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

Union Pacific RR (UPRR) Yard
Existing Project Site

I-215 CD 4 Lanes w/ minimum shoulders

I-15 SB 5 Lanes w/ full shoulders
Existing Project Site

- Widen I-15 by 22 ft.
- Narrow I-215 CD by 14 ft.
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
Remove Part of I-215 CD
Widened I-15 Bridge
Final Configuration
### Project

#### I-15

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<th>SPAN 1 (ft)</th>
<th>SPAN 2 (ft)</th>
<th>SPAN 3 (ft)</th>
<th>Radius (ft)</th>
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#### I-215 CD

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Widened I-15 Bridge

Existing Configuration

Counterweight

New Configuration
Site Access: RR Must Stay Open

- 2 – 40 ton Mi-Jack Cranes
- 1 wheel line on each bridge
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
I-215 CD Narrowing

Step 7

Step 8
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

Closure Pour

Construction Bolt
Field Drill
Other Holes
- 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
Seismic Response

PGA ≈ 0.45

SD1 ≈ 0.5

S_{DS} ≈ 1.0

I-15 Response Spectrum

Spectral Response (g)

PGA ≈ 0.45

Period (sec)
Seismic Strategy

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

Allow up to +/- 12” of movement

- Existing I-215 CD Pier
- New Pedestal
- Stainless Steel
- PTFE
- Elastomeric Bearing
- Top Plate
- New Girder

2019 partnering CONFERENC acec-ky-thwa-kyio
Questions?

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