Skews and Railroads and Seismic Oh My!

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Presentation Overview

- Project Description & Goals
- Project Challenges
- Project Solutions

Project Goals: I-15 SB DB

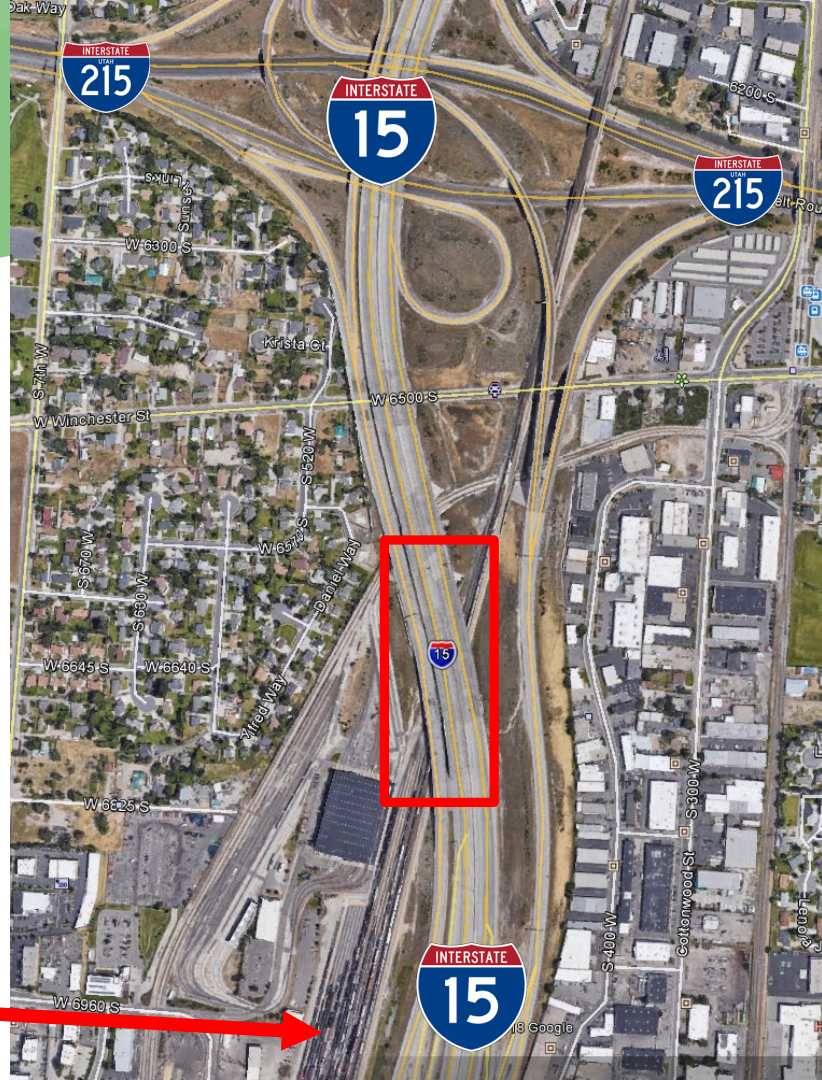
- $135.9 Million Design Built Project awarded to Ralph L Wadsworth/Michael Baker Team
- Add 1 lane to 14 miles of urban interstate I-15 SB
- Structures Task:
  - Replace 2 railroad bridges
  - Widen 8 bridges
  - Narrow 3 CD bridges

Project Site

- I-15 South
- I-215 to I-15 SB Ramp & CD Road

Project Site

- I-15 South
- I-215 to I-15 SB Ramp & CD Road



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Existing Project Site

Existing Project Site

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Initial Louisville Office Involvement

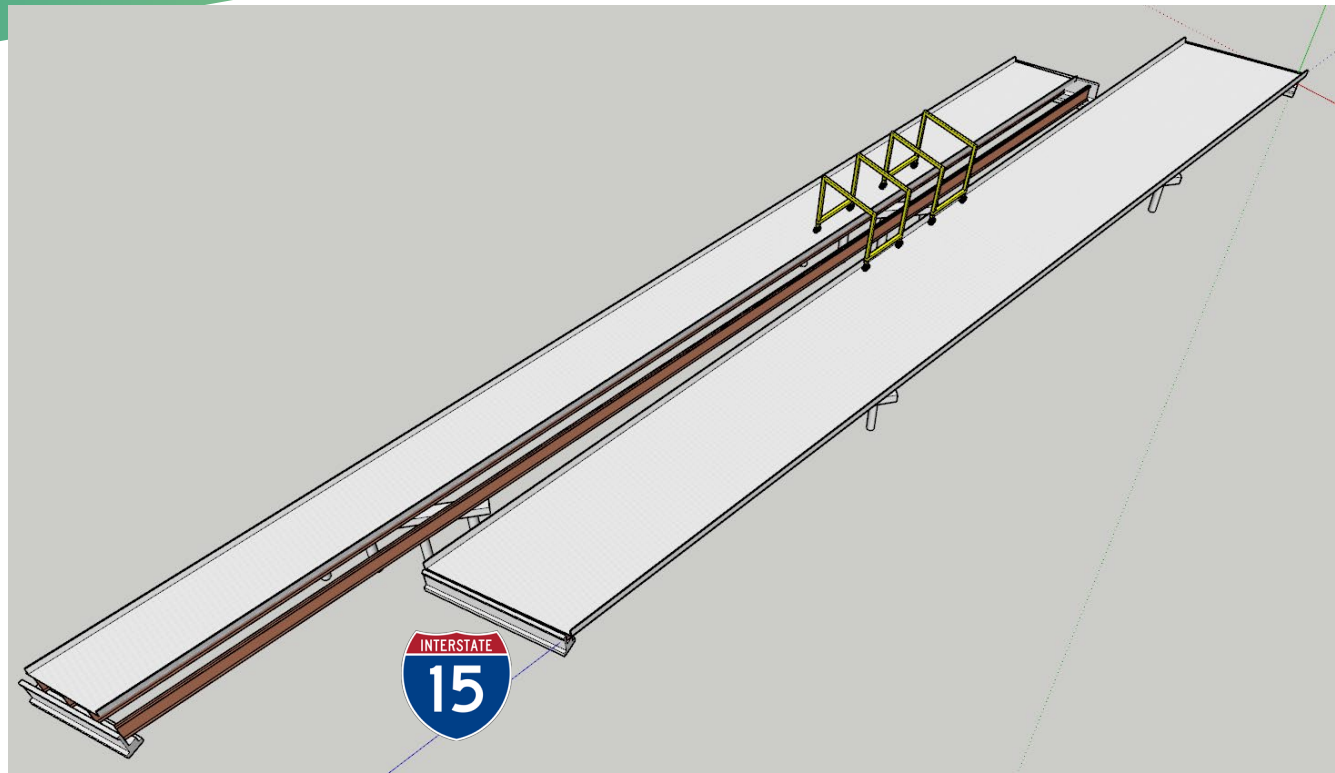
- Steel tariffs announced early 2018
- Need final steel design in 1 month to get mill order in before potential increase in cost

Project Challenges

- Curved non-concentric bridges
- Varying skews (20° – 60°)
- Unbalanced spans
- Over 2 railroad company tracks
- High seismic
- Substructure reuse
- No construction access

Existing Bridges

Remove Part of I-215 CD



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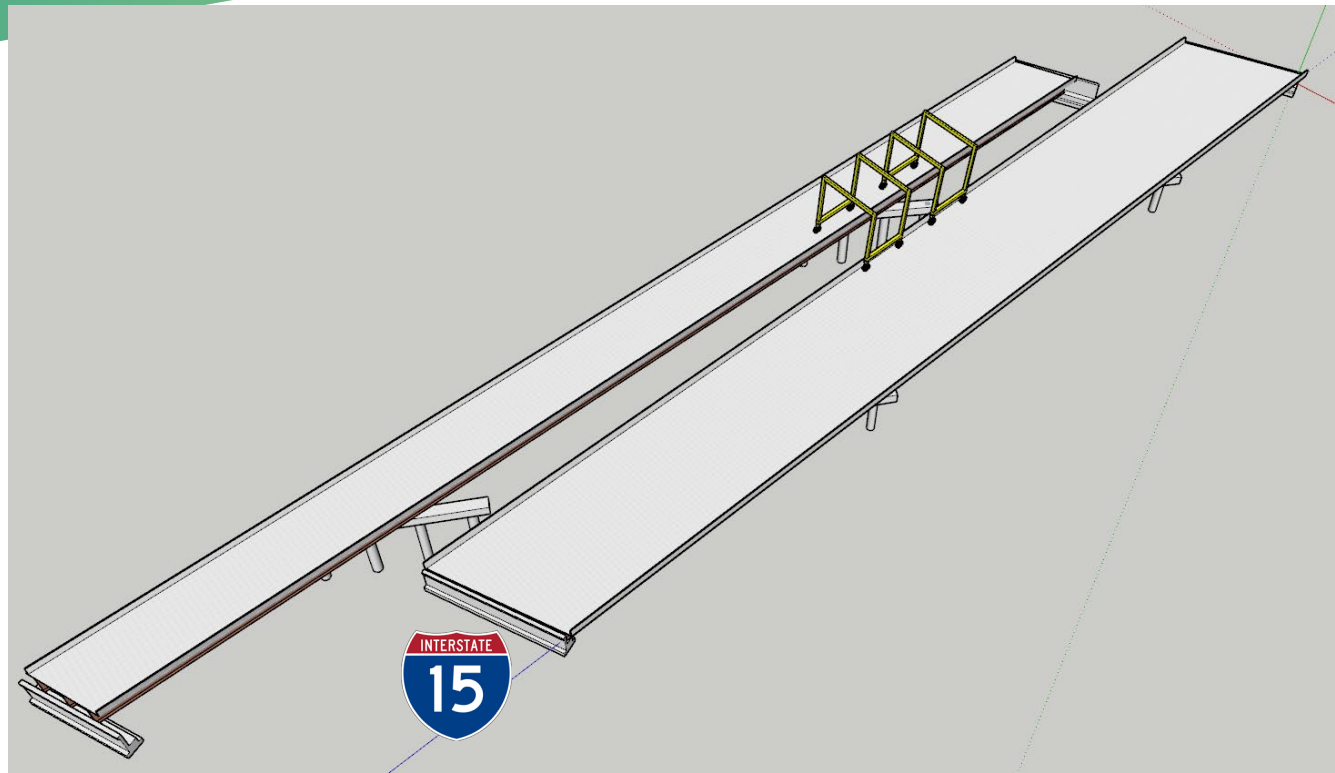
Remove Part of I-215 CD



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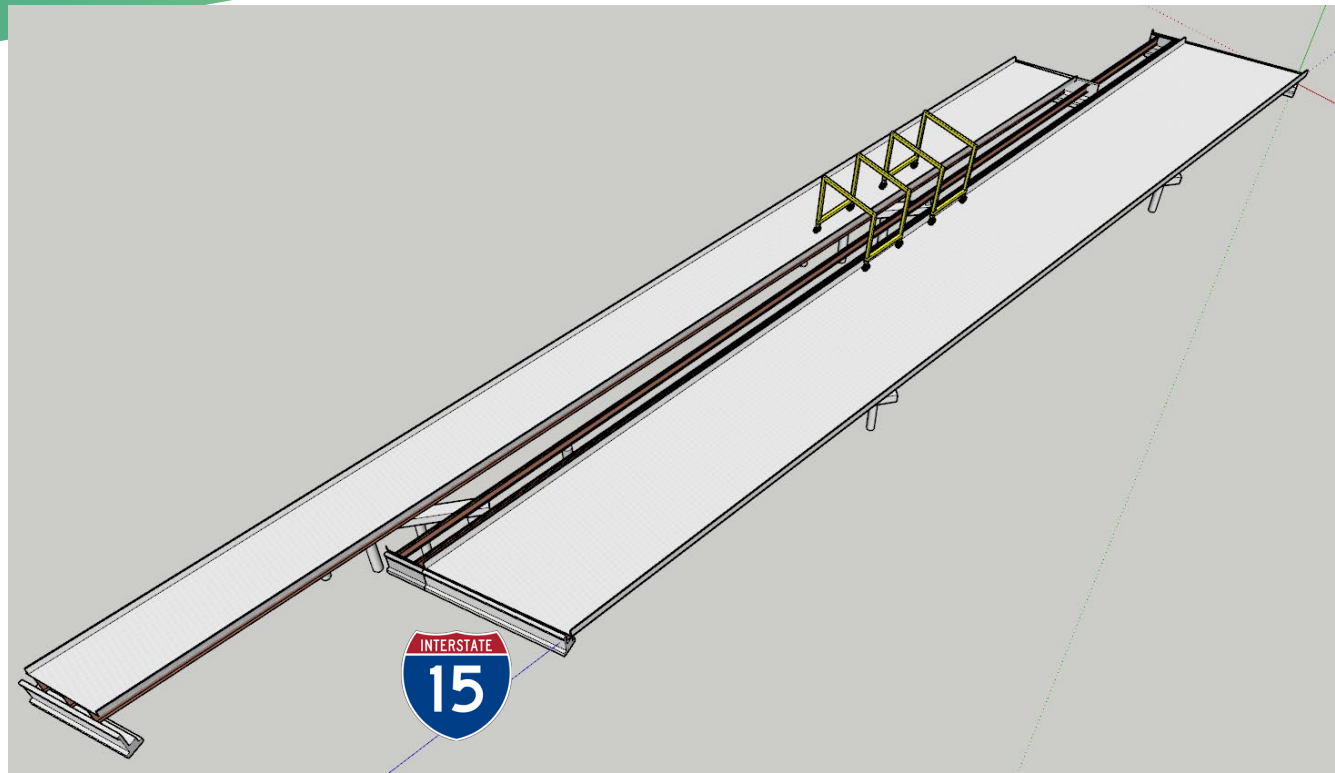
Widened I-15 Bridge



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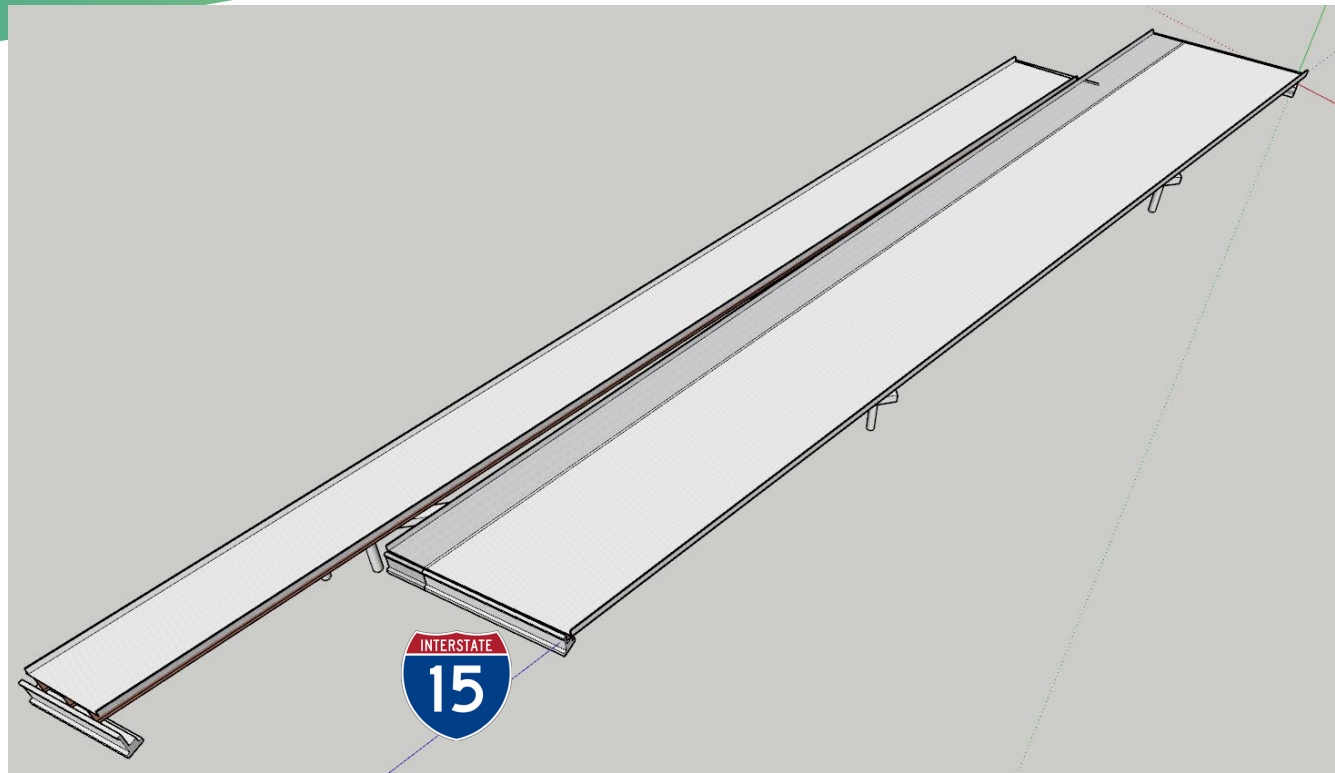
Final Configuration



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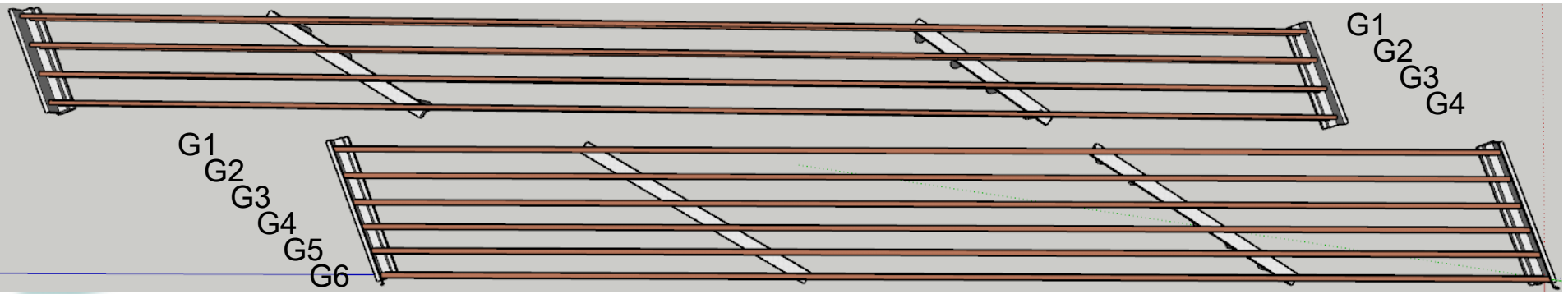
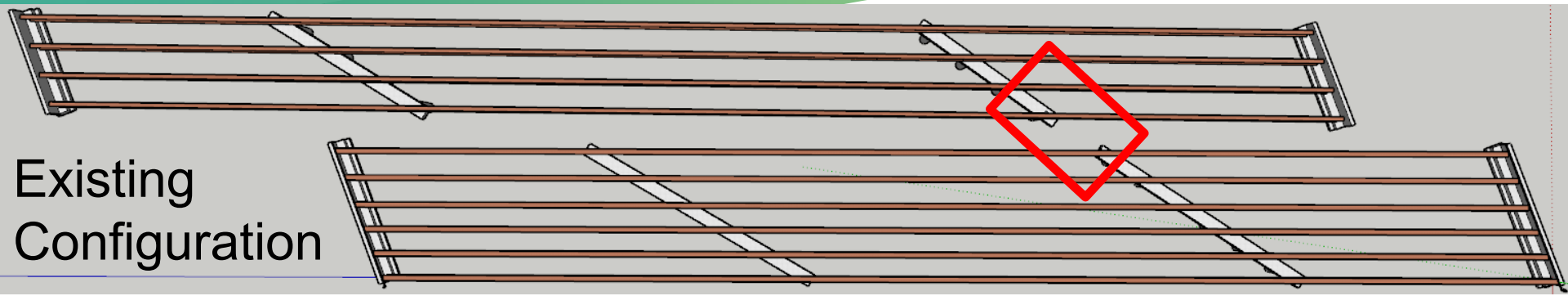
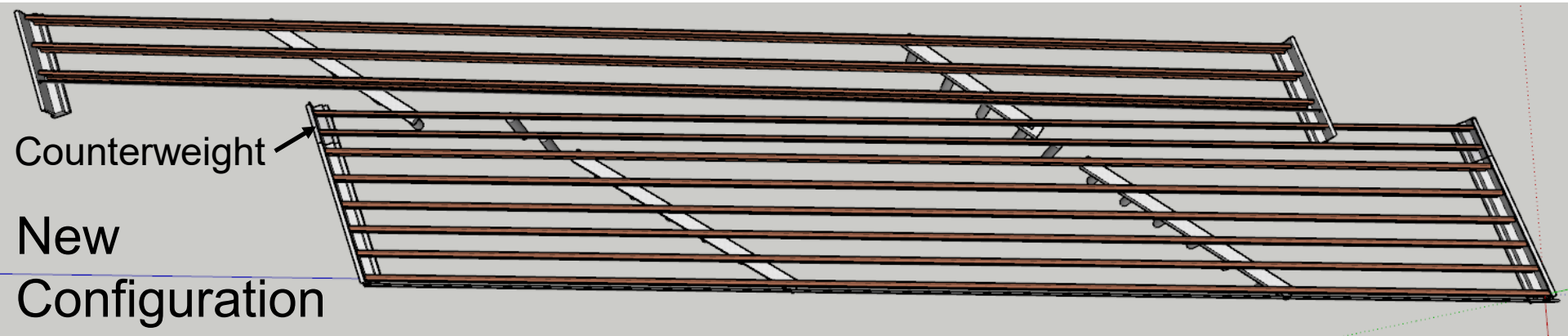
Project

		SPAN 1 (ft)	SPAN 2 (ft)	SPAN 3 (ft)	Radius (ft)
I-15	G1A	109	278	249	4491
	G1B	124	275	238	4502
	G1	139	272	227	4513
	G6	239	269	140	4588
I-215 CD	G1	135	337	217	3589
	G4	203	335	161	3637



Widened I-15 Bridge





Site Access: RR Must Stay Open

- 2 – 40 ton Mi-Jack Cranes
- 1 wheel line on each bridge

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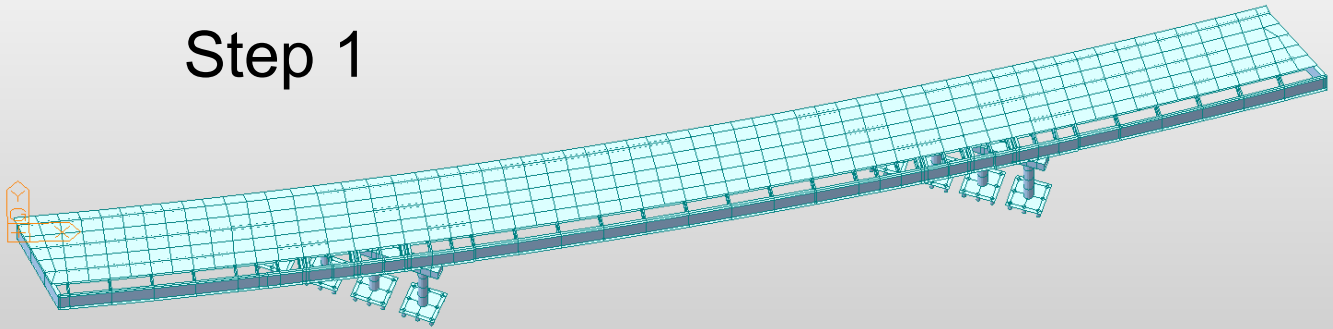
I-215 CD Narrowing

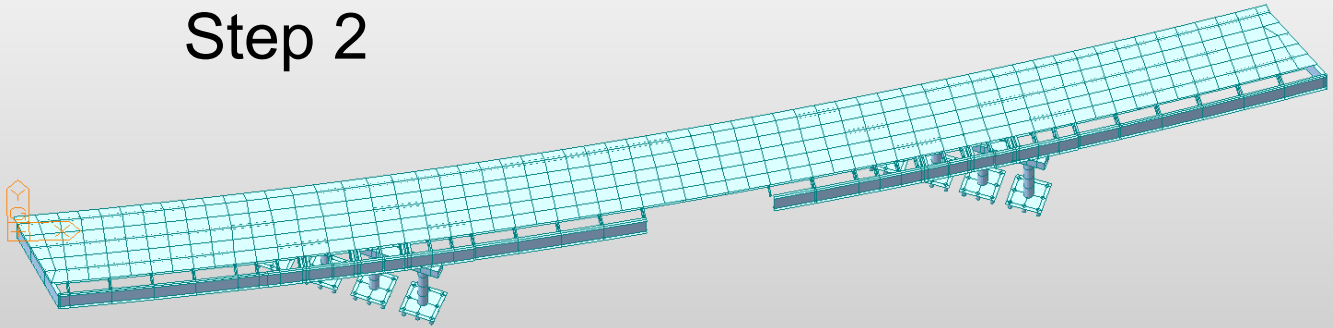
- Need to use Mi-jack crane: Limit weight
- Falsework not possible in span 2
- Cross-frames all WT sections
- Major design considerations
  - Girder Stability
  - Cross-frame capacity

I-215 CD Narrowing

Step 1

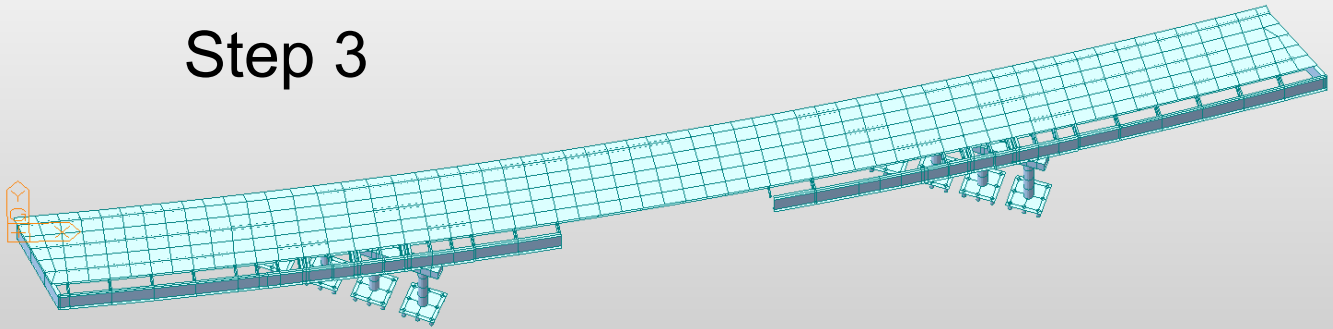


Step 2

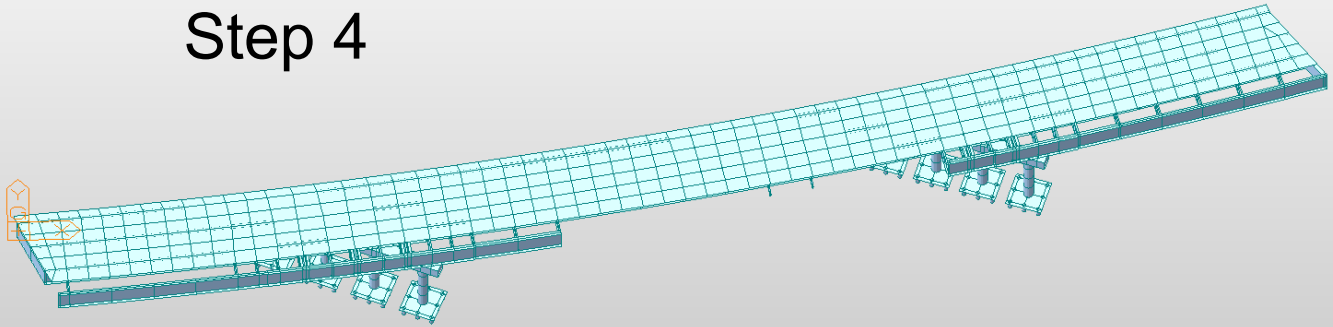


I-215 CD Narrowing

Step 3



Step 4



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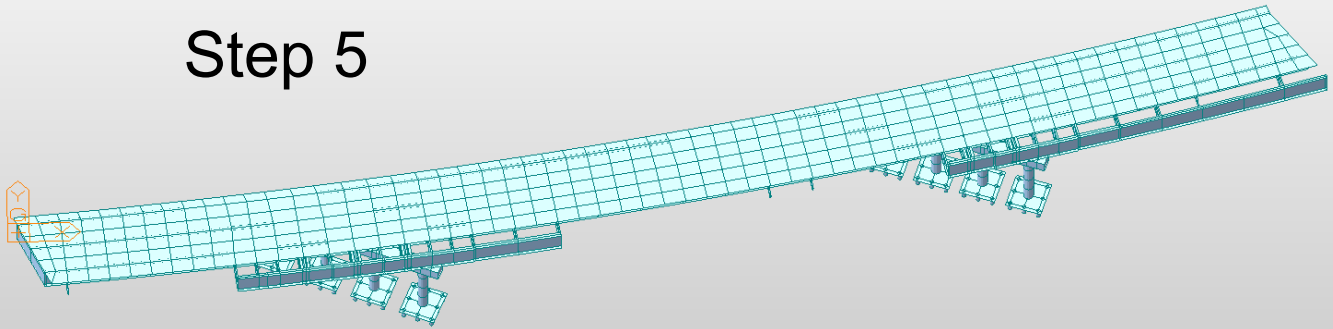
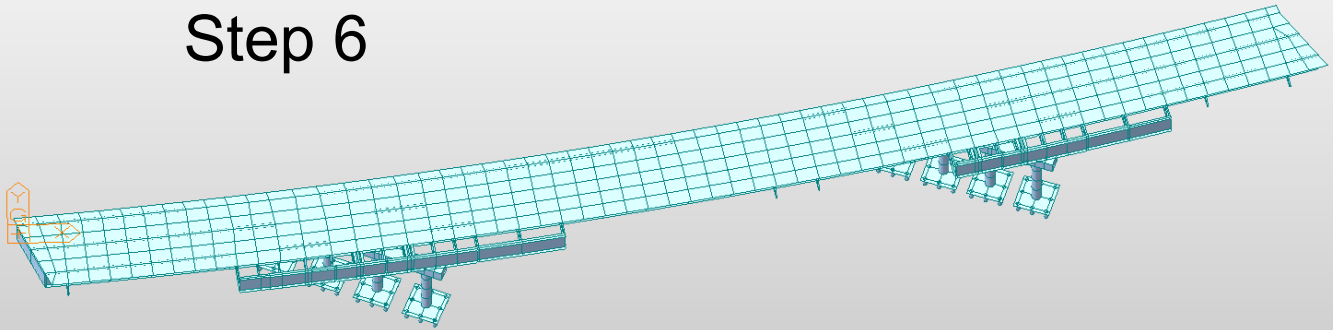
I-215 CD Narrowing

Step 5



Step 6



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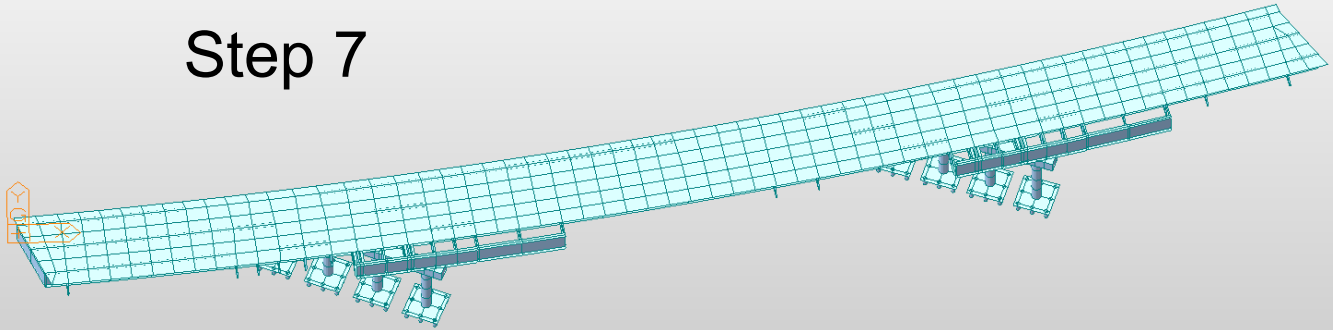
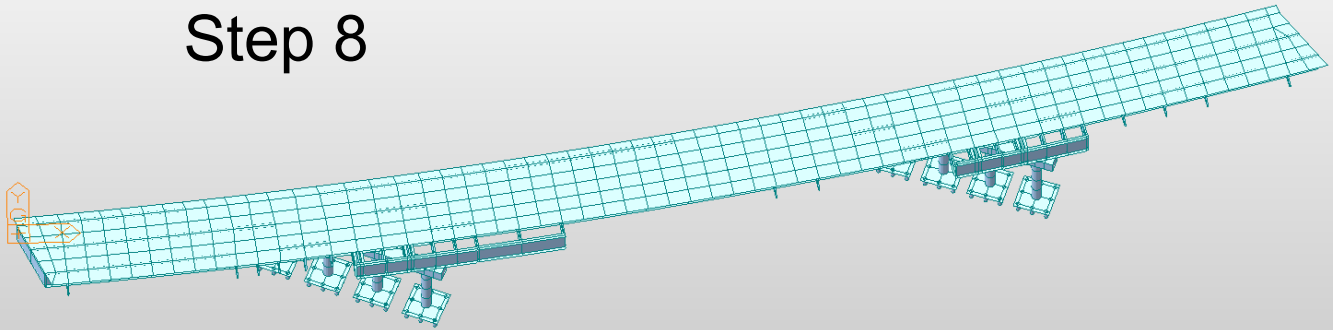
I-215 CD Narrowing

Step 7



Step 8



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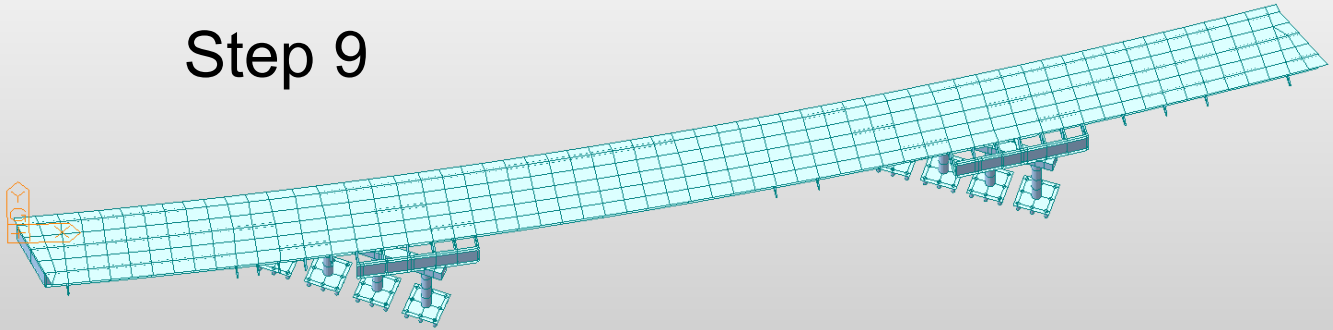
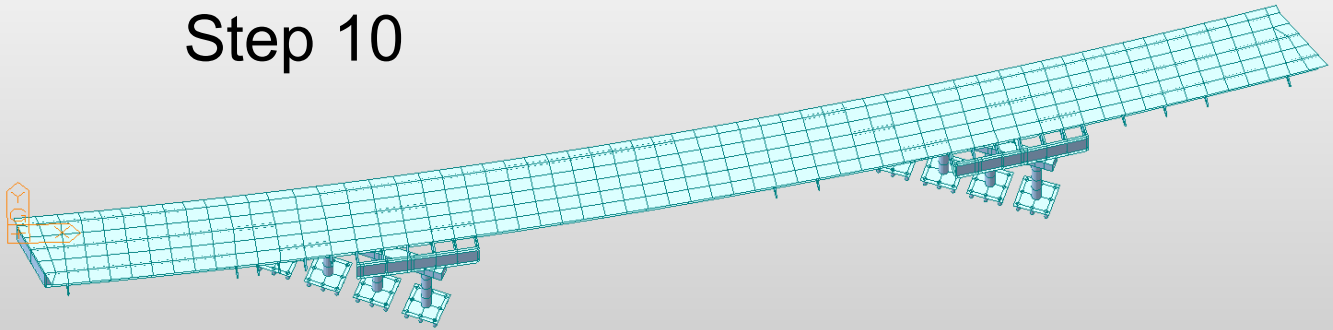
I-215 CD Narrowing

Step 9



Step 10

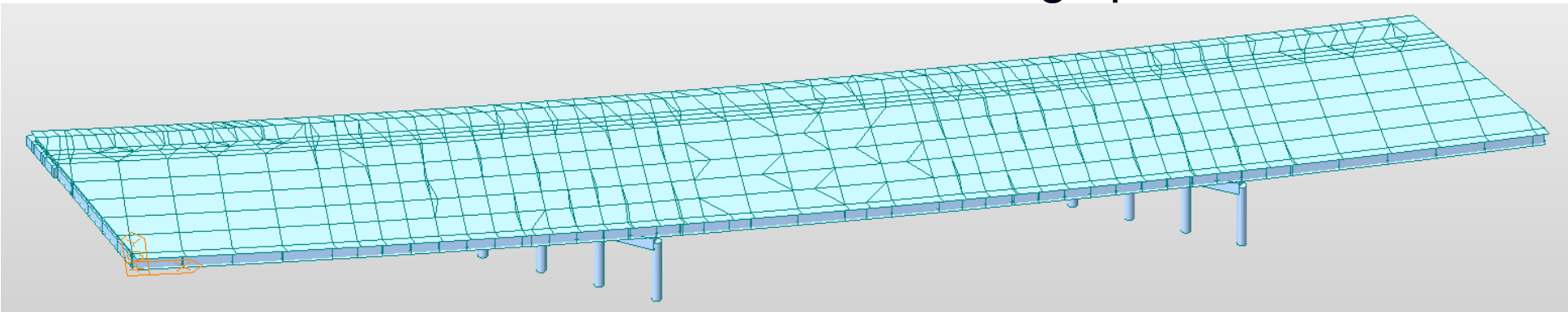


I-15 Bridge Girder Design

- Existing girders are ~84” Deep
- New girders maximum depth 72”(RR Clearance)
- Minimize weight
  - Use hybrid girder with HPS70W flanges
- Load rating: Do no harm!

I-15 Bridge Girder Design

- Plate & eccentric beam Midas model with construction staging
- Warping DOF beam element
- In-house code checking spreadsheet

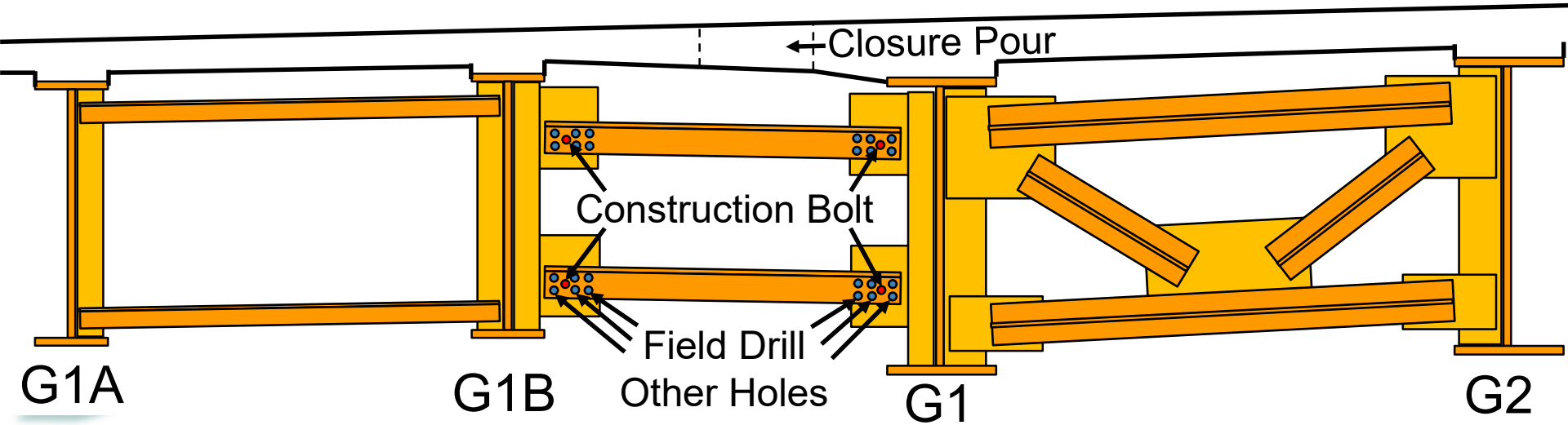


I-15 Bridge Girder Design

- Large cambers (10% Rule)
  - Include ½” extra clear cover to provide extra depth for post-deck placement milling
  - Closure pour
- LMC overlay across the entire width of bridge
- Lean-on bracing

I-15 Bridge Girder Design

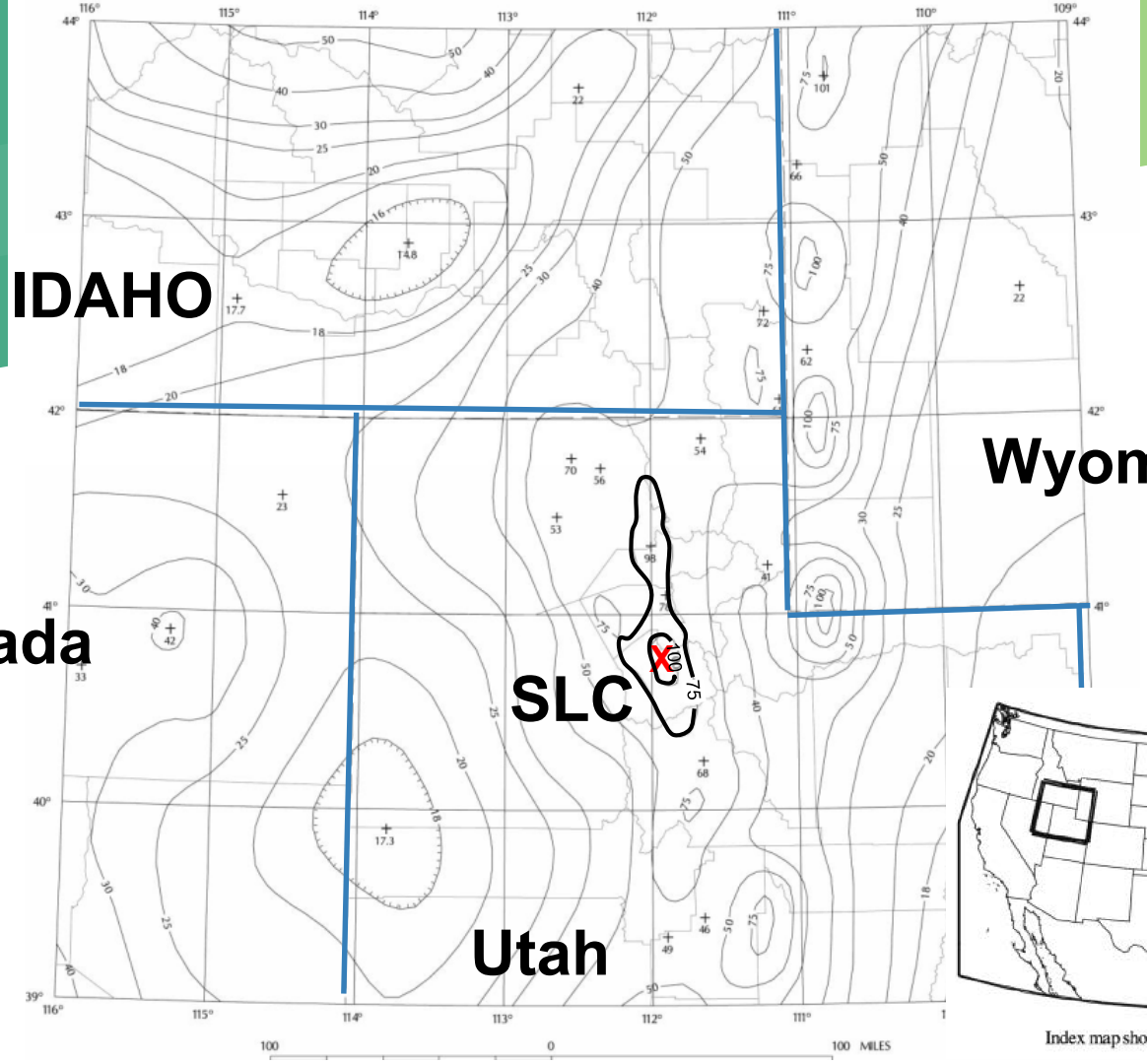
- Lateral-torsional buckling stability
- Lateral **OR** torsional bracing

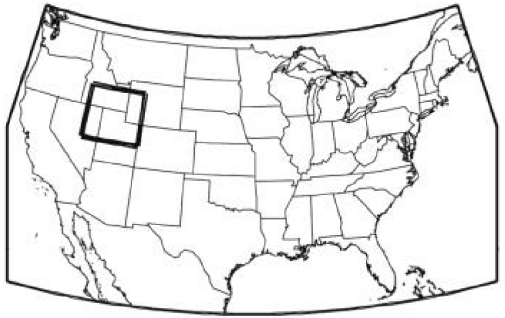


Seismic Details

- Essential bridge
- 7% exceedance in 75 years or 1000 year return period
- Seismic design category C
- I-15: ERS Type 3 w/ lead core elastomeric isolation bearings
- I-215 CD: ERS Type 1 with heavy pin & cross-frames attached to piers

Utah Seismic Map





Index map showing location of study area

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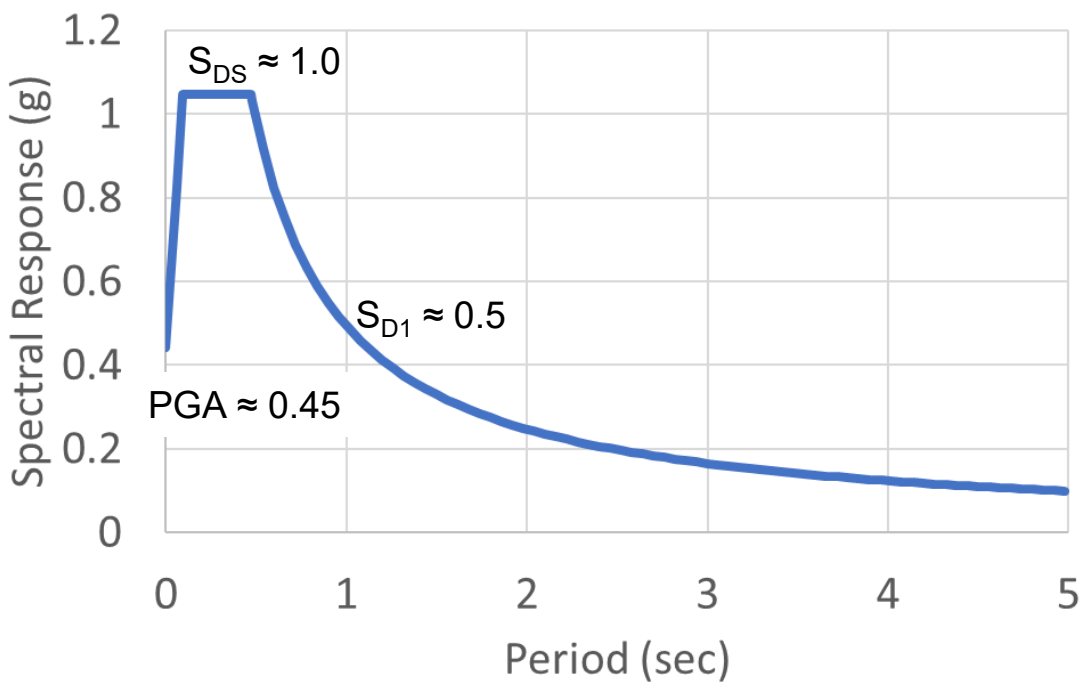
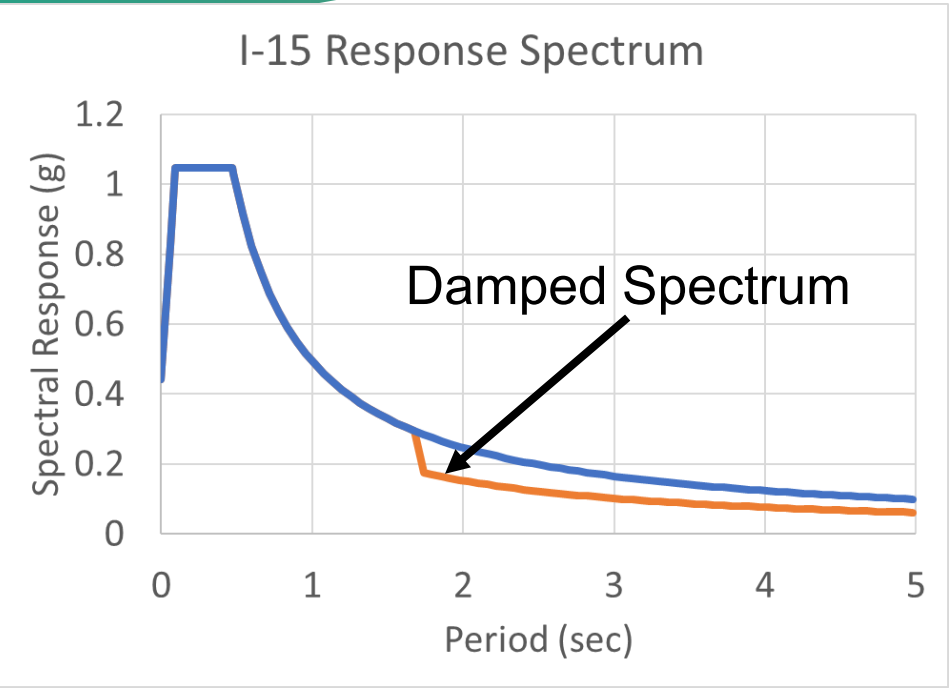
Seismic Response



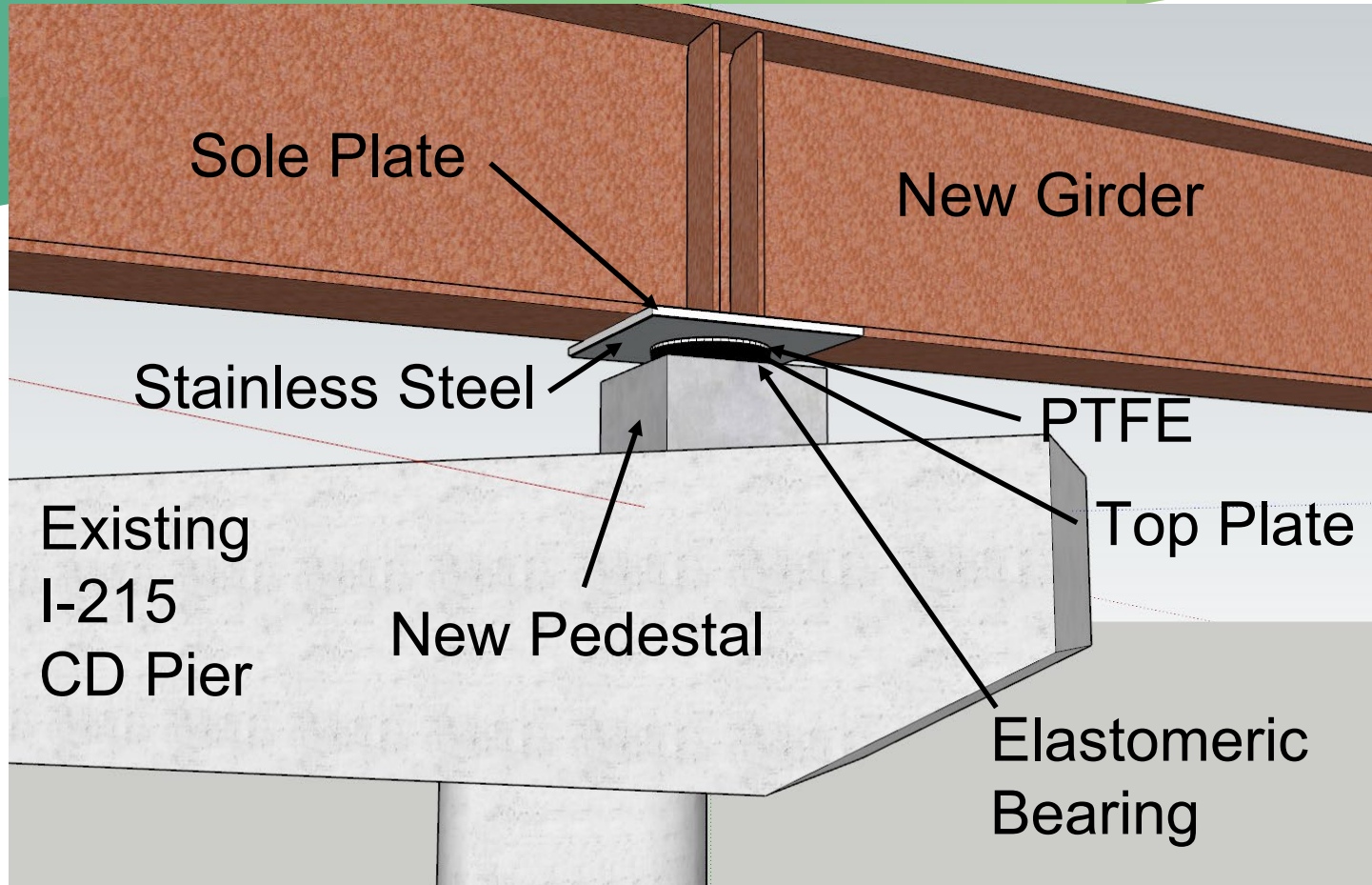
Seismic Strategy



- Match existing lead core seismic isolation bearing
  - Stiffness
  - Minimum EDC – Energy Dissipated per Cycle
- K_{eff}: minimum and maximum effective stiffness
- Target 25% Damping

Sliding Bearing

- Allow up to +/- 12” of movement



Construction

Construction

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Questions?

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