

Bayonne Bridge "Raise the Roadway" Project

RAISING THE NAVIGATIONAL CLEARANCE OF THE BAYONNE BRIDGE

Chester Werts, PE SE
Sr. Bridge Engineer/Professional Associate

Western Bridge Engineers' Seminar
September 2013

HDR/PB, A Joint Venture

- **HDR Engineering / Parsons Brinckerhoff Joint Venture**
 - **Joint Venture**
 - HDR Engineering
 - Parsons Brinckerhoff
 - **Subconsultants**
 - Arora Associates
 - Arora Engineers
 - Barbara Thayer Associates
 - ECI
 - Gilmore
 - Hartgen Associates
 - HNTB
 - Huie Services
 - IH Engineers
 - Illumination Arts
 - Karl Frank
 - Khaled Mahmoud
 - KPFF
 - Pennoni
 - Purdue University
 - RWDI
 - Sam Schwartz Engineers
 - VJ Associates
 - Weidlinger Associates

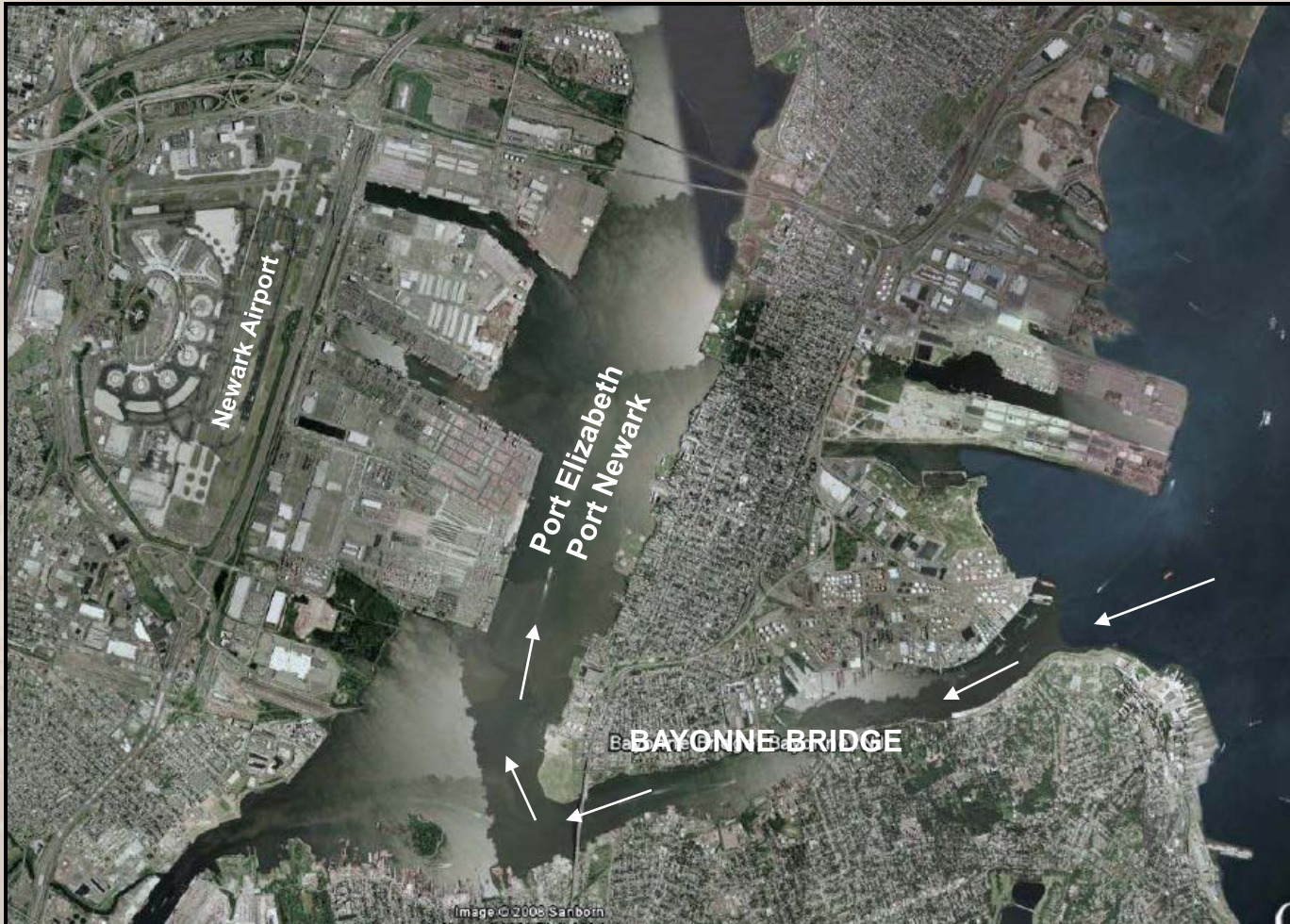
Project Background: Port Authority Bridges



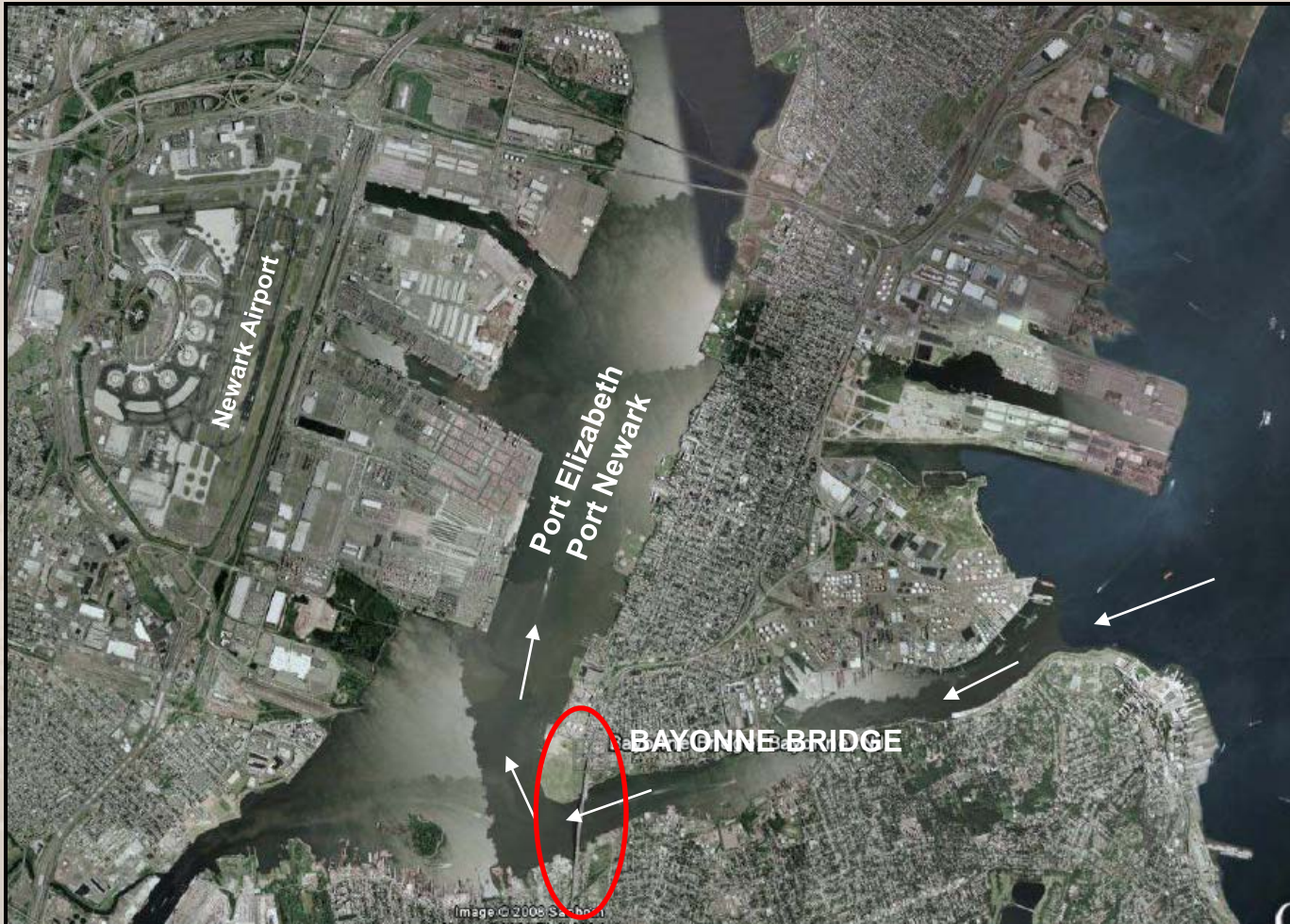
Project Background: Port Authority Bridges



Project Background: Existing Facility



Project Background: Existing Facility

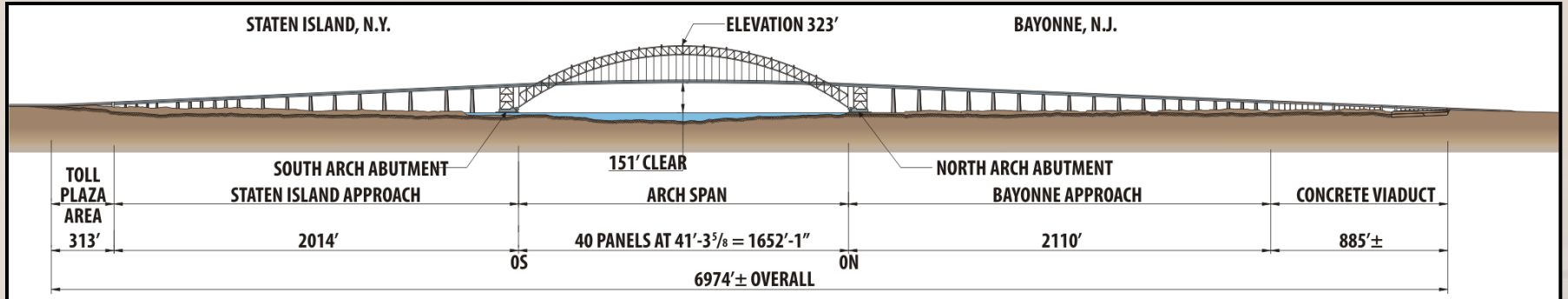


Project Background: Existing Facility

- **Opened to traffic on November 15, 1931**
- **Third longest steel arch bridge in the world**
- **Longest in the world at the time of completion**
- **Connects Bayonne, New Jersey with Staten Island, New York - spanning the Kill Van Kull**
- **Arch span of 1,652 feet from pin to pin**
- **Height of the arch above the water at the crown is 325 feet**
- **Original bridge designed by Othmar Ammann**



Project Background: Existing Facility



Existing Facility: 6,974'



Project Background: 2008 Feasibility Study

INCREASE NAVIGATIONAL CLEARANCE

- +35' → 185' Clearance
- +50' → 200' Clearance
- +65' → 215' Clearance

BY

- Raise the Roadway
- Jacking the Arch Vertically
- New Replacement Bridge
- Tunnel under Kill Van Kull

Project Background: 2008 Feasibility Study

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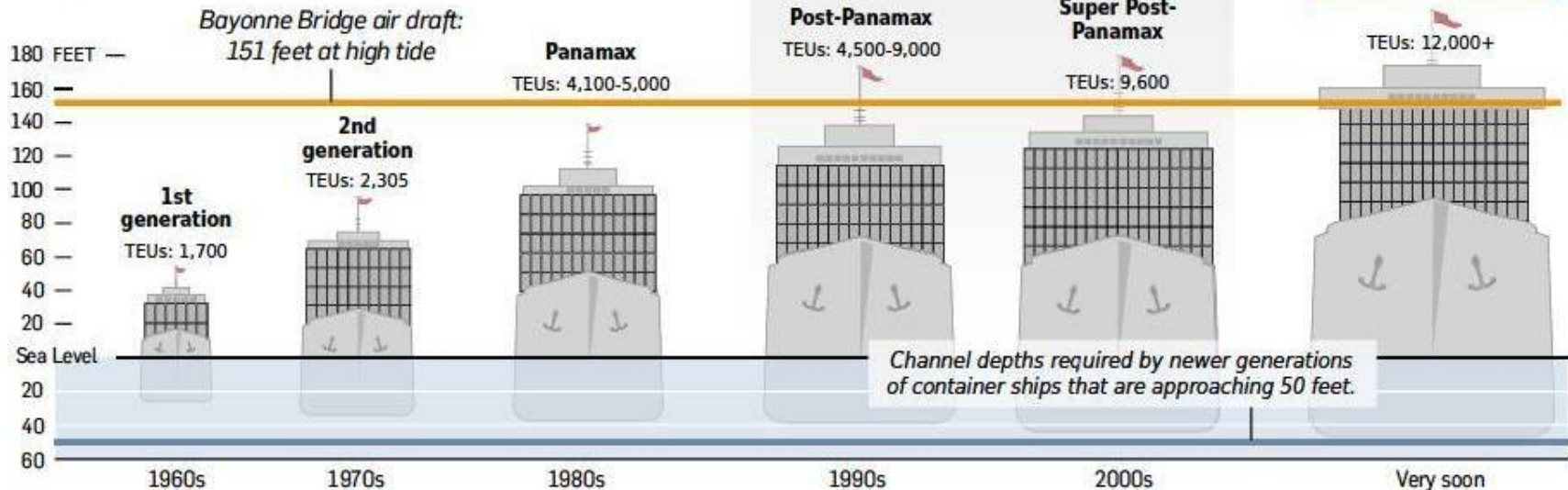
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- **Jacking the Arch Vertically**
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- **Tunnel under Kill Van Kull**

Project Background: Container Ships

TEU: Twenty-foot equivalent unit

A measure of volume or capacity based on the standard dimensions of a 20-foot cargo-carrying container; a 40-foot container provides for the same volume or capacity as two 20-foot containers (2 TEUs).

■ = one 40-foot container



U.S. Army Corp of Engineers; Maher Terminals; The Port Authority of N.Y. and N.J.; Pictonmetry

FRANK CECALA and ANDRE MALOK/THE STAR-LEDGER

Project Background: Container Ships

Current

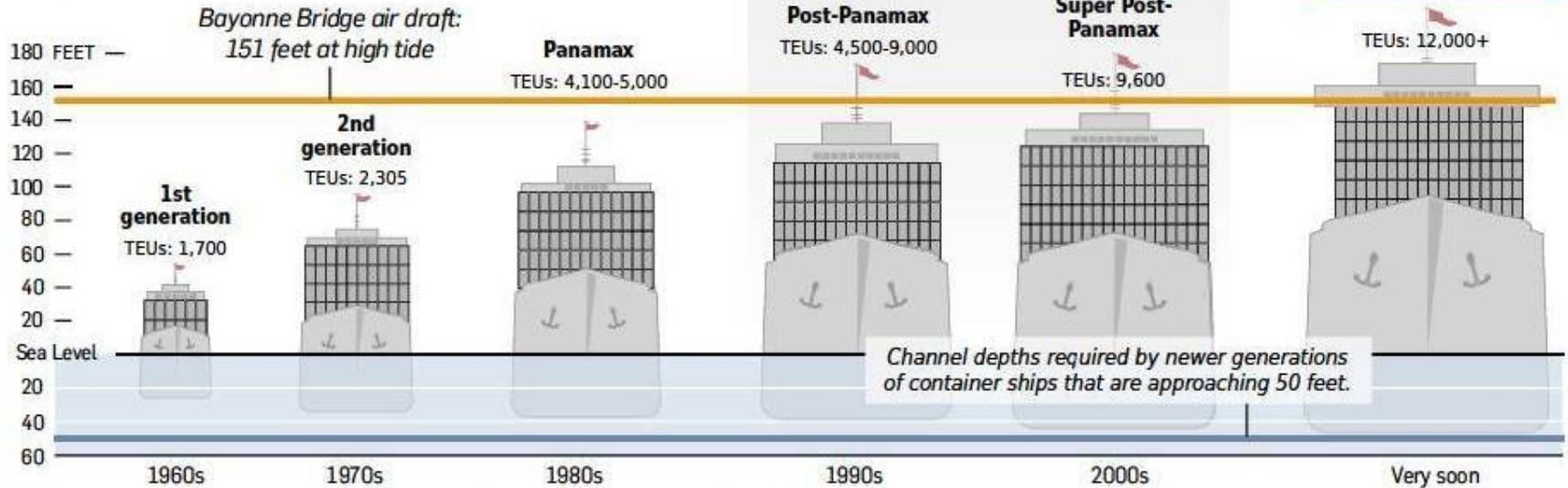


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"Post-Panamax" refers to ships that are too large to navigate the Panama Canal. But they will fit through after 2014, when the expansion of the canal is expected to be completed.



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Project Background: Container Ships

Current



Future

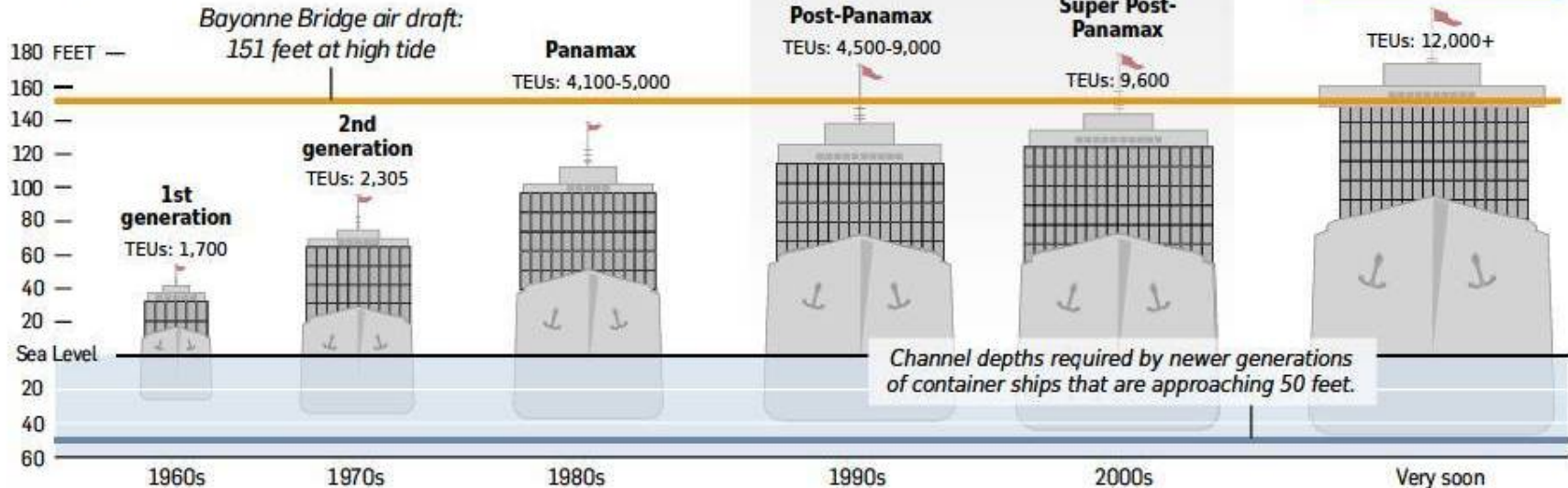


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FRANK CECALA and ANDRE MALOK/THE STAR-LEDGER

“Raise the Roadway”

Rehabilitate, Retrofit, and Reuse – Arch



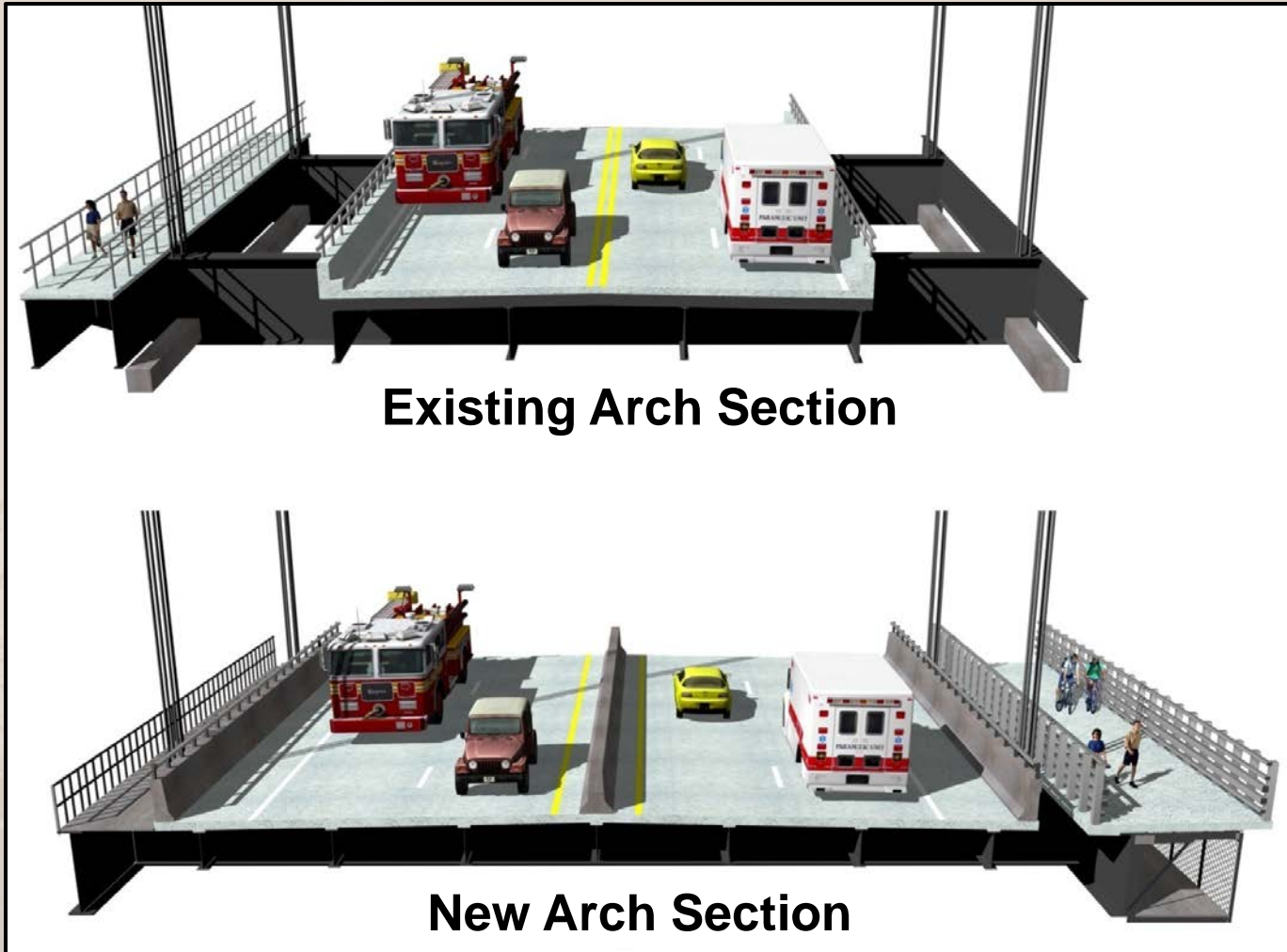
The Existing Bayonne Bridge



The “New” Bayonne Bridge

- **Rehabilitate:** Strengthening the Existing Arch
- **Retrofit:** Relocation of the Arch Portals
- **Reuse:** Raising the Roadway within Existing Arch

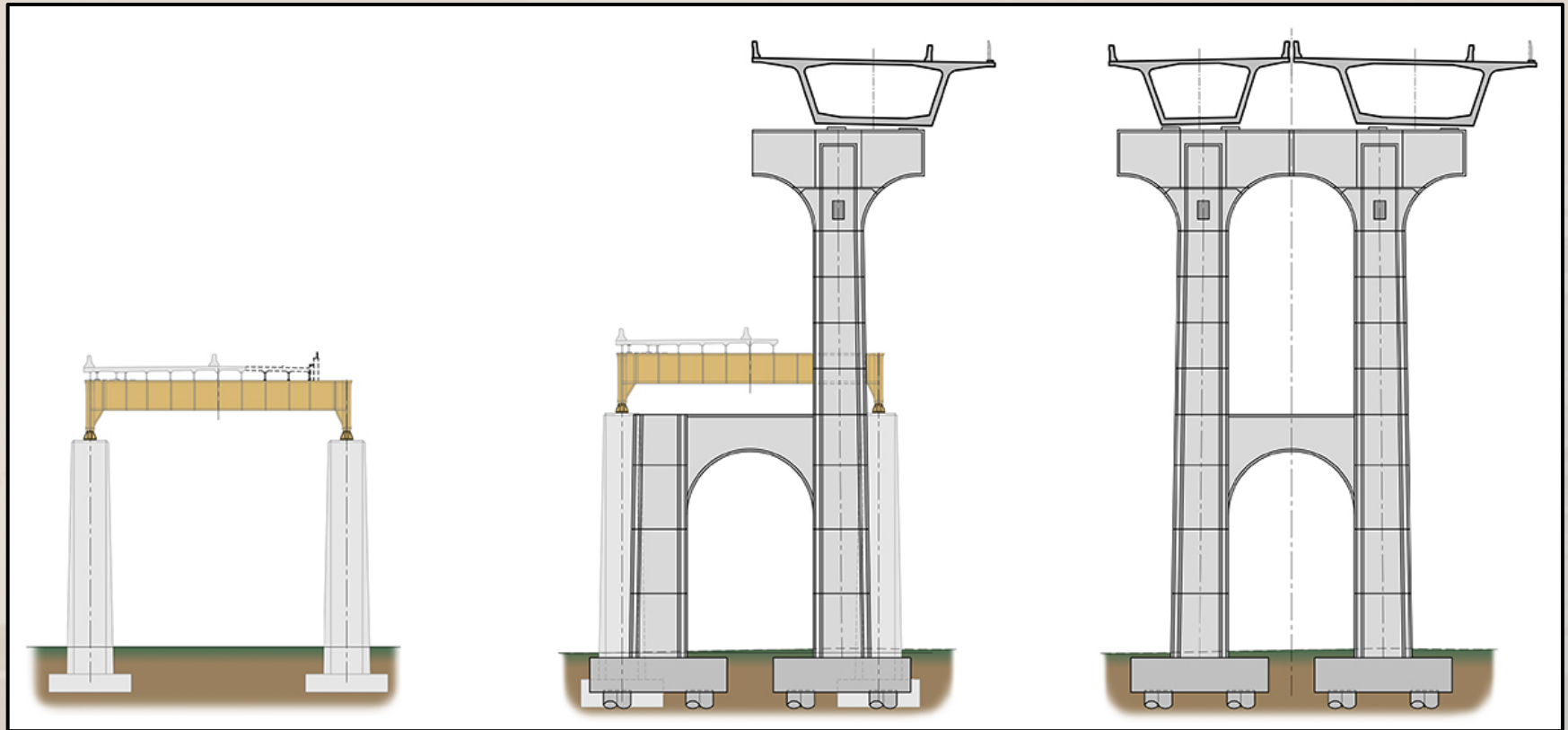
Wider Roadway – Arch



Construction Overview: Arch Construction



“Raise the Roadway” Replacement – Approach Structures

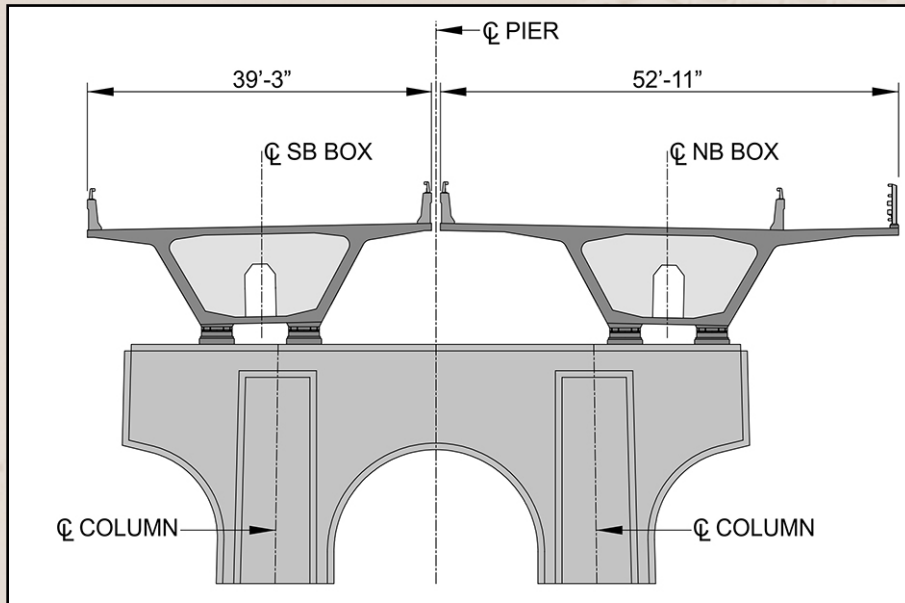


Existing

NB Approach

Final Condition

Approach Structure: New Precast Concrete Box Girders

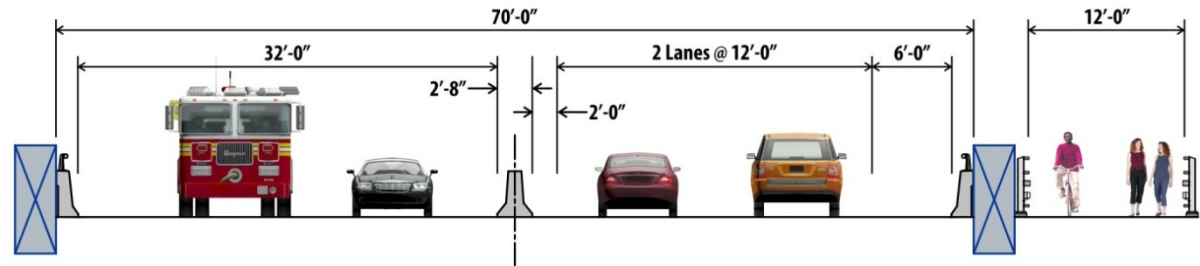


Construction Overview: Approaches

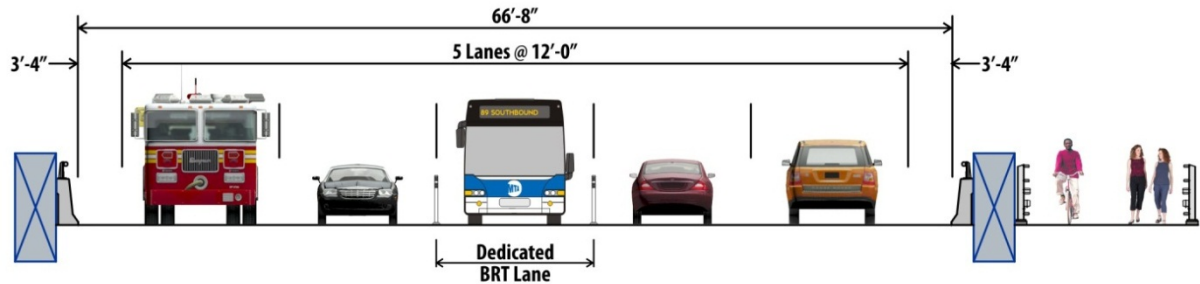


Design Criteria: Live Loads – Future BRT/LRT

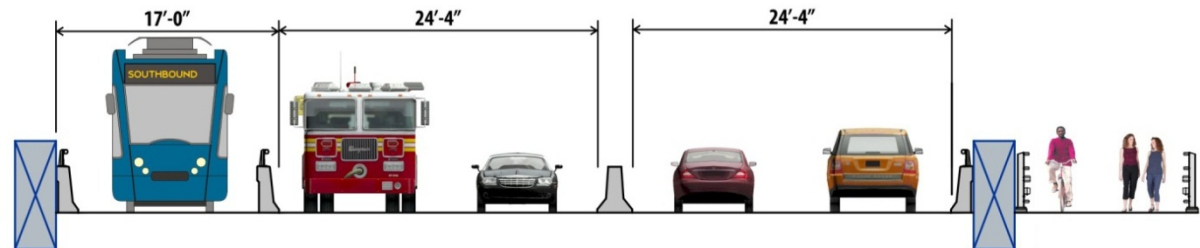
- **BASE**



- **BRT**

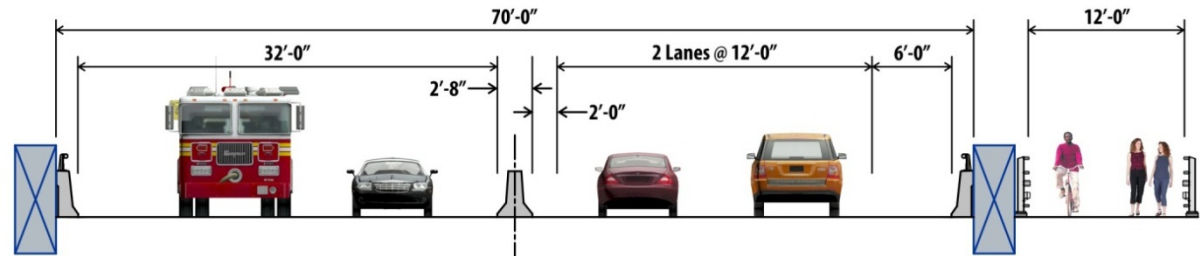


- **LRT**

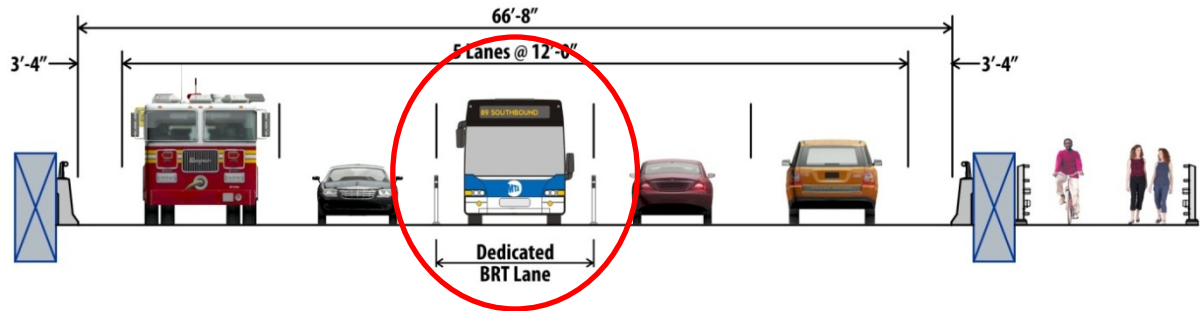


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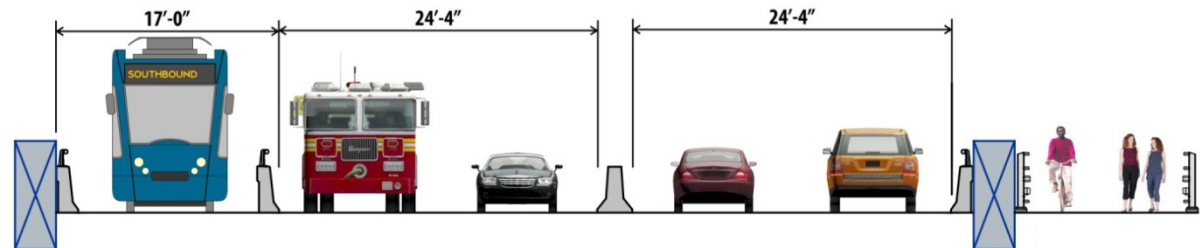
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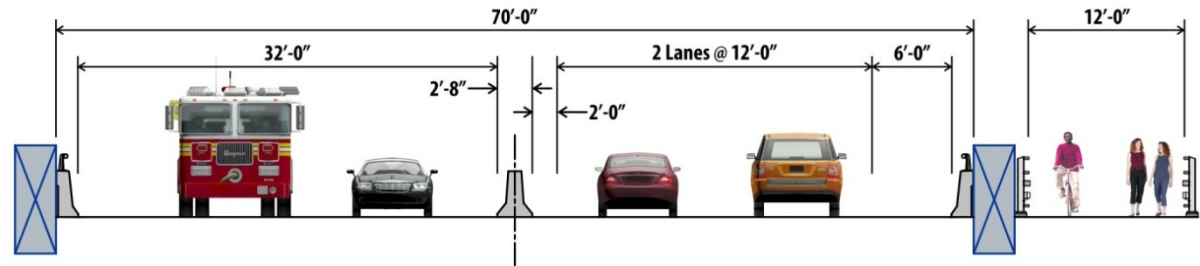


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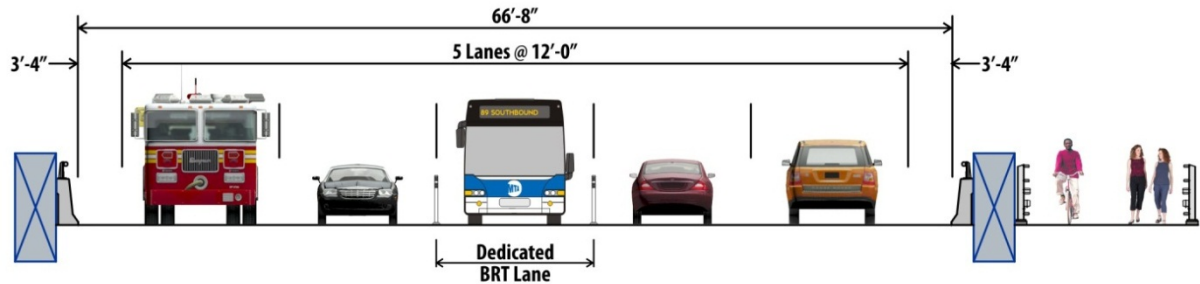


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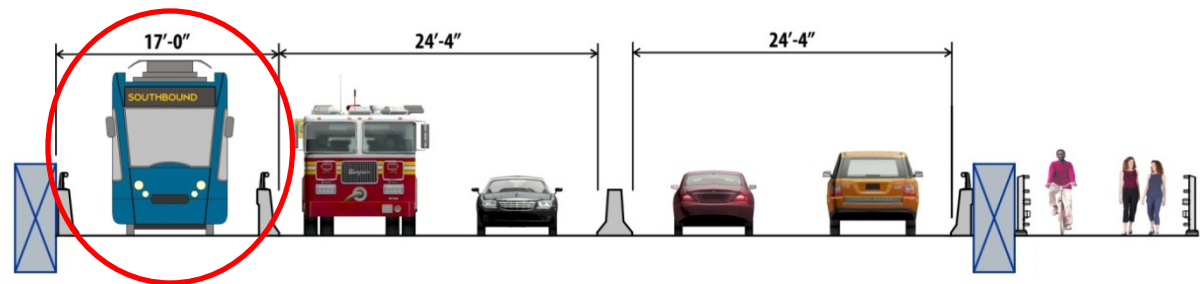
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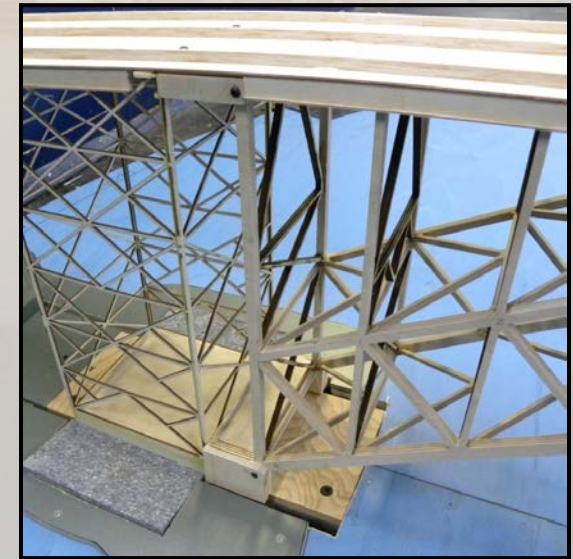
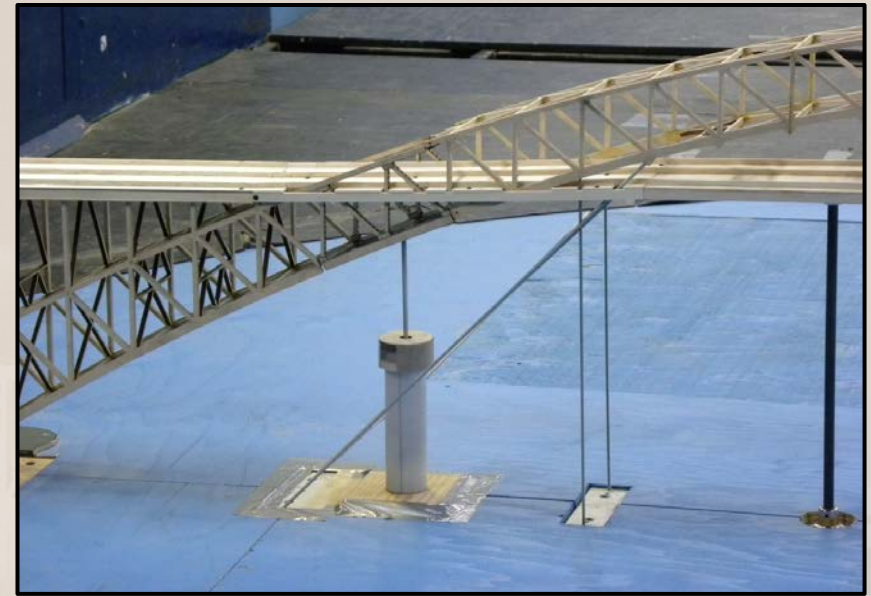
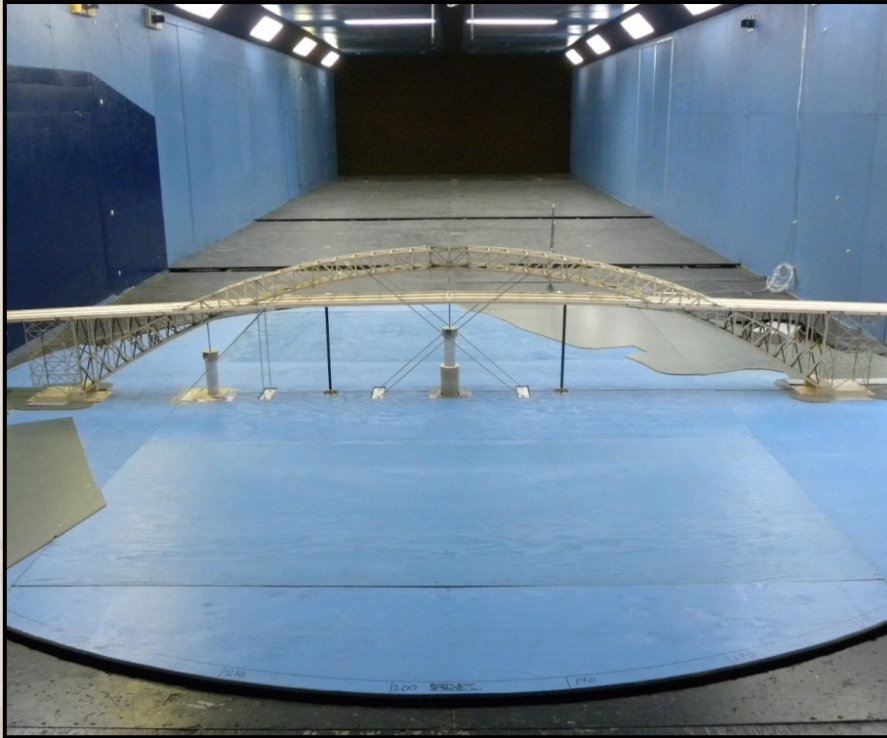
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- **LRT**



Design Criteria: Wind Tunnel Tests



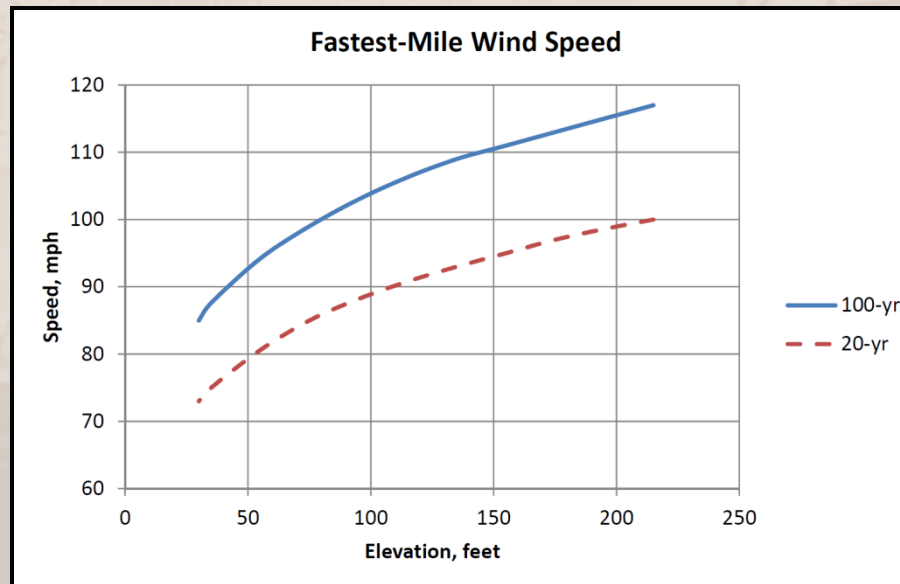
- Arch Model Wind Tests performed by RWDI

Design Criteria: Wind Speeds

Arch:

Wind Speed Applicable for	Return Period (years)	Mean Wind Speed (mph) at Deck Level 215 ft and Averaging Time		Corresponding 3-sec Gust Speed (mph) at 33 ft Open Terrain
Design during construction	20	78.5	1 h	95.5
Design of completed bridge	100	90.0	1 h	110.7
Stability during construction	1,000	110.0	10 min	140.8
Stability of completed bridge	10,000	133.0	10 min	166.8

Approaches:

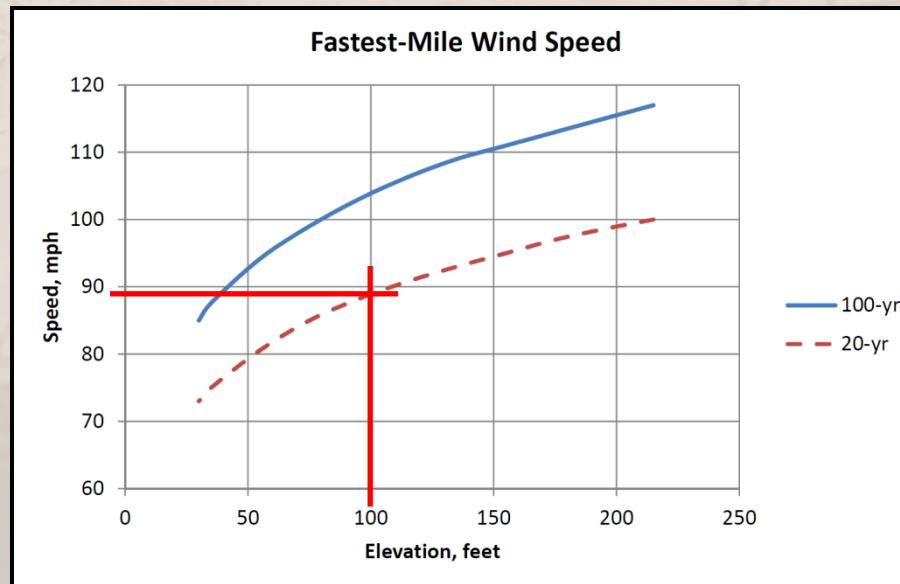


Design Criteria: Wind Speeds

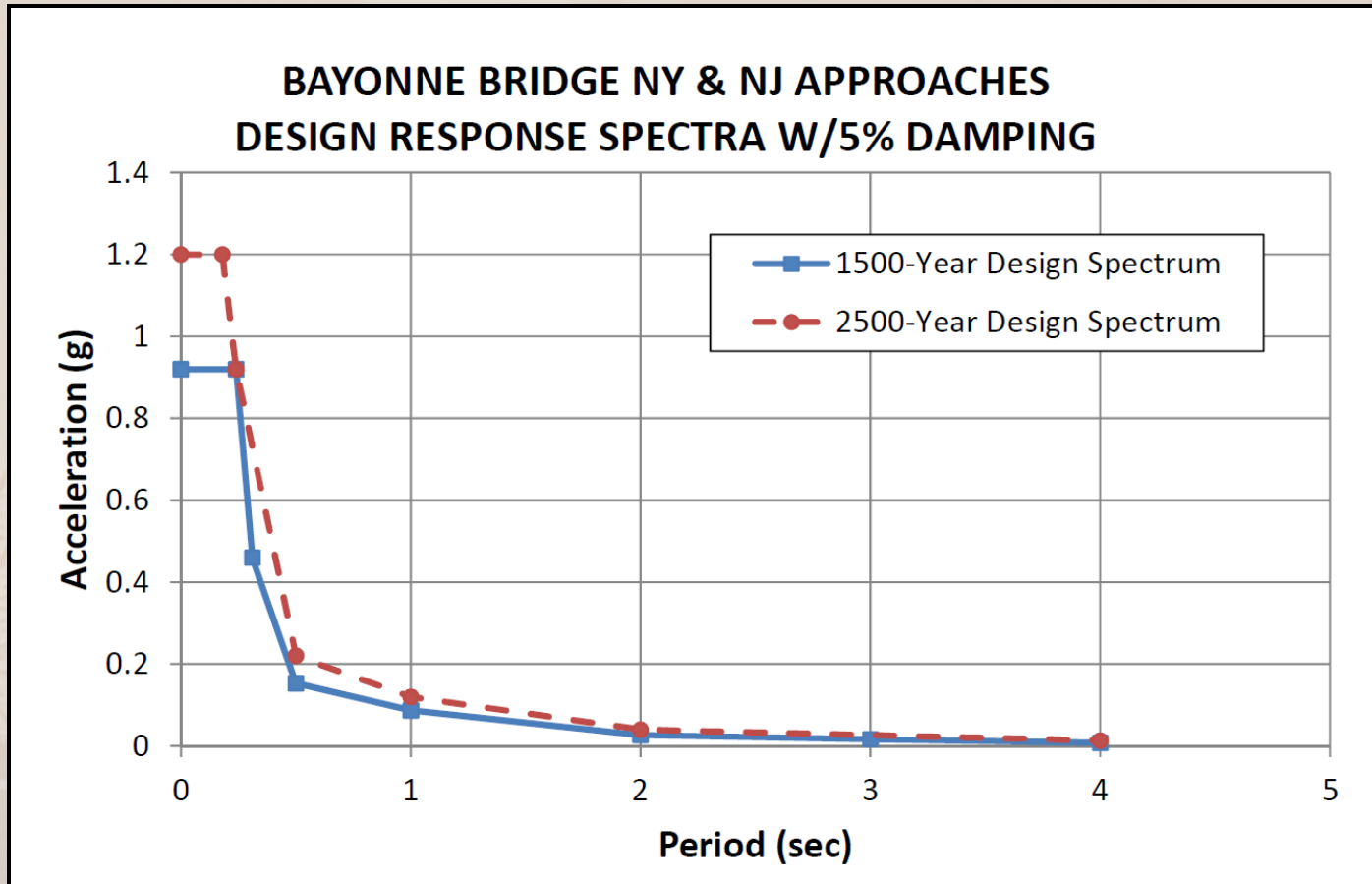
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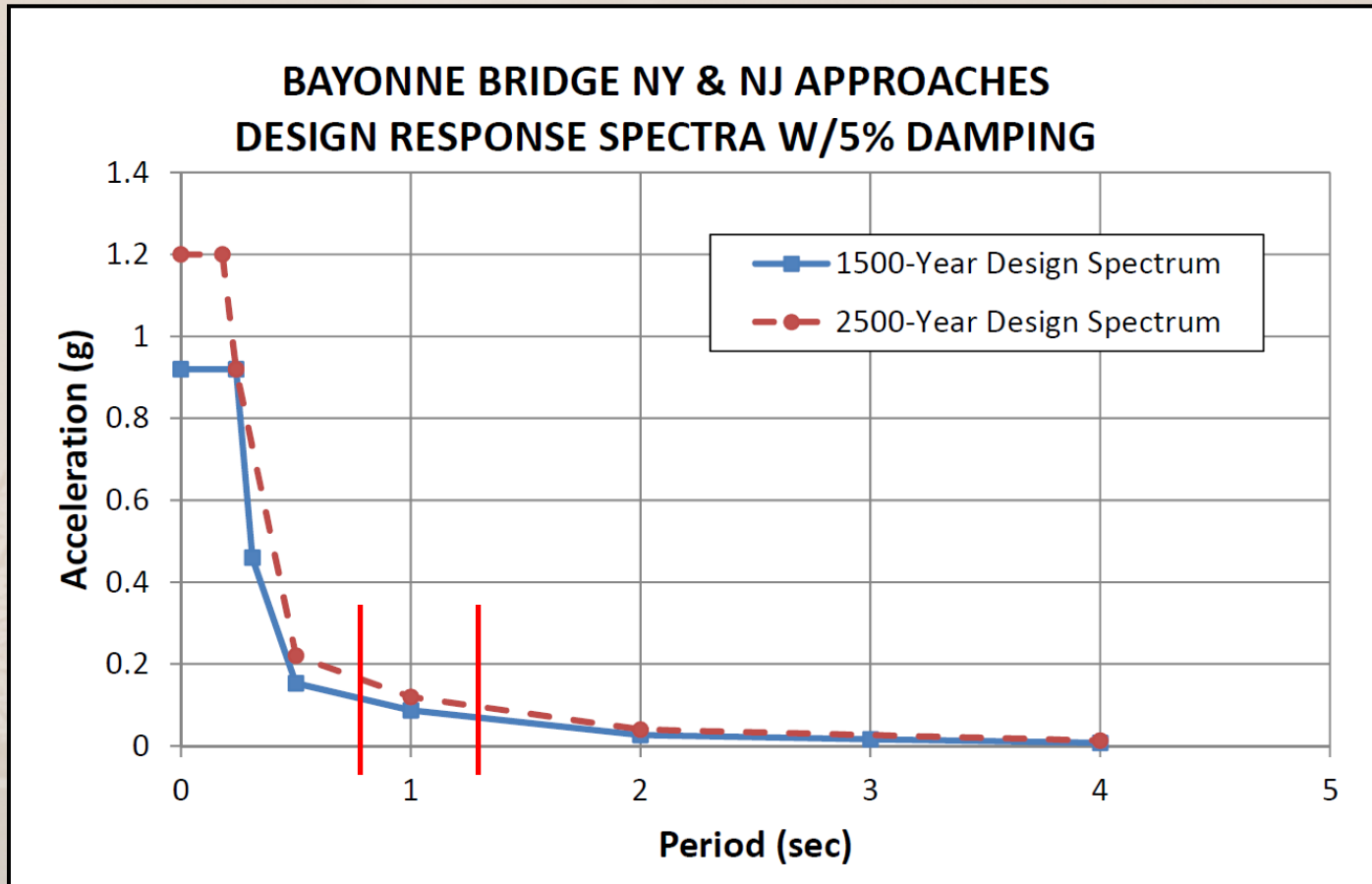
Approaches:



Design Criteria: Site Specific Seismic



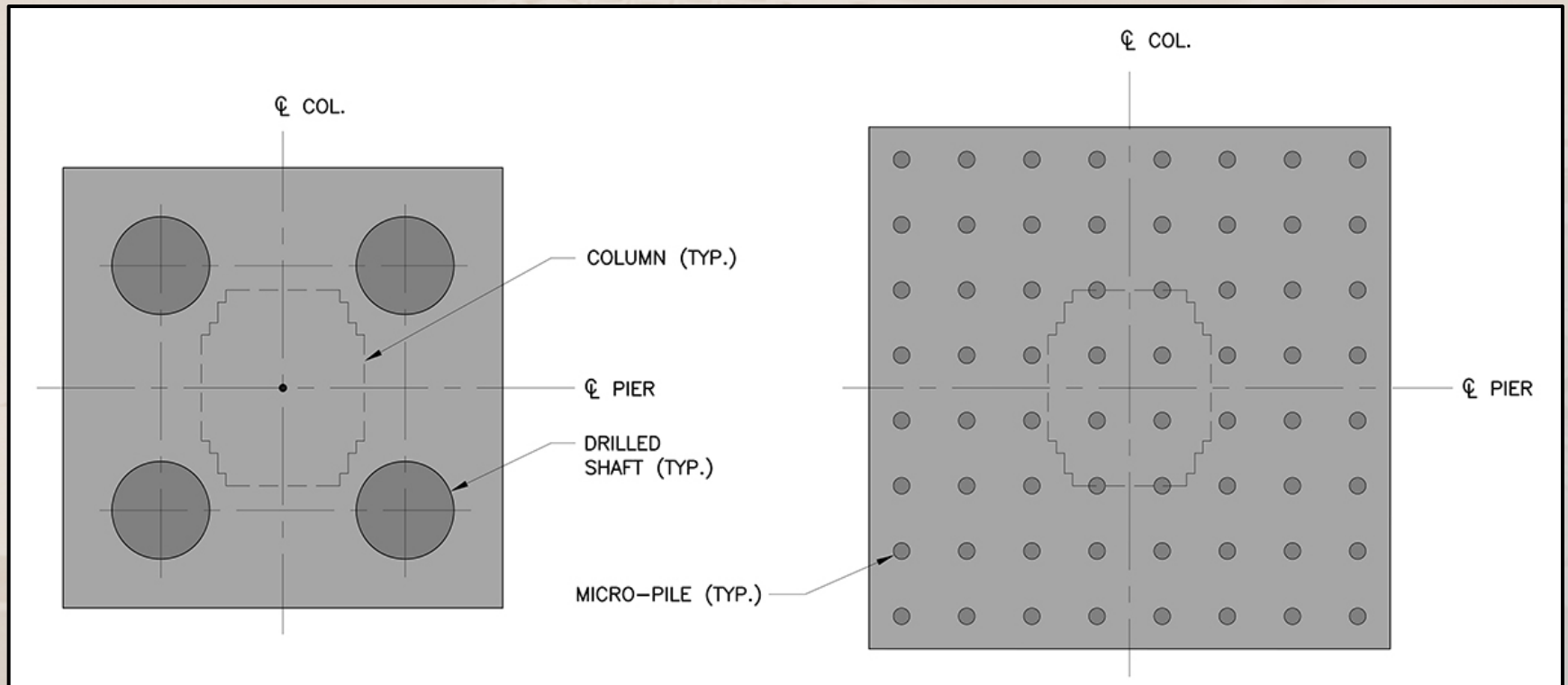
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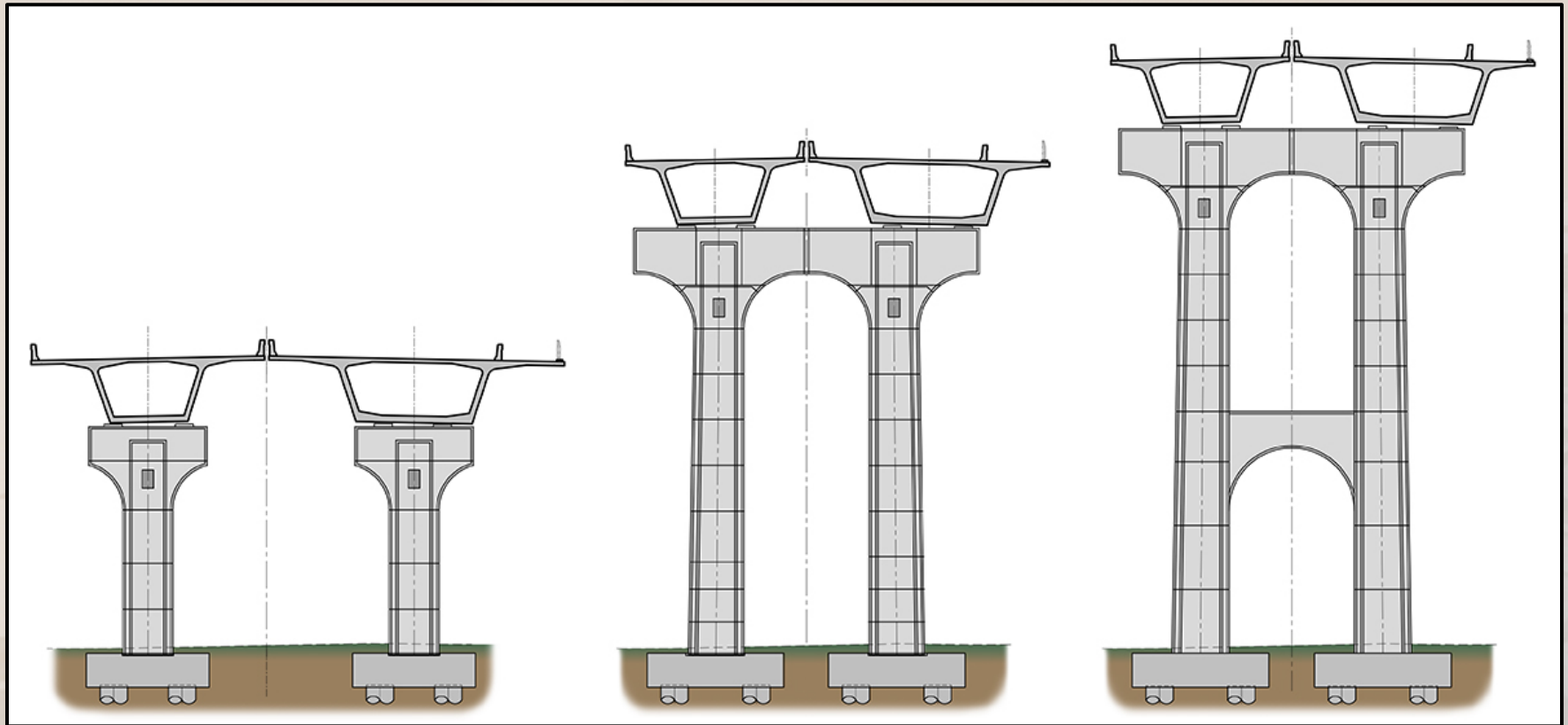
Approach Structures: Foundation Types

6' Dia. Drilled Shaft

12" Micro-Pile



Approach Structures: Pier Types

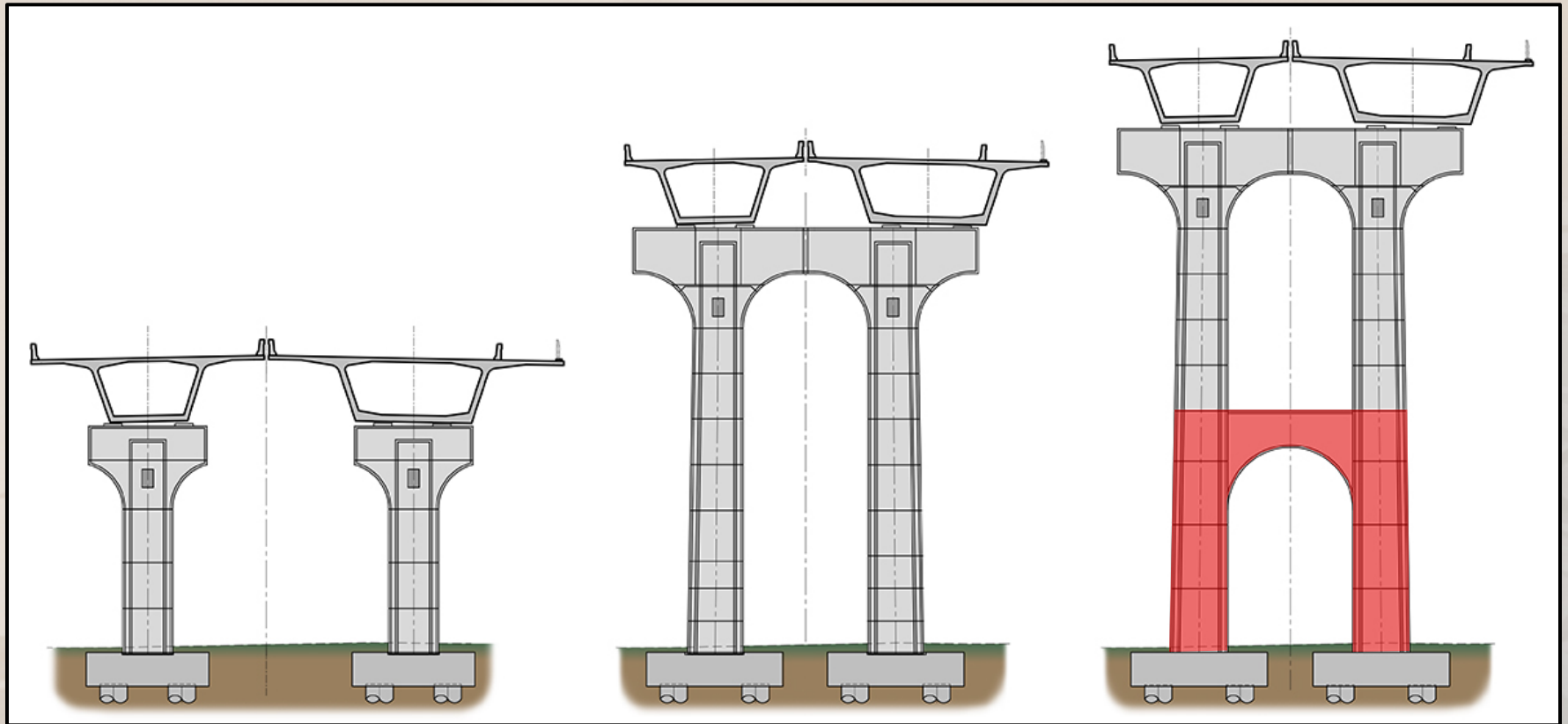


Single Pier

Combined Pier

Tall Pier

Approach Structures: Pier Types



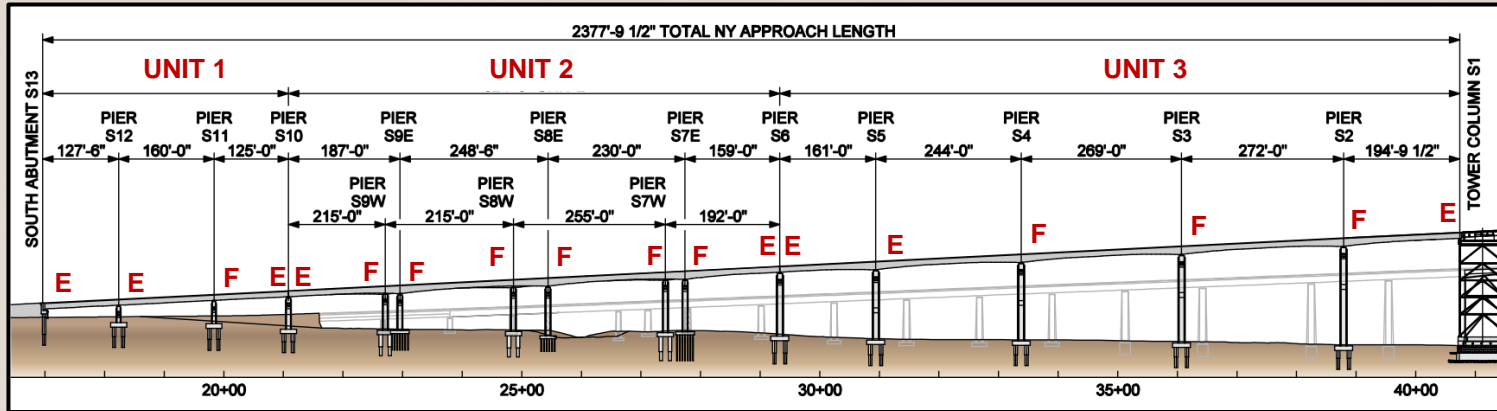
Single Pier

Combined Pier

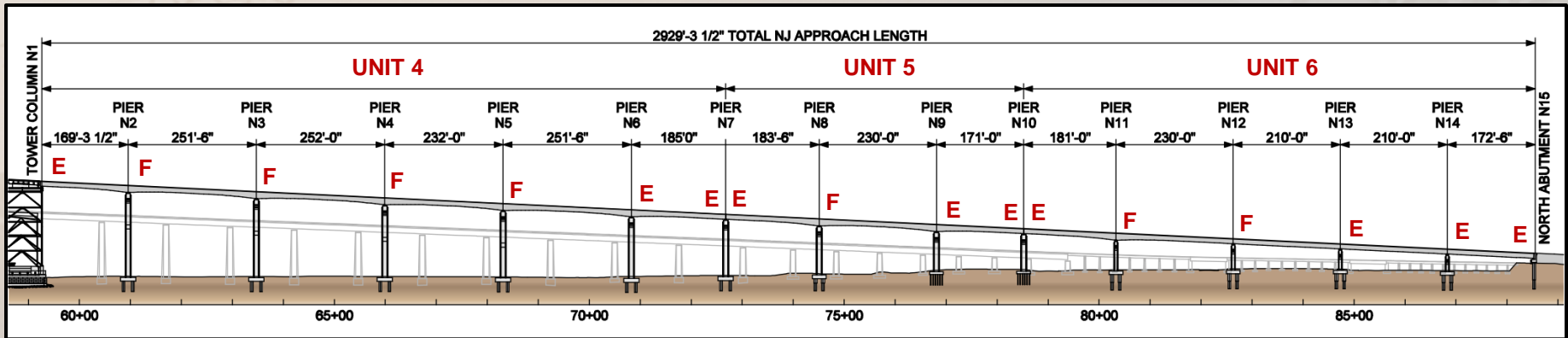
Tall Pier

Approach Structures: Articulation/Pier Fixity

New York

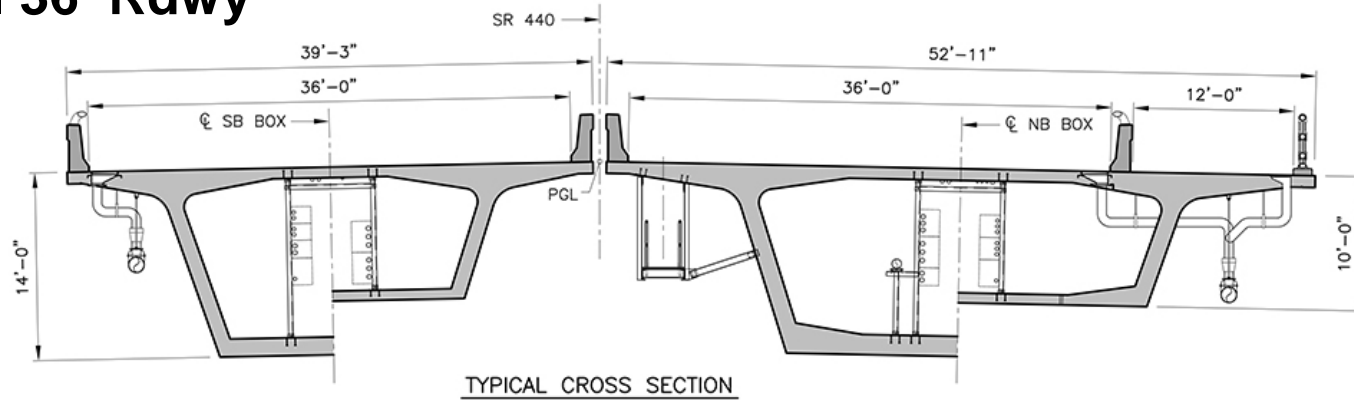


New Jersey

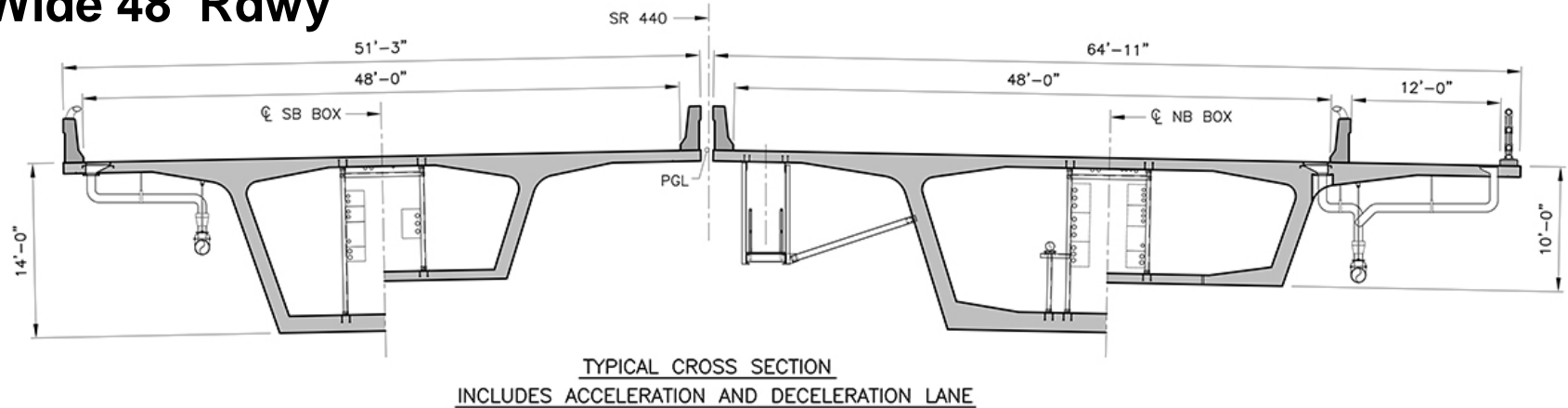


Approach Structures: Box Geometry

Typical 36' Rdwy

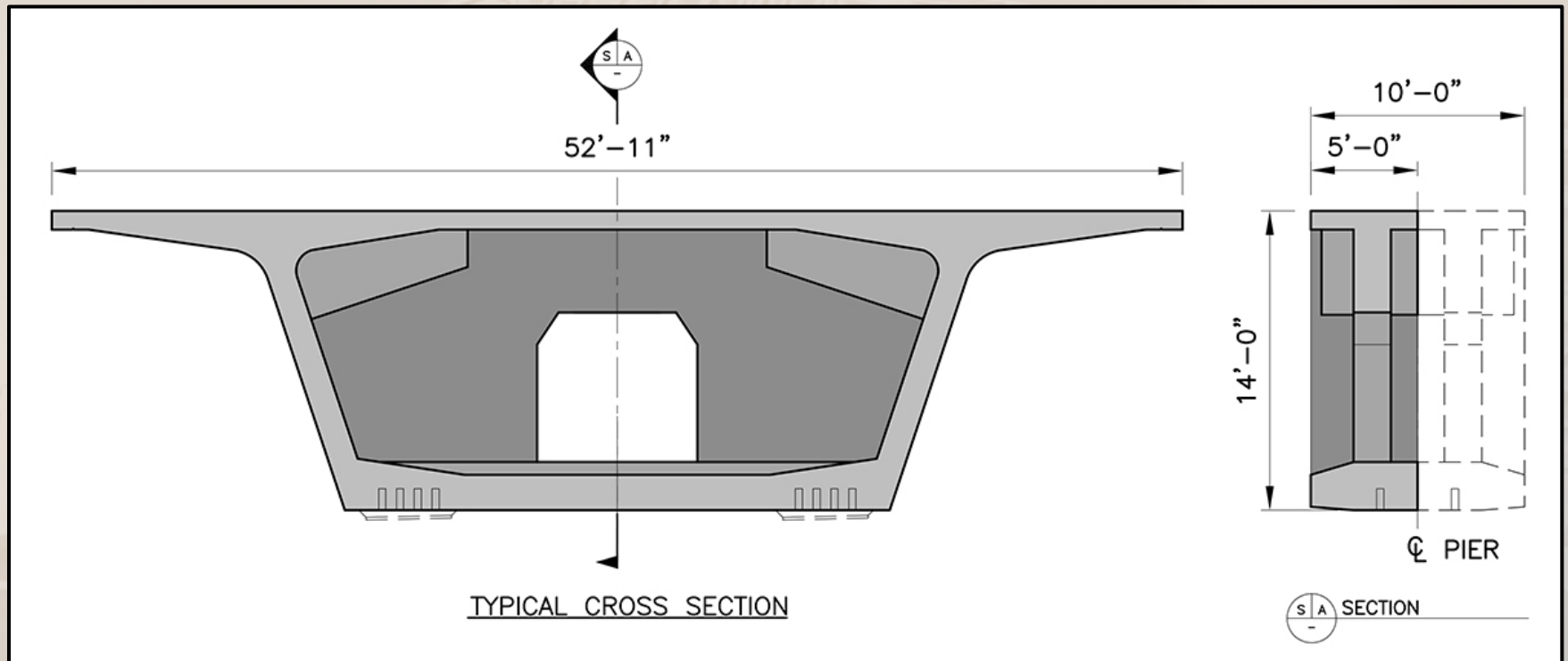


Wide 48' Rdwy



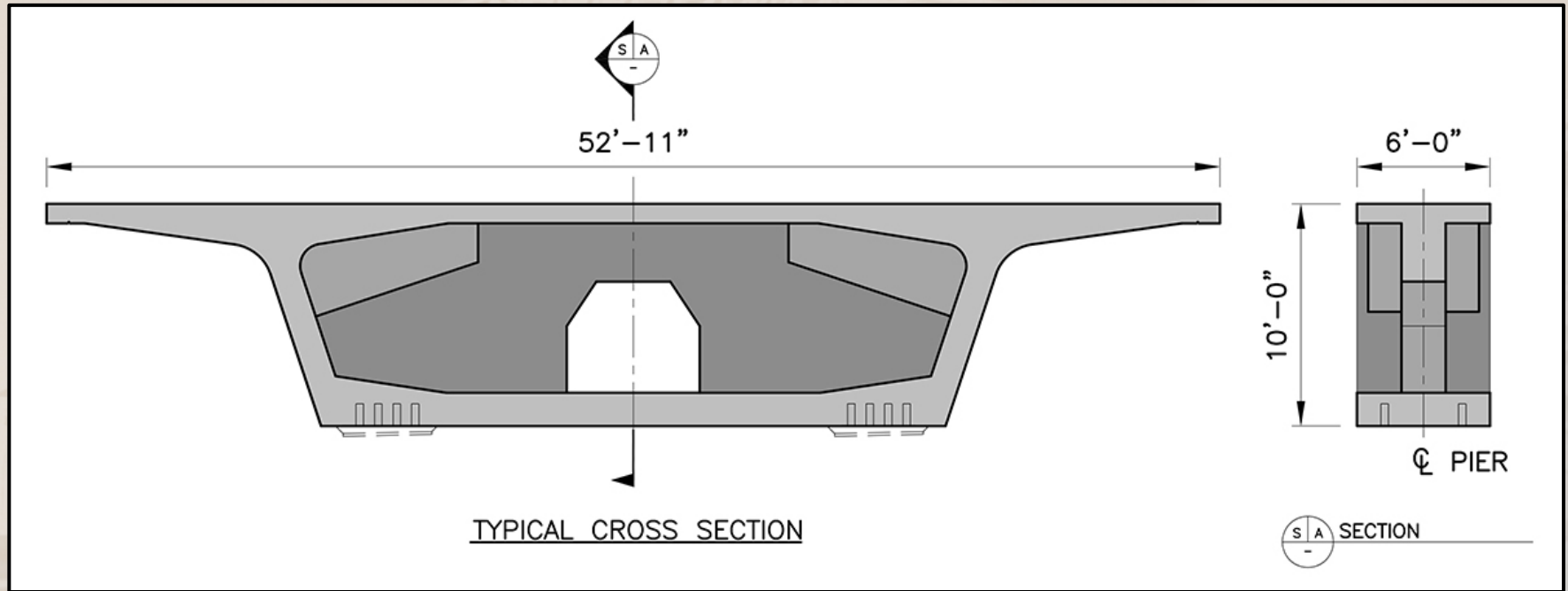
Approach Structures: Pier Diaphragms

Typical Haunched Girder



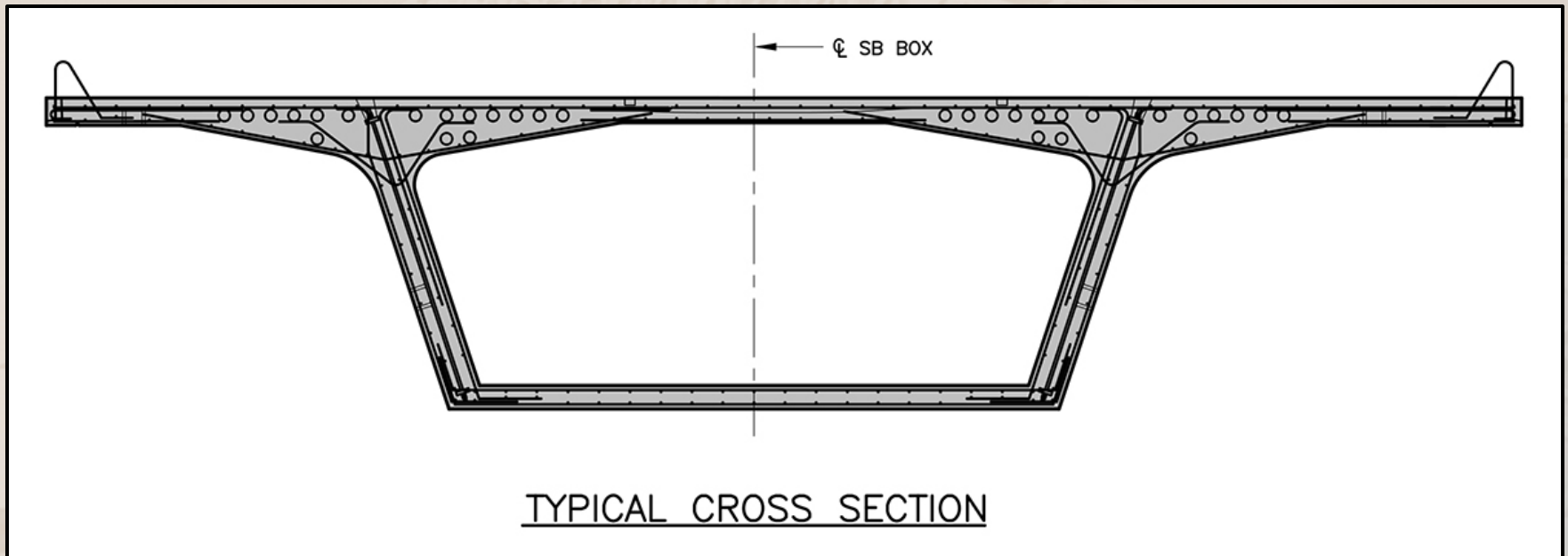
Approach Structures: Pier Diaphragms

Typical Constant Depth Girder



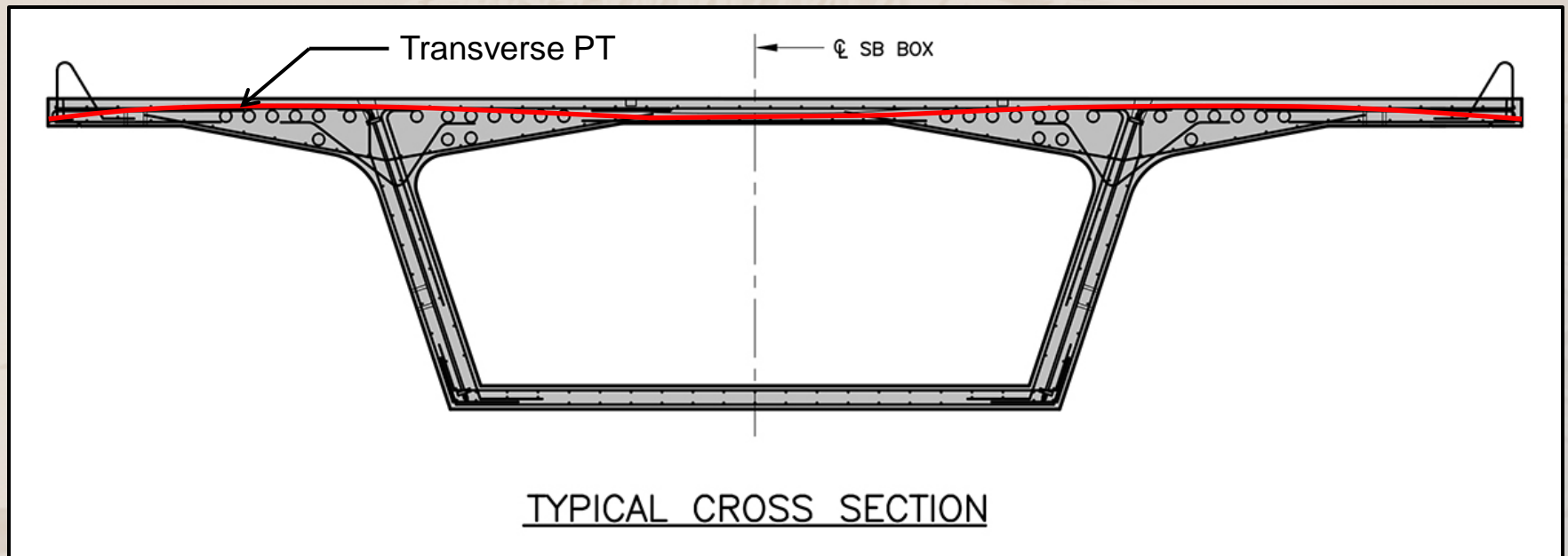
Approach Structures: Section Design

Typical Constant Depth Section



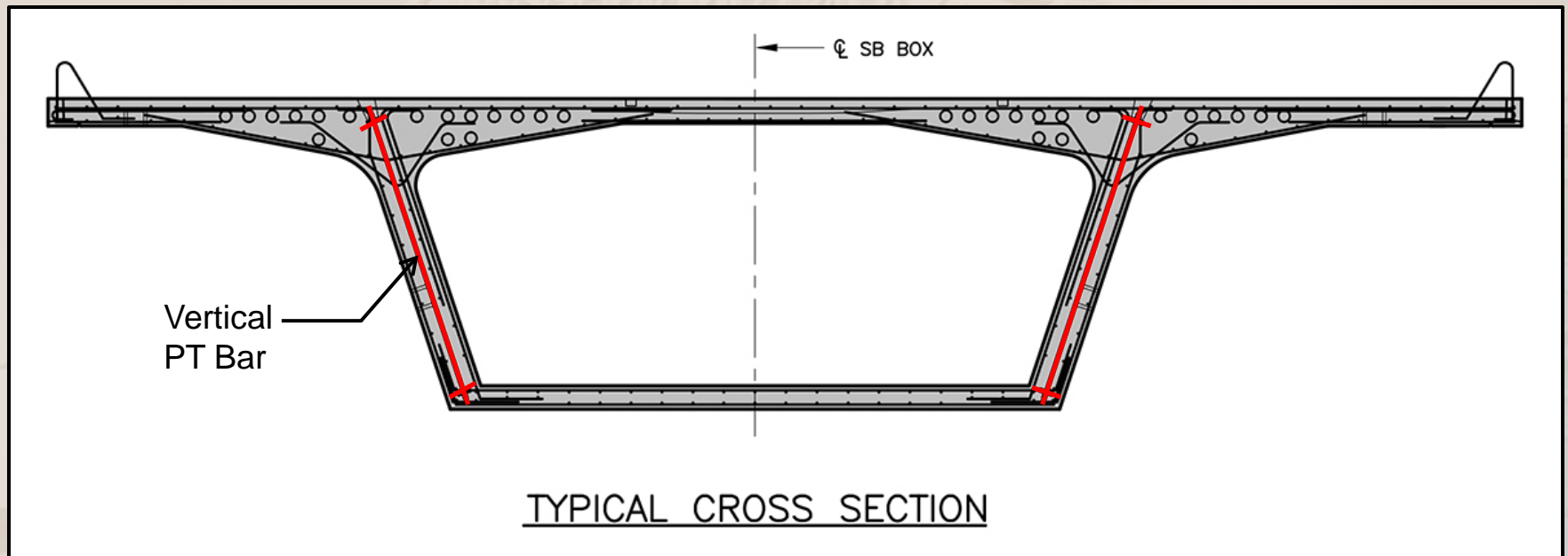
Approach Structures: Section Design

Typical Constant Depth Section

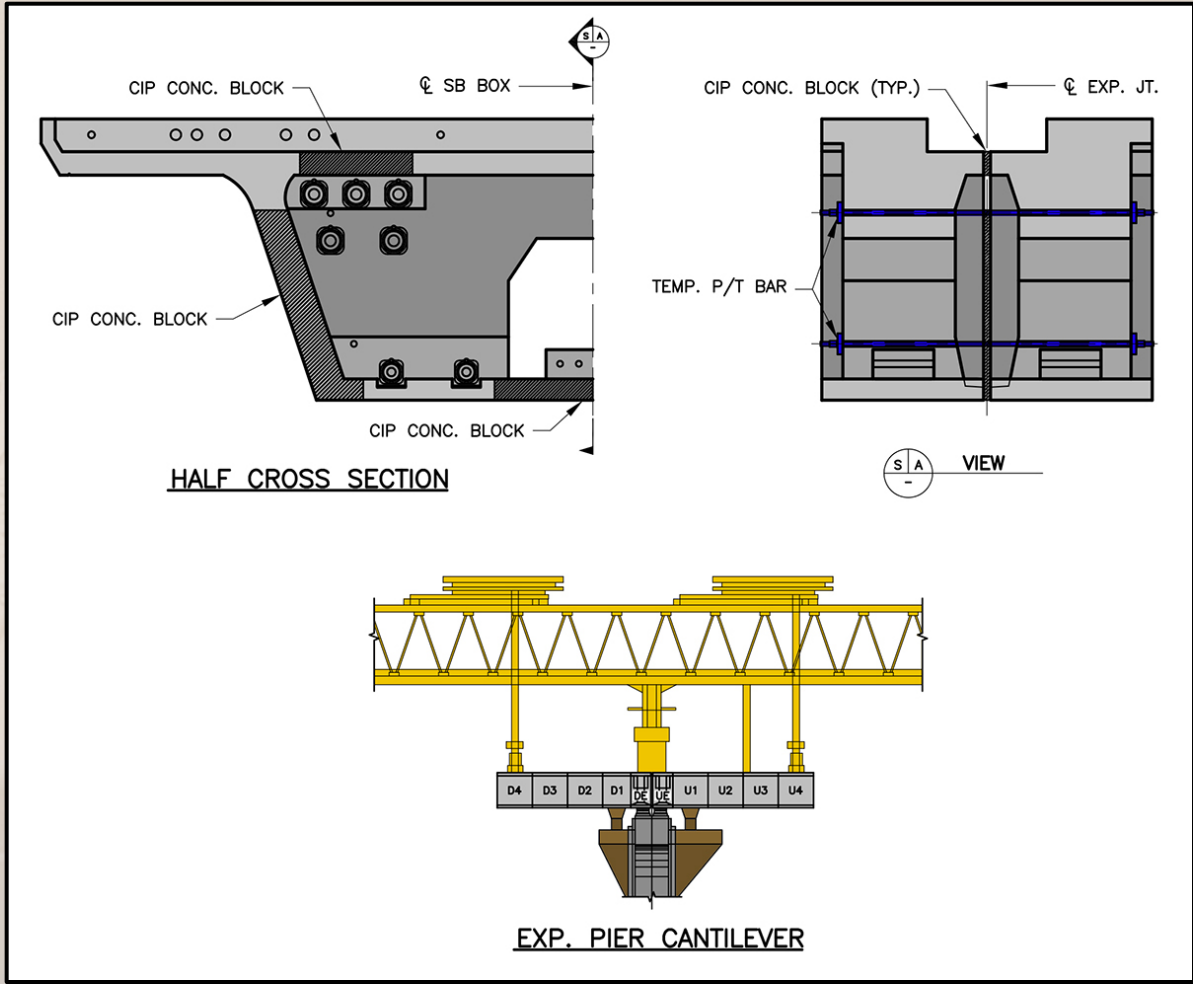


Approach Structures: Section Design

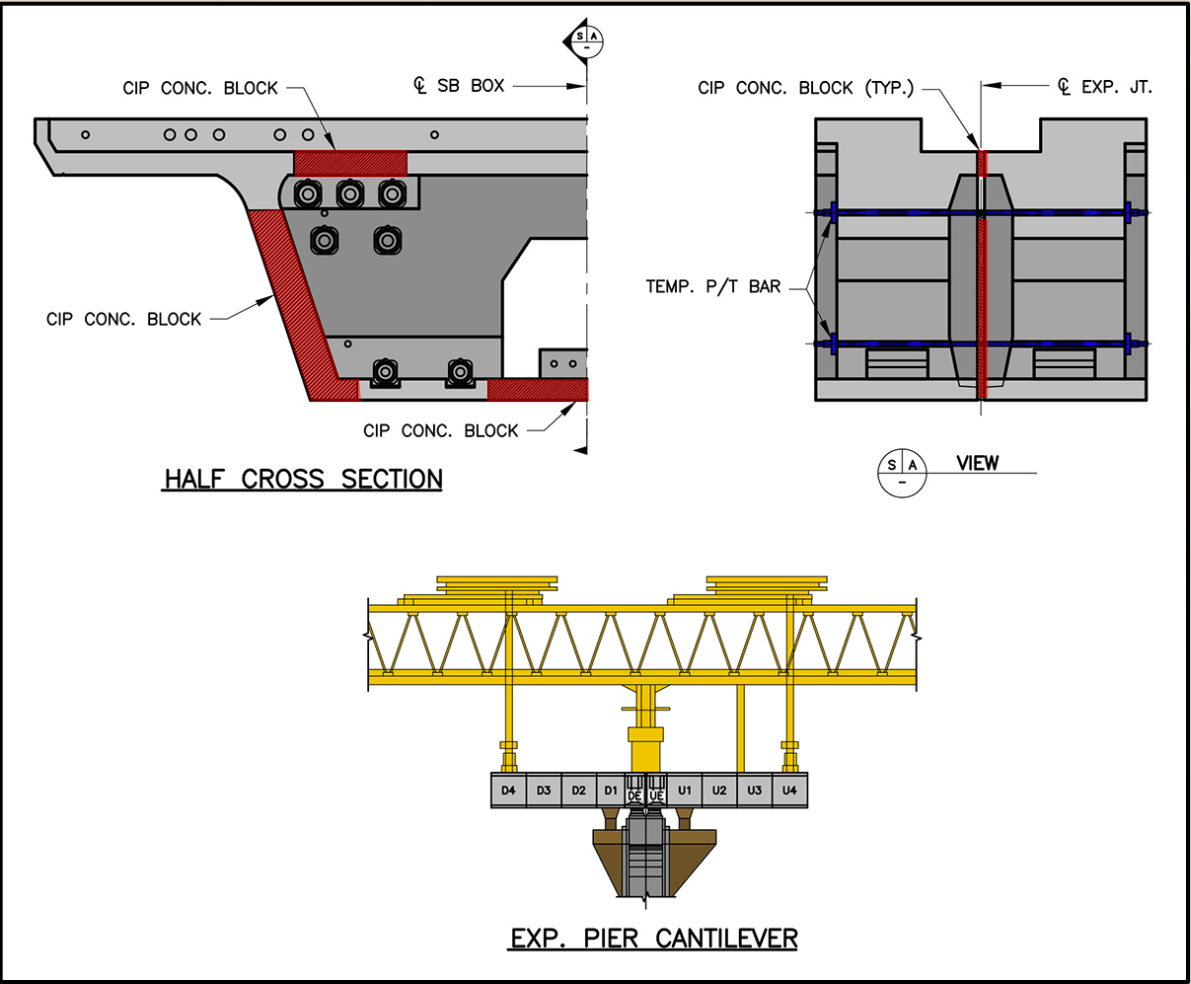
Typical Constant Depth Section



Approach Structures: Exp. Piers – Construction

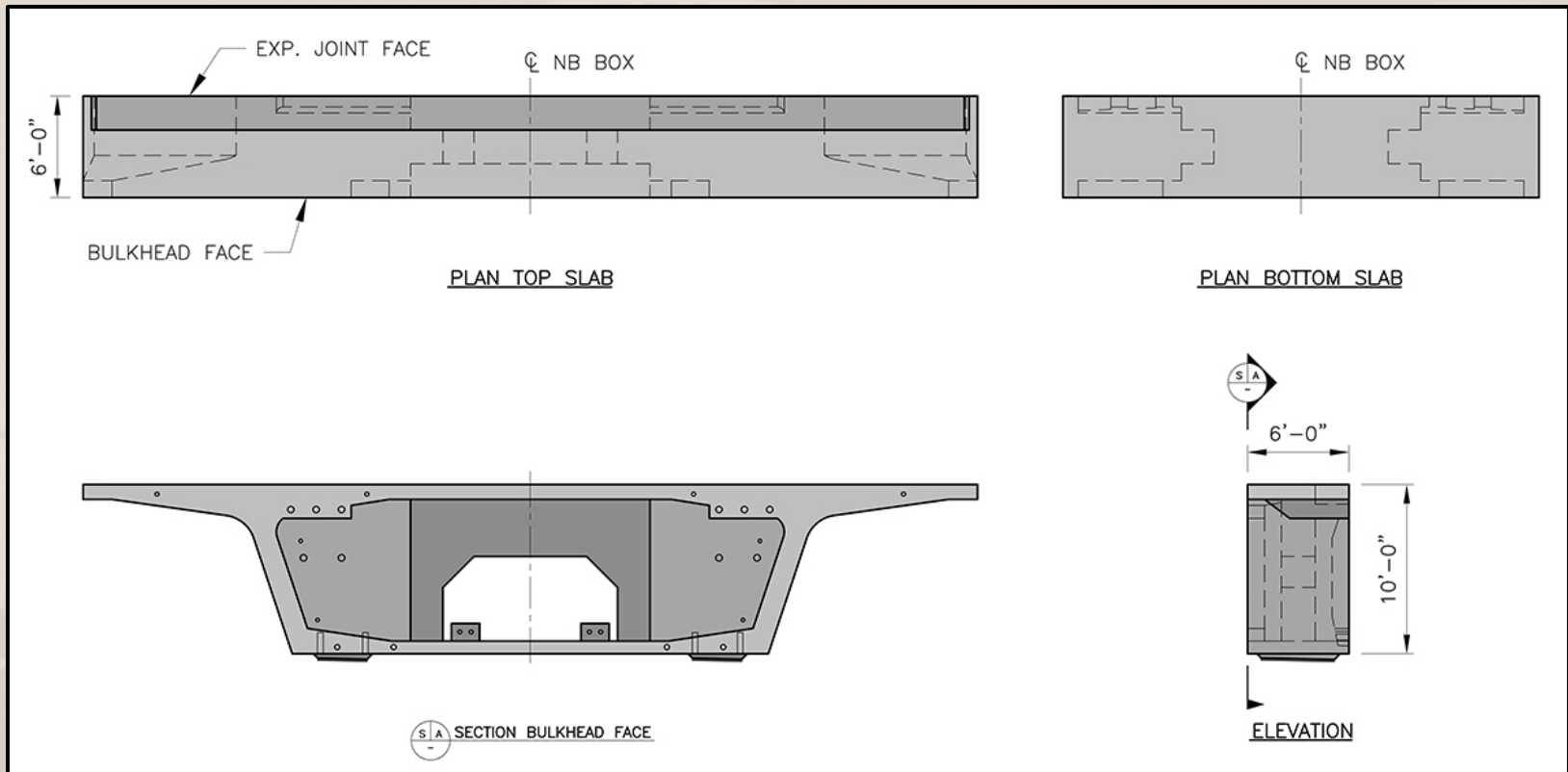


Approach Structures: Exp. Piers – Construction



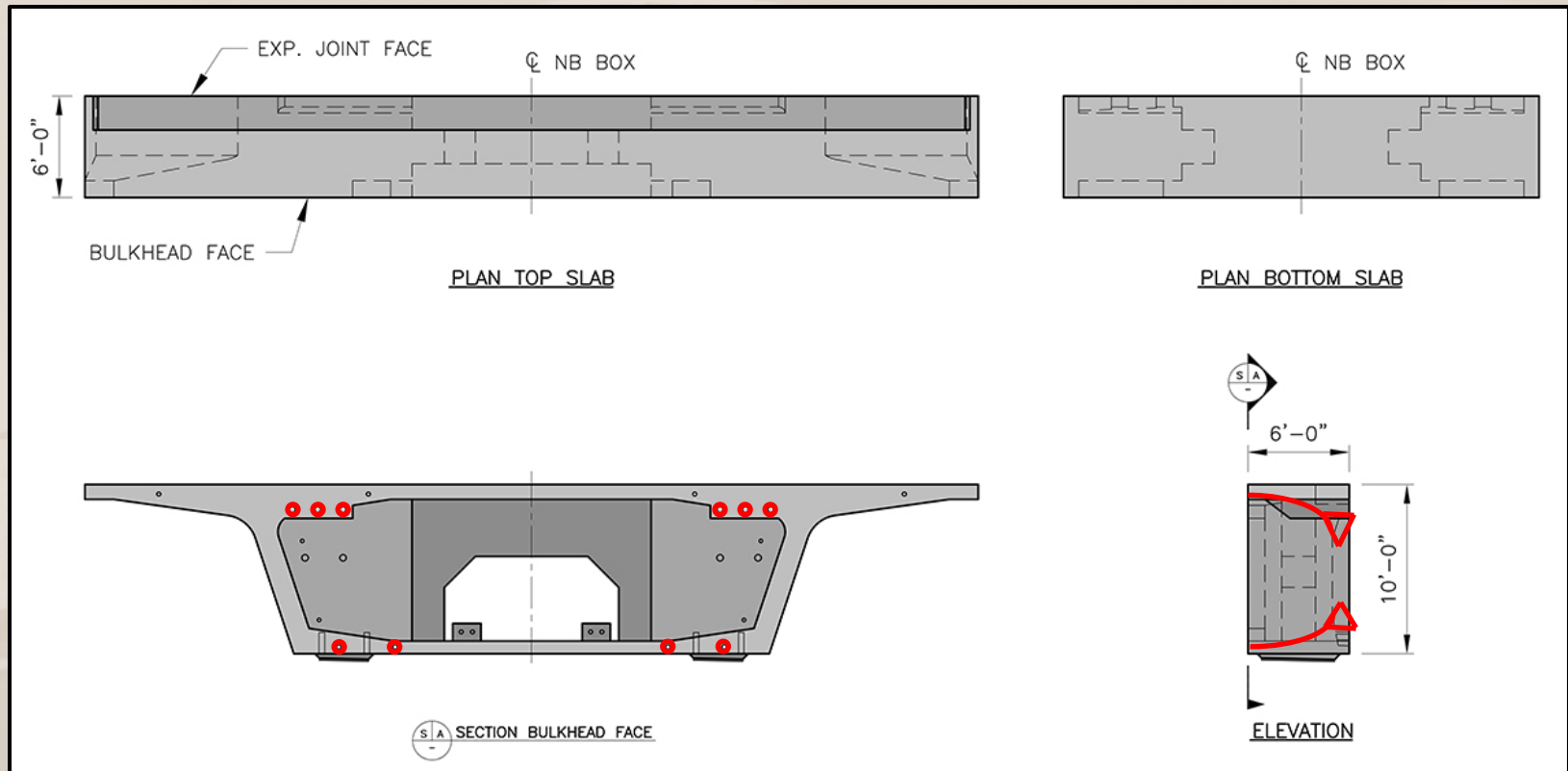
Approach Superstructures – End Diaphragms

Typical End Diaphragm Segment



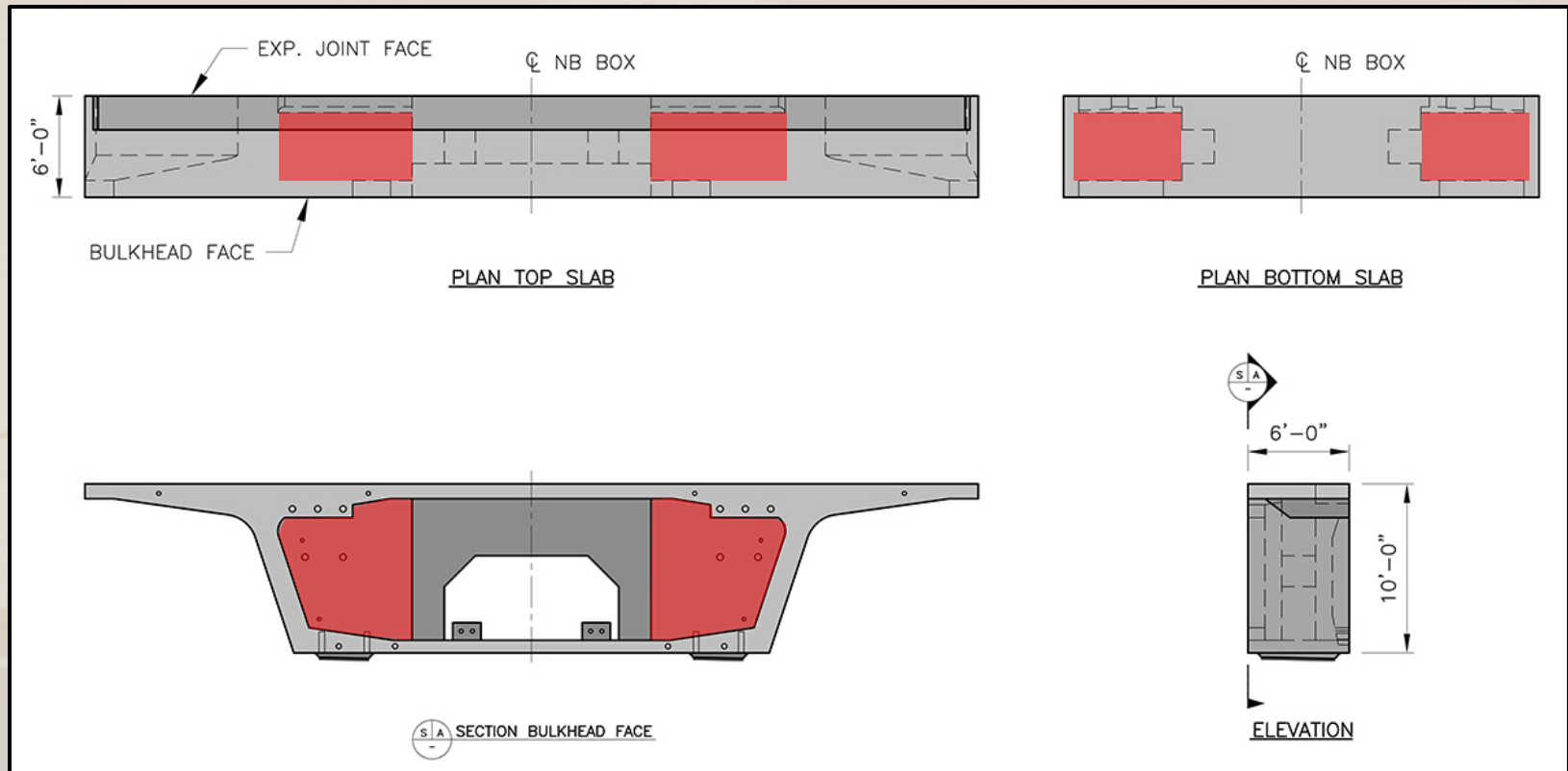
Approach Superstructures – End Diaphragms

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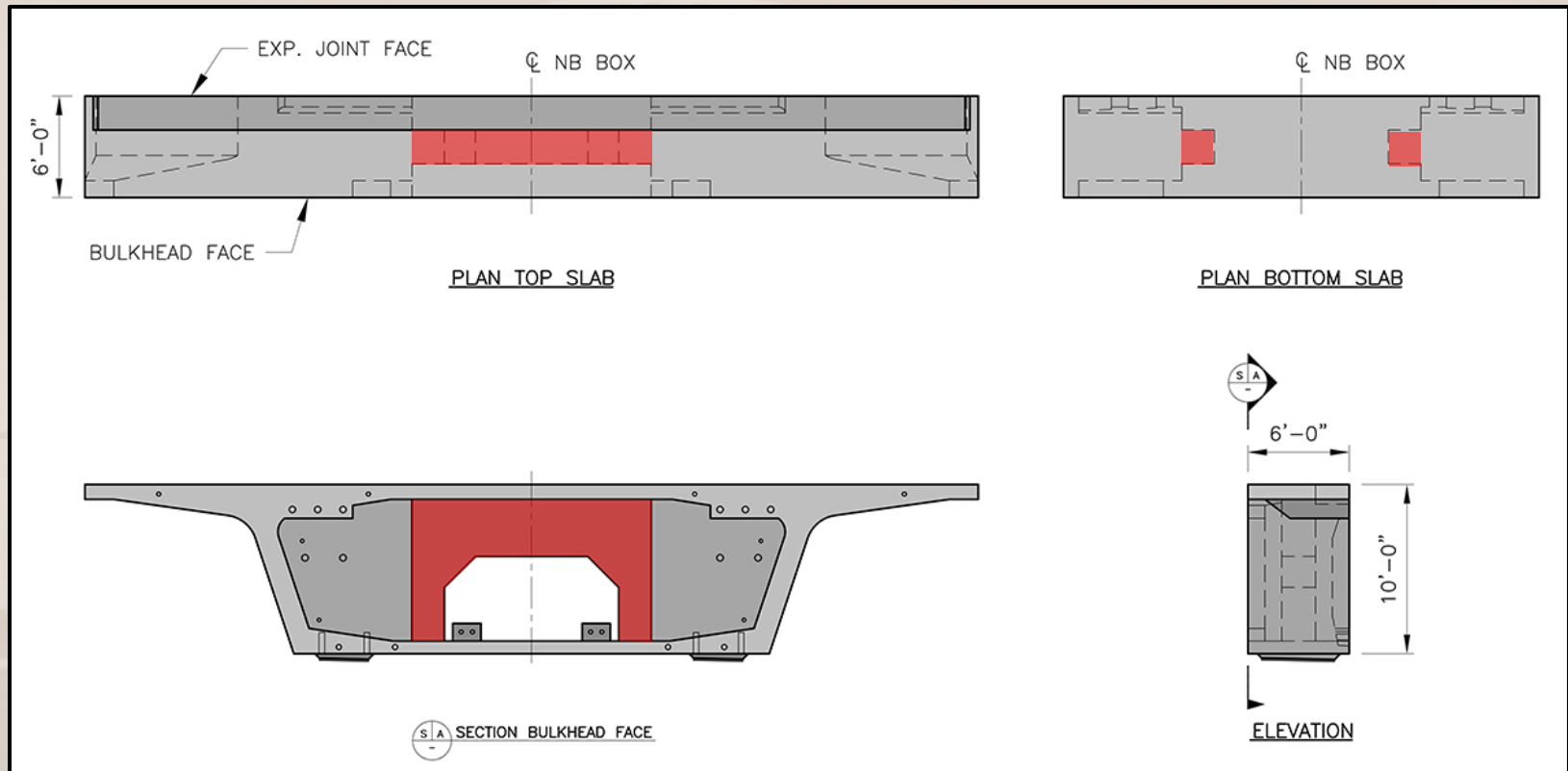
Approach Superstructures – End Diaphragms

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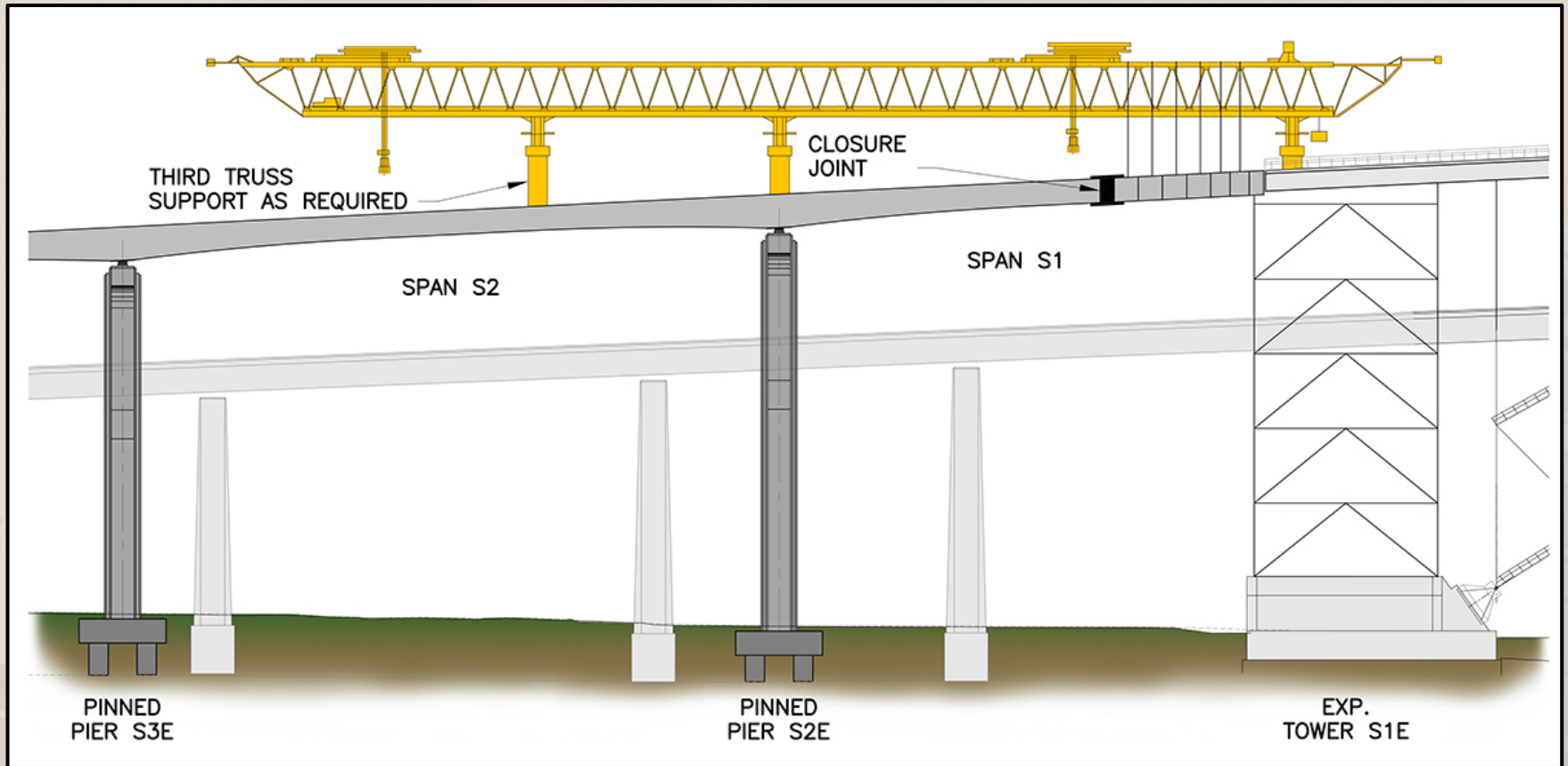


Approach Superstructures – End Diaphragms

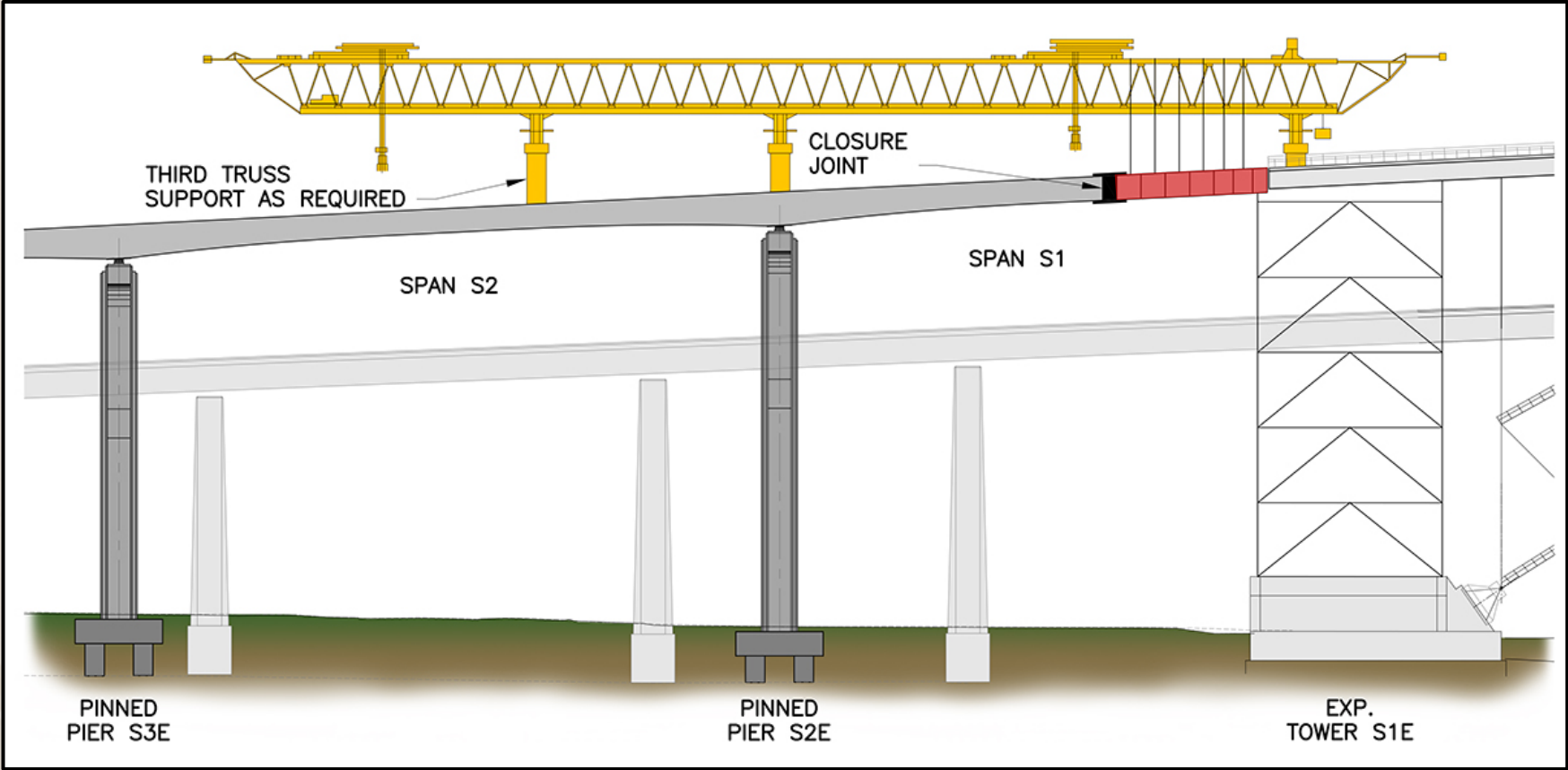
Typical End Diaphragm Segment



Approach Structures: End Span – Construction

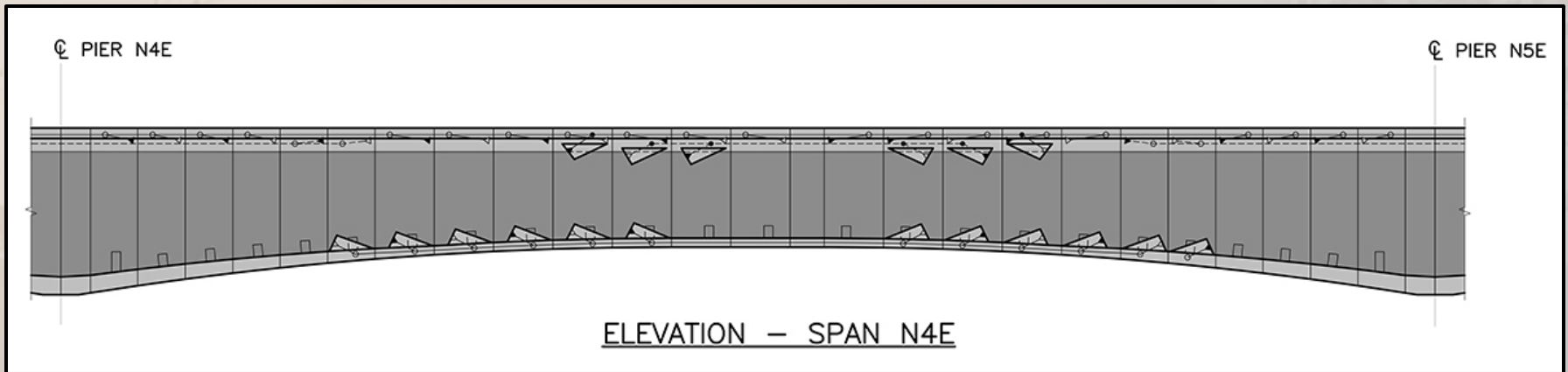
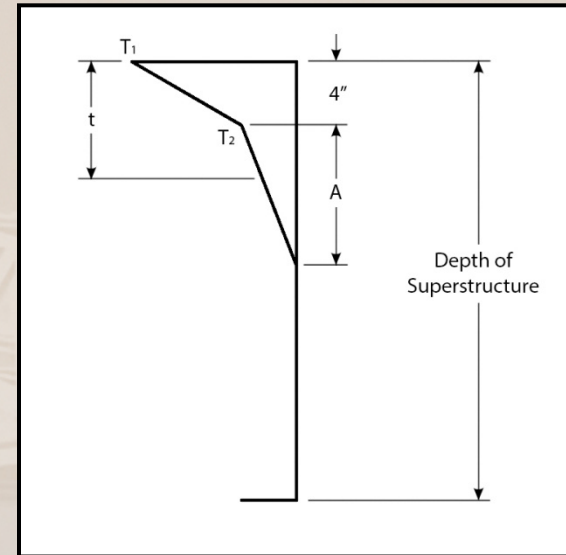


Approach Structures: End Span – Construction



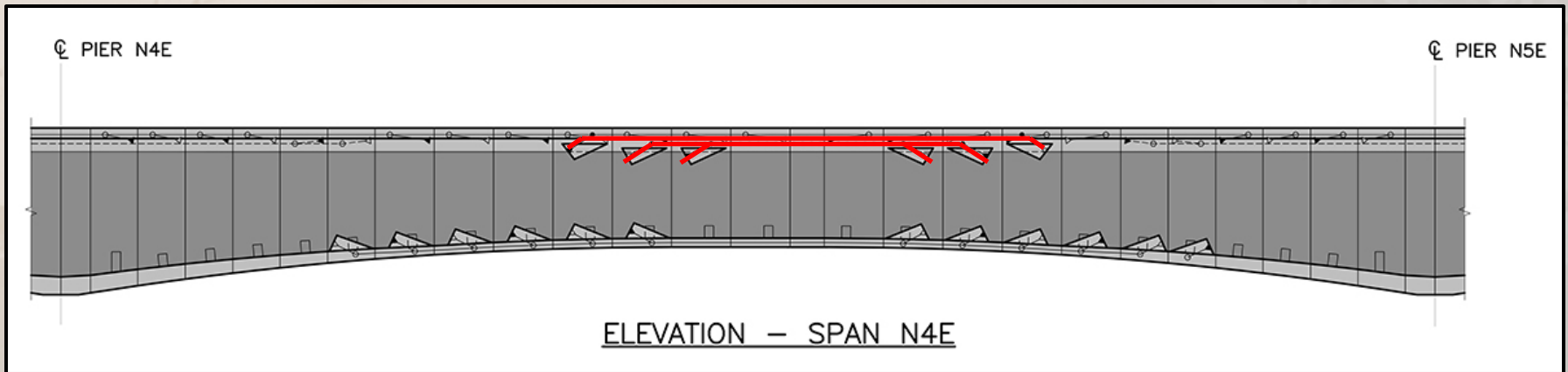
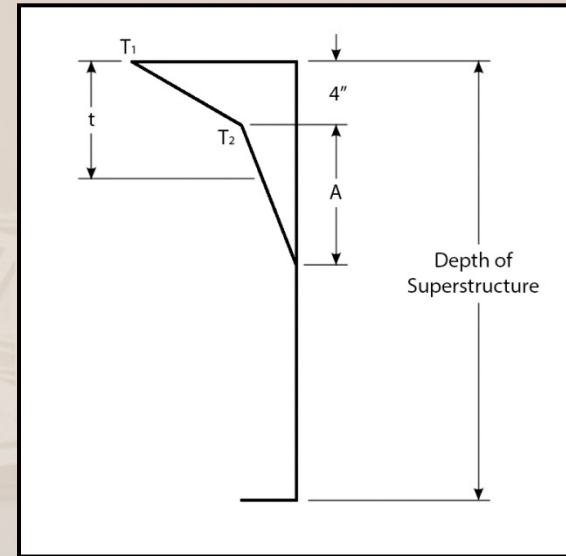
Approach Structures: Top Continuity PT

- **AASHTO LRFD Thermal Gradient**
- **Wide Deck Produces Large Loads**
- **Combination of TG- with Zero LL at Opening Day**
- **Controlled Top Continuity PT**



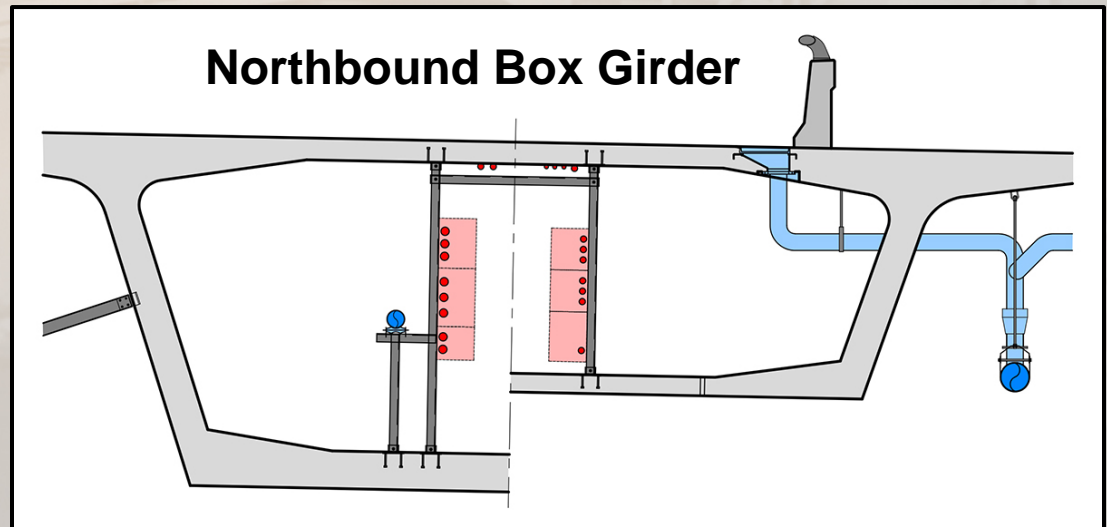
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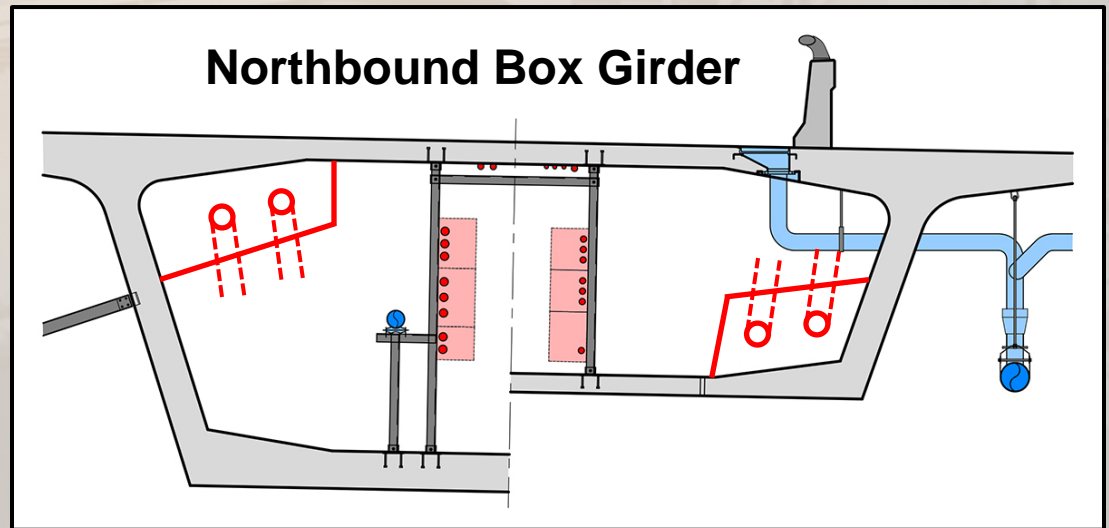
Approach Structures: Utilities

- **Northbound Approach**
 - 24 Utility Conduits inside Box Girder
 - 8" Fire Standpipe
 - Drainage in Typical Box Section
- **Southbound Approach**
 - 15 Utility Conduits



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Construction Milestones

- **Bids Received** **April 2013**
- **Project Awarded** **April 2013**
 - Skanska-Koch/Kiewit \$743 Million
- **Construction Notice to Proceed** **May 2013**
- **Foundation Construction** **4th Quarter 2013**
- **Main Span Arch Strengthening** **1st Quarter 2014**
- **New Arch Roadway** **1st Quarter 2014**
- **Approach Pier Construction** **1st Quarter 2014**
- **NB Approach Superstructure** **2nd Quarter 2014**
- **Existing Arch Deck Removal** **4th Quarter 2015**

Thank you



HDR/PB, A Joint Venture

THE PORT AUTHORITY
OF NY & NJ