RISA Webinar

AISC 14th Edition Steel Design in RISA

Presenter: Matt Brown, P.E.
INTEGRATED PROGRAMS

RISAFloor 6.0

RISA-3D 10.0
AISC 360-10 (14th Edition Steel Construction Manual)
Today’s Topics

• Slenderness (Chapter B)
• Local Buckling (Chapter F)
• Torsional Buckling (Chapter E)
• Direct Analysis Method (Chapter C)
• Leaning Column Effect (Chapter C)
New Slenderness Check

SLENDERNESS (CHAPTER B)
Local Buckling due to Bending

• WT’s and Double Angles
• Flange Local Buckling
• Stem Local Buckling
L-torque = Unbraced Length for Twisting

Torsional Buckling of Wide Flange shapes applies when....

L-torque > Lbyy and L-torque > Lbzz

FLEXURAL-TORSIONAL BUCKLING (CHAPTER E)
AISC Specification Appendix 7

Direct Analysis Method

AISC Specification Chapter C

Design for Stability
Direct Analysis Requirements

1. Second Order Analysis (P- $\Delta$, P- $\delta$)
2. Stiffness Reduction (EI*, EA*)
3. Notional Loads
Cantilever Column

- W12x45
- 200k Gravity Load
- 10k Lateral Load
- 12’-0” Tall
Initial Shear:  10k
Initial Moment:  \((10k) \times (12 \text{ ft}) = 120 \text{ ft-k}\)
Initial Deflection:  1.021”
<table>
<thead>
<tr>
<th>Step</th>
<th>Deflections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 0 (Initial)</td>
<td>1.021”</td>
</tr>
<tr>
<td>Step 1</td>
<td>1.166”</td>
</tr>
<tr>
<td>Step 2</td>
<td>1.186”</td>
</tr>
<tr>
<td>Step 3</td>
<td>1.189”</td>
</tr>
<tr>
<td>Step 4 (Final)</td>
<td>1.190”</td>
</tr>
</tbody>
</table>
Cantilever Column

- W8x35
- 200k Gravity Load
- 10k Lateral Load
- 12’-0” Tall

EXAMPLE PROBLEM 2
Initial Shear: 10k

Initial Moment: (10k)*(12 ft) = 120 ft-k

Initial Deflection: 8.073”
## Deflections

<table>
<thead>
<tr>
<th>Step</th>
<th>Deflection (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 0 (Initial)</td>
<td>8.073”</td>
</tr>
<tr>
<td>Step 1</td>
<td>17.146”</td>
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<tr>
<td>Step 2</td>
<td>27.479”</td>
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<tr>
<td>Step 3</td>
<td>39.565”</td>
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<tr>
<td>Step 4</td>
<td>54.345”</td>
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</table>

**EXAMPLE PROBLEM 2**
Direct Analysis Requirements

1. Second Order Analysis ($P-\Delta$, $P-\delta$)

2. Stiffness Reduction ($EI^*$, $EA^*$)

3. Notional Loads
Flexural Stiffness \[ EI^* = 0.8\tau_b EI \]

Axial Stiffness \[ EA^* = 0.8EA \]
Without Reduction

Initial Deflection = 1.021”
Final Deflection = 1.19”
Final Moment = 140 k-ft
U.C. = 1.021

With Reduction

Initial Deflection = 1.268”
Final Deflection = 1.538”
Final Moment = 146 k-ft
U.C. = 1.042
Direct Analysis Requirements

1. Second Order Analysis ($P-\Delta$, $P-\delta$)
2. Stiffness Reduction ($EI^*$, $EA^*$)
3. Notional Loads
Per AISC Code of Standard Practice

Erection Tolerance for Columns
(out of plumb) = $H/500$

Notional Load $(N) = P/500$
Direct Analysis Requirements

1. Second Order Analysis ($P-\Delta$, $P-\delta$)
2. Stiffness Reduction ($EI^*$, $EA^*$)
3. Notional Loads

$K = 1.0$
Traditional Design
M = 120 k-ft
K = 2.1
Req’d Shape: W12x65

Direct Analysis
M = 148 k-ft
K = 1.0
Req’d Shape: W12x50

COMPARISON
Middle Column is Pin-Pin (Leaning)
Problem:

P-Δ effect on Middle Column adds to Destabilizing (Leaning) Effect.

Because column is Pin-Pin it cannot resist this effect.
Solution:

Add additional (fictitious) story shear which will be carried by the non-leaning columns
Additional Resources

- AISC Publications
- RISA-3D Help File / Manual
- www.risanews.com
Questions?

Please let us know if you have questions.

We will answer as many questions as time permits during the webinar.

Once the webinar is closed, we will post all Q&A’s, as well as the Quick Reference Guide, to our website: www.risa.com

For further information, contact us at: info@risatech.com

Thank you for Attending!