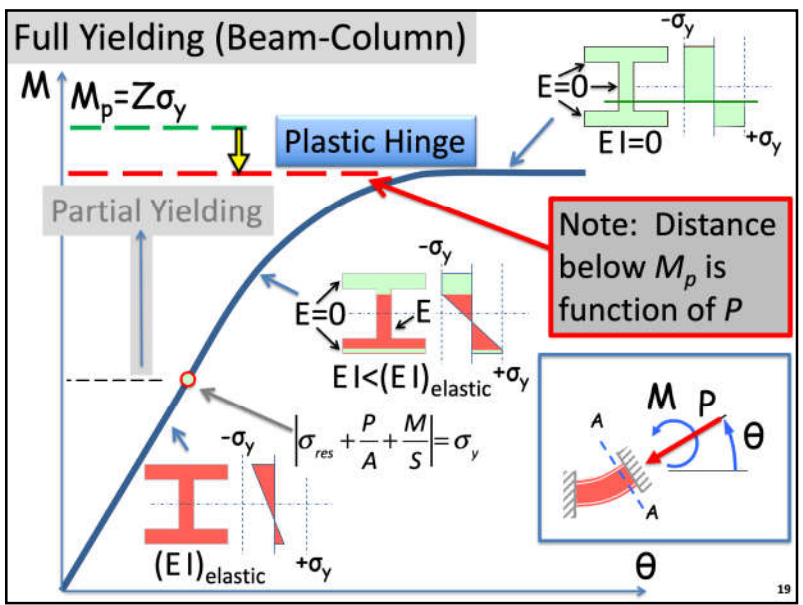
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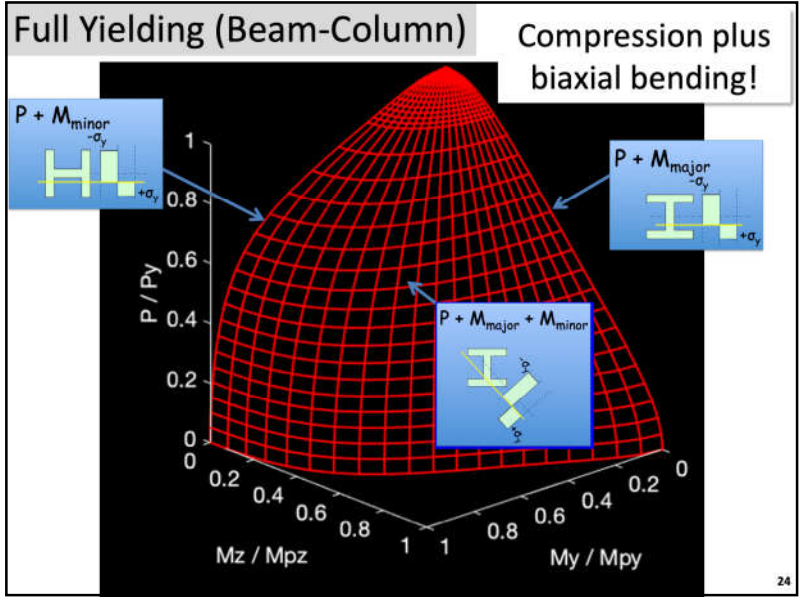
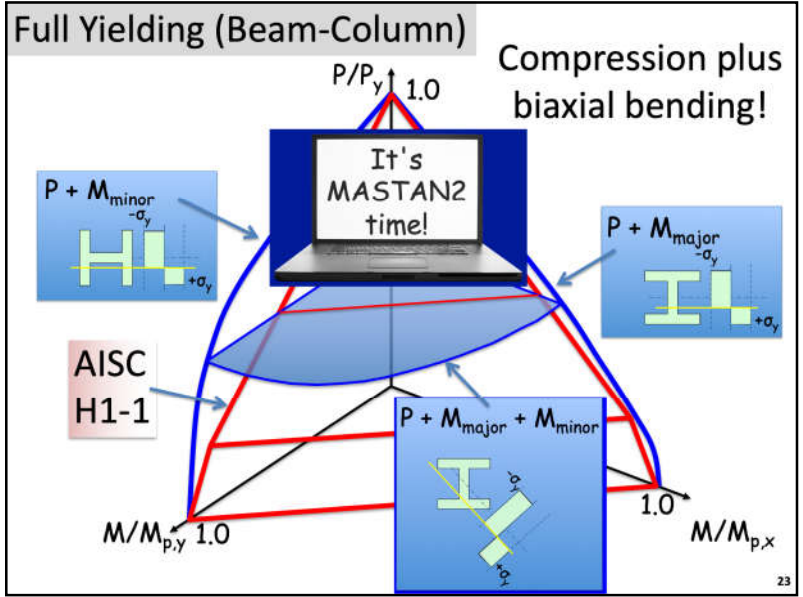


Beam-Column Strengths

- **Cross section strength (small L/r)**
 - full yield
 - local buckling
- **Elastic member strength (large L/r)**
 - compressive (P): flexural buckling (or torsional or flexural-torsional)
 - flexural (M_{major}): lateral torsional buckling
 - torsional-flexural buckling ($P + M_{major}$)
- **Inelastic member strength (intermediate L/r)**
 - same possible failure modes as elastic, except reduced due to partial yielding accentuated by presence of initial imperfections (geometric and residual stresses)







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$P \neq 0$ and $M = 0$ (compression slides)
 $P_E = \pi^2 E I_y / L_b^2$

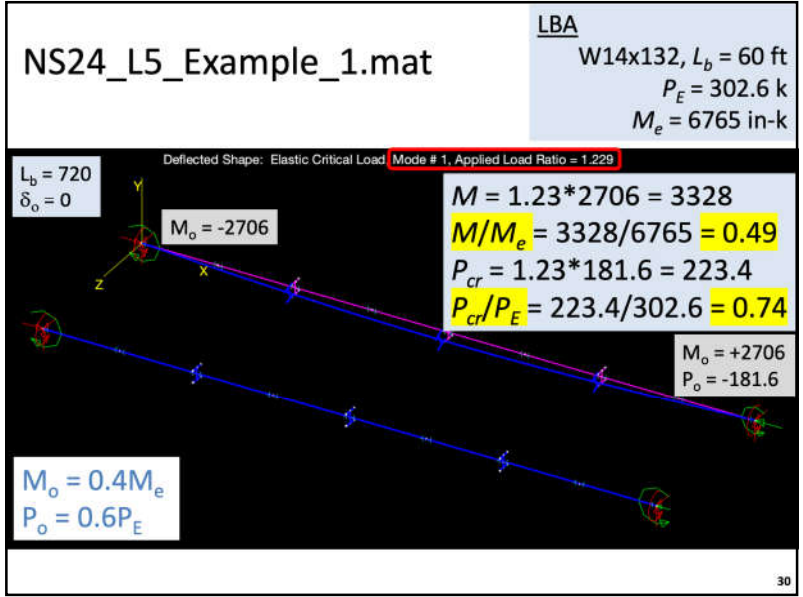
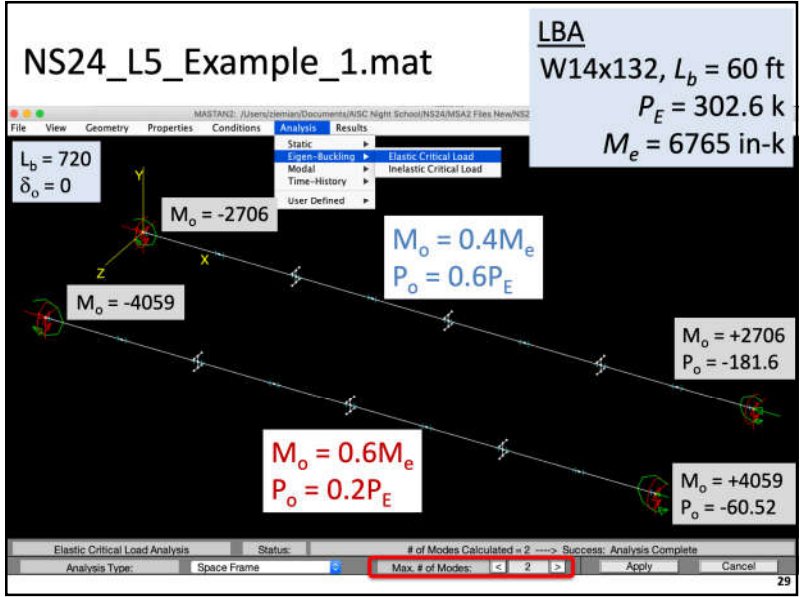
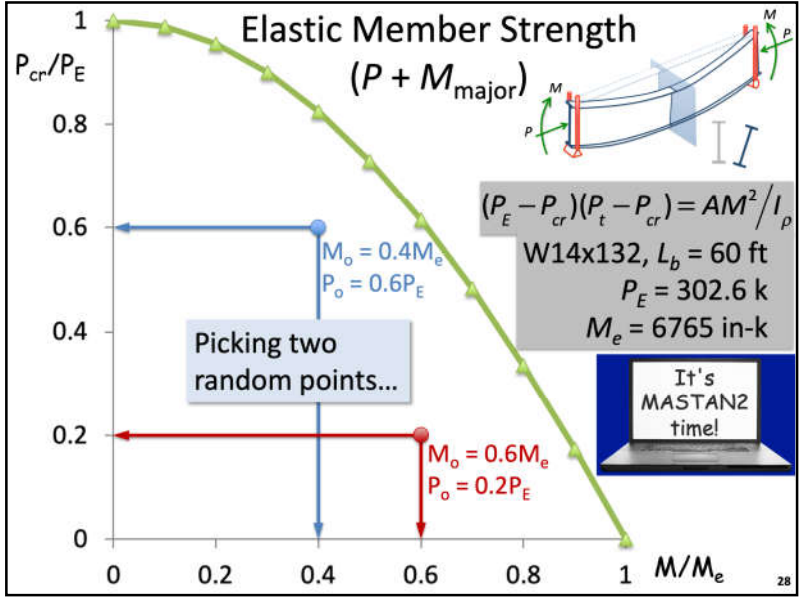
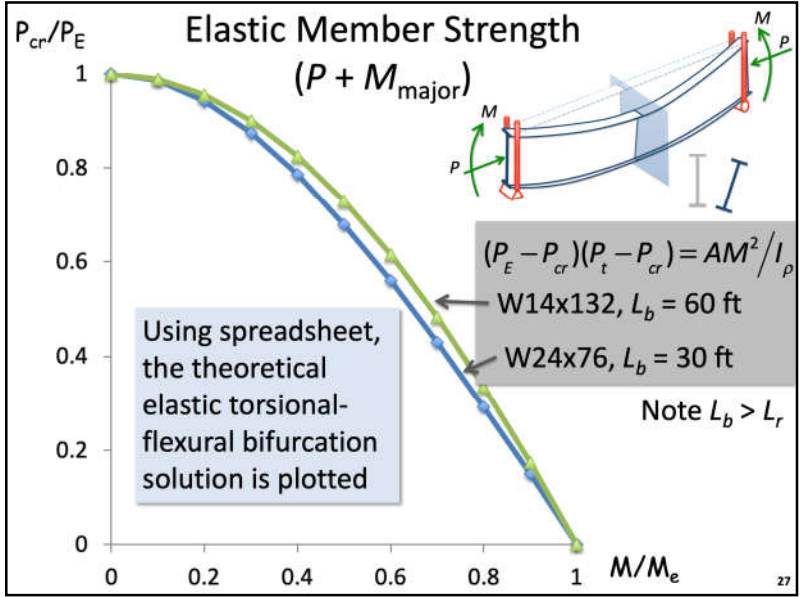
$P = 0$ and $M \neq 0$ (flexure slides)
 $M_e = \frac{\pi}{L_b} \sqrt{E I_y G J + \left(\frac{\pi E}{L_b}\right)^2 I_y C_w}$

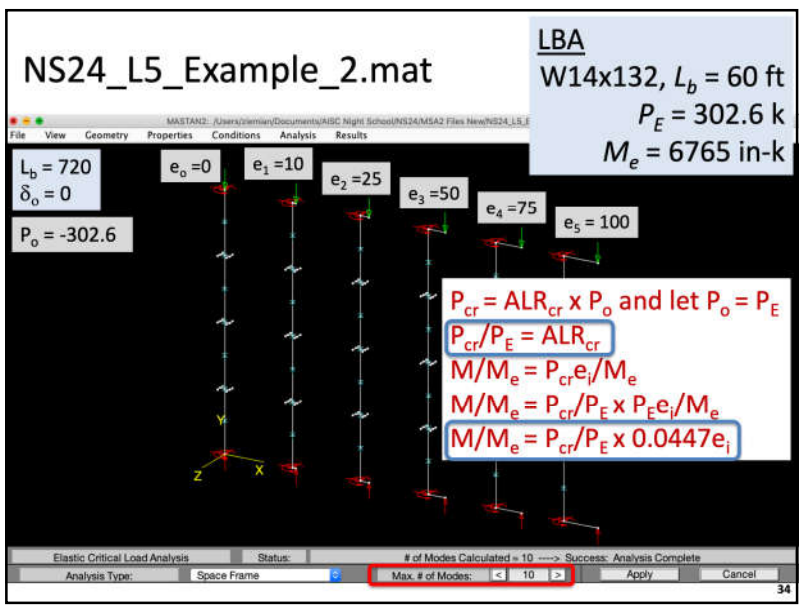
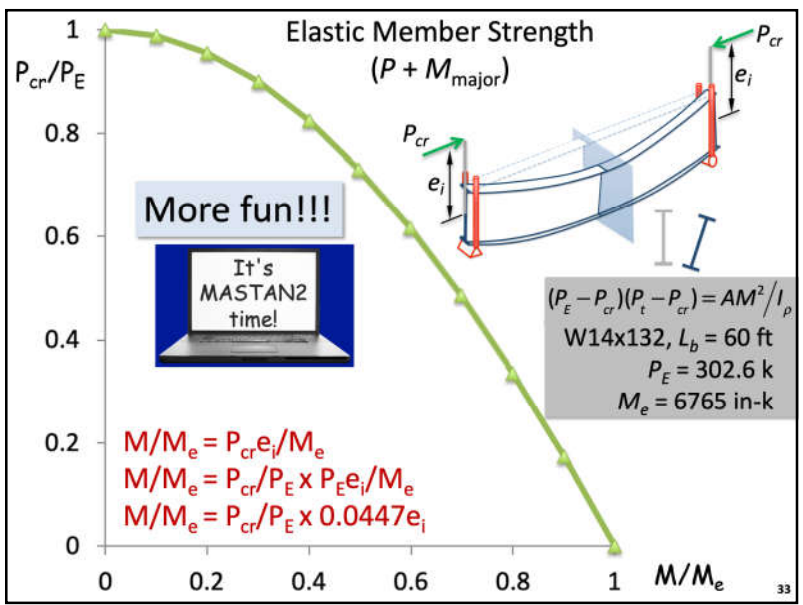
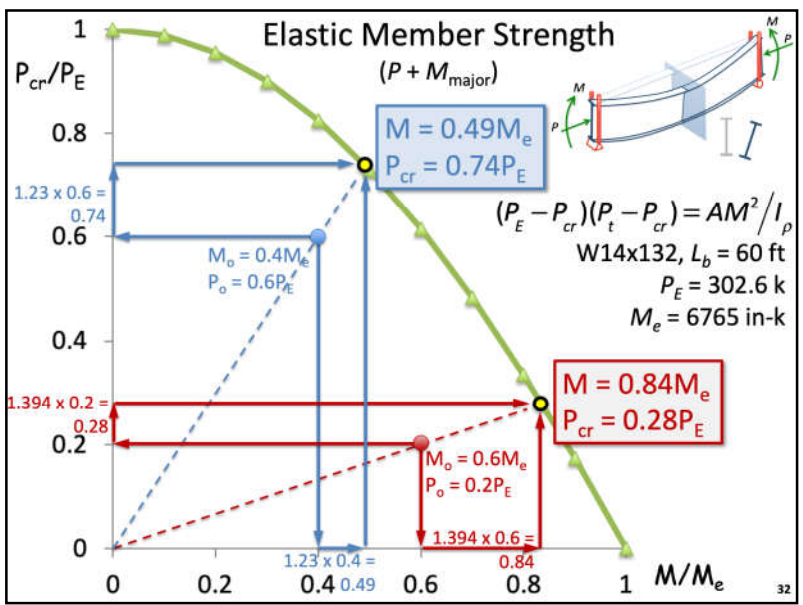
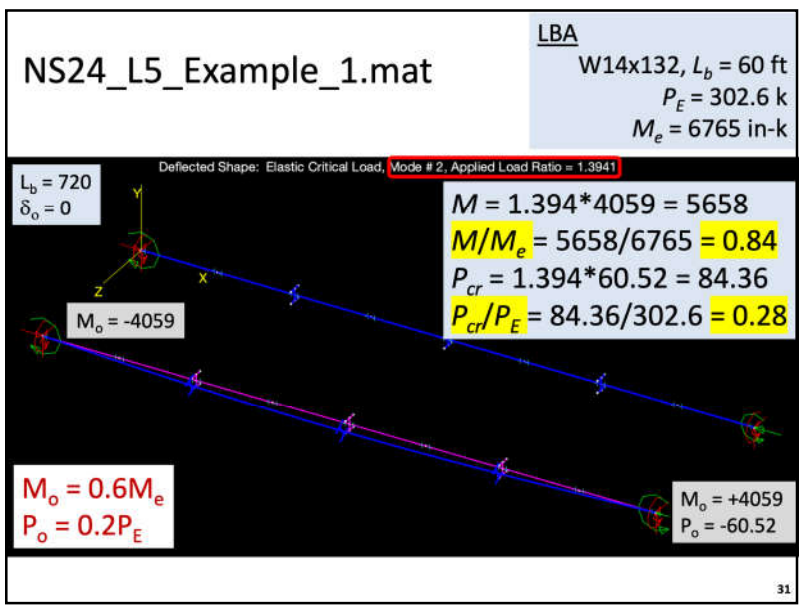
$P \neq 0$ and $M \neq 0$ (Beam-Column)
 For a given M , P_{cr} is smallest root of:
 $(P_E - P_{cr})(P_t - P_{cr}) = A M^2 / I_p$ with: $I_p = I_x + I_y$
 $P_t = \frac{A}{I_p} \left(G J + \frac{\pi^2 E C_w}{L_b^2} \right)$

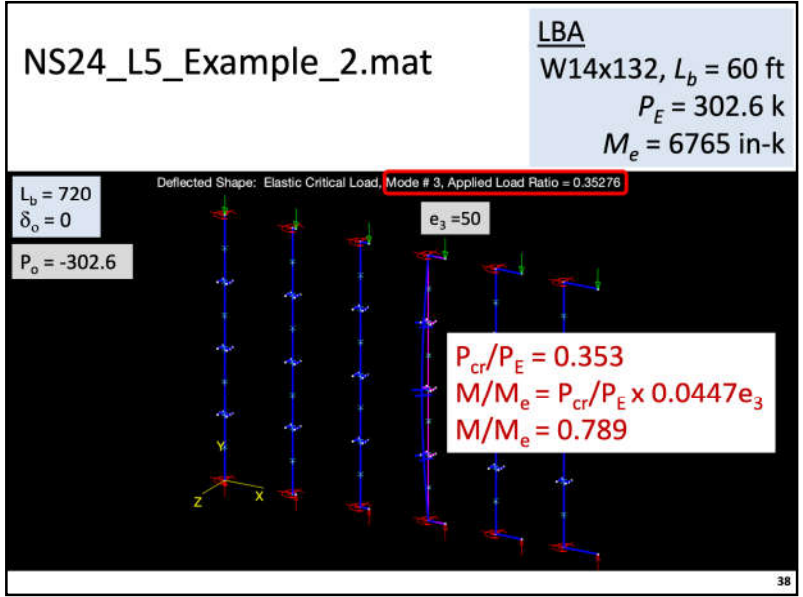
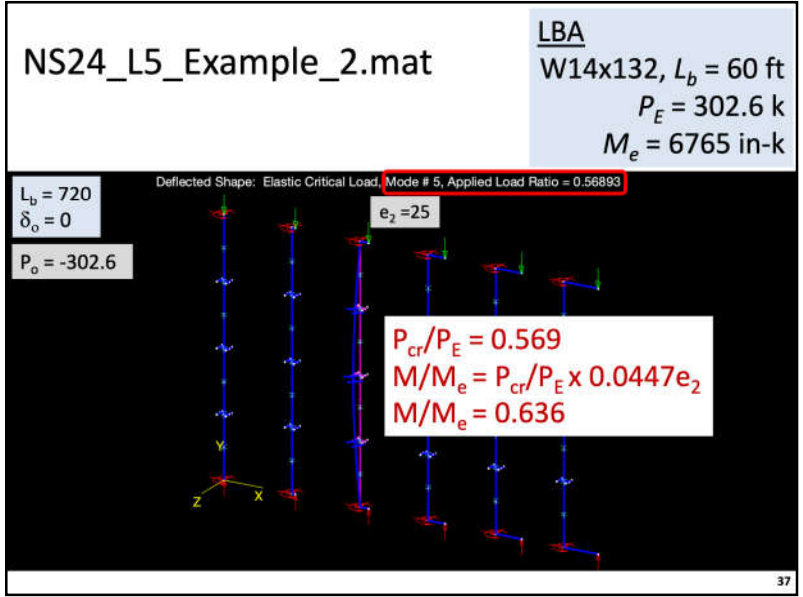
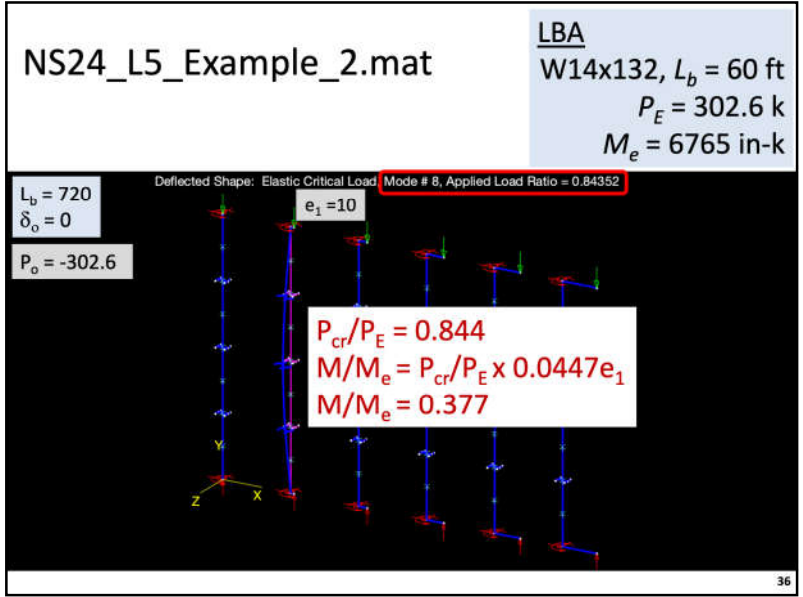
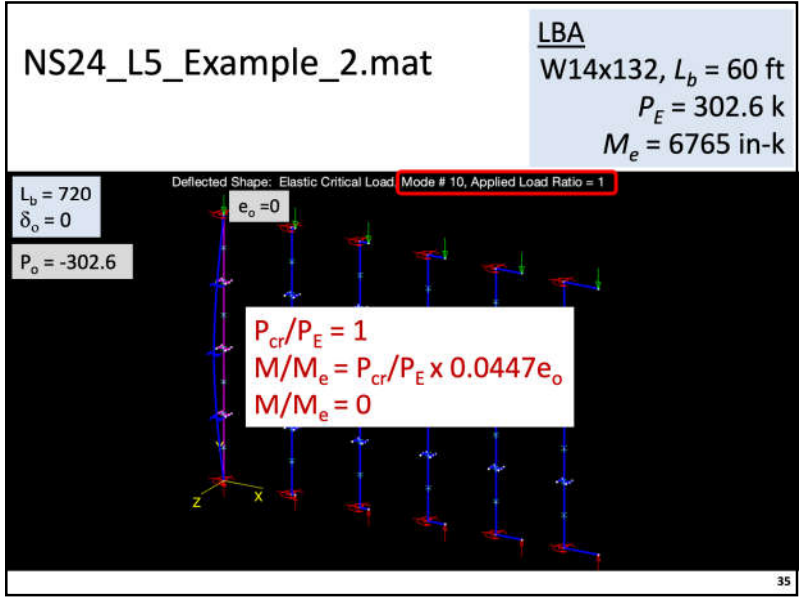
obtained by solving lots of fun diff. eqs.!!!

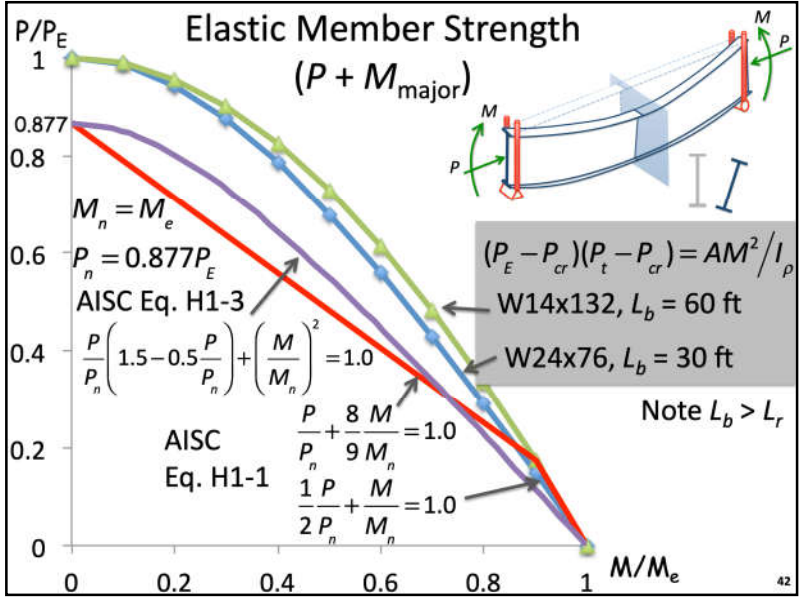
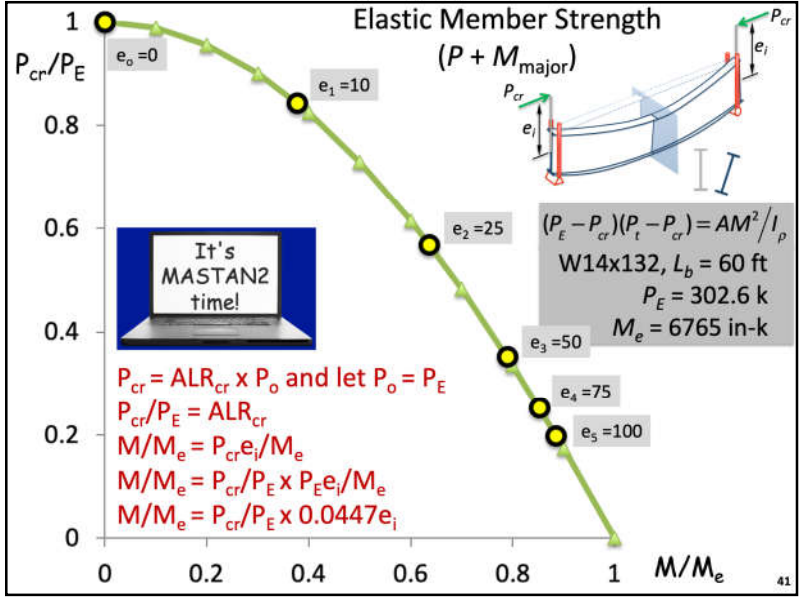
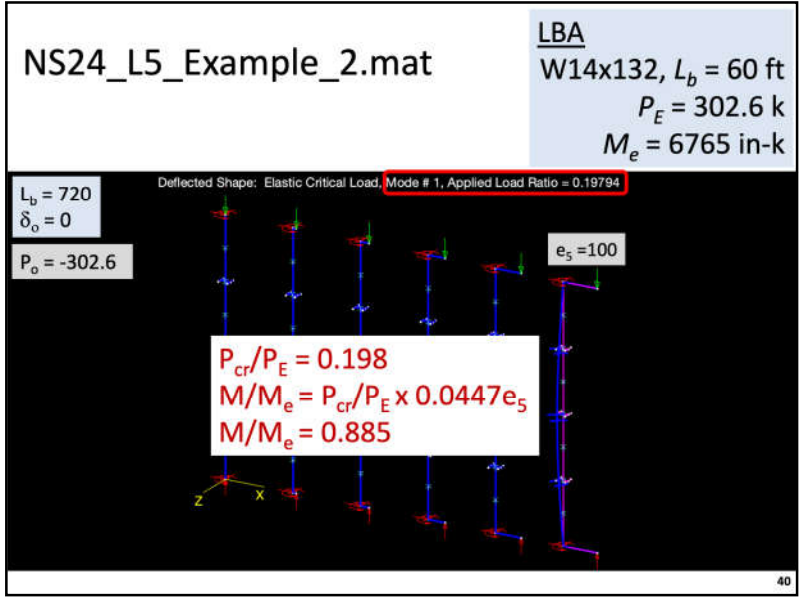
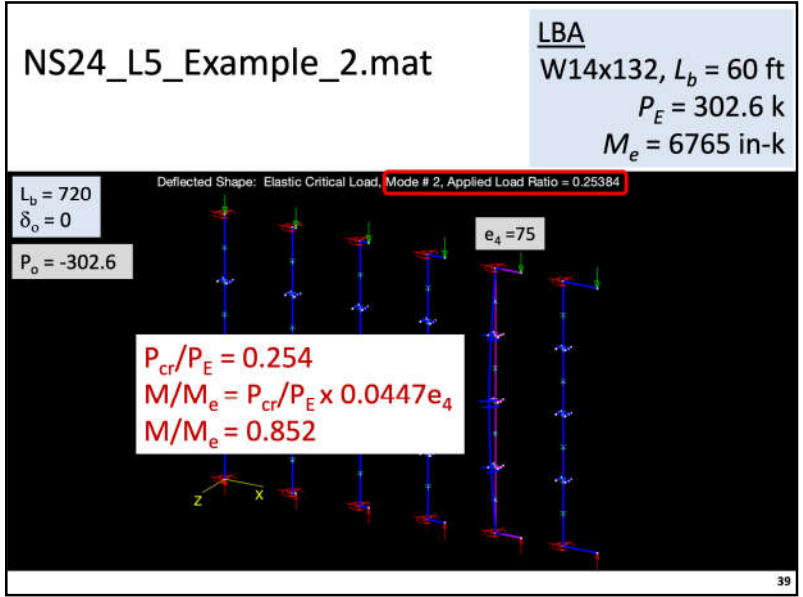
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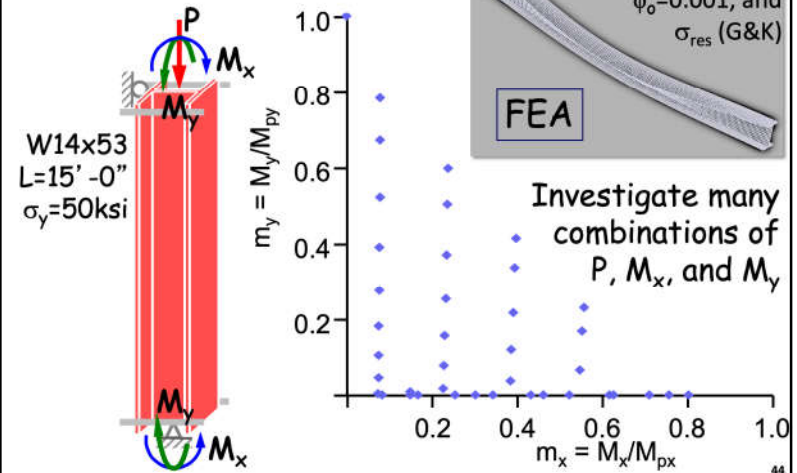


Beam-Column Strengths

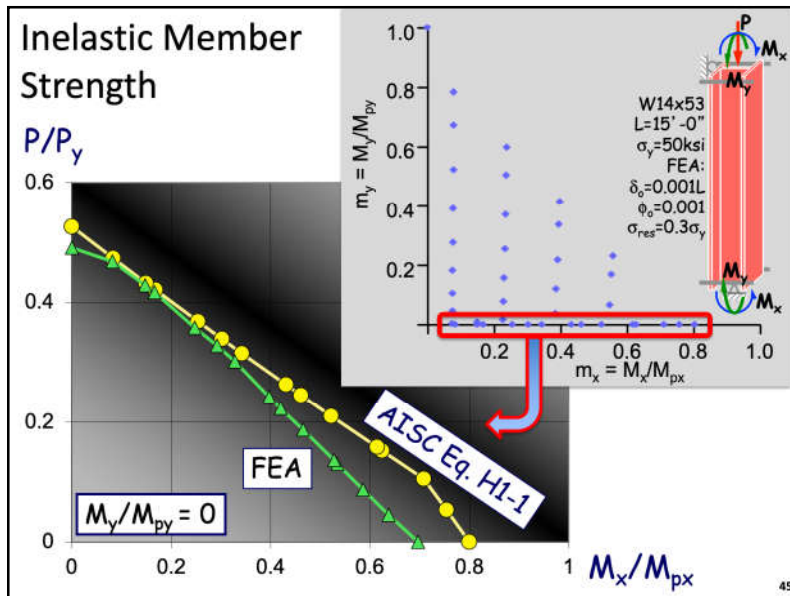
- Cross section strength (small L/r)
 - full yield
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 - same possible failure modes as elastic, except reduced due to partial yielding accentuated by presence of initial imperfections (geometric and residual stresses)

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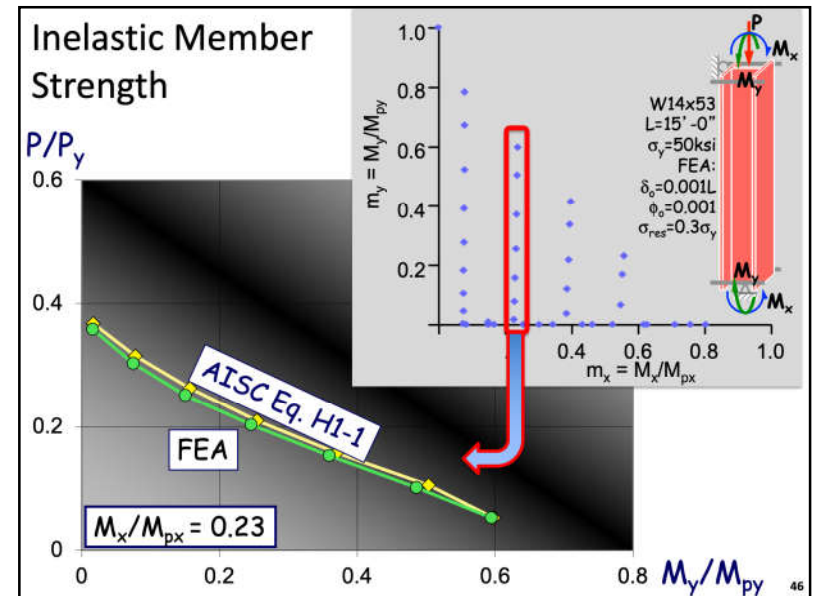
Inelastic Member Strength (Beam-Column)



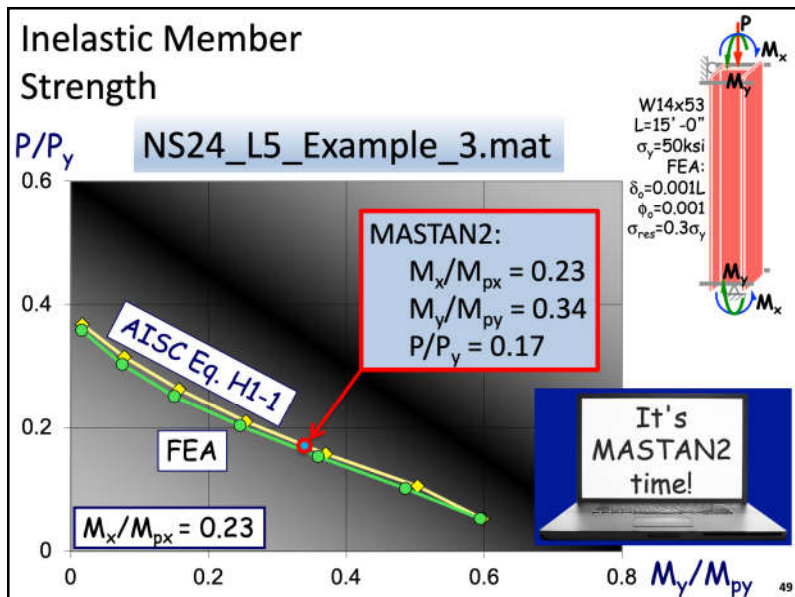
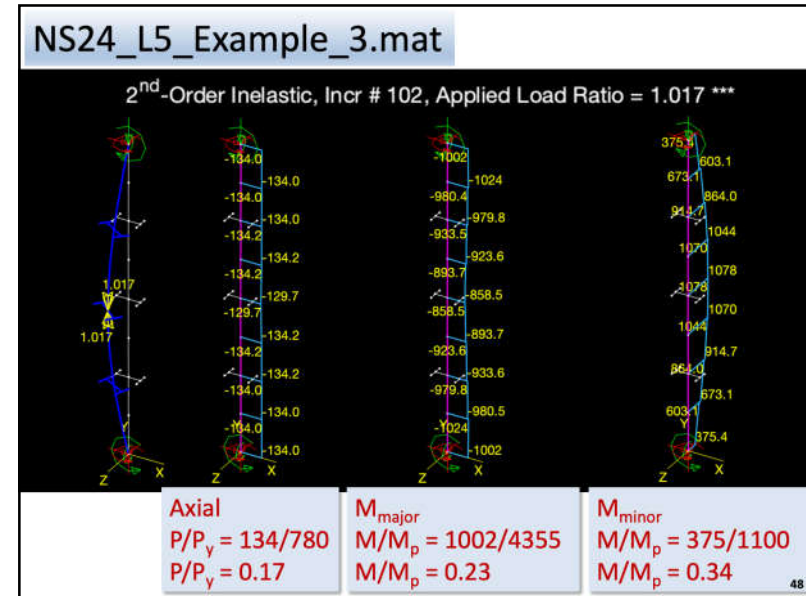
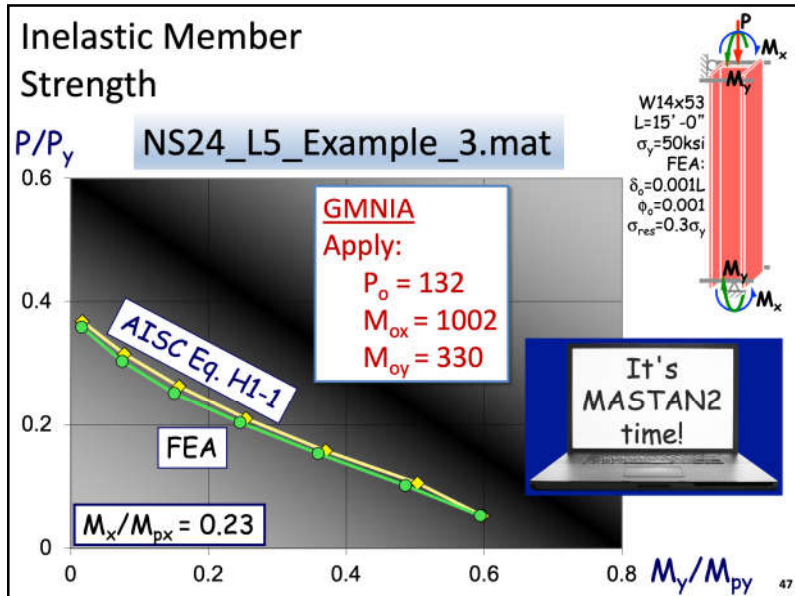
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AISC Interaction Equation for Member Strength

P and M are required strengths from the structural analysis and must account for effects that may impact stability of member

For $\frac{P}{P_n} \geq 0.2$, $\frac{P}{P_n} + \frac{8M}{9M_n} \leq 1.0$

For $\frac{P}{P_n} < 0.2$, $\frac{1}{2} \frac{P}{P_n} + \frac{M}{M_n} \leq 1.0$

M_n = flexural strength (earlier slides)

P_n = Compressive strength (earlier slides)



Analysis Essentials to obtain Required Strengths

For $\frac{P}{P_n} \geq 0.2$, $\frac{P}{P_n} + \frac{8}{9} \frac{M}{M_n} \leq 1.0$

Effects that may impact stability of member:

- axial, flexural, shear, torsional, connection deformations, ...
- second-order effects
- geometric imperfections
- stiffness reductions due to inelasticity

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Analysis Essentials to obtain Required Strengths

For $\frac{P}{P_n} \geq 0.2$, $\frac{P}{P_n} + \frac{8}{9} \frac{M}{M_n} \leq 1.0$

Effects that may impact stability of member:

- axial, flexural, shear, torsional, connection deformations, ...

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Analysis Essentials to obtain Required Strengths

For $\frac{P}{P_n} \geq 0.2$, $\frac{P}{P_n} + \frac{8}{9} \frac{M}{M_n} \leq 1.0$

Effects that may impact stability of member:

- second-order effects

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Axial plus uniform bending: P-δ (1)

Equilibrium:

$$\sum M_* = 0$$

$$M(x) + M_o + Pv(x) = 0$$

$$M(x) + Pv(x) = -M_o$$

Moment-curvature:

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

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Axial plus uniform bending: P-δ (2)

Equilibrium: $M(x) + Pv(x) = -M_o$

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

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

wolframalpha.com: a2*y''(x)+a1*y(x)=a3

Axial plus uniform bending: P-δ (3)

$v(x) = C_1 \cos\left(\sqrt{\frac{P}{EI}}x\right) + C_2 \sin\left(\sqrt{\frac{P}{EI}}x\right) - \frac{M_o}{P}$

Boundary Conditions!

$v(x=0) = 0 \Rightarrow C_1 = M_o/P$

$v(x=L) = 0 \Rightarrow C_2 = \frac{M_o}{P} \frac{1 - \cos\left(\sqrt{\frac{P}{EI}}L\right)}{\sin\left(\sqrt{\frac{P}{EI}}L\right)}$

Axial plus uniform bending: P-δ (4)

$v(x) = C_1 \cos\left(\sqrt{\frac{P}{EI}}x\right) + C_2 \sin\left(\sqrt{\frac{P}{EI}}x\right) - \frac{M_o}{P}$

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

$M(x) = -C_1 P \cos\left(\sqrt{\frac{P}{EI}}x\right) - C_2 P \sin\left(\sqrt{\frac{P}{EI}}x\right)$

Axial plus uniform bending: P-δ (5)

$M(x) = -C_1 P \cos\left(\sqrt{\frac{P}{EI}}x\right) - C_2 P \sin\left(\sqrt{\frac{P}{EI}}x\right)$

Substituting C_1 and C_2 from previous slide and letting $\beta = \left(1 - \cos\left(\sqrt{\frac{P}{EI}}L\right)\right) / \sin\left(\sqrt{\frac{P}{EI}}L\right)$

$M(x) = -M_o \left(\cos\left(\sqrt{\frac{P}{EI}}x\right) + \beta \sin\left(\sqrt{\frac{P}{EI}}x\right) \right)$



Axial plus uniform bending: P-δ (6)

$$M(x) = -M_o \left(\cos\left(\sqrt{\frac{P}{EI}}x\right) + \beta \sin\left(\sqrt{\frac{P}{EI}}x\right) \right)$$
 with $\beta = \left(1 - \cos\left(\sqrt{\frac{P}{EI}}L\right)\right) / \sin\left(\sqrt{\frac{P}{EI}}L\right)$

Let's monitor the moment at some point, say the mid-span (which should be the largest)

$$M(x = \frac{L}{2}) = -M_o \left(\cos\left(\sqrt{\frac{P}{EI}}\frac{L}{2}\right) + \beta \sin\left(\sqrt{\frac{P}{EI}}\frac{L}{2}\right) \right)$$

Axial plus uniform bending: P-δ (7)

$$M(x = \frac{L}{2}) = -M_o \left(\cos\left(\sqrt{\frac{P}{EI}}\frac{L}{2}\right) + \beta \sin\left(\sqrt{\frac{P}{EI}}\frac{L}{2}\right) \right)$$
 with $\beta = \left(1 - \cos\left(\sqrt{\frac{P}{EI}}L\right)\right) / \sin\left(\sqrt{\frac{P}{EI}}L\right)$

Letting:

$$u = \sqrt{\frac{P}{EI}}\frac{L}{2}$$

$$M(x = \frac{L}{2}) = -M_o \left(\cos(u) + \beta \sin(u) \right)$$
 with $\beta = (1 - \cos(2u)) / \sin(2u)$

Axial plus uniform bending: P-δ (8)

$$M(x = \frac{L}{2}) = -M_o \left(\cos(u) + \beta \sin(u) \right)$$
 with $\beta = (1 - \cos(2u)) / \sin(2u)$

Employing trig. identities

$$\cos(2u) = 1 - 2\sin^2(u)$$

$$\sin(2u) = 2\sin(u)\cos(u)$$

after simplifying

$$M(x = \frac{L}{2}) = -M_o \left(\frac{1}{\cos(u)} \right)$$
 with $u = \sqrt{\frac{P}{EI}}\frac{L}{2}$

$$M(x = \frac{L}{2}) = -M_o \left(\frac{1}{\cos\left(\sqrt{\frac{P}{EI}}\frac{L}{2}\right)} \right)$$

Axial plus uniform bending: P-δ (9)

$$M(x = \frac{L}{2}) = -M_o \left(\frac{1}{\cos\left(\sqrt{\frac{P}{EI}}\frac{L}{2}\right)} \right)$$

BUT!!! As $\sqrt{\frac{P}{EI}}\frac{L}{2} \rightarrow \frac{\pi}{2}$, $\frac{1}{\cos\left(\sqrt{\frac{P}{EI}}\frac{L}{2}\right)} \rightarrow \infty$

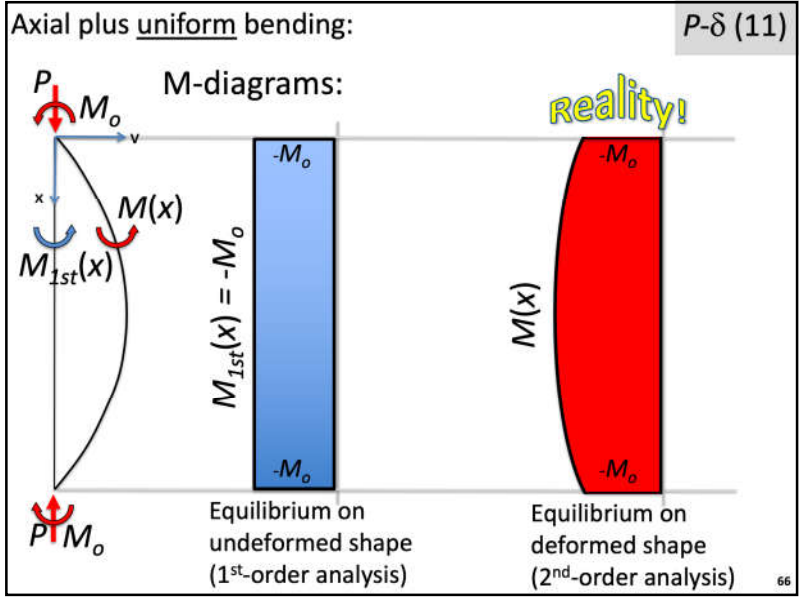
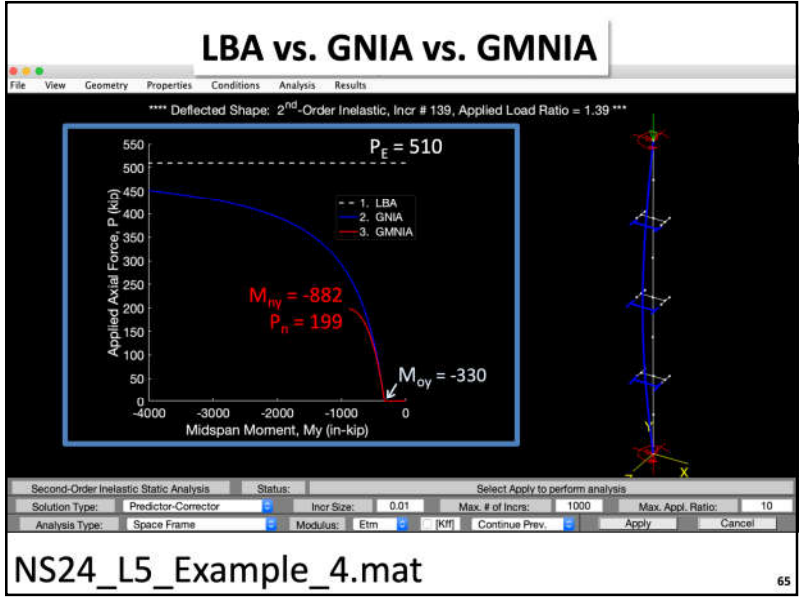
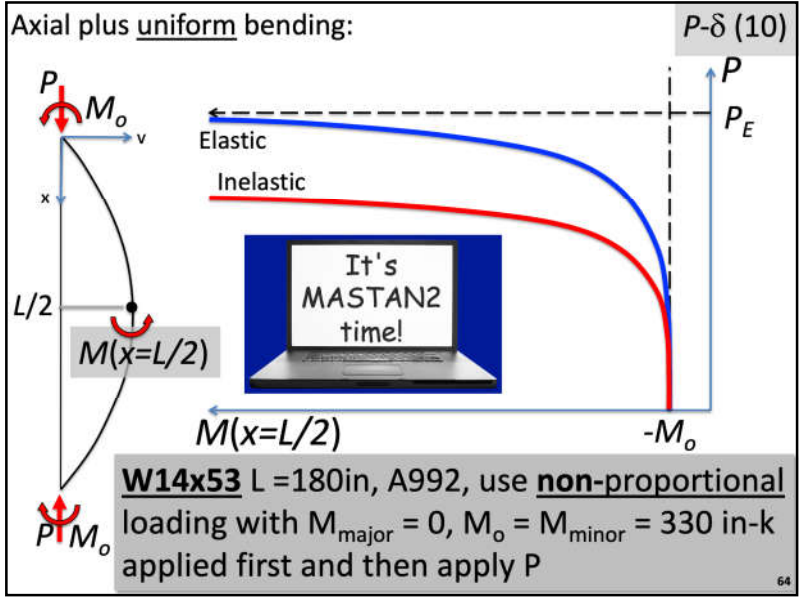
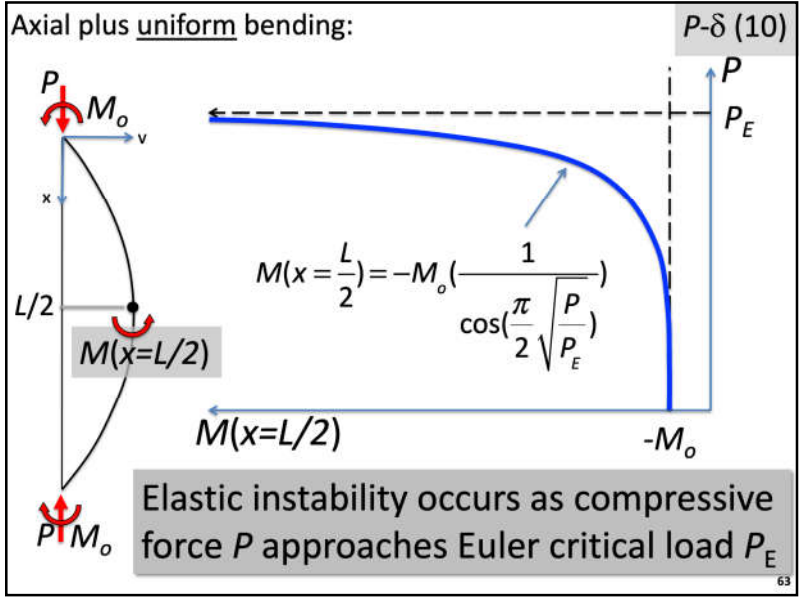
Noting:

$$\sqrt{\frac{P}{EI}}\frac{L}{2} = \frac{\pi}{2} \Rightarrow P = \frac{\pi^2 EI}{L^2} = P_E$$
 and $\sqrt{\frac{P}{EI}}\frac{L}{2} = \frac{\pi}{2} \sqrt{\frac{P}{P_E}}$

I'm back!!!

$$M(x = \frac{L}{2}) = -M_o \left(\frac{1}{\cos\left(\frac{\pi}{2} \sqrt{\frac{P}{P_E}}\right)} \right)$$





Axial plus uniform bending: P-δ (12)

$$M(x) = -M_o \left(\cos\left(\sqrt{\frac{P}{EI}}x\right) + \beta \sin\left(\sqrt{\frac{P}{EI}}x\right) \right)$$

In terms of a moment amplification factor, B_1 :

$$M(x) = B_1 M_{1st}(x)$$

with

$$B_1 = \cos\left(\sqrt{\frac{P}{EI}}x\right) + \beta \sin\left(\sqrt{\frac{P}{EI}}x\right)$$

and

$$\beta = \frac{1 - \cos\left(\sqrt{\frac{P}{EI}}L\right)}{\sin\left(\sqrt{\frac{P}{EI}}L\right)}$$

Equilibrium on deformed shape (2nd-order analysis)

At mid-span: P-δ (13)

$$M\left(x = \frac{L}{2}\right) = -M_o \left(\frac{1}{\cos\left(\frac{\pi}{2} \sqrt{\frac{P}{P_E}}\right)} \right)$$

In terms of a moment amplification factor, B_1 :

$$M\left(x = \frac{L}{2}\right) = B_1 M_{1st}\left(x = \frac{L}{2}\right)$$

with

$$B_1 = \frac{1}{\cos\left(\frac{\pi}{2} \sqrt{\frac{P}{P_E}}\right)}$$

-or-

$$M^{\max} = B_1 M_{1st}^{\max}$$

Equilibrium on deformed shape (2nd-order analysis)

Axial plus uniform bending: P-δ (14)

In terms of a moment amplification factor, B_1 :

$$M^{\max} = B_1 M_{1st}^{\max}$$

with

$$B_1 = \frac{1}{\cos\left(\frac{\pi}{2} \sqrt{\frac{P}{P_E}}\right)}$$

which is often approximated by

$$B_1 = \frac{1}{1 - \frac{P}{P_E}}$$

Equilibrium on deformed shape (2nd-order analysis)

Approximate B_1 : P-δ (15)

Spring: $M_s = k\theta = \frac{4k}{L} \Delta$

Equilibrium w/ $M_o=0$, provides P_{cr}

$$M_s = P_{cr} \Delta \Rightarrow P_{cr} = \frac{4k}{L}$$

Equilibrium w/ $M_o \neq 0$,

$$M_s = M_o + P \Delta$$

w/ $\Delta = \frac{L}{4k} M_s = \frac{1}{P_{cr}} M_s$

$$M_s = M_o + \frac{P}{P_{cr}} M_s$$

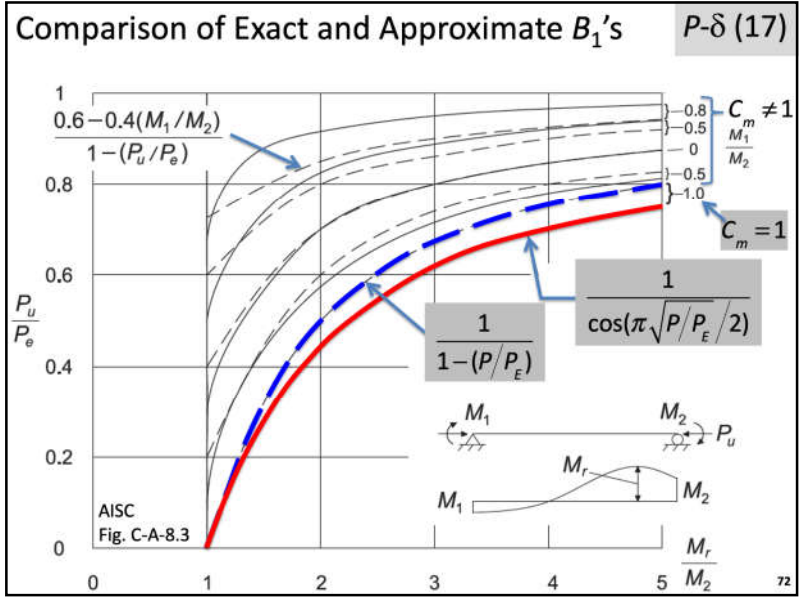
$$M_s = \left(\frac{1}{1 - \frac{P}{P_{cr}}} \right) M_o = B_1 M_o$$


P-δ (16)

What about cases where the $M(x)$ is not uniform?

$B_1 = C_m B_1^{\text{uniform}} M$
 with $C_m \leq 1$

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SECTION 12. COMBINED STRESSES.

(a) Axial and Bending.

1949 Members subject to both axial and bending stresses shall be so proportioned that the quantity

$$\frac{f_a}{F_a} + \frac{f_b}{F_b}$$

shall not exceed unity, in which

SECTION 1.6 COMBINED STRESSES

1.6.1 Axial Compression and Bending

Members subject to both axial compression and bending stresses shall be proportioned to meet the requirements of both Formula (6) and Formula (7).

1961

$$\frac{f_a}{F_a} + \left(\frac{C_m f_b}{1 - \frac{f_a}{F'_a}} \right) \leq 1.0 \quad \text{Formula (6)}$$

$B_1 = C_m B_1^{\text{uniform}} M$
 with $C_m \leq 1$

2nd-order effects introduced before RZ and CQ were born...

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SECTION 12. COMBINED STRESSES.

(a) Axial and Bending.

1949 Members subject to both axial and bending stresses shall be so proportioned that the quantity

$$\frac{f_a}{F_a} + \frac{f_b}{F_b}$$

shall not exceed unity, in which

By the Committee,

William C. Alsmeyer	Theodore R. Higgins	James A. Munro
Ethan F. Ball	Sol Horwitz	William H. Munse
Lynn S. Beedle	John W. Hubler	Charles I. Orr
Walter E. Blessey	Bruce G. Johnston	Egor P. Popov
Reuben W. Binder	William J. LeMessurier	James Ruderman
Frederick H. Dill	Arthur S. Marvin	Ivan M. Viest
Milton E. Eliot	Carl A. Metz	David M. Wilson
Edward R. Estes, Jr.	William A. Milek, Jr.	George Winter
Edwin H. Gaylord, Jr.		Robert J. Wood

1961

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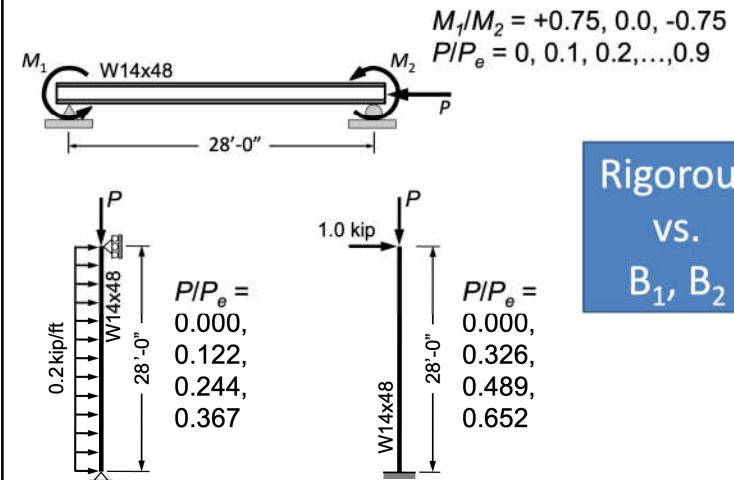
LM7. Second-order Effects ($P-\Delta$ and $P-\delta$) Effects

Learning Objectives

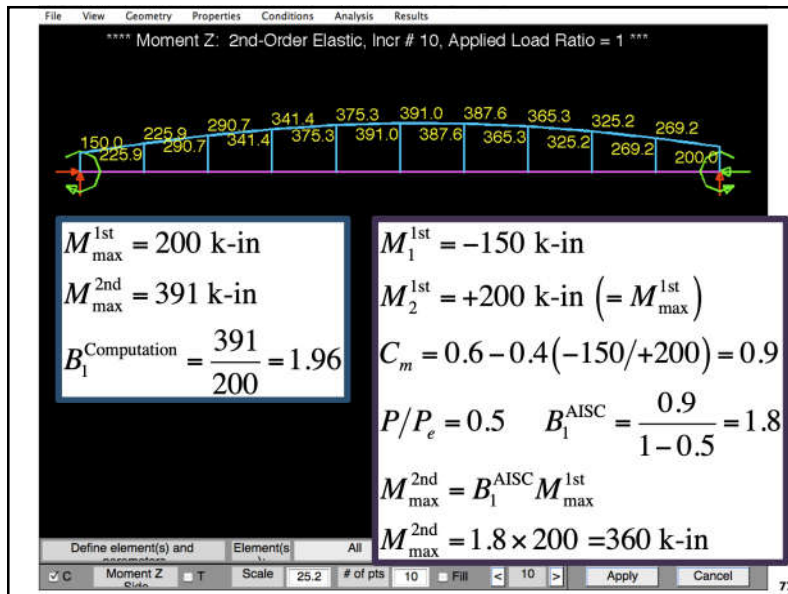
- Employ second-order elastic analysis
- Observe the relationship between extent of moment amplification and P/P_e
- Investigate the impact of single or double(reverse) curvature bending has on the degree of moment amplification
- Compute and assess the AISC moment amplification factor B_1 defined in App. 8

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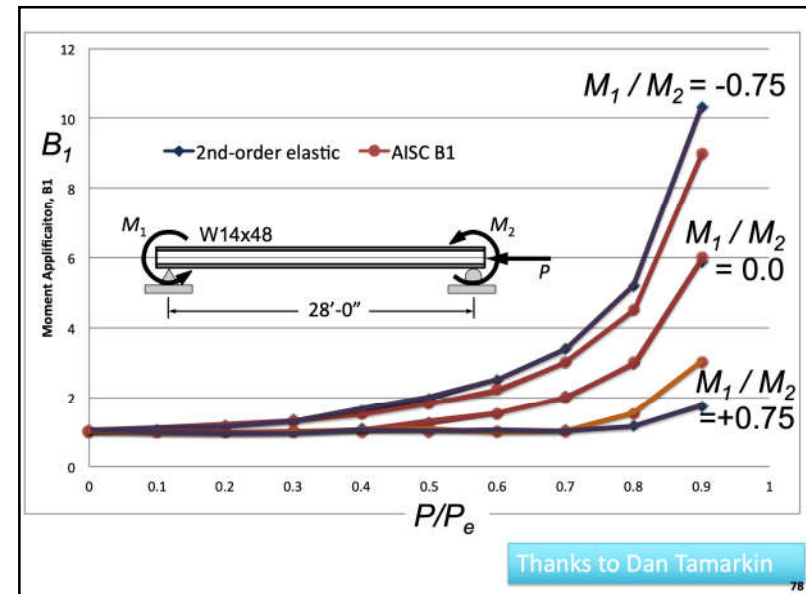
1st-order vs. 2nd-order



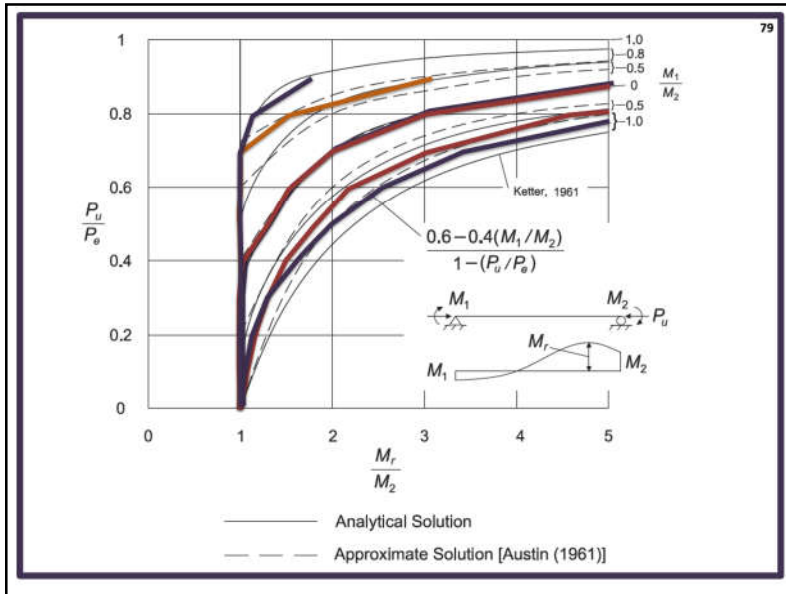
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78

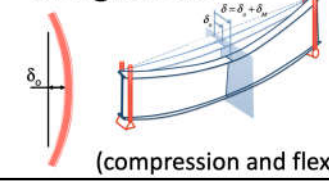


Analysis Essentials to obtain Required Strengths

For $\frac{P}{P_n} \geq 0.2$, $\frac{P}{P_n} + \frac{8}{9} \frac{M}{M_n} \leq 1.0$

- Effects that may impact stability of member:
- geometric imperfections

Member out-of-straightness:



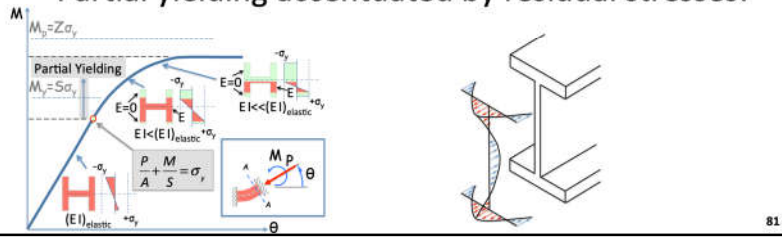
80

Analysis Essentials to obtain Required Strengths

For $\frac{P}{P_n} \geq 0.2$, $\frac{P}{P_n} + \frac{8}{9} \frac{M}{M_n} \leq 1.0$

- Effects that may impact stability of member:
- stiffness reductions due to inelasticity

Partial yielding accentuated by residual stresses:



Analysis Essentials to obtain Required Strengths

For $\frac{P}{P_n} \geq 0.2$, $\frac{P}{P_n} + \frac{8}{9} \frac{M}{M_n} \leq 1.0$

- Effects that may impact stability of member:
- axial, flexural, shear, torsional, connection deformations, ... ✓
 - second-order effects ✓
 - geometric imperfections ✓
 - stiffness reductions due to inelasticity ✓

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Summary – Beam-Columns

- Stability of members
 - Compression (earlier slides)
 - Flexural (earlier slides)
 - Combined compression and flexure
 - Behavior of beam-columns (today!)
 - Design
- Behavior of Beam-Columns
 - full yield (interaction surface)
 - member instability
 - from flexural buckling -to- lateral torsional buckling, including torsional-flexural buckling
 - AISC Interaction Equations

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Summary – Beam-Columns (cont.)

- Factors impacting stability
 - axial, flexural, shear, torsional, connection deformations, ...
 - second-order effects
 - geometric imperfections
 - stiffness reductions due to inelasticity

Your virtual laboratory assignment...

Rerun examples presented in this lecture
Try to recreate Learning Module 7 results
Complete a portion of Learning Module 8

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Thank You!

Hope you enjoyed this lecture!



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!



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.



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.

The screenshot shows the AISC website's login page. At the top, there is a navigation menu with links for EDUCATION, PUBLICATIONS, STEEL SOLUTIONS CENTER, AWARDS AND COMPETITIONS, and TECHNICAL RESOURCES. Below the menu is a large banner image of a modern building with a glass facade. The AISC logo is prominently displayed in the center of the banner. Below the banner, there is a login form with fields for USERNAME and PASSWORD, a "Remember Me" checkbox, and a "LOGIN" button. To the right of the login form, there is a "DON'T HAVE AN ACCOUNT?" section with a brief description of the benefits of having an account and a "REGISTER NOW" button. At the bottom of the login form, there are links for "Forgot Username?" and "Forgot Password?".

8-Session Registrants

Course Resources

Go to www.aisc.org and sign in.

The screenshot shows the MyAISC user profile page. On the left side, there is a sidebar menu with links for "IN THIS SECTION", "Edit Profile", "My Downloads", "My Pending Quizzes", "My Events", "Order History", "Course History", and "Course Resources". The "Course Resources" link is circled in red. On the right side, there is a "MyAISC" profile section with a "MY PROFILE" subsection containing an "EDIT PROFILE" button. Below that is a "MY PURCHASED DOWNLOADS" subsection with a "VIEW DOWNLOADS" button. At the bottom, there is a "MY COURSE RESOURCES" subsection with a "VIEW RESOURCES" button, which is also circled in red. The text below this button reads: "View online resources for Night School and Live Webinar package registrations."

8-Session Registrants

Course Resources

The screenshot shows the Course Resources page. At the top, there is a navigation menu with links for EDUCATION, PUBLICATIONS, AWARDS AND COMPETITIONS, TECHNICAL RESOURCES, and STEEL SOLUTIONS CENTER. Below the menu is a large banner image of a modern building with a glass facade. The AISC logo is prominently displayed in the center of the banner. Below the banner, there is a breadcrumb trail: "AISC > MY ACCOUNT > COURSE RESOURCES". Below the breadcrumb trail, there is a section titled "Course Resources" with a table listing various sessions.

Event	Start Date
Session Overview on Steel	1/12/2019 12:00:00 AM
8-Session Package: Design of Facade Attachments	5/9/2019 1:00:00 PM
NS 24 8-Session Package: Night School 24 - Fundamentals of Connection Design	10/15/2020 7:00:00 PM
NS 16 8-Session Package: Night School 16 - Seismic Design on Steel	2/9/2018 7:00:00 PM
NS 12 8-Session Package: Night School 12 - Design of Frame Structures	7/16/2018 7:00:00 PM
NS 23 8-Session Package: Night School 23 - Steel Construction: Mid To Tallness Dist	10/5/2018 7:00:00 PM
NS 22 8-Session Package: Night School 22 - Connections Design	2/16/2019 7:00:00 PM
NS 20 8-Session Package: Night School 20 - Classical Methods of Structural Analysis	6/9/2019 7:00:00 PM
8-Session Package: Seismic Design on Steel - Concrete & Steel/Al	7/16/2018 1:00:00 PM

8-Session Registrants

Course Resources

Night School 24: Modern Methods for Learning Structural Stability

8-SESSION PACKAGE RESOURCES

The screenshot shows the 8-Session Package Resources page. At the top, there is a navigation menu with links for EDUCATION, PUBLICATIONS, AWARDS AND COMPETITIONS, TECHNICAL RESOURCES, and STEEL SOLUTIONS CENTER. Below the menu is a large banner image of a modern building with a glass facade. The AISC logo is prominently displayed in the center of the banner. Below the banner, there is a breadcrumb trail: "AISC > MY ACCOUNT > COURSE RESOURCES > NS24 8-SESSION PACKAGE RESOURCES". Below the breadcrumb trail, there is a section titled "Night School 24: Modern Methods for Learning Structural Stability" and a sub-section titled "8-SESSION PACKAGE RESOURCES" with a table listing various sessions.

Event	Date	Platform	Video	Class	Attendance	
NS24.1 - Compression Members - The Fundamentals	Oct 6 2020 7:00PM EDT	OnDemand	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	OnDemand	Available	10/13/2020 5:00PM EDT	Available 10/13/2020 5:00PM EDT	Pending
NS24.3 - Behavior of Torsion Members - The Fundamentals	Oct 20 2020 7:00PM EDT	OnDemand	Available	10/20/2020 5:00PM EDT	Available 10/20/2020 5:00PM EDT	Pending
NS24.4 - Torsion Members - Practical Considerations	Oct 27 2020 7:00PM EDT	OnDemand	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	OnDemand	Available	11/03/2020 5:00PM EDT	No longer available	Pending
NS24.6 - Stability of Beam-Columns - Practical Considerations	Nov 10 2020 7:00PM EDT	OnDemand	Available	11/10/2020 5:00PM EDT	No longer available	Pending
NS24.7 - Behavior of Structural Systems - The Fundamentals	Nov 17 2020 7:00PM EDT	OnDemand	Available	11/17/2020 5:00PM EDT	No longer available	Pending
NS24.8 - Structural Systems - Practical Considerations	Nov 24 2020 7:00PM EDT	OnDemand	Available	11/24/2020 5:00PM EDT	No longer available	Pending
NS24 - Final Exam	N/A	N/A	Available	12/01/2020 5:00PM EDT	No longer available	Pending



