RISA Webinar

Understanding and Optimizing Hot Rolled Steel Design in RISA

Presenter: Matt Brown, P.E.

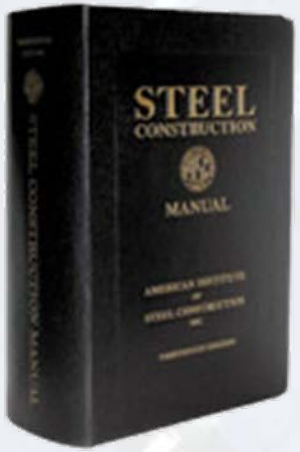
RISA TECHNOLOGIES

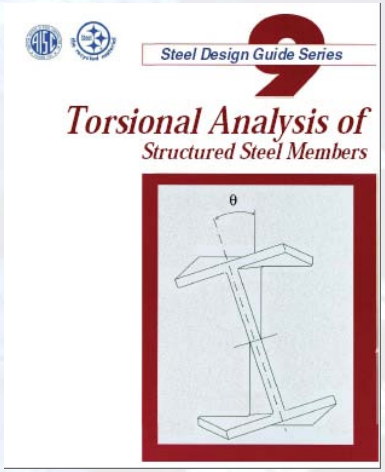
RISAFloor 5.1

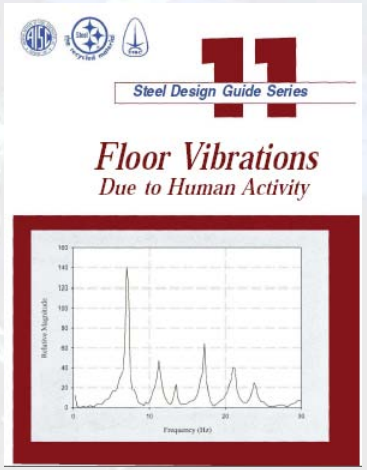
RISA-3D 9.1

INTEGRATED PROGRAMS

- AISC 360-05 (13th Edition Steel Construction Manual)
- AISC Design Guide #9 (Torsion)
- AISC Design Guide #11 (Vibration)







Images courtesy of AISC.org

REFERENCED CODES

Today's Topics

- Direct Analysis Method
- Warping Torsion
- Single Angles
- Floor Vibrations
- Steel Joists

AISC Specification Chapter C

Stability Analysis and Design

AISC Specification Appendix 7

Direct Analysis Method

DIRECT ANALYSIS METHOD

Direct Analysis Requirements

1. Second Order Analysis (P- Δ, P- δ)
2. Stiffness Reduction (EI*, EA*)
3. Notional Loads

Cantilever Column

- W12x45
- 200k Gravity Load
- 10k Lateral Load
- 12’-0” Tall

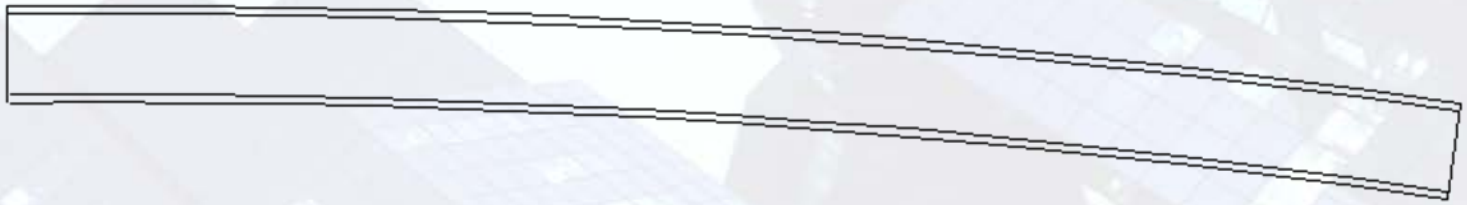
EXAMPLE PROBLEM

Initial Shear: 10k

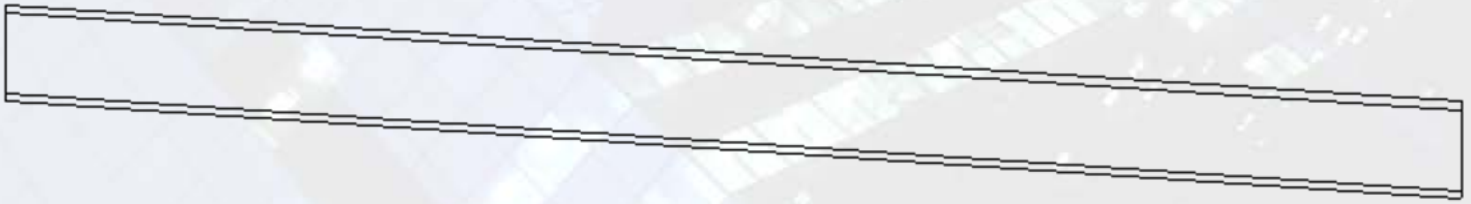
Initial Moment: (10k)*(12 ft) = 120 ft-k

Initial Deflection: $\frac{PL^3}{3EI}$ = 0.981”

Bending Deflection: $\frac{PL^3}{3EI}$ = 0.981”



Shear Deflection: $\frac{cPL}{A_w G}$ = 0.035”



Final Shear:	11.6k
Final Moment:	139 ft-k
Final Deflection:	1.182”

16% Increase over First-Order

Final Shear:	12.5 k
Final Moment:	140 ft-k
Final Deflection:	1.216”

Direct Analysis Requirements

1. ~~Second Order Analysis (P-Δ, P-δ)~~
2. Stiffness Reduction (EI*, EA*)
3. Notional Loads

Flexural Stiffness

$$EI^* = 0.8\tau_b EI$$

$$\tau_b = f\left(\frac{P_u}{P_n}\right)$$

Axial Stiffness

$$EA^* = 0.8EA$$

STIFFNESS REDUCTION

Direct Analysis Requirements

1. ~~Second Order Analysis (P-Δ, P-δ)~~
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-Δ, P-δ)~~

~~2. Stiffness Reduction (EI*, EA*)~~

~~3. Notional Loads~~

$$K = 1.0$$

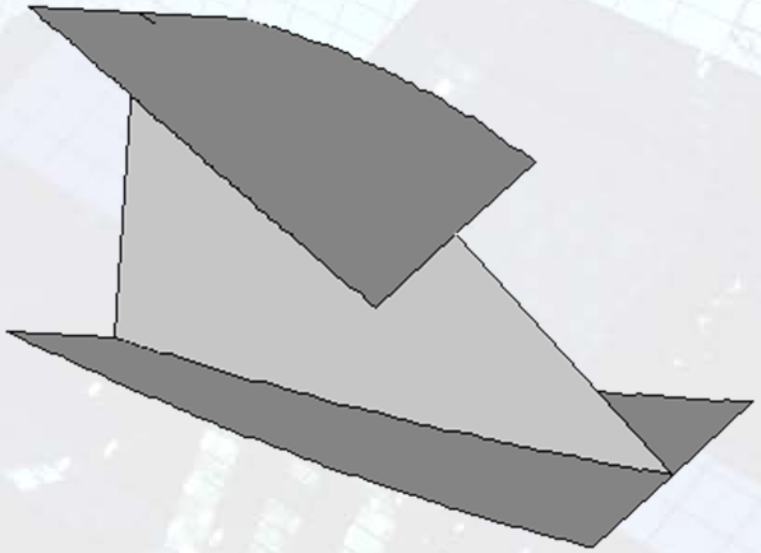
Traditional Design	Direct Analysis
M = 120 k-ft	M = 152 k-ft
K = 2.1	K = 1.0
Req'd Shape:	Req'd Shape:
W12x40	W12x45

COMPARISON

Warping Torsion

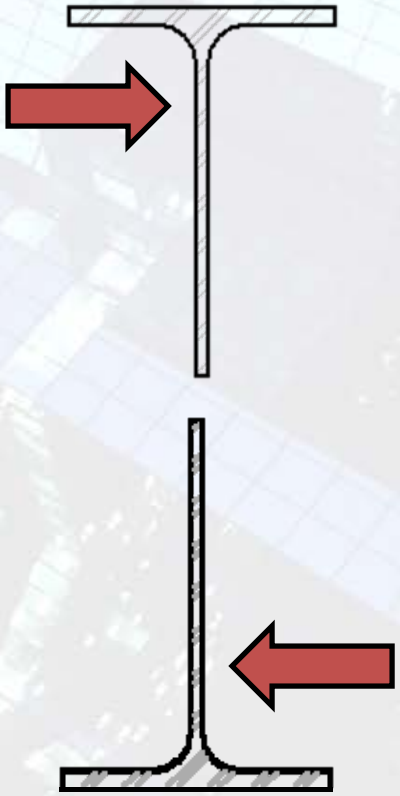
affects Wide Flange

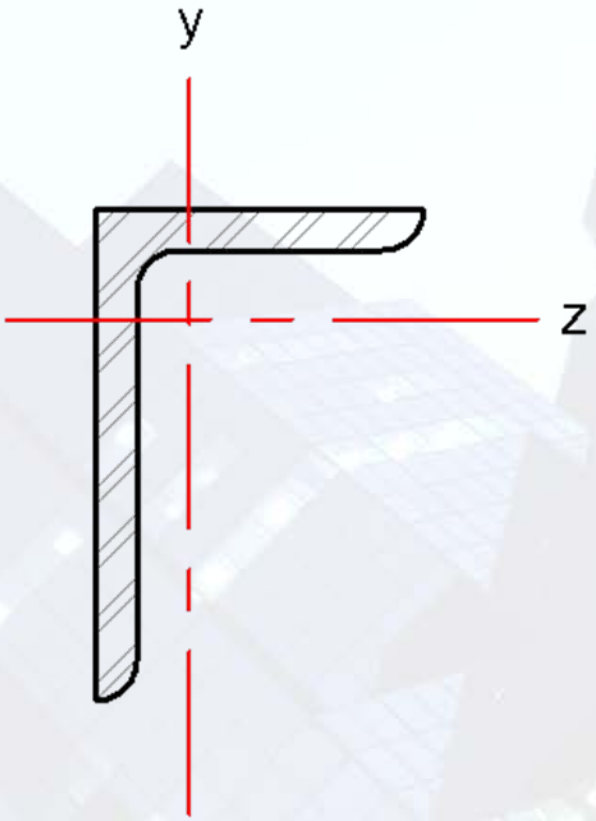
and Channel Shapes



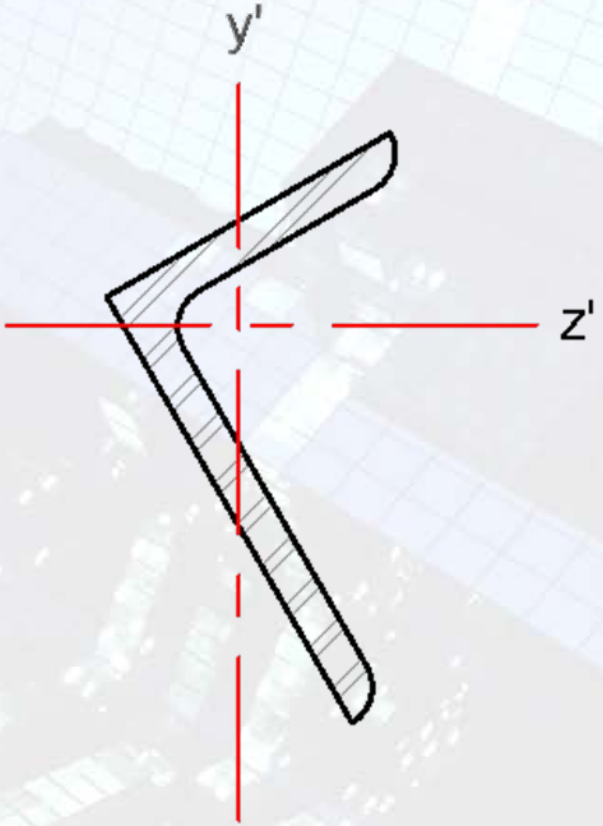
Idealize as two WT sections,

each in minor axis bending





Geometric Bending



Principal Bending

SINGLE ANGLES

Floor Vibration Procedure:

1. Determine damping weight
2. Determine beam natural frequency
3. Calculate expected acceleration

Damping Weight

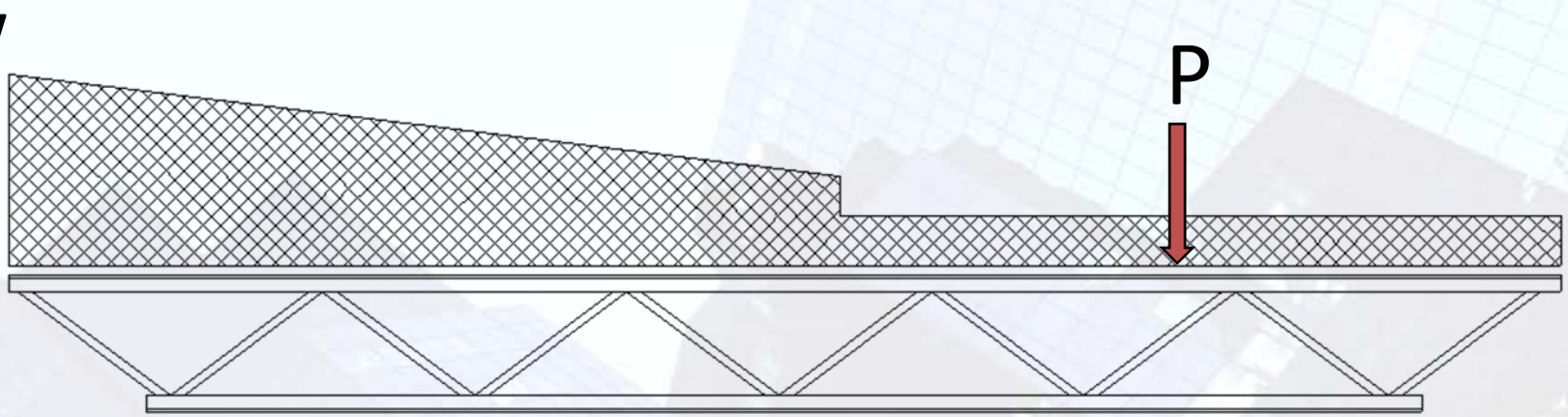
Beam Self Weight

+ Slab Weight

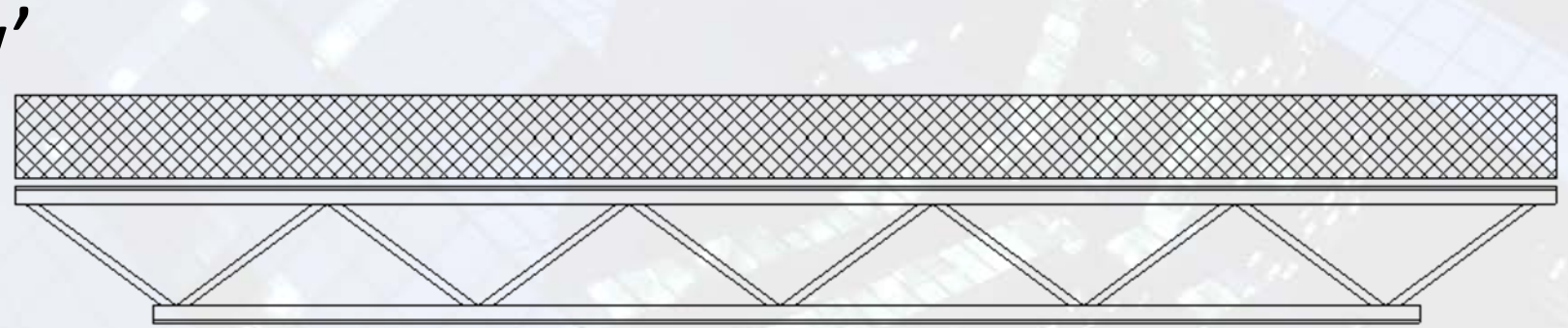
+ Realistic Superimposed Load (11 psf?)

Allowable Acceleration

- Based on 65 lb excitation force (footfall)
- 0.5% g for Offices, Residences, Churches
- 1.5% g for Shopping Malls



Actual Load



Equivalent Uniform Load

STEEL JOISTS

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!