Fresno SR 180 Braided Ramp Design-Build Project

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ARUP
Fresno SR 180 Braided Ramp Design-Build Project

• Project Overview
• Construction
• Design
• Aesthetic
• DB Experience
Existing Condition
Project Overview

Final Condition

- Proposed Connection Improvement on SR 180 between SR 41 and 168
- Braided Ramp N5
- Braided Ramp S5
- First Street UC (Widen)
- Wall 2
- Wall 5
- Wall 6
- Wall 3 & 4
- End Construction

Legend:
- Proposed Project
- Proposed Bridge
- Existing SR 180
- Existing Ramps

Not to Scale
Project Overview

• Two New Bridges
• One Bridge Widening
• MSE Walls
• Sound Walls
• PCC Pavement
Project Overview

Aerial View- January 2013
Project Overview

Aerial View- July 2013
North Bridge Falsework
North Bridge - Forming Diaphragms
South Bridge Falsework
South Bridge- Early Morning Deck Placement
MSE Walls
Soundwall Construction
Soundwalls
Paving Crew Operations
Paving Crew Operations
Batch Plant
Job Wide Safety Meeting
Design

Foundation
Foundation Flexibility

- Check rigid footing response
- Computer model for spread footings w/soil springs

North Bridge Bent 2
Transverse Direction

\[ \Delta Y = 3.415 \text{ in} \]
\[ = \Delta f + \Delta y_{col} \]
\[ \Delta f = 0.00442 \times 25 \text{ ft} = 1.326 \text{ in} \]
\[ \Delta y_{col} = \Delta Y - \Delta f = 3.415 \text{ in} - 1.326 \text{ in} = 2.09 \text{ in} \]
## Foundation Flexibility

### P-Δ Effect

<table>
<thead>
<tr>
<th></th>
<th>S5 Bent 2</th>
<th>N5 Bent 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δf (ftg flexibility, in)</td>
<td>1.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Δy\text{col} (yield displ., in)</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Δy (yield displ., in)</td>
<td>3.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Δp (plastic displ., in)</td>
<td>6.9</td>
<td>6.3</td>
</tr>
<tr>
<td>Δr (lateral offset, in)</td>
<td>10.8</td>
<td>9.7</td>
</tr>
<tr>
<td>P (axial load, k)</td>
<td>3500</td>
<td>1900</td>
</tr>
<tr>
<td>P × Δr (k-ft)</td>
<td>3150</td>
<td>1536</td>
</tr>
<tr>
<td>0.2 × Mp (k-ft)</td>
<td>5695</td>
<td>1735</td>
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</table>
Seismic Design - Dynamic Analysis

- Effective sections for ductile members
- Flexible foundation at the bases of columns
- Soil resistance at the abutments neglected in longitudinal direction

3D Extrude View

Fixed for non-seismic load
Flexible base for seismic analysis (a 6 degree spring constant assigned)
Seismic Design - Push Over Analysis

- Calculation per SDC 3.1.3
- Rigid foundation assumption
Seismic Design – Displacement D/C Ratios

<table>
<thead>
<tr>
<th>Braided Ramp S5</th>
<th>Longitudinal Direction</th>
<th>Transverse Direction</th>
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<tbody>
<tr>
<td></td>
<td>Δd (in)</td>
<td>Δc (in)</td>
</tr>
<tr>
<td>Bent 2</td>
<td>1.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Bent 3</td>
<td>1.4</td>
<td>8.9</td>
</tr>
<tr>
<td>Bent 4</td>
<td>1.5</td>
<td>7.1</td>
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# Seismic Design - Ductility Demands

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<tr>
<td></td>
<td>( \Delta d ) (in)</td>
<td>( \Delta y(i) ) (in)</td>
</tr>
<tr>
<td>Bent 2</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Bent 3</td>
<td>1.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Bent 4</td>
<td>1.5</td>
<td>2.0</td>
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Seismic Design - Ductility Capacities

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<tr>
<td></td>
<td>$\Delta c$ (in)</td>
<td>$\Delta y^{\text{col}}$ (in)</td>
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<td><strong>Braided Ramp S5</strong></td>
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Design – Unity Geometry
Fresno SR 180 Braided Ramp Design-Build Project

Design

Column Confinement – Spiral vs. Hoop

Spirals – The most effective & economic
AASHTO Seismic Guide Specification C8.6.3
WSDOT BDM

Hoops - Improved constructability and better Seismic Performance
AASHTO Bridge Design Specifications C5.10.11.4.1C
Caltrans’ MTD
Aesthetic Appearance of Existing Structures

- CIP concrete structures
- Integral bent caps
- Flared columns
- Fracture FIN texture
Aesthetic Appearance of Braided Ramps

- CIP concrete structures
- Integral bent caps
- Columns:
  - Straight columns
  - Flared columns w/ flare gap
- Abutment
  - Match Existing Structure
- MSE Wall
  - Fracture FIN Architectural Treatment
Aesthetic Appearance

Te insert Box Bridge Elevation View Showing integral bent cap box girder.
Aesthetic Appearance
Aesthetic Appearance

Textured FIN finish
DB Experience

Team Work

Caltrans

Arup Designer

SR 180

RBL Builder

City of Fresno
Communications

CT head office - SAC

Arup Designer - SF

CT Region - Fresno

RBL - Fresno Project office

RBL - Walnut Creek
DB Experience

QC/QA
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Question?