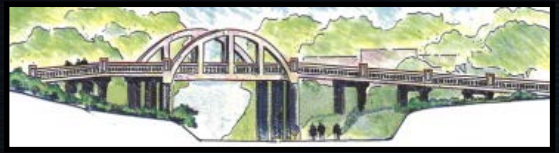
Alexander Avenue Bridge
Seismic Retrofit & Rehabilitation Project



CARLOS E RAMIREZ, P.E.
WSP | PARSONS BRINCKERHOFF

PRESENTATION OUTLINE

1. Project Description
   - Project Team
   - Timeline
   - Elevation & Typical Sections
2. Structure Description
   - Setting
   - Overview
3. Key Challenges
4. Structural Analysis & Retrofit
5. Final Condition
6. Conclusions & Lessons Learned

1. PROJECT DESCRIPTION – Project Team

Public Agencies

- City of Larkspur

Design Engineer

- **WSP | Parsons Brinckerhoff**

Condition Assessment

- **Wiss, Janney, Elstner Associates, Inc (WJE)**

Contractor

- **Ghilotti Construction Company**

Sub-Contractor

- **Sullivan Thompson Masonry & Restoration**

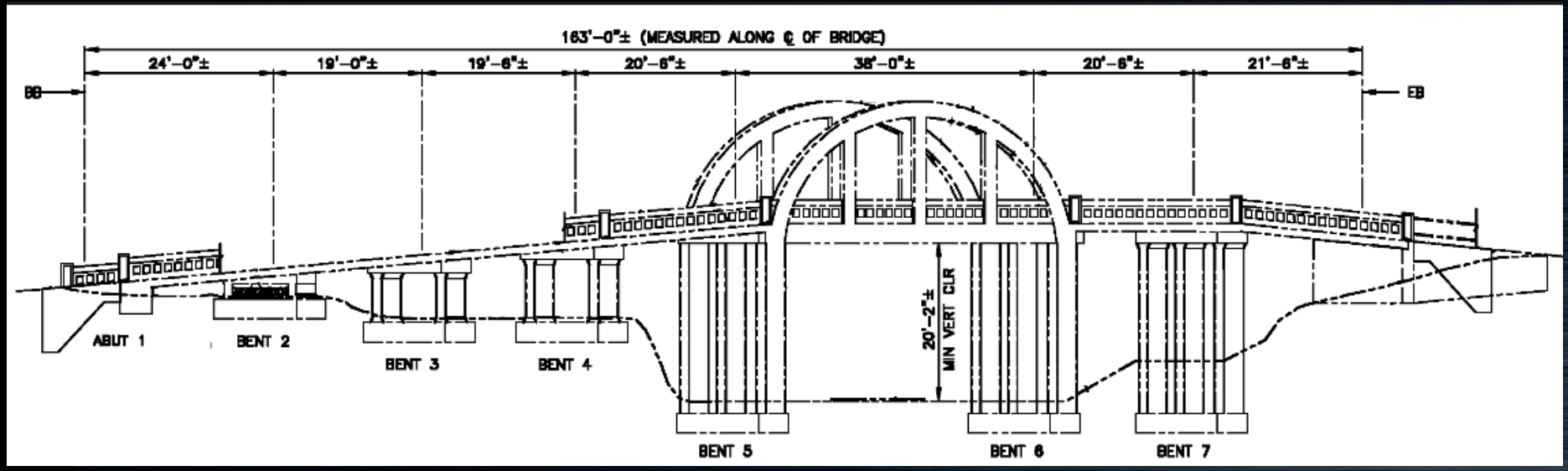
Construction Manager

- **The Hanna Group**

1. PROJECT DESCRIPTION - Timeline

Milestone	Date
NEPA/CEQA Environmental Approvals	Feb 2011
Retrofit Strategy Approval	Feb 2011
Final PS&E	Sept 2011
Award and Start Construction	Dec 2011
Construction Complete	Nov 2012

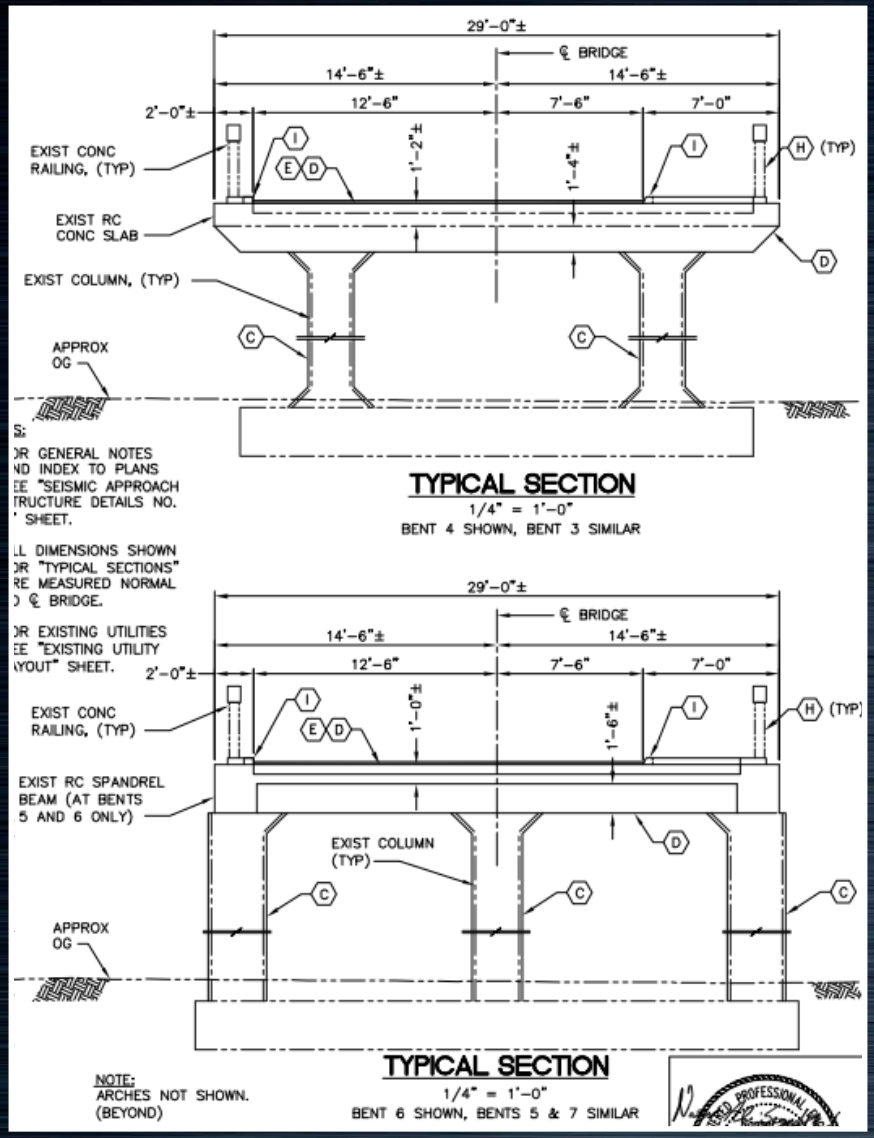
1. PROJECT DESCRIPTION – Elevation



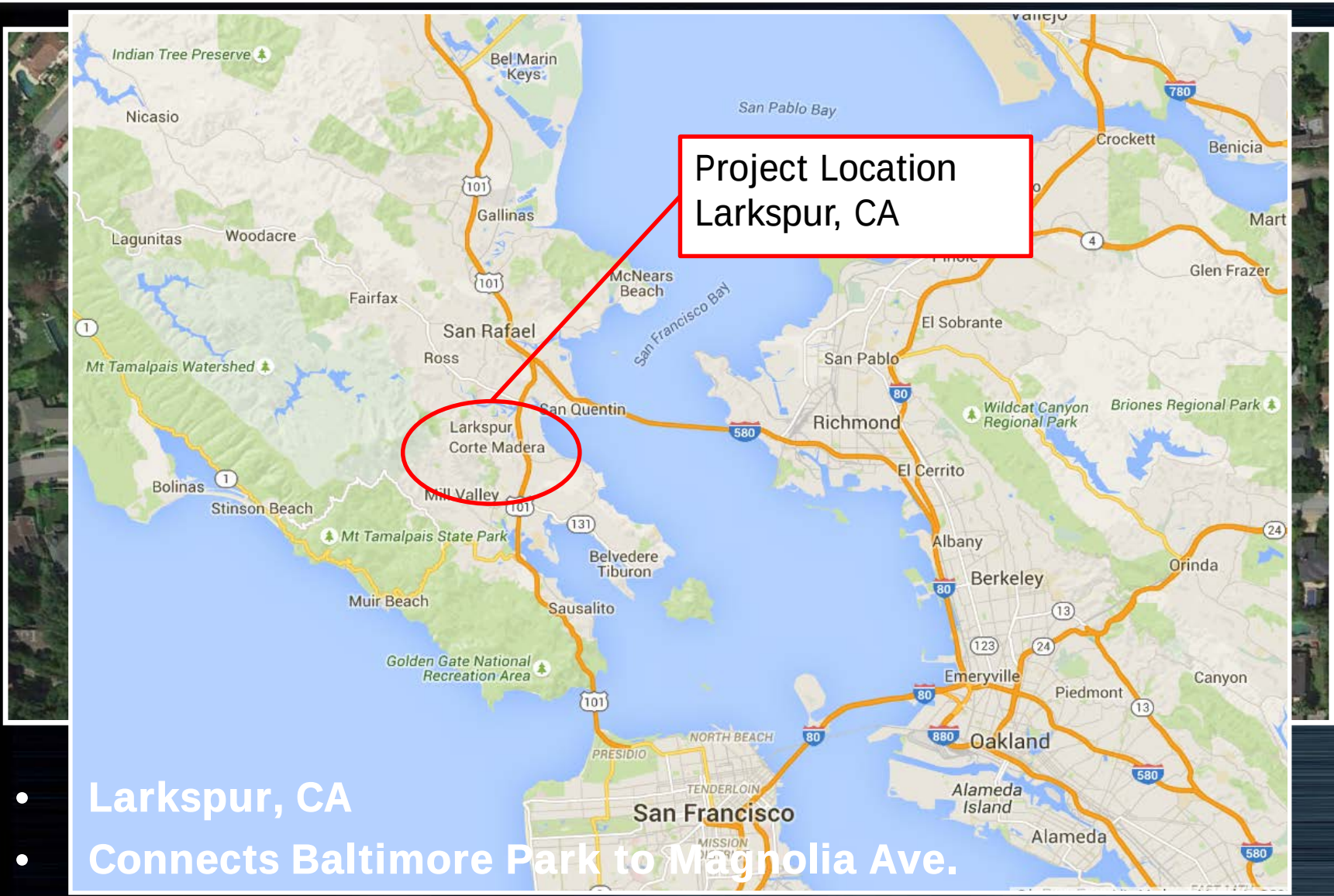
- Length 163 feet and 29 ft wide
- 6 Spans RC Slab
- Main span RC Rainbow thru-arch

1. PROJECT DESCRIPTION – Typical Section

- Bents with 2 & 3 columns on spread footings
- Two Lanes of traffic
- Pedestrian Sidewalk



2. STRUCTURE DESCRIPTION - Setting



- Larkspur, CA
- Connects Baltimore Park to Magnolia Ave.

2. STRUCTURE DESCRIPTION - Overview

View of north side of arch span taken from bike path

- Built in 1925
- Designed to span the Railroad right-of-way
- Listed in National Registry of Historic Places in 1984
- Structurally & seismically deficient structure

2. STRUCTURE DESCRIPTION - Overview

Underside of bridge taken from east side

View of bridge approach deck taken from west side

2. STRUCTURE DESCRIPTION - Overview

View of the south arch span taken from the westbound lane

2. STRUCTURE DESCRIPTION - Overview

View the south railing

View sidewalk and deck

3. KEY CHALLENGES – No As-Built Information

- Condition Assessment Report by WJE, Inc

  1. Determine concrete materials conditions
  2. Determine extent of bridge deterioration
  3. Rebar Survey

3. KEY CHALLENGES – Bridge Deterioration

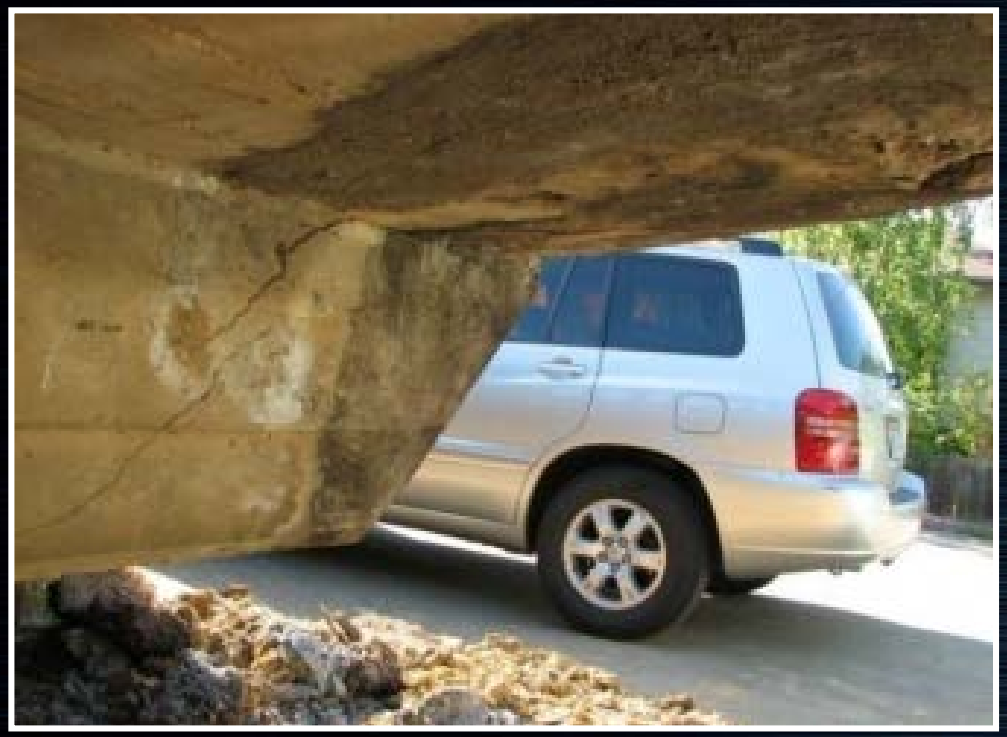
Delaminated Parge

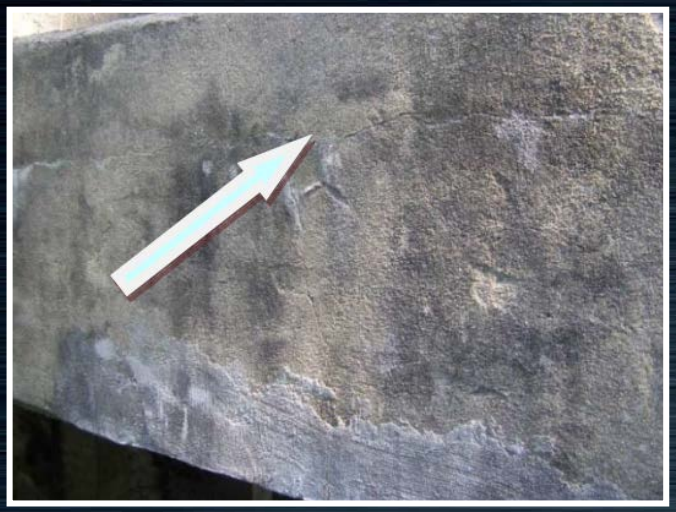
3. KEY CHALLENGES – Bridge Deterioration

Concrete Spalls

3. KEY CHALLENGES – Bridge Deterioration

Cracking





3. KEY CHALLENGES – Bridge Deterioration

Surface Staining

3. KEY CHALLENGES – Bridge Deterioration

Exposed Rebar

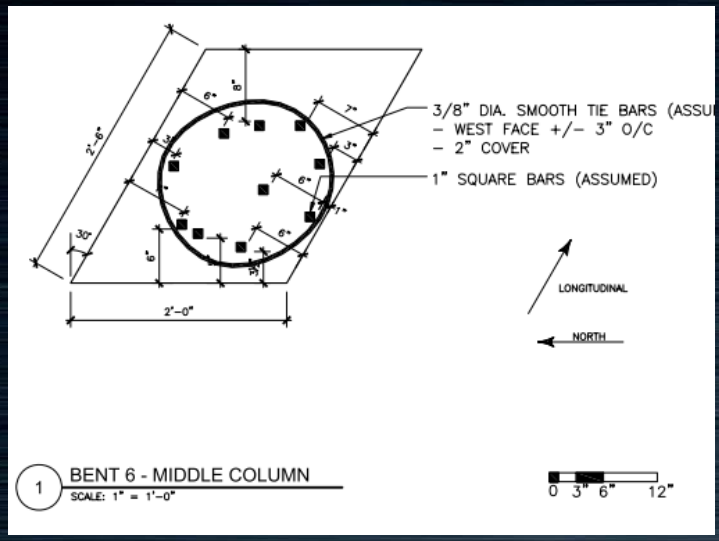
3. KEY CHALLENGES – Bridge Deterioration

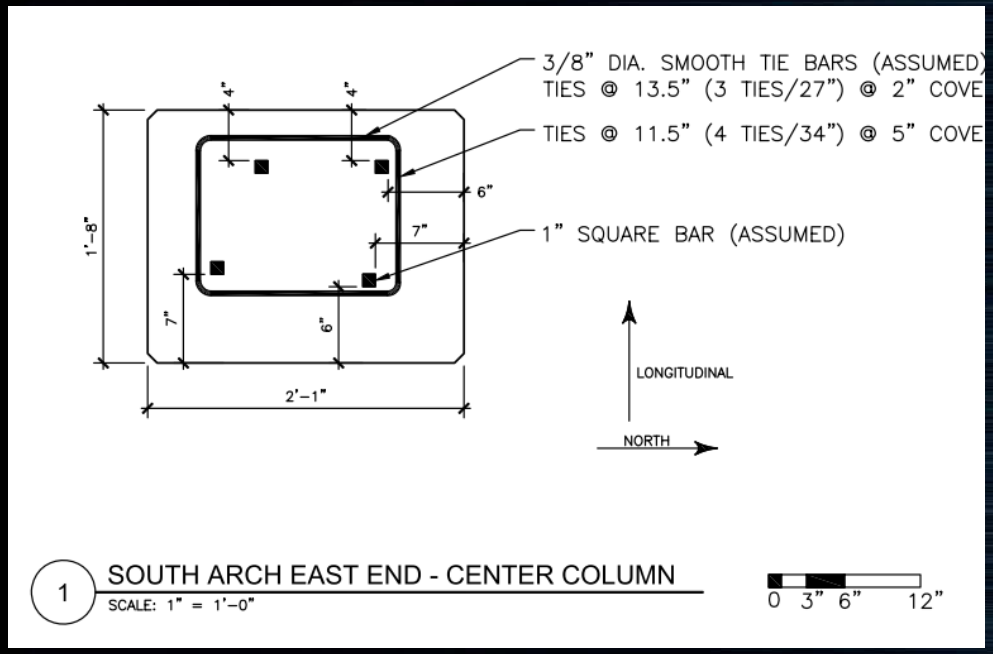
Surveyed Field Conclusions

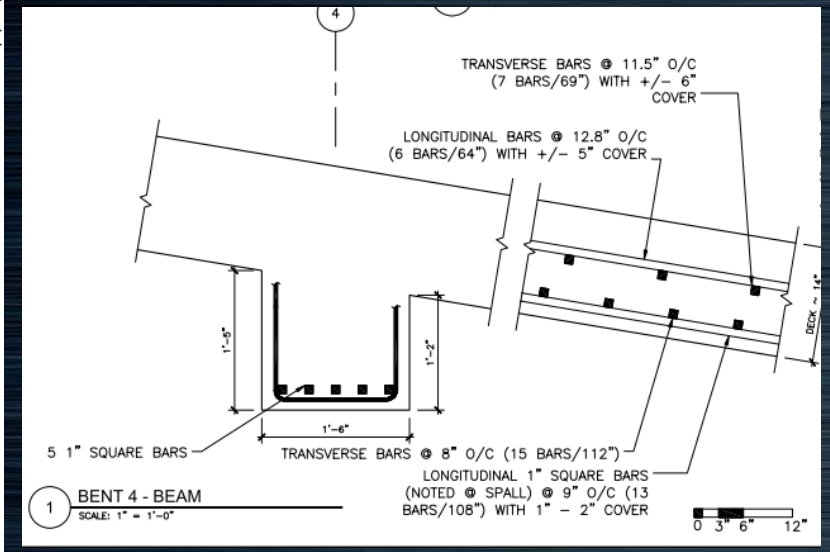
- Extensive repairable concrete surface deterioration
- Concrete in fair to good conditions
- Carbonation to the depth of the steel reinforcement leaving rebar susceptible to corrosion
- Footing condition not determined

3. KEY CHALLENGES – Concrete Rebar Survey

1. Concrete cover
2. Rebar locations
3. Number of size of rebar
4. Visual Inspection, GPR, and Ferroscan Instruments used







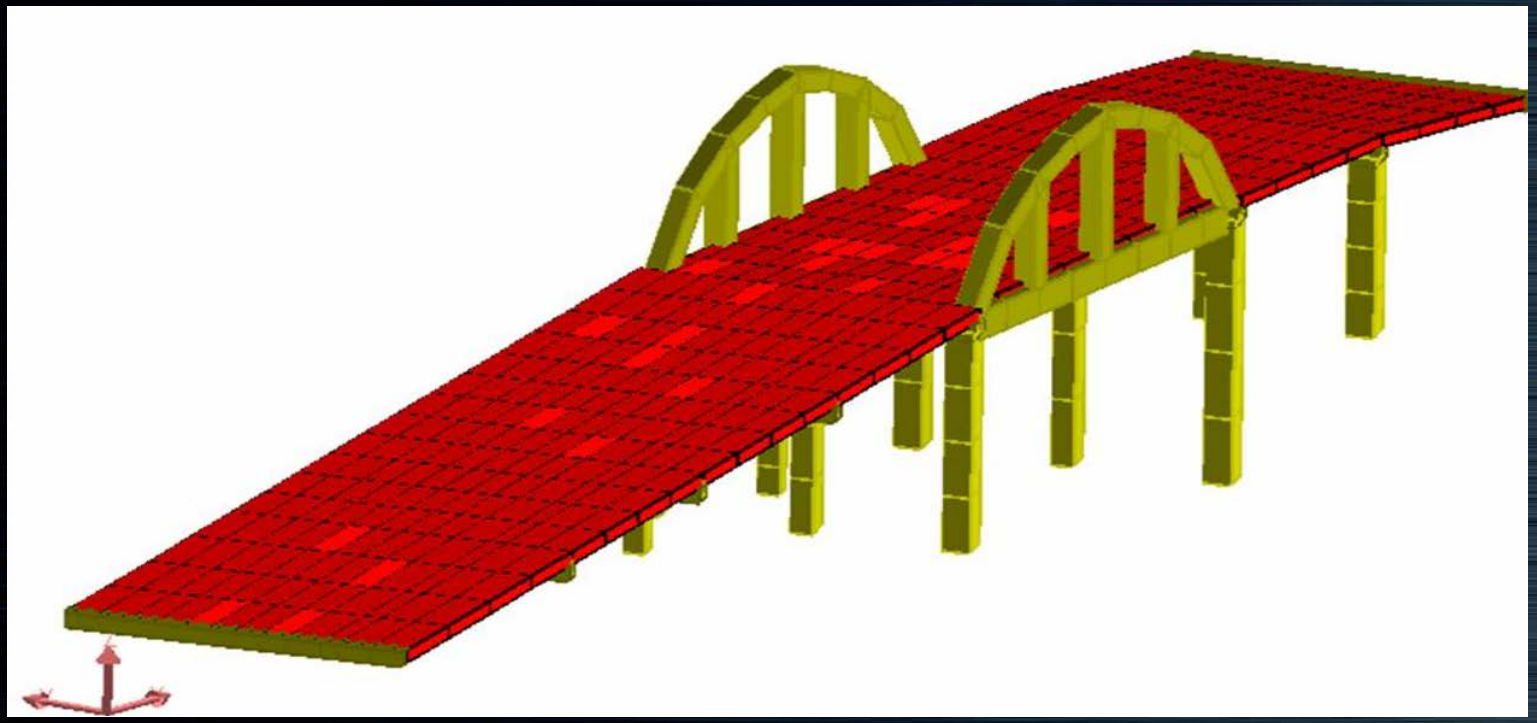
4. STRUCTURAL ANALYSIS & RETROFIT

- **Existing condition:**

  1. **Existing bridge service & seismic analysis**

  2. **Firetruck analysis**

  3. **LARSA Finite Element Analysis Model**



4. STRUCTURAL ANALYSIS & RETROFIT

- **Rehabilitation Strategy**

1. Remove and repair delaminated concrete
2. Add rebar when lost or corroded
3. Remove AC overlay and unsound deck
4. Treat deck with methacrylate and overlay with polyester concrete
5. Update approach guardrail with MBGR

4. STRUCTURAL ANALYSIS & RETROFIT

- **Retrofit Strategy**

  1. **Add section / confinement at columns to increase ductility and shear capacity**

4. STRUCTURAL ANALYSIS & RETROFIT

- **Retrofit Strategy**

  2. **Add section / reinforcement to bents caps to prevent hinging & shear failure**

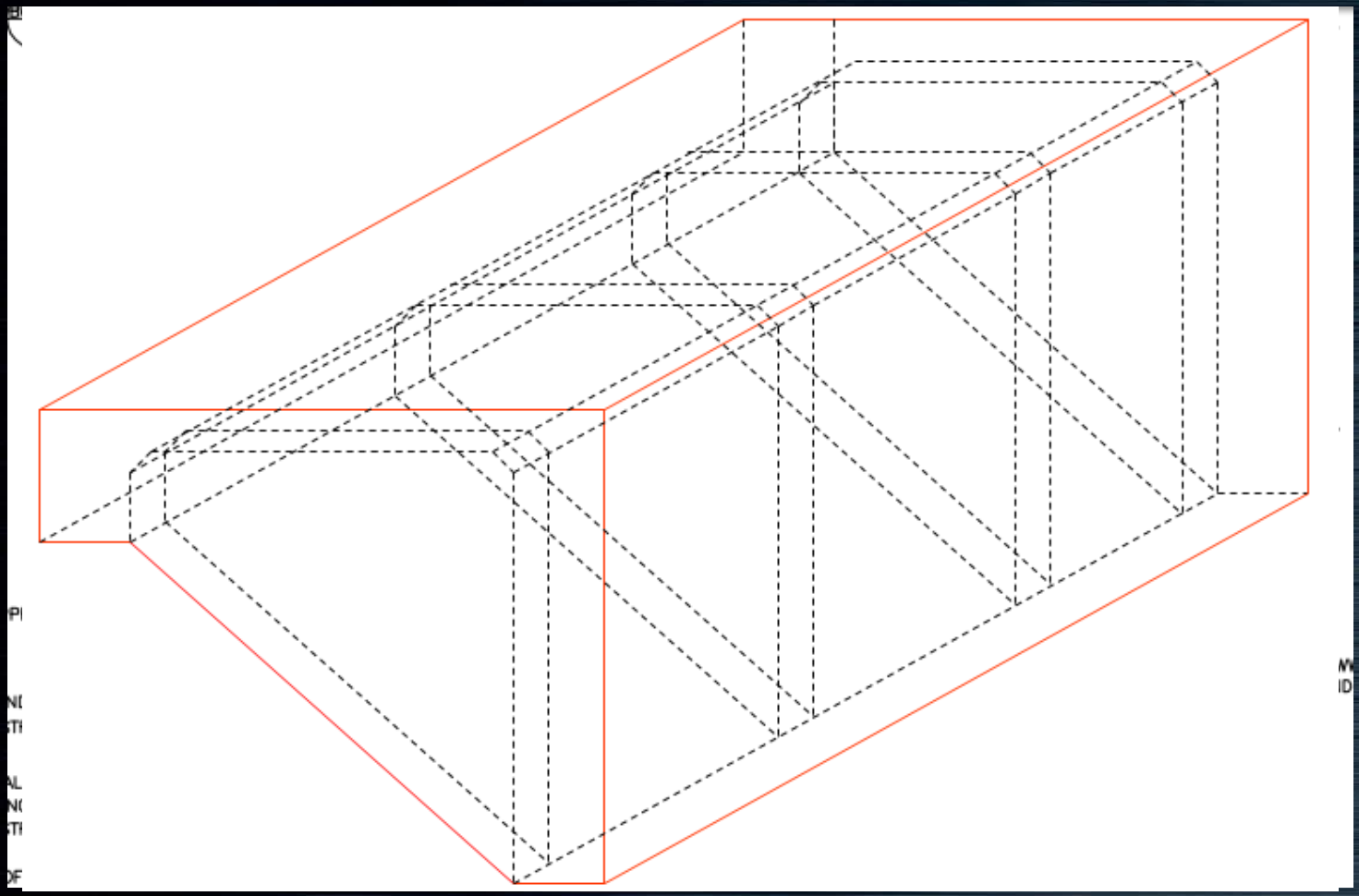
4. STRUCTURAL ANALYSIS & RETROFIT

- **Retrofit Strategy**

  3. Add infill wall at Bent 2 to increase shear capacity

4. STRUCTURAL ANALYSIS & RETROFIT

- **Retrofit Strategy**
  4. **Add seismic approach structure at abutments**



3. KEY CHALLENGES – Engineers' Estimate

- **Structure Repair $ 570,000 ***
- **Retrofit $830,000**
- **Total Construction Estimate $ 1,400,000**
- **Contactors' bid $ 1,194,000**

** included contingency of $154,000 for potential additional deterioration*

5. FINAL CONDITION

- **BEFORE**

- **AFTER**

5. FINAL CONDITION

- **BEFORE**

- **AFTER**

5. FINAL CONDITION

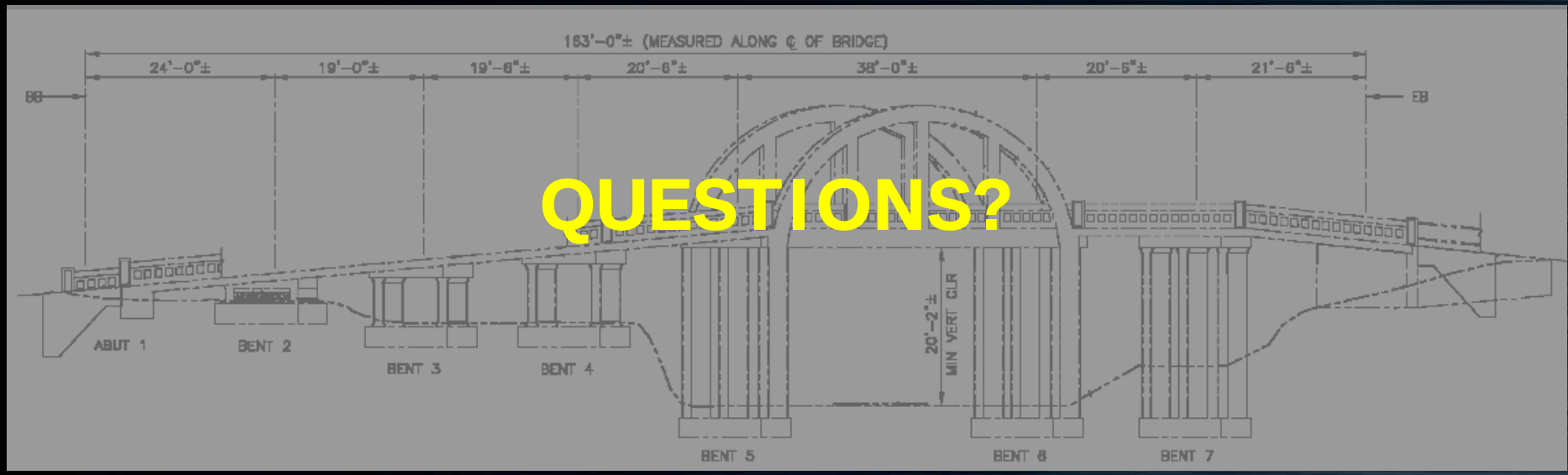
- **BEFORE**

- **AFTER**

5. FINAL CONDITION

5. CONCLUSIONS & LESSONS LEARNED

1. Rehab / retrofit extended life of structure
2. Confirmed emergency vehicles crossing bridge
3. Add contingency for unforeseen repairs
4. Localized repairs vs overall repairs
5. Contractor with experience in rehabilitation


163'-0"± (MEASURED ALONG ℄ OF BRIDGE)
24'-0"±
19'-0"±
19'-6"±
20'-6"±
38'-0"±
20'-5"±
21'-6"±
WB
EB
ABUT 1
BENT 2
BENT 3
BENT 4
BENT 5
BENT 6
BENT 7
20'-2"±
MIN VERT CLR

QUESTIONS?