
# Light Rail Transit Bridge – Crenshaw/LAX Transit Corridor Design-Build

**Western Bridge Engineer's Seminar 2017**

**Portland, Oregon**

**Aamir Aleem Durrani - HNTB Corporation**

**Kevin Acosta - ARUP**

# CRENSHAW/LAX DESIGN-BUILD PROJECT

- Preliminary Planning Study - 1994
- **Bid – $2.058 Billion**
- Bid Announcement – Jun. 7, 2013
- Notice To Proceed (NTP) – Sep 2013
- Official Ground-Breaking Ceremony – Jan. 21, 2014
- **Forecasted Opening – 2019**




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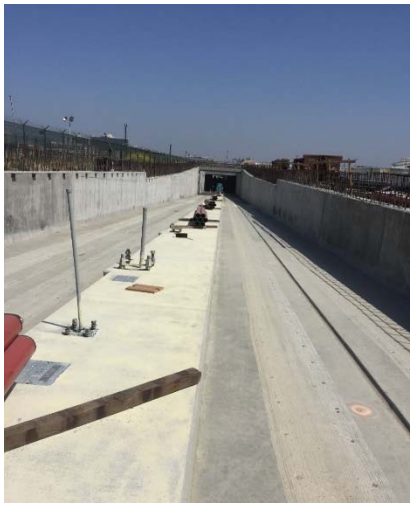
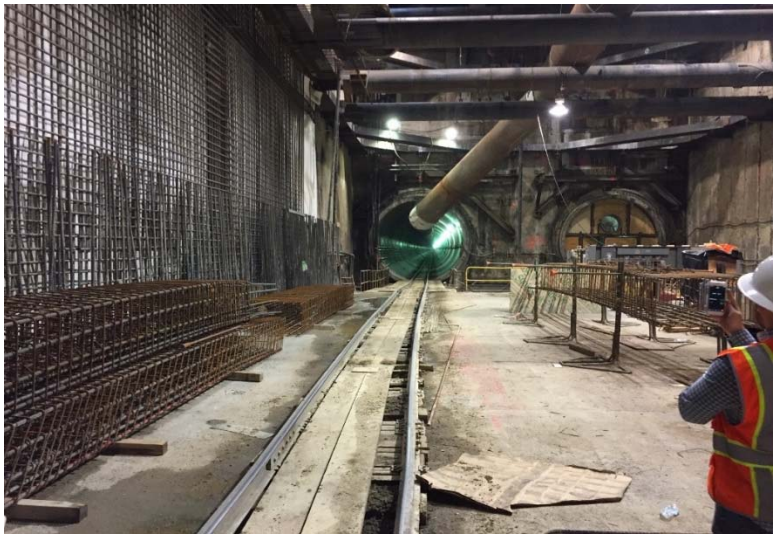
# CRENSHAW/LAX DESIGN-BUILD PROJECT

- Project Length - **8.5 mile** (13.7 km)
- 4 Underground Guideway Structures – 8,400 LF Cut-and-Cover Tunnels; a Mile Long Dual-Bore TBM Tunnels
- 8 Stations – 3 Underground; 4 At-Grade; 1 Elevated on Aerial Guideway
- Several Miles of Earth Retaining Walls and Miscellaneous Other Structures
- **7 Aerial Guideway Structures (New Bridges)**





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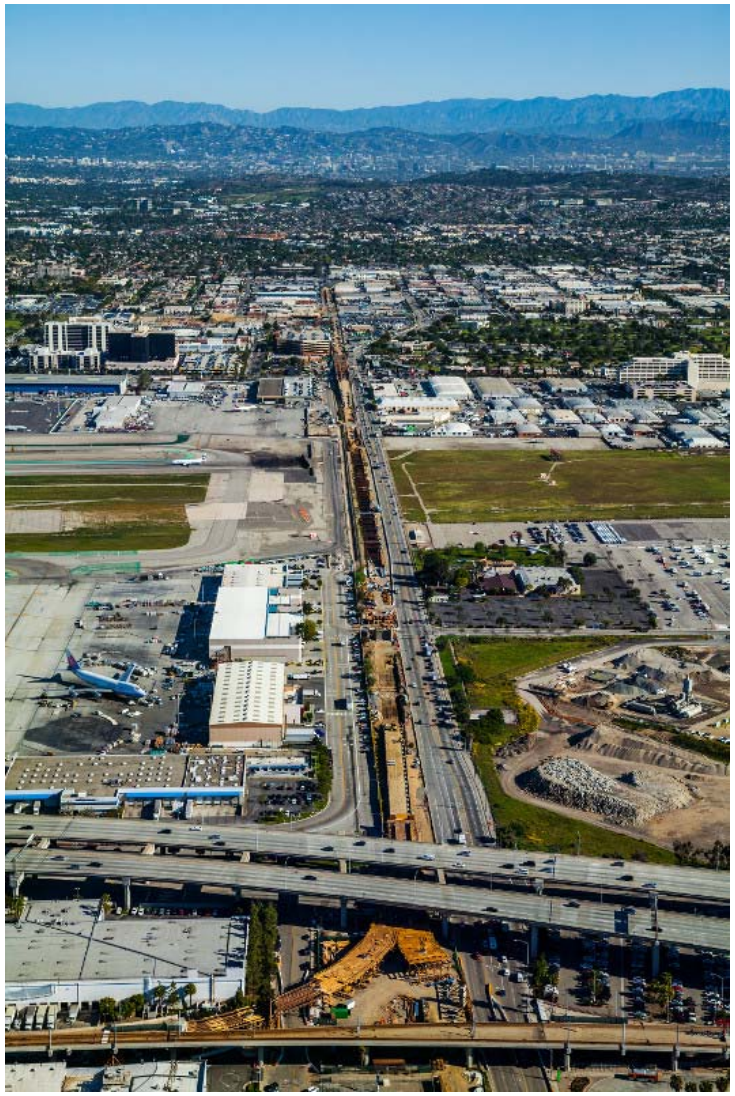
# CRENSHAW/LAX DESIGN-BUILD PROJECT

**7 Aerial Structures (Design Firm):**

- Green Line Connector (ARUP)
- 111th Street Overpass (IDC)
- Aviation/Century Bridge and Aerial Station (MGE)
- Manchester Avenue Overpass (IDC)
- La Brea Avenue Overpass (MGE)
- I-405 Overpass (HNTB)
- Faithful Central Bible Church Pedestrian Underpass (IDC)





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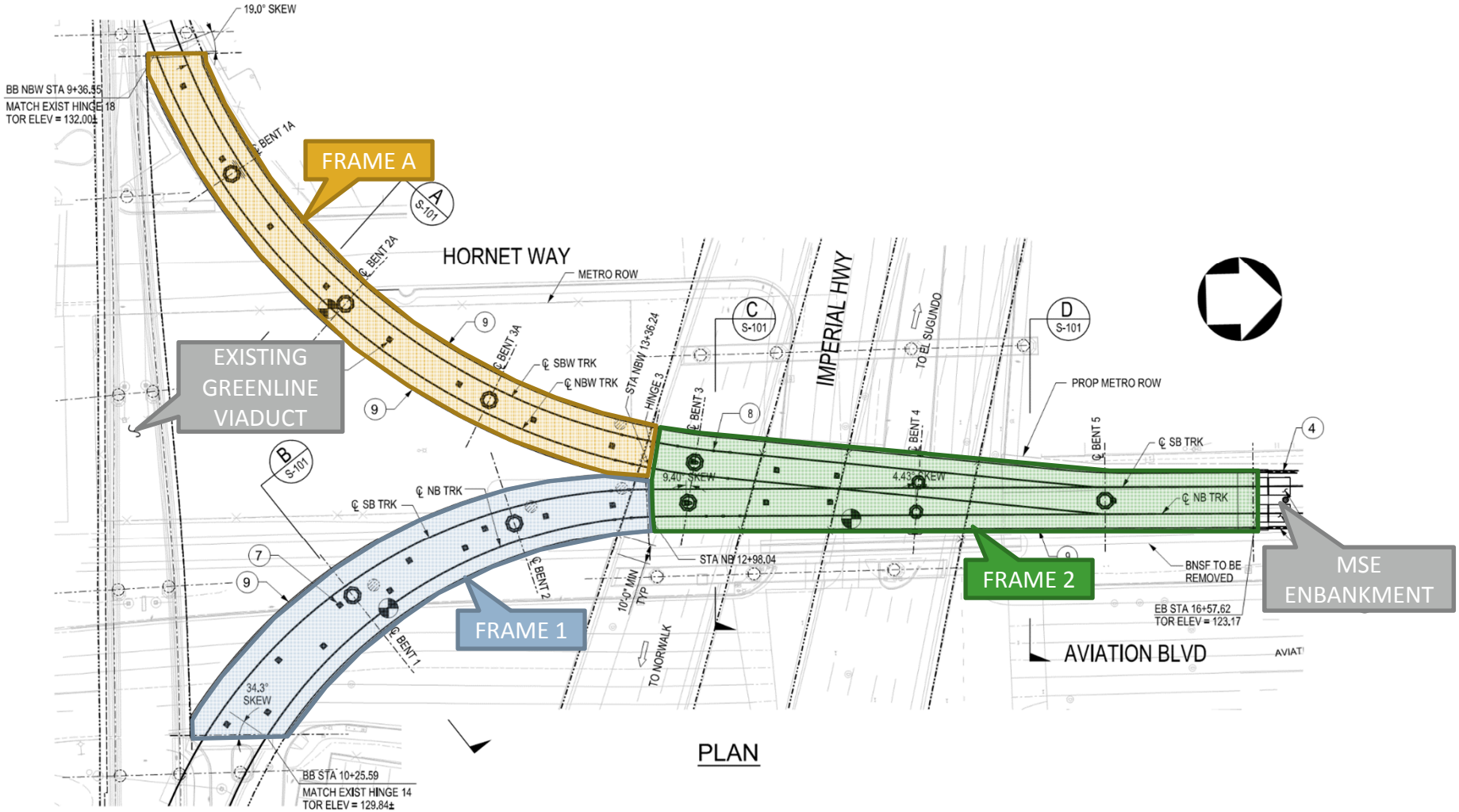
# GREEN LINE CONNECTOR

- Provides Connection of the New Crenshaw/LAX Line to the Existing Green Line
- Alignments of the Lines Being Perpendicular to Each Other Lead to a **Y-Shaped Structure**
- The structure Broken Down into **Three Frames** for Seismic Purposes.
- **10 Spans** Ranging From **85'** to **136'**
- Cast-In-Place Curved Concrete Post-Tensioned Box-Girder Superstructure
- Total of **8 Bents** with 6-Single Column Bents and 2-Two Column Bents
- **Type II Column-Pile Shaft** Foundation

# GREENLINE CONNECTOR **LAYOUT**



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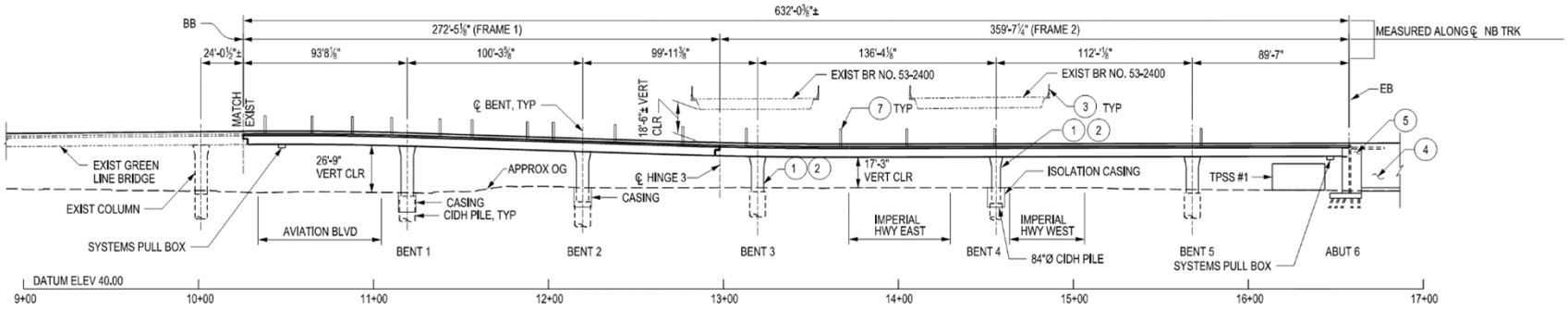
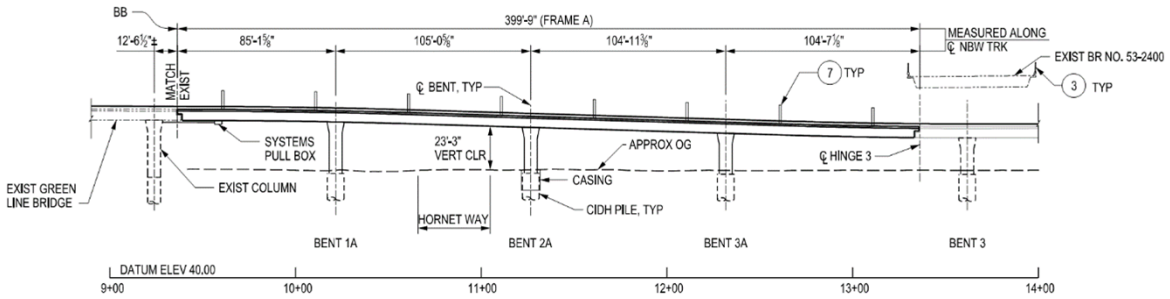
# GREENLINE CONNECTOR **LAYOUT**




DEVELOPED ELEVATION - FRAMES 1 AND 2




DEVELOPED ELEVATION - FRAME A



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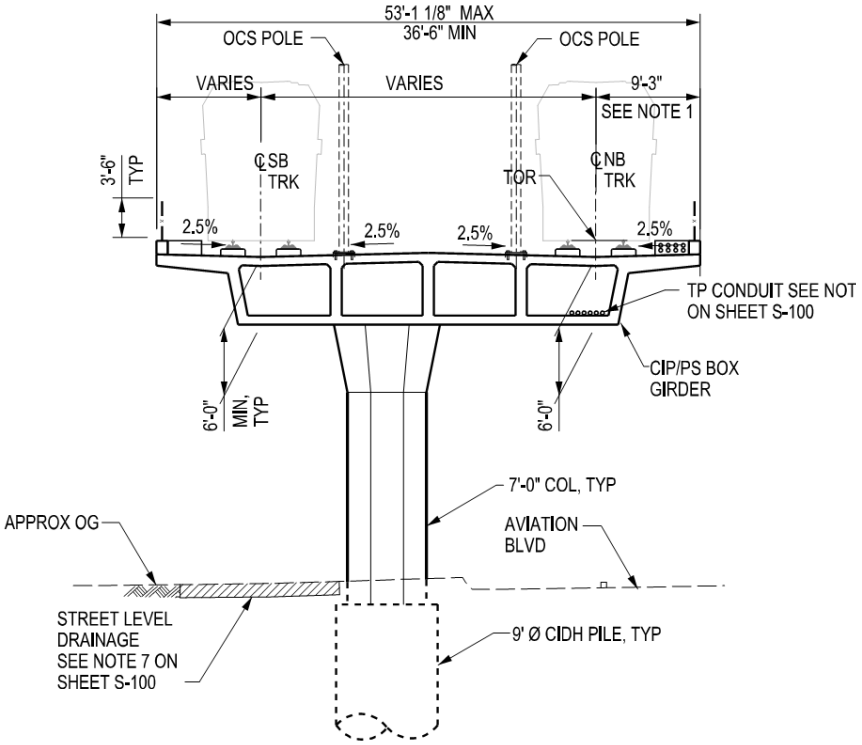
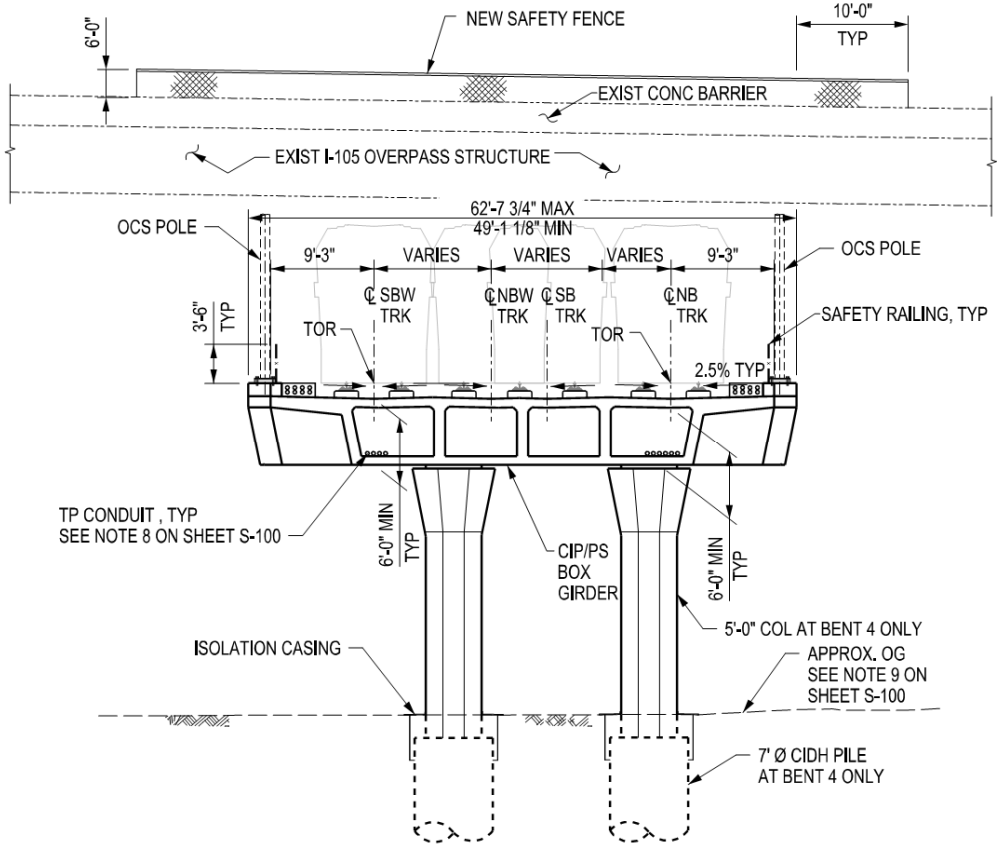
# GREENLINE CONNECTOR
# TYP SECTIONS



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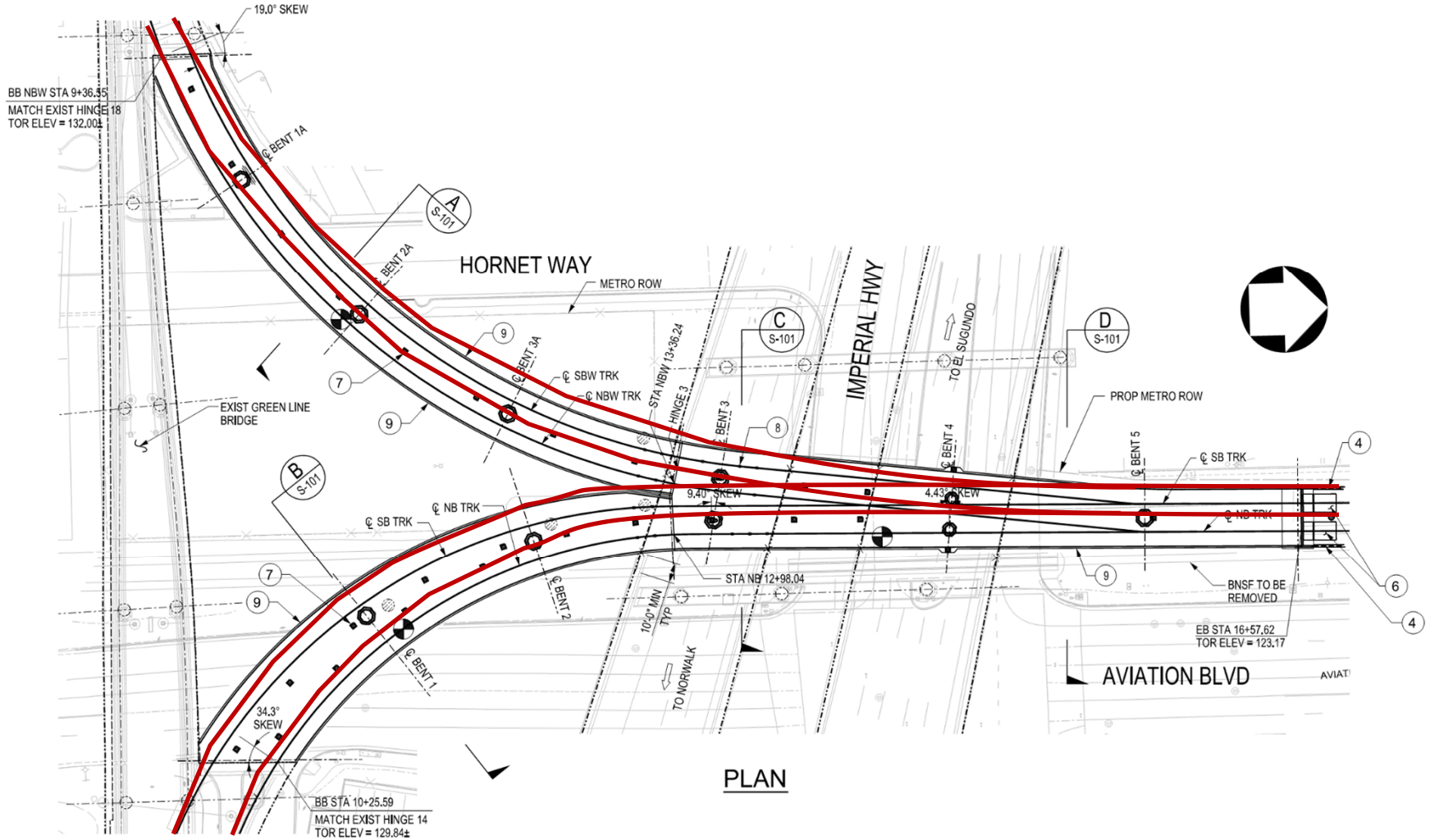
# GREENLINE CONNECTOR DESIGN CHALLENGES

- Connecting to an existing structure after alignment changes
- Linking to an existing pre-Northridge EQ design
- Tuning natural frequencies and stiffness of 5 interacting structures
- Foundation placement with utility congestion
- Rail-structure interaction

GREENLINE CONNECTOR

# CONNECTING TO AN EXISTING STRUCTURE



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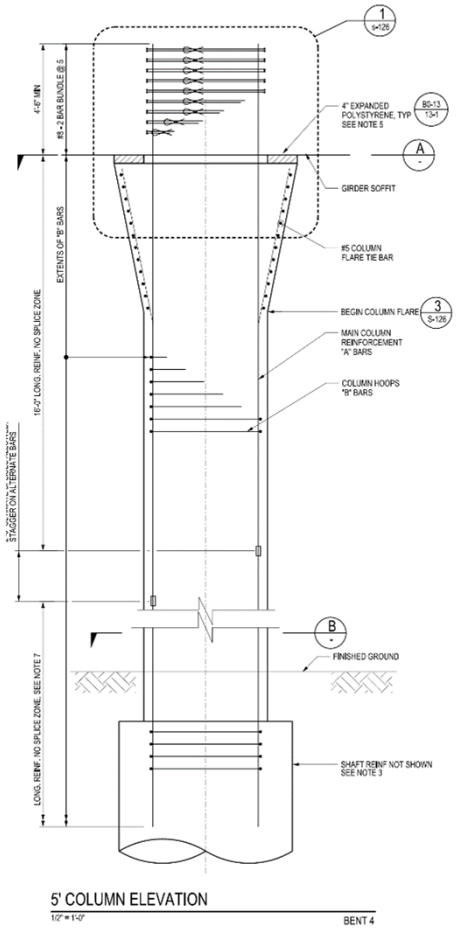
# GREENLINE CONNECTOR - **LINKING TO AN EXISTING PRE-NORTHRIDGE EQ DESIGN**

- Caltrans Seismic Design Criteria 1.6

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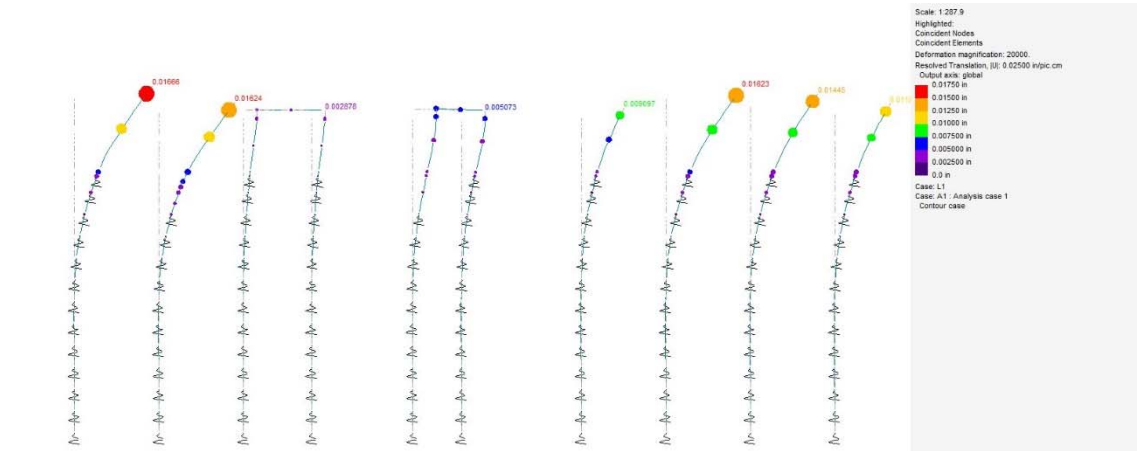
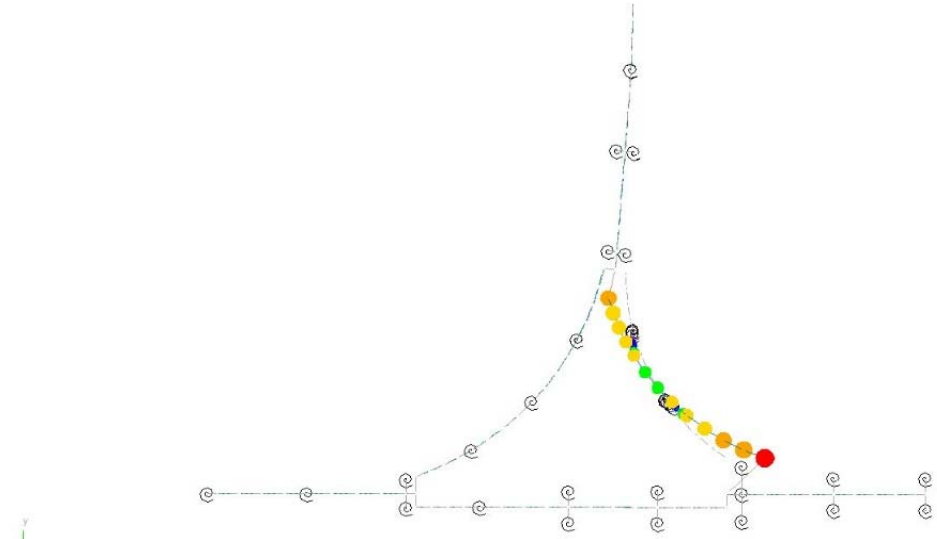
# GREENLINE CONNECTOR - **TUNING NATURAL FREQUENCIES AND STIFFNESS**



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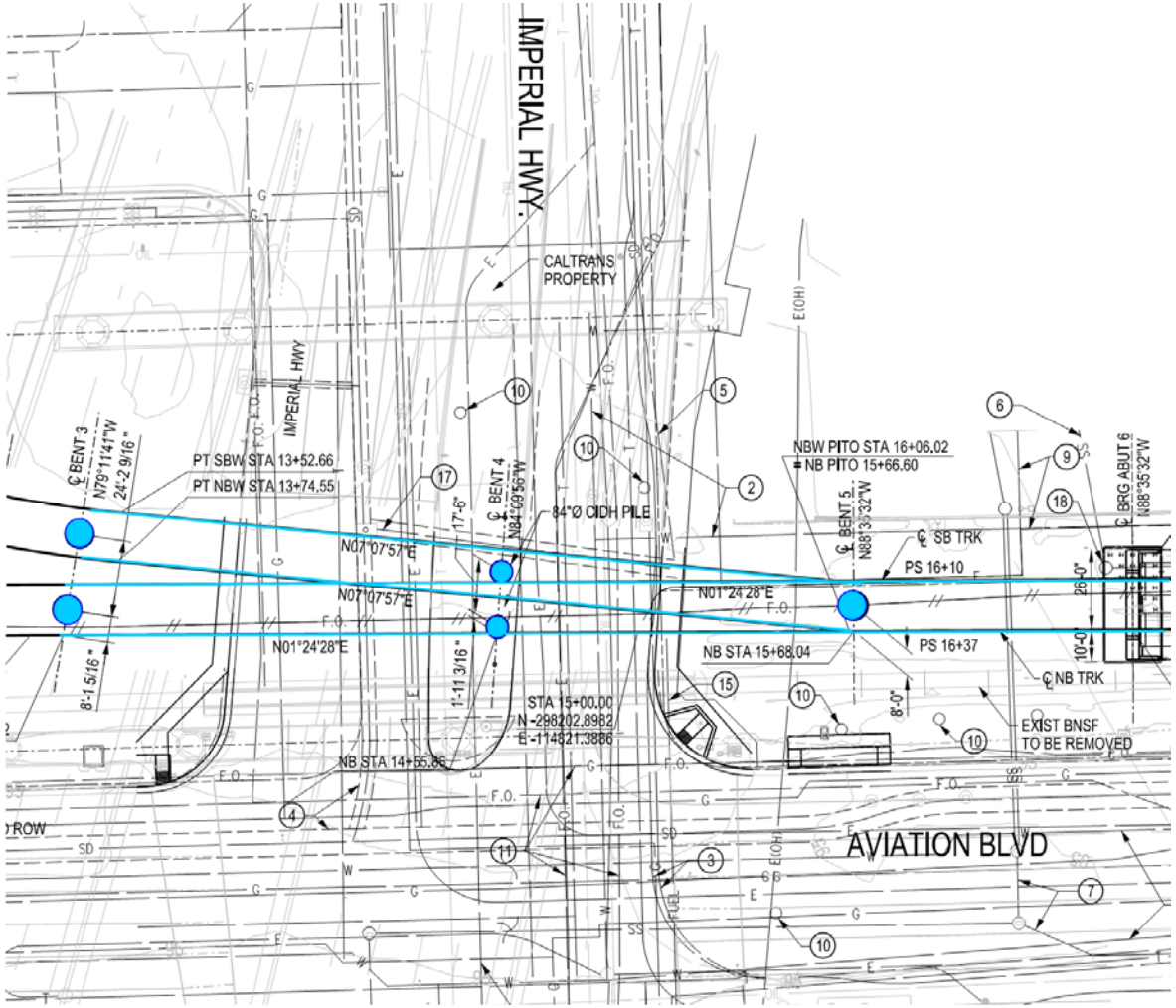
# GREENLINE CONNECTOR - **FOUNDATION PLACEMENT WITH UTILITY CONGESTION**




## UTILITY LEGEND

| | | |
|---|---|---|
| 1 | fo | 20" QWEST FIBER OPTIC (ABANDONED) |
| 2 | W | WATER SUPPLY PIPING |
| 3 | t | TELEPHONE LINES (UNDERGROUND) |
| 4 | sd | STORM DRAIN PIPE WALL |
| 5 | st | STORM DRAIN |
| 6 | s | 18" LA CITY SEWER PIPE (SEE 14 ) |
| 7 | s | SEWER UNDERGROUND |
| 8 | t | TELEPHONE LINES UNDERGROUND |
| 9 | e | POWER UNDERGROUND |
| 10 | O | LAWA COMMUNICATION |
| 11 | fo | FIBER OPTIC |
| 12 | g | GAS PIPE UNDERGROUND |
| 13 | gs | FUEL GAS |
| 14 | O | SEWER MANHOLE |
| 15 | FUEL | MAIN FUEL PIPING |
| 16 | OIL | OIL LINE |
| 17 | s | COES REINF. CONCRETE BOX |
| 18 | O | SEWER MANHOLE (TO BE RELOCATED) |



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GREENLINE CONNECTOR

# RAIL STRUCTURE INTERACTION

- Continuous welded rail
- Direct fixation
- Rail fracture
- Limits on expansion joint movement



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GREENLINE CONNECTOR

# CONSTRUCTION CHALLENGES


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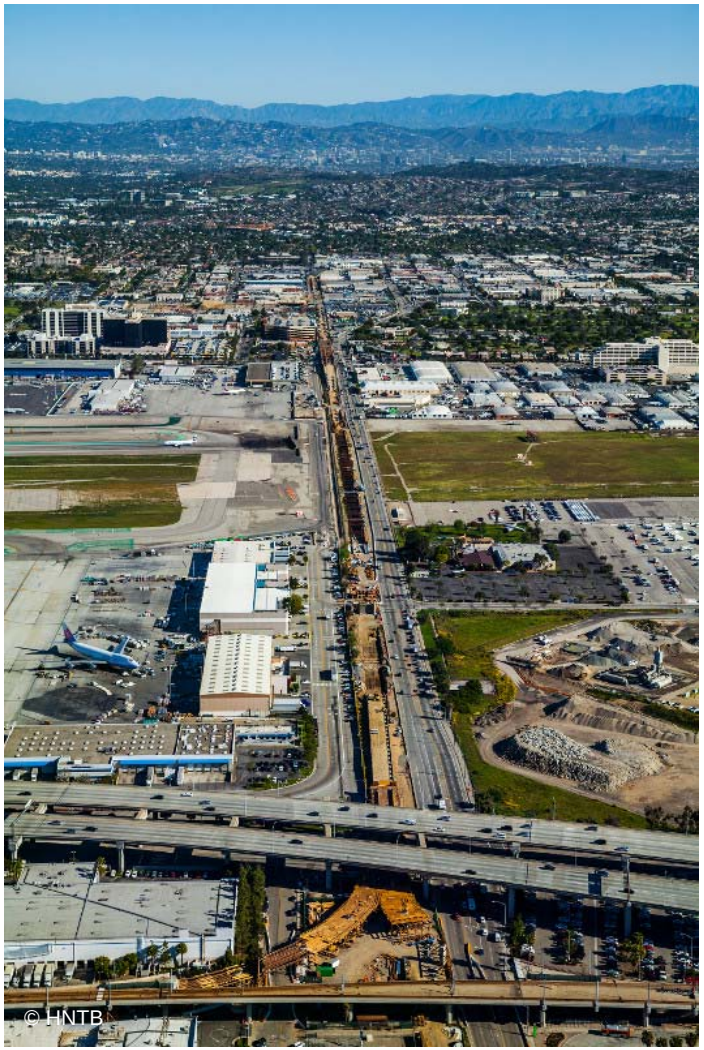
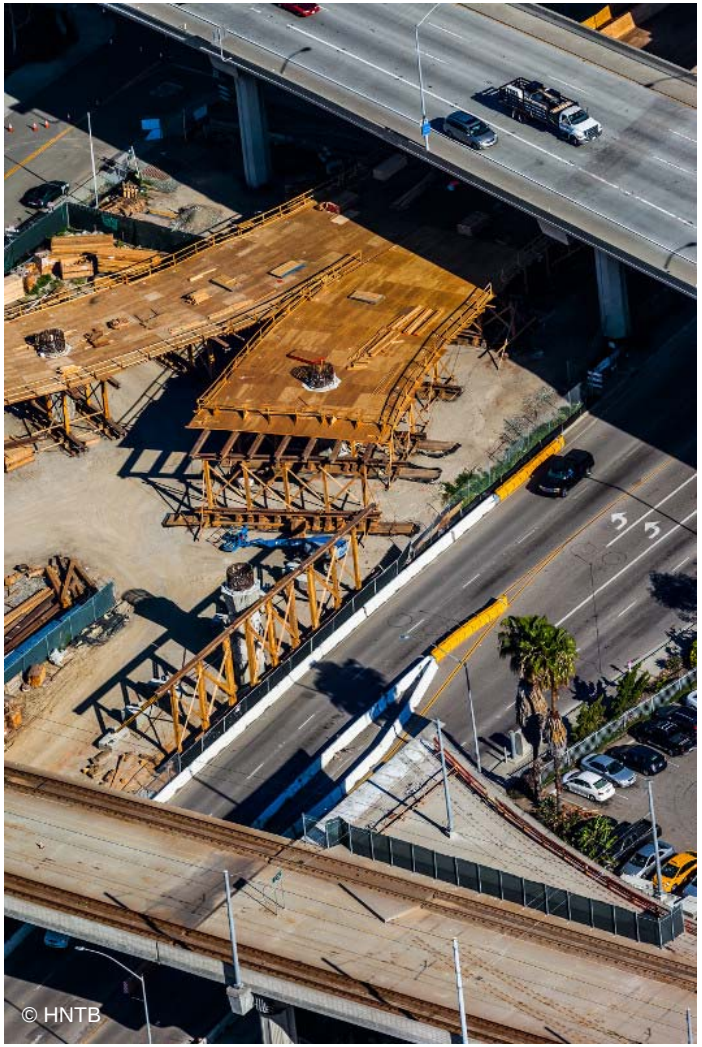
GREENLINE CONNECTOR

# CONSTRUCTION CHALLENGES



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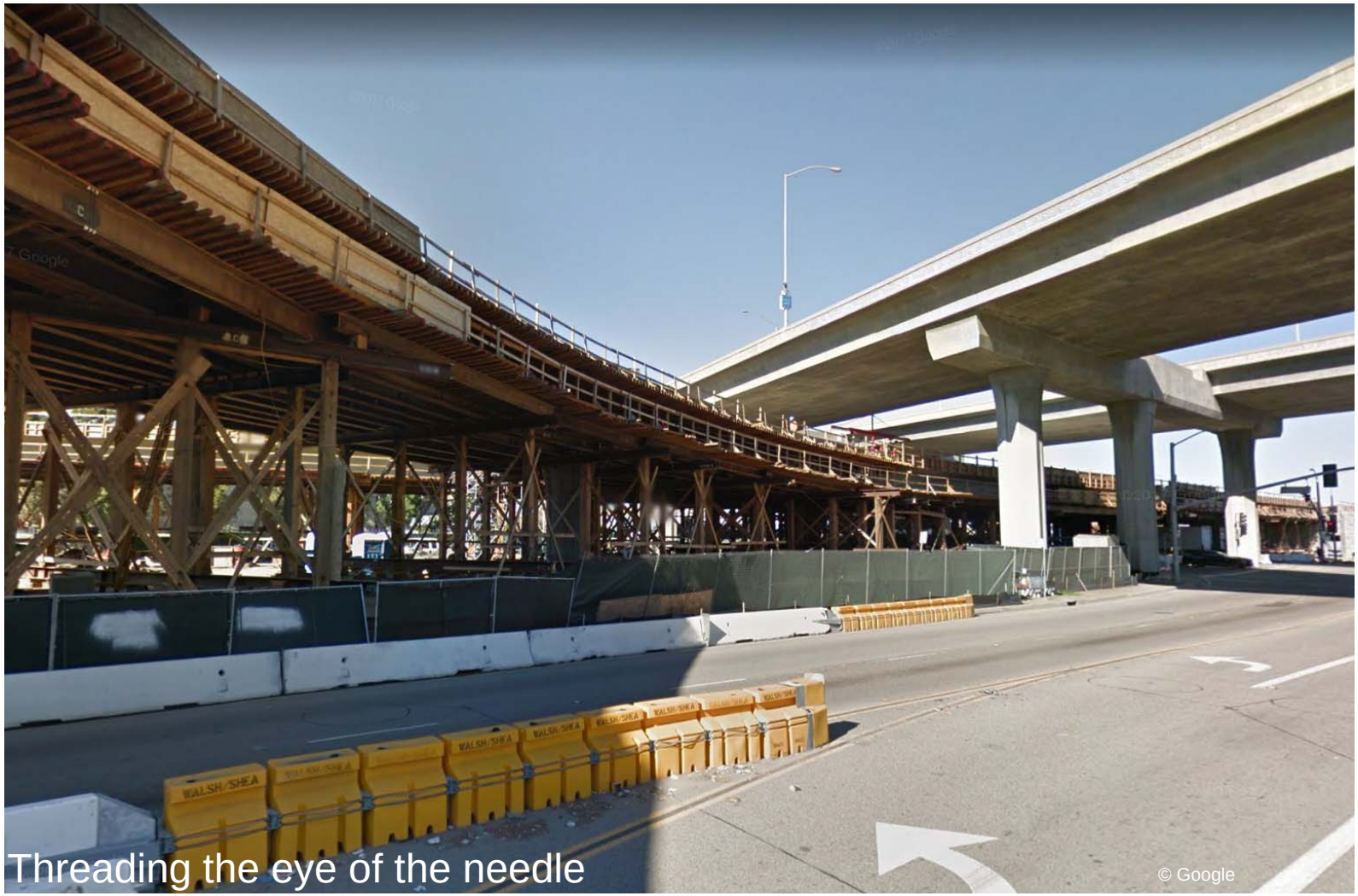
GREENLINE CONNECTOR

# CONSTRUCTION CHALLENGES




Threading the eye of the needle



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GREENLINE CONNECTOR

# CONSTRUCTION CHALLENGES




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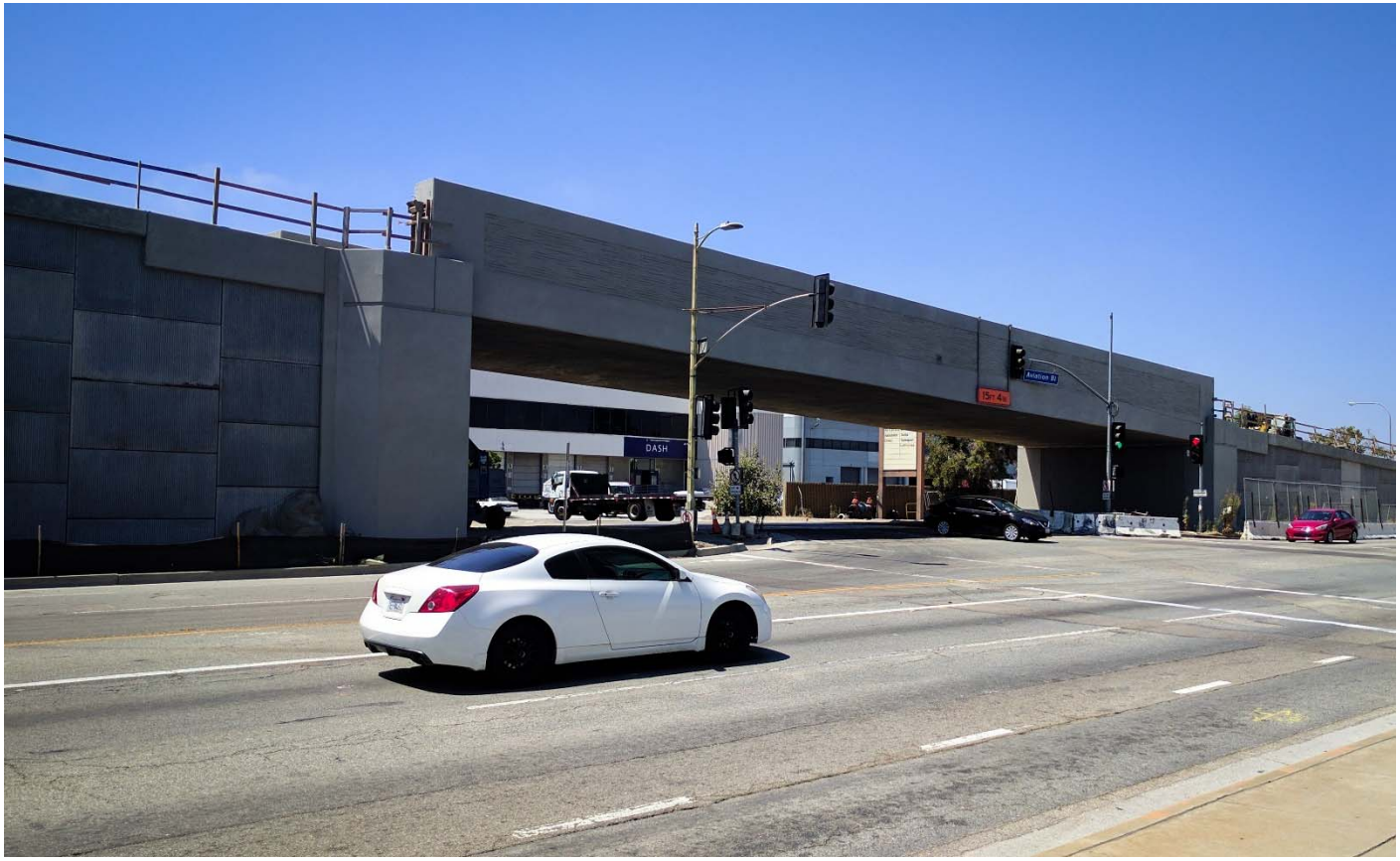
# 111TH STREET OVERPASS

- Single-Span Post-Tensioned Concrete Through-Girder Bridge
- Total Bridge Length = **140’-0”**



# AVIATION/CENTURY OVERPASS


- **9-Span Post-Tensioned Concrete Box-Girder** ranging from 75 feet to 110 feet
- The Bridge Supports a Station in addition to the Light Rail Tracks
- Total Bridge Length= **876'-10 ½"**
- Gateway to Los Angeles International Airport and in the Future may Contain Direct Link to the LAX



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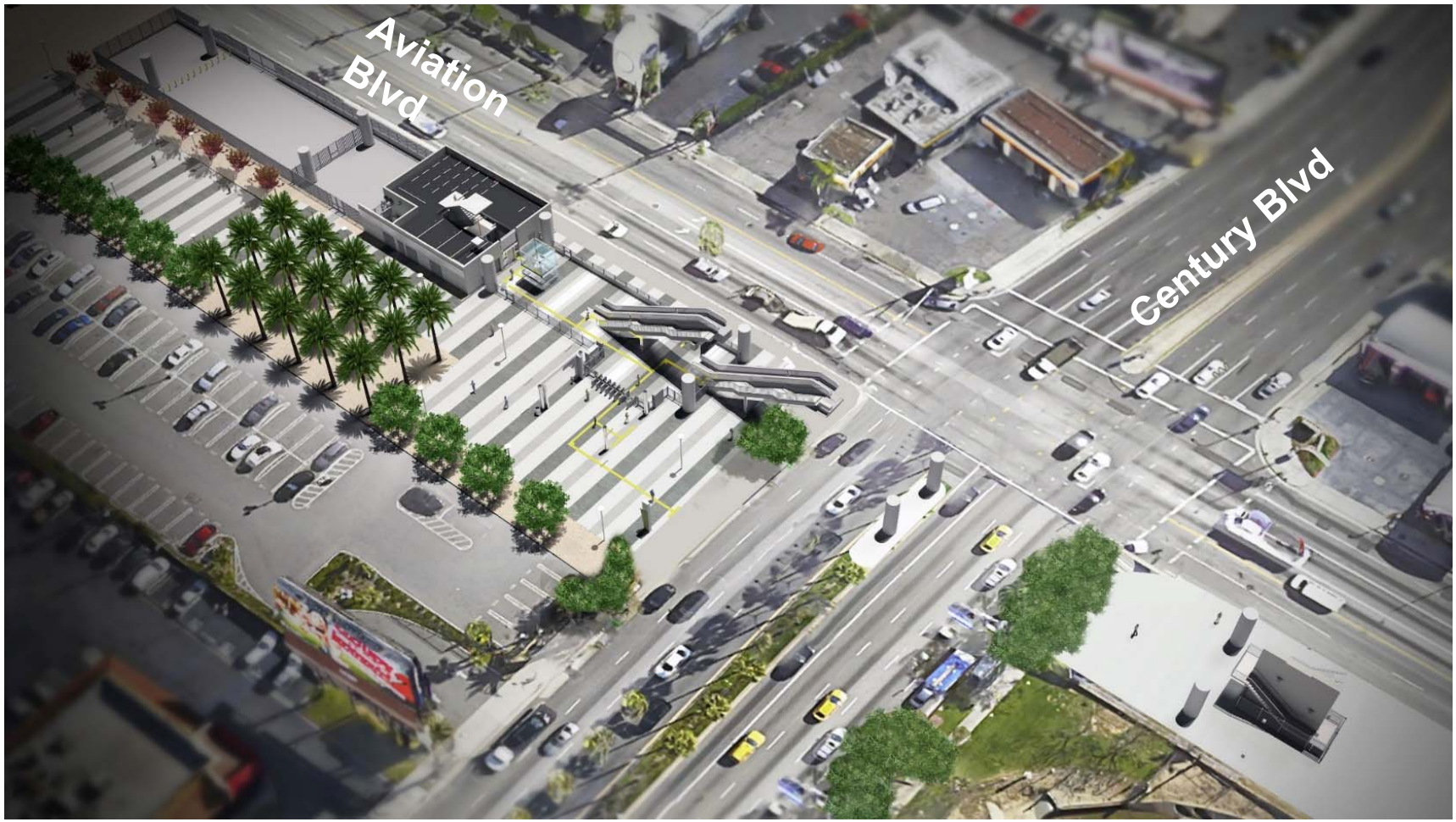
# AVIATION/CENTURY OVERPASS




- Station – Lower-Level



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# AVIATION/CENTURY OVERPASS


- Station – Platform Level



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# AVIATION/CENTURY OVERPASS
# CONSTRUCTION PHASE

- Bridge Deck/Bent Cap Reinforcement Cages



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# MANCHESTER AVENUE OVERPASS

- Two-Span Twin-Cell Post-Tensioned Concrete Box Girder Bridge
- Total Bridge Length = **284’-0”**



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# LA BREA AVENUE OVERPASS

- Single-Span Concrete Post-Tensioned Box Girder Bridge
- Spans a Seismic Fault Line
- Bridge Total Length = **128’-0”**




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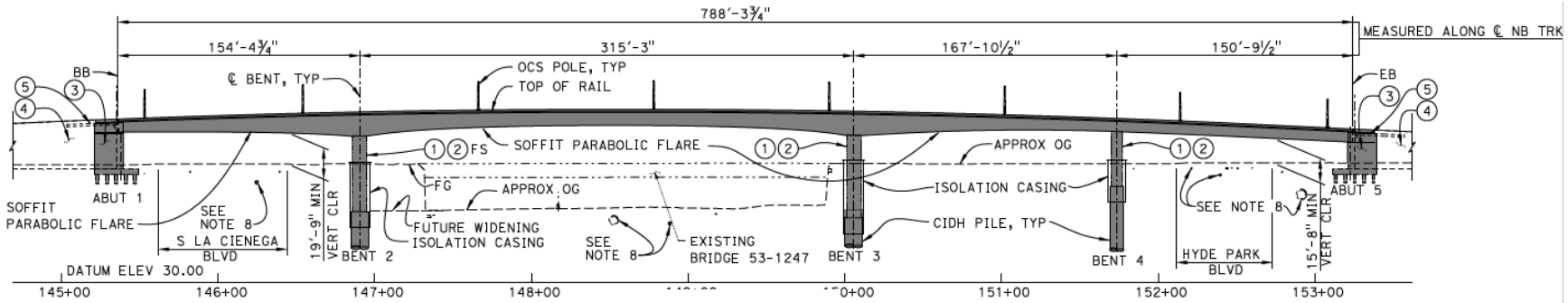
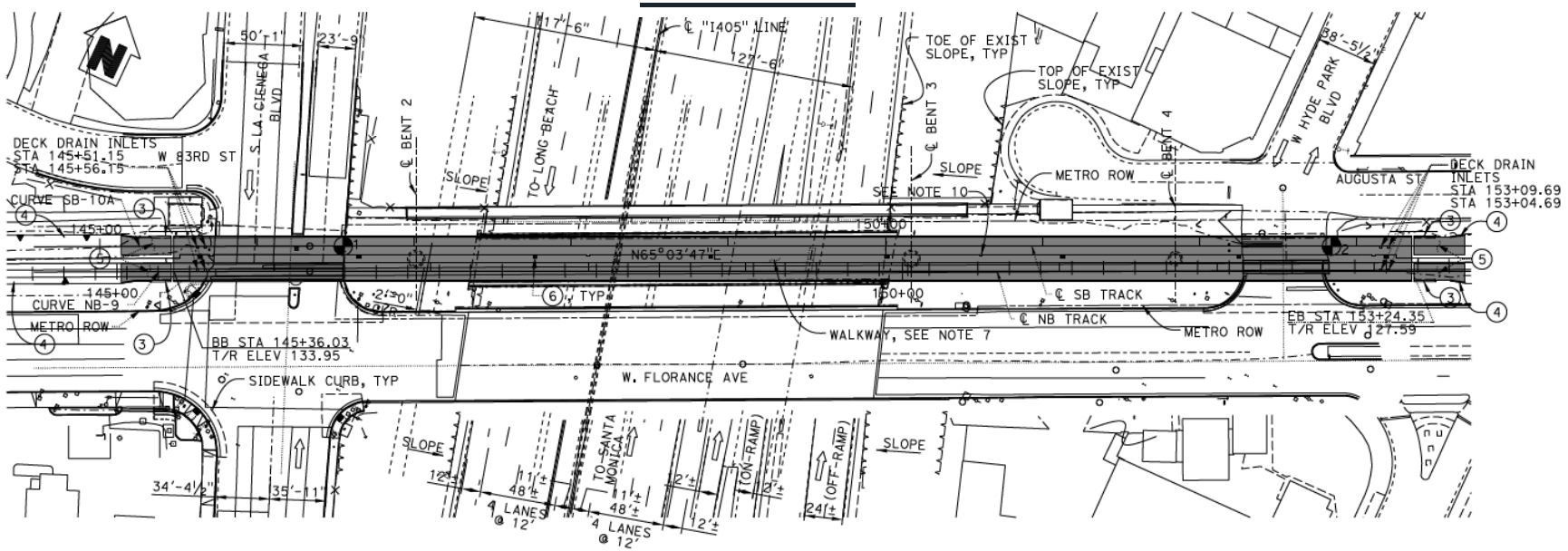
# I-405 UNDERPASS BRIDGE


- 4-Span Post-Tensioned Concrete Haunched Box-Girder Over I-405 Freeway
- Bridge Total Length = **788'- 3¾"**
- Main Span Length = **315'-3"**
- **Tangent Alignment** with Slight Curve at Bridge Approach
- **3 Single-Column Bents on Type-II Mono Shafts**, 2 Seat-Type Abutments
- **Use of Special Bridge Isolation Components** - isolation casings for the piles, soldier pile supported air-gap at the abutment footing were designed to protect 100-yr old Central Outfall (Brick) Sewer from bridge seismic movements.

# I-405 UNDERPASS BRIDGE
# PLANS and ELEVATION

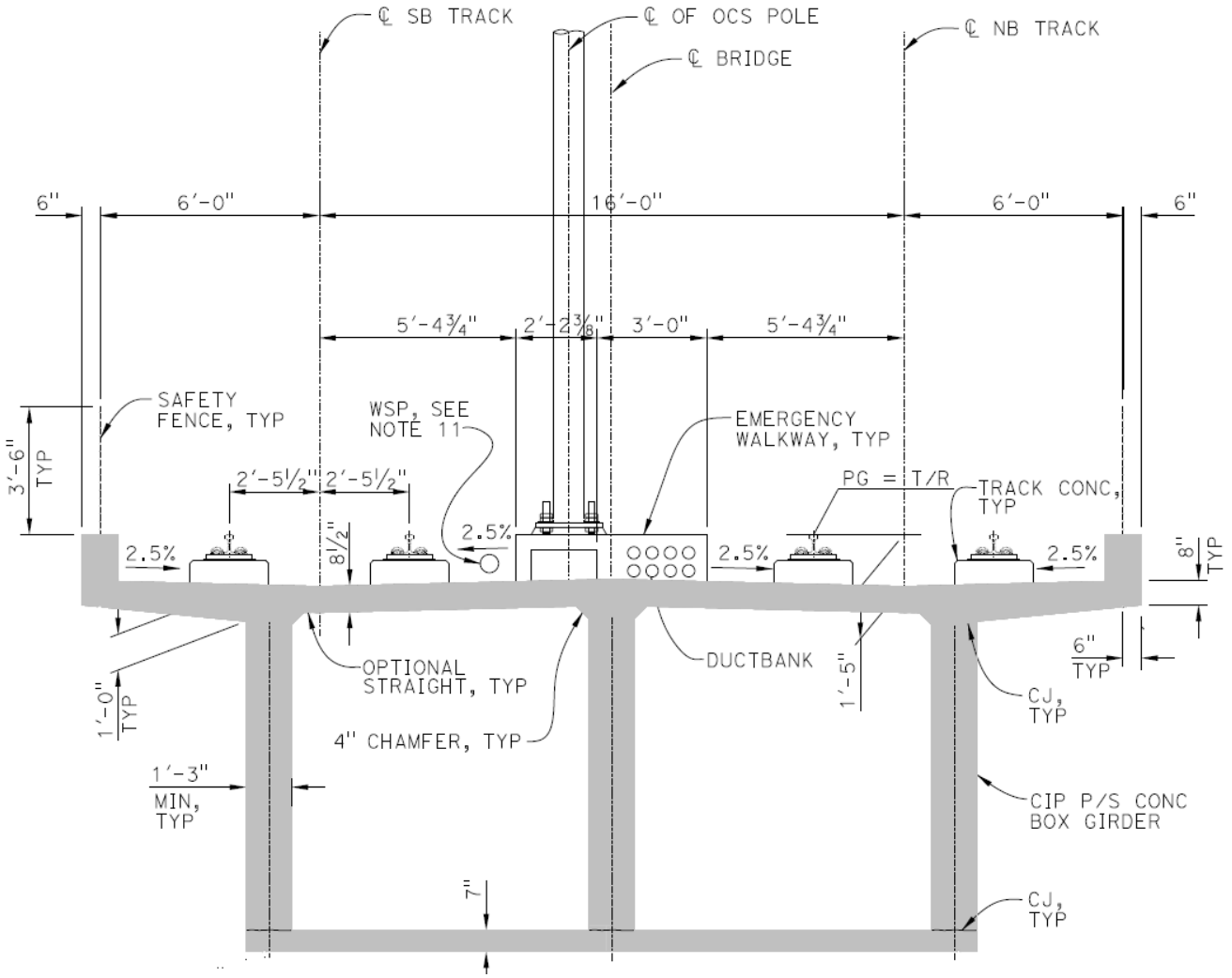



## ELEVATION




## PLAN

# I-405 UNDERPASS BRIDGE
# TYPICAL SECTION



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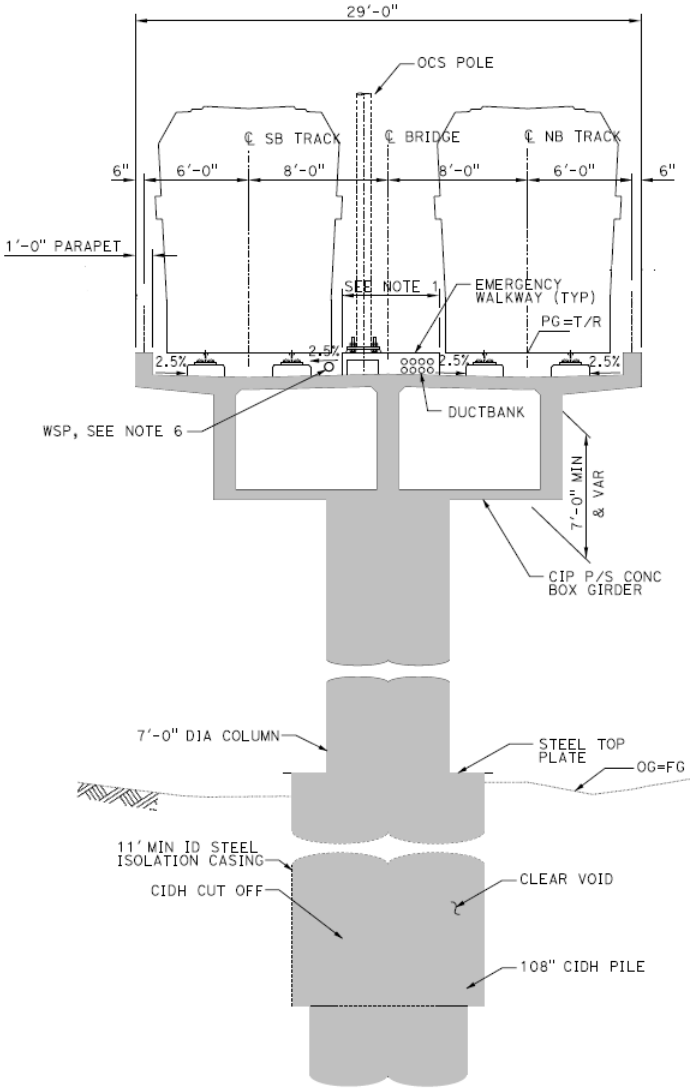
# I-405 UNDERPASS BRIDGE
# TYPICAL SECTION



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# I-405 UNDERPASS BRIDGE
# CONSTRUCTION PHASE - FALSEWORK



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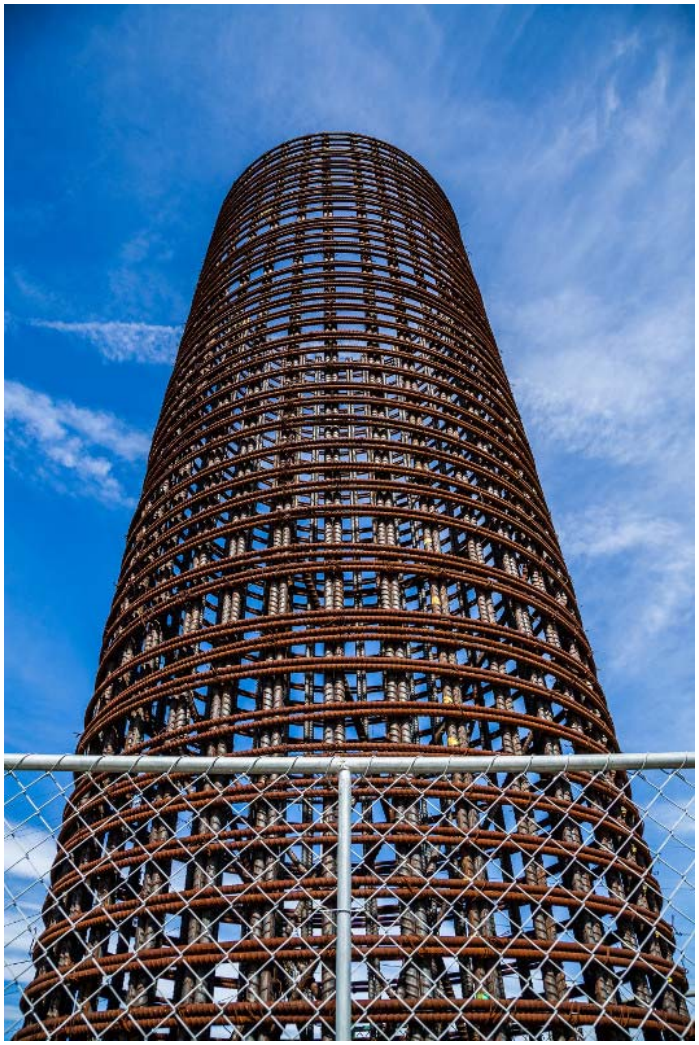
# I-405 UNDERPASS BRIDGE
# CONSTRUCTION PHASE



- **20-hr <u>Continuous</u> Concrete Pour!**
- **Extra Laborers took turns Rotating to Maintain Quality**



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# I-405 UNDERPASS BRIDGE
# CONSTRUCTION PHASE



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# QUESTIONS

## Thank you

*Q & A*

*Email: adurrani@hntb.com for Additional Questions*



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