Speakers

Jacob Dolas

4+ years of experience
- Bridge Deconstruction and Demolition
- Movable Bridge Demolition, Rehabilitation, and Balancing
- Shoring Design

Edgar Nunez, PE

10+ years of experience
- Bridge Erection and Demolition
- Bridge Design & Inspection
- Load Ratings

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Learning Objectives

- What loads, critical points of analysis, and failure modes to consider for a demolition analysis.
- Effective solutions to common challenges.
- Best practices for communication (interoffice and with client)

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Key to Demo Engineering

Demo Engineering **IS NOT** New Bridge Design.

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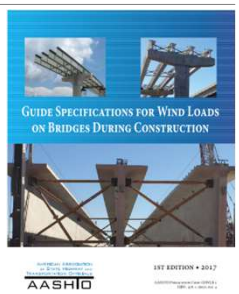
Environmental Loading

- Demo **IS** temporary
- Wind! Reduce in accordance with ->



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Live Loading

- Demo **IS** controlled
- Control: Equipment size and weight, carry weight, positioning, operating speed, offset between other equipment and slab edges

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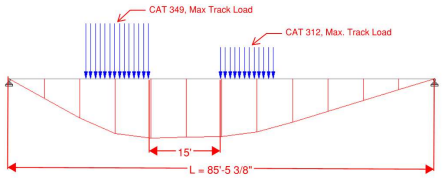
Analysis of Live Loads

- Load factors
- Dynamic load allowance (Impact)
- Load distribution factors
- AASHTO vs ASCE Bridge Demolition Best Practices



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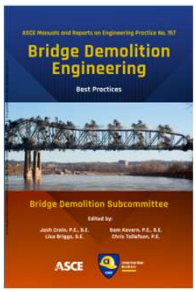
Impact Factor

Demolition Operation	Minimum Impact Factor	Notes
Walking (traveling)	1.05	Demolition equipment is often moving at very slow speeds, and as such, a nominal dynamic allowance is considered appropriate. Wheeled equipment impact should be based on bridge deck conditions and speed constraints
Hoisting and swinging operations	1.05	A larger dynamic factor than listed may be considered to account for potential binding of the member
Concrete removal operations	Hammering—1.25 Shearing—1.10 Panelized slab removal—1.15	Dynamic Allowance during deck removal operations will vary depending on the removal operation. Suggested minimum impact factors given are based on a survey of demolition engineers

The Demo Bible! ->



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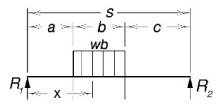
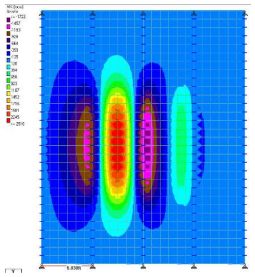
Load Distribution - Deck

- Quick = AISC Beam Eqn. (left)
- Refined = STAAD PL Model (right)





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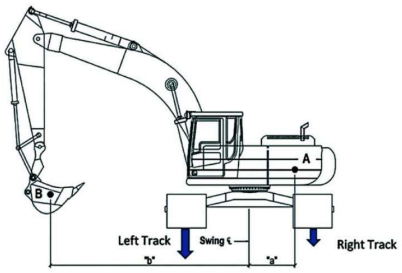
Load Distribution - Deck



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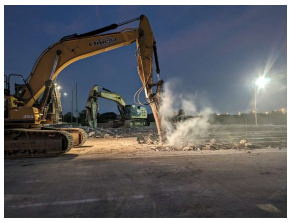
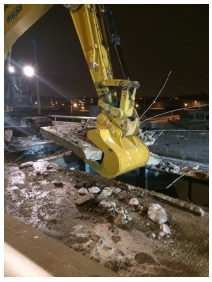
Load Distribution

- Wrecking-in-place vs. Panelized Removal
- Both can create track load imbalance!





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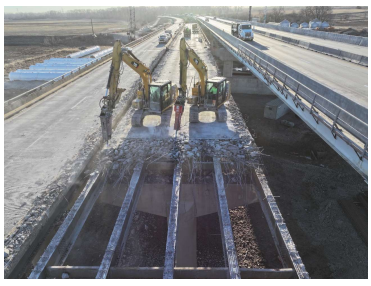
Load Distribution



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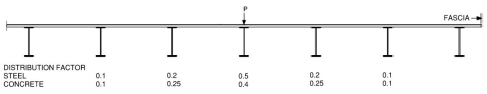
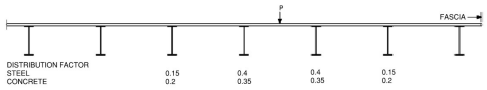
Load Distribution - Girders

CASE I



CASE II



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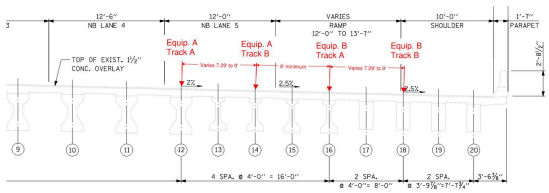
Load Distribution - Girders



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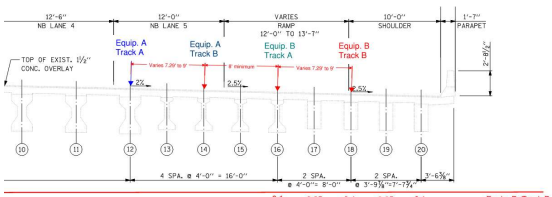
Load Distribution - Girders



					0.1	0.25	0.4	0.25	0.1	Equip. B, Track B
				0.1	0.25	0.4	0.25	0.1		Equip. B, Track A
		0.1	0.25	0.4	0.25	0.1				Equip. A, Track B
0.1	0.25	0.4	0.25	0.1						Equip. A, Track A

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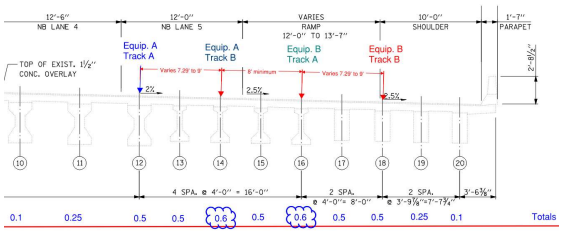
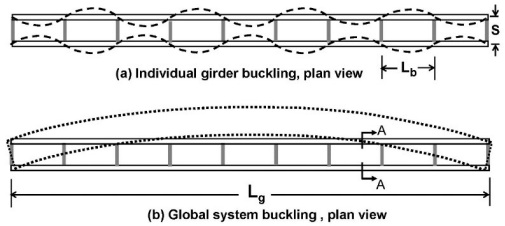
Load Distribution - Girders



Failure Modes



Failure Modes

- Loss of composite action

Failure Modes

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Bracing Conditions

- Changes as demolition progresses

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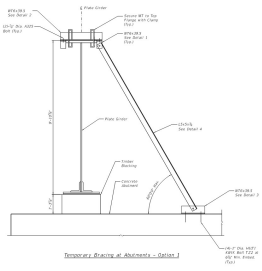
Girder Stability – Temp. Bracing

- Fabricated option
  - Ensure constructability
  - Ensure material availability



Temporary Bracing at Abutments – Option 1

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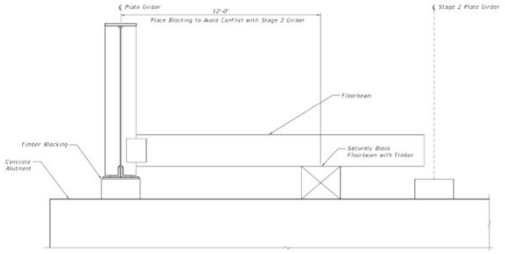
Girder Stability – Temp. Bracing

- "Creative" option
  - Verify adequacy of member



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Girder Stability – Dropping Girders

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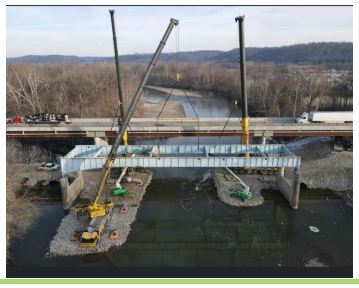
Girder Stability

- "Hold Crane"



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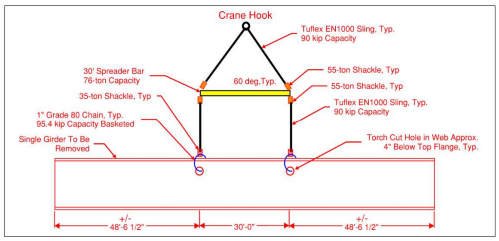
Girder Stability - Lifting

- Balanced Lifting



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Girder Stability - Lifting

- NHI Engineering for Structural Stability in Bridge Construction
- Elastic buckling moment capacity:

$$M_u < \phi_b M_{cr} = \phi_b C_{bL} \frac{\pi}{L_b} \sqrt{EI_y GJ + E^2 I_y C_w \left(\frac{\pi^2}{L_b^2}\right)}$$ **Equation 7-7**

$$C_{bL} = 6.0 \; for \; 0.225 < \frac{L_{Lift}}{L} < 0.3$$ **Equation 7-9**

$$C_{bL} = 4.0 \; for \; \frac{L_{Lift}}{L} \geq 0.3$$ **Equation 7-10**

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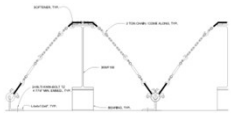
Girder Stability

- Uplift – Design/Construction vs Demolition



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Useful Resources

- Wisconsin Highway Research Program (WHRP) Bridge Construction Live Load Analysis Guide
- NHI Engineering for Structural Stability in Bridge Construction
- ASCE Bridge Demolition Best Practices
- Caltrans Bridge Removal Manual
- Useful, but remember the fundamentals

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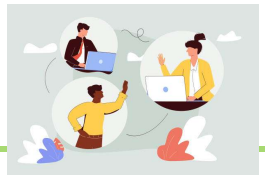
Communication

TO REVIEWER

- Complete package upon submittal
- Concise, easy to follow
- Will it be repeated or adapted?

TO CLIENT

- Demolition Procedure
- Communicate throughout the entire process
- Will it be repeated or adapted?



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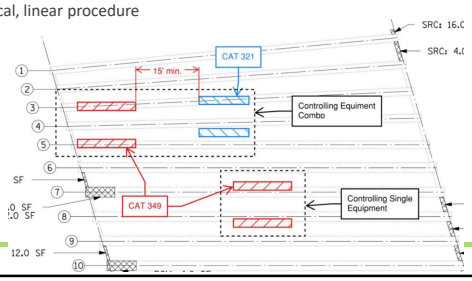
Communication, cont'd

- A (sketch) is worth a thousand words
- Clear assumptions and restrictions
- Logical, linear procedure



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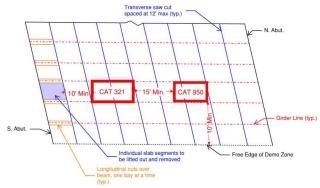
Restrictions

- Concise and consistent, even if that means more conservative
- Communicate ahead of time if it's a significant change
- If possible, mark out the restrictions in the field
  - Cut lines, equipment travel paths, etc.



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Summary

- Failure modes - local and global behavior
- Use fundamentals AND helpful resources to determine accurate loading and load distribution
- Be thorough, clear, concise, and use visuals

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Questions?

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