THE NEW NY BRIDGE

NEW NY BRIDGE PROJECT

Western Bridge Engineers' Seminar 2015

Presented by: Kenneth Wright, PE

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Photos courtesy of New York State Thruway Authority.

AGENDA

- **A New Bridge**
  - Project Overview
  - Project Drivers and Solutions
  - Community Outreach
  - Environmental Compliance
- **Design & Construction**
  - Approach Spans and Foundations
  - Main Span and Foundations
  - Facilities
  - BrIM
  - Project Look-Ahead

DESIGN-BUILD TEAM

THE NEW NY BRIDGE

TAPPAN ZEE CONSTRUCTORS

FLUOR®

GRANITE™

AB American Bridge

TRAYLOR TRAYLOR BROS., INC.

HDR

A NEW BRIDGE

THE NEW **NY** BRIDGE

PROJECT LOCATION

THE NEW NY BRIDGE

- Located in New York State 30 miles north of NYC
- 3.1 mile crossing over the Hudson River
- Existing bridge carries 138K vehicles per day vs. design capacity of 100K
- Functionally obsolete, major structural and operational deficiencies, high accident rate
- Forecasting $750M in maintenance over next 10 years

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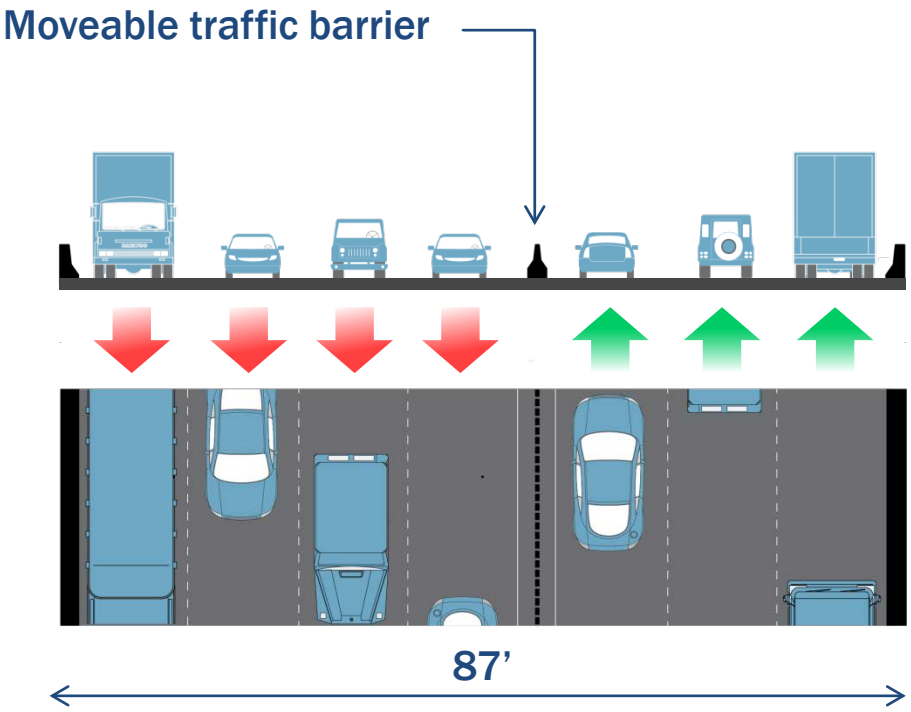
CHANGING LANES: EXISTING BRIDGE

THE NEW NY BRIDGE



Existing Tappan Zee Bridge

1 span, 7 lanes

11’ lanes with movable traffic barrier

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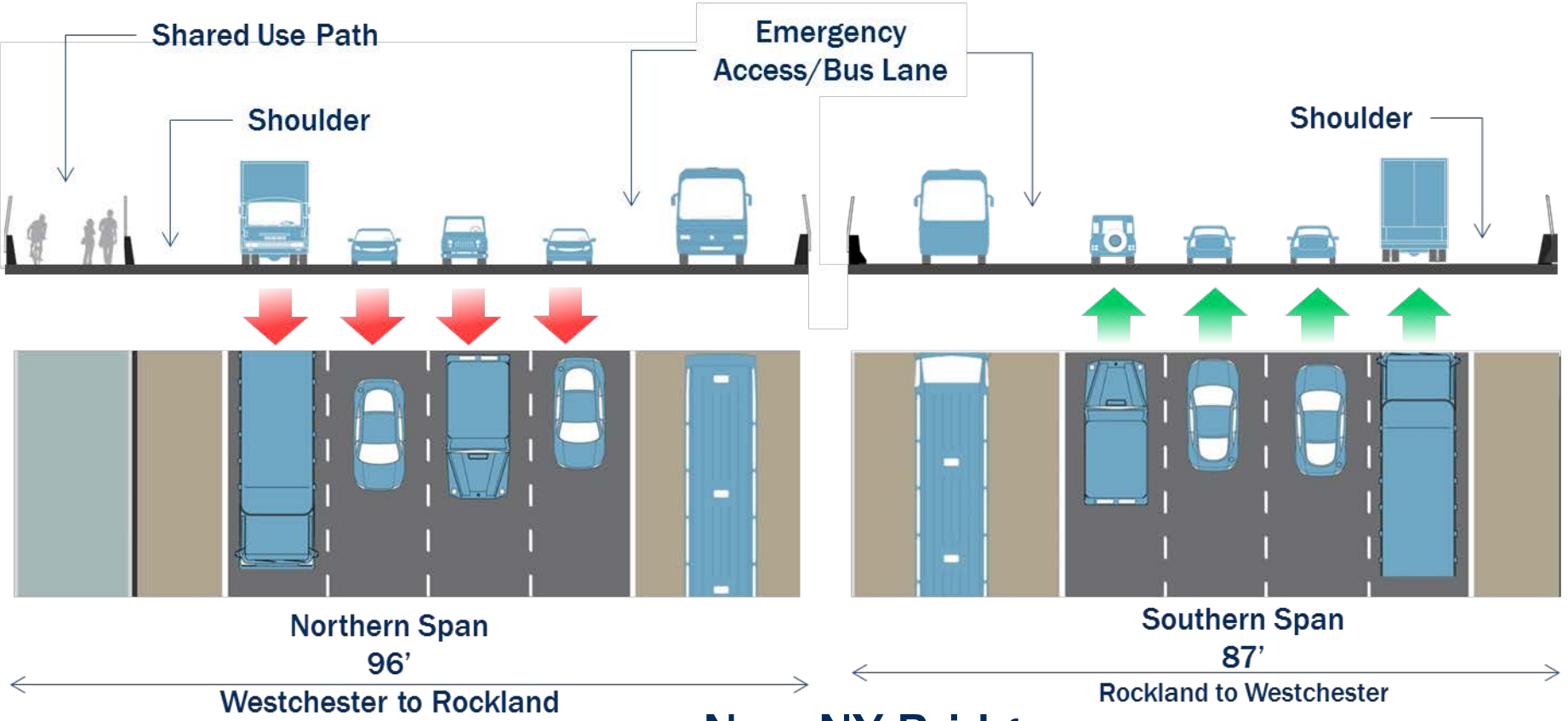
CHANGING LANES: THE NEW NY BRIDGE

THE NEW NY BRIDGE



New NY Bridge

2 spans, 8 general traffic lanes

12' lanes, wide shoulders, bus lanes, shared use path

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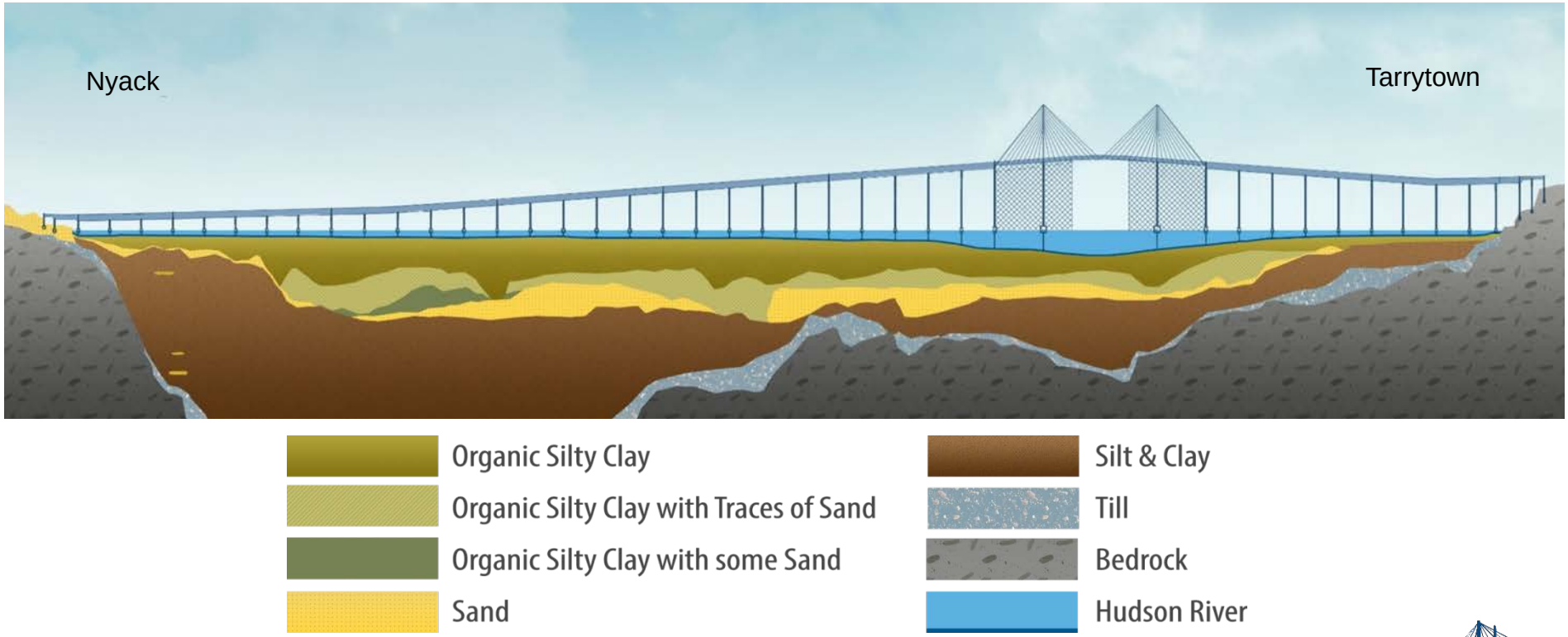
PROJECT DRIVERS AND SOLUTIONS

THE NEW NY BRIDGE

PROJECT DRIVERS

THE NEW NY BRIDGE

- Foundation Conditions
  - Soft Clays, Deep Rock and Limited Capacities



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PROJECT DRIVERS

THE NEW NY BRIDGE

- Select Structure Type
  - 100-year Proven Life
  - Minimize Foundation Demands
  - Least Expensive
- Maximize Span Lengths
  - Fewer Foundations
- Use Proven Technology
- Use Accelerated Construction Techniques

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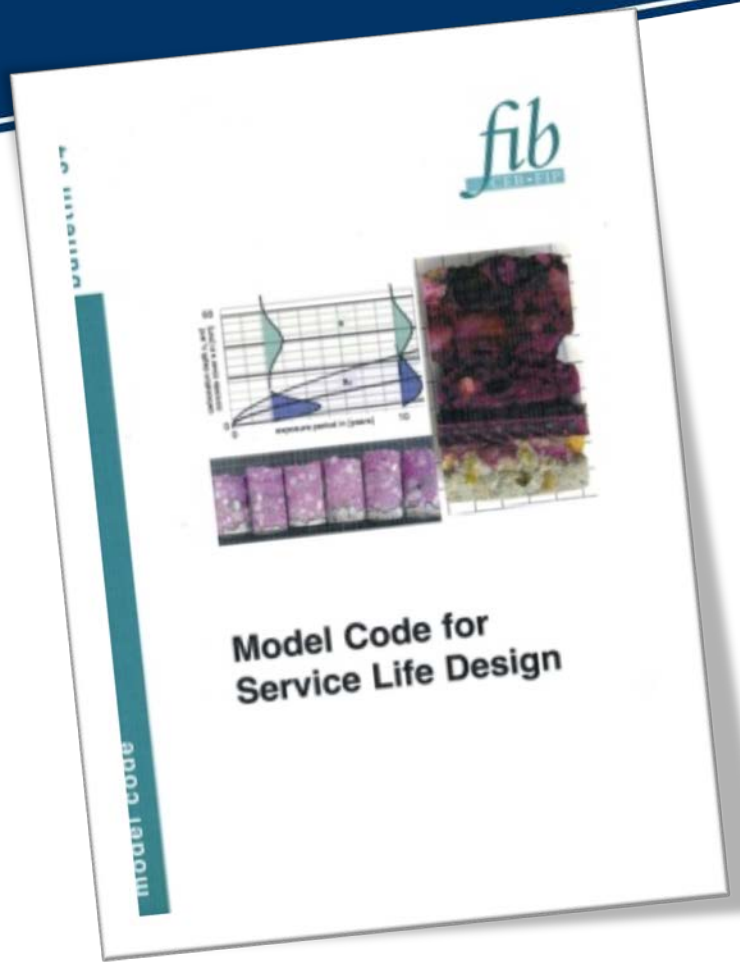
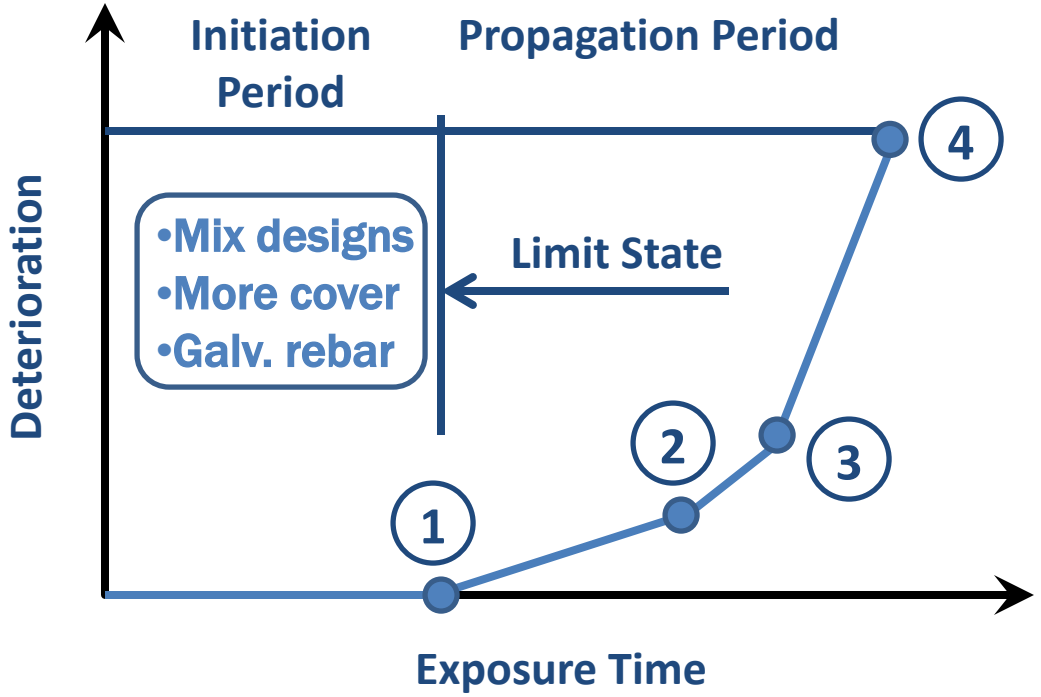
CONCRETE STRUCTURES





1 Depassivation

2 Crack Formation

3 Spalling

4 Failure

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THE NEW NY BRIDGE

Design

- Thoughtful Detailing
- Service Life Modeling
- Material Specification
- Trial Testing

Construction

- Proven Methods
- Quality Control
- Quality Assurance
- "Birth Certificate"

Operations

- Monitor
- Inspect
- Maintain
- Update Service Life

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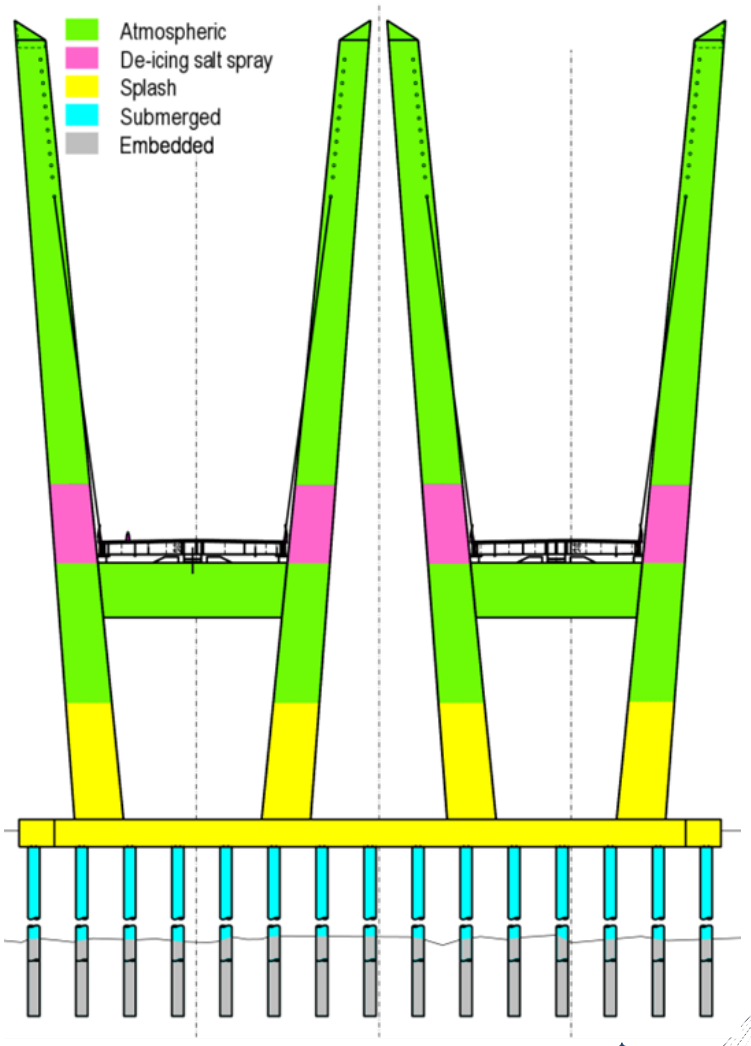
SERVICE LIFE DESIGN

THE NEW NY BRIDGE

- Classification of component into exposure zone
- Design strategies for concrete durability:
  - Strategy A: Avoidance
  - Strategy B: Probabilistic modelling



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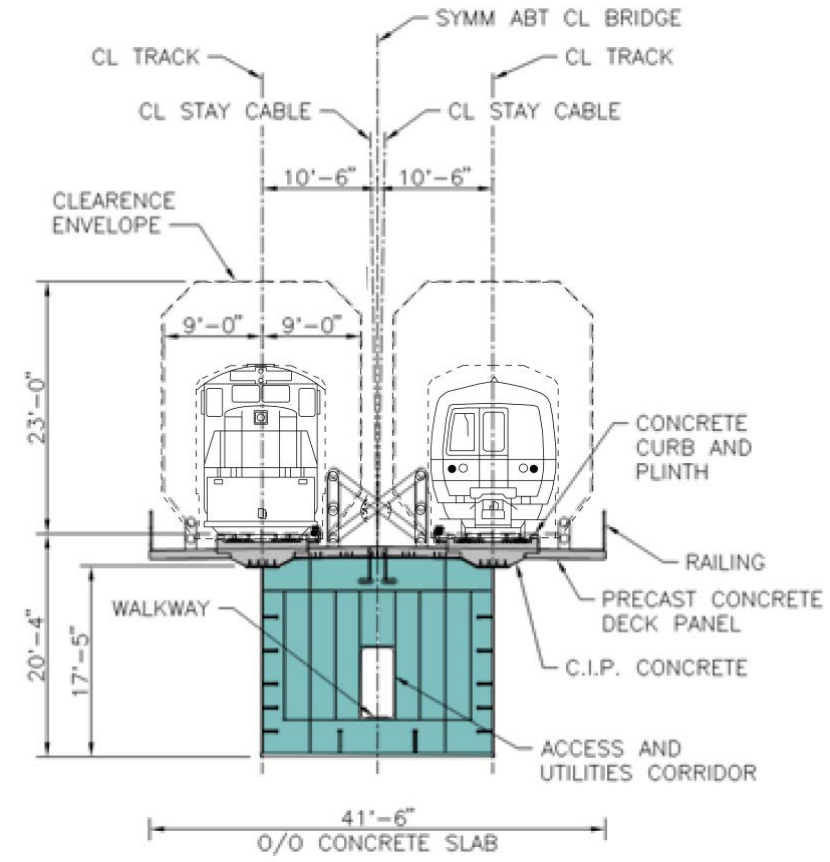
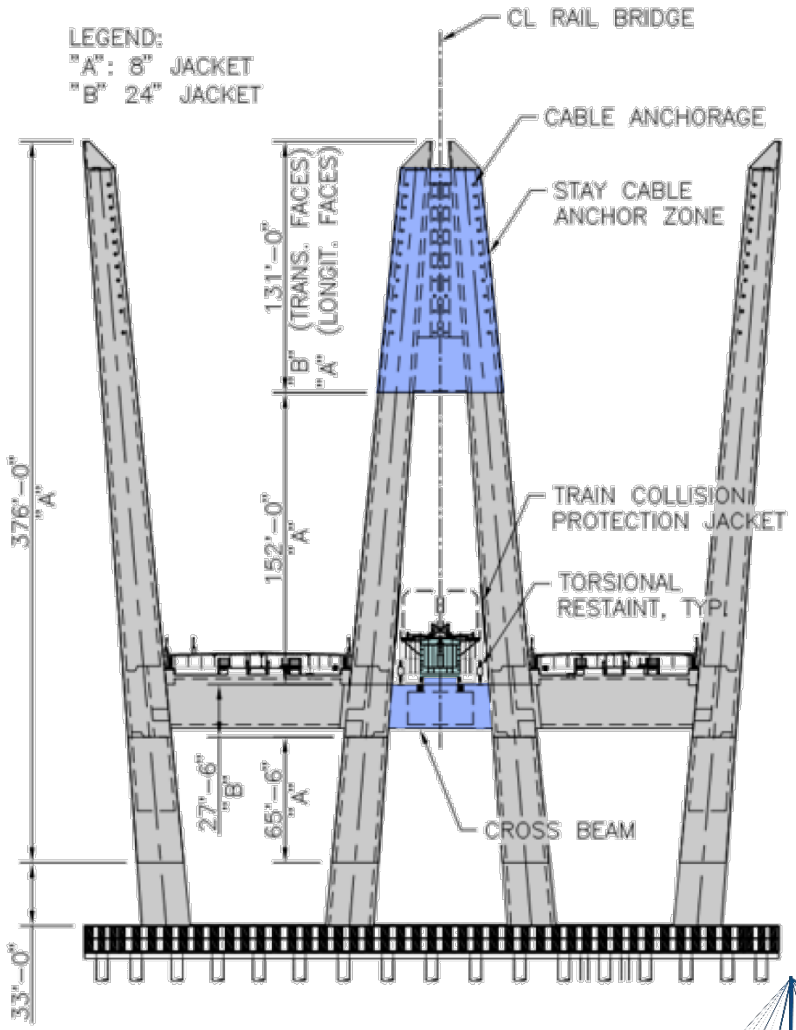
FUTURE RAIL BRIDGE – FOUNDATION IMPACTS

THE NEW NY BRIDGE





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PROJECT DRIVERS

THE NEW NY BRIDGE

- Available equipment & labor
  - Marine Equipment – Left Coast Lifter

- Largest Barge Crane Used on the U.S. West Coast
- Boom Length: 328 feet (100 m)
- Displacement: 992 tons (886 long tons)
- Lift Capacity: 1,800 tons (1,607 long tons)

Photo Credit: New York State Thruway Authority

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PROJECT DRIVERS

THE NEW NY BRIDGE

- High Percentage of Work on the Water
  - Worker Access
  - Risks of Water Work
  - Material Access

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DESIGN SOLUTION

THE NEW NY BRIDGE

- Bridge Foundations on Steel Open Pipe Piling
- Significant Use of Pre-cast Components
- Approach Superstructure Using Long Span Steel Girders
- Composite Cable-stayed Main Span Structures
- Erect Large Pre-assemble Units

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FEATURES OF DESIGN

- Uncluttered Aesthetics – clean, elegant lines
- Cost Effective
  - Based on strengths of the construction team
- Balance In-Service Loading with Vessel Collision
- Durability

NEW NY BRIDGE

THE NEW NY BRIDGE

Photo Credit: New York State Thruway Authority

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NEW NY BRIDGE

THE NEW NY BRIDGE

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CURRENT CONDITION:

EXISTING BRIDGE WITH NORTHBOUND AND SOUTHBOUND TRAFFIC

THE NEW NY BRIDGE

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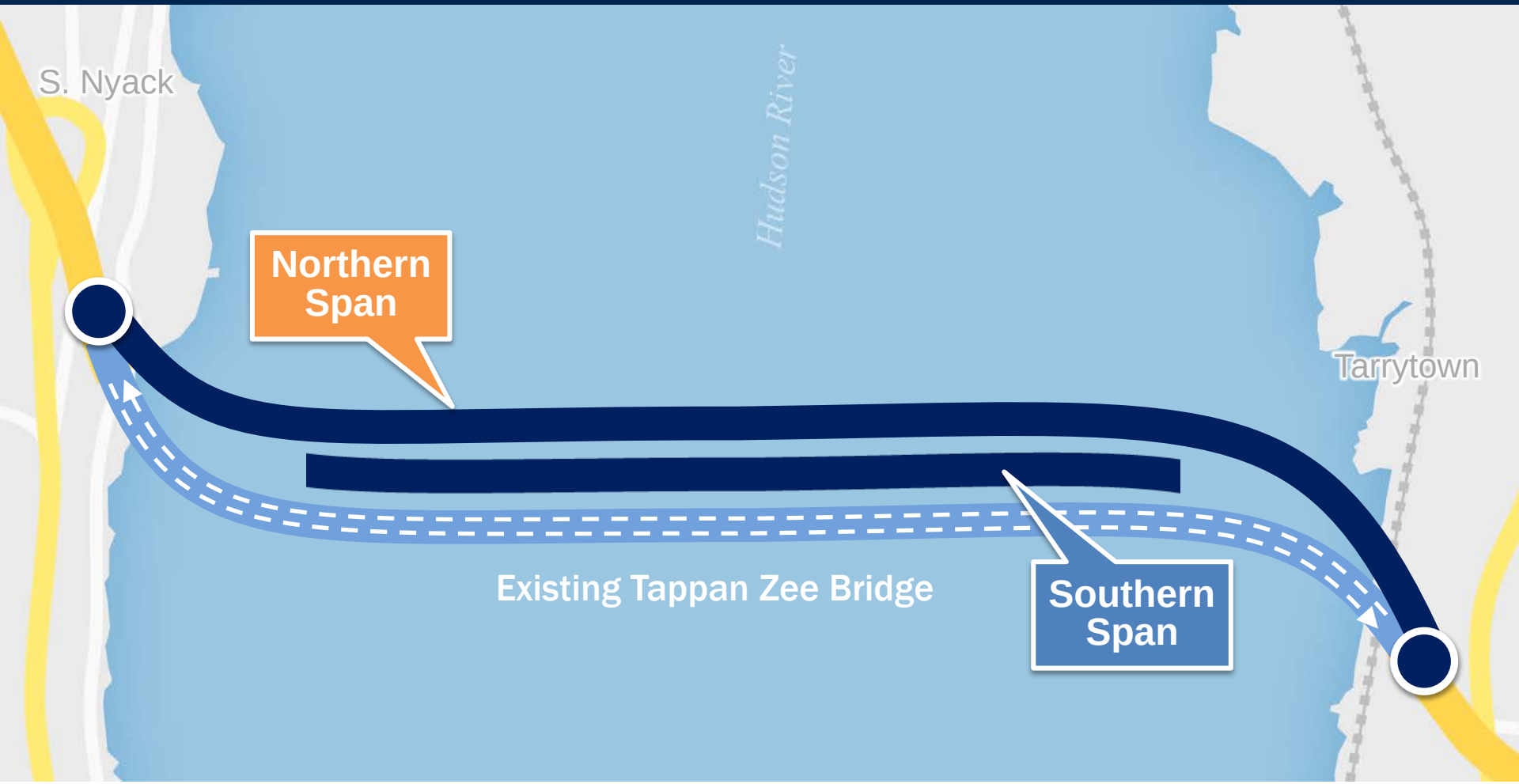
STAGE 1:
COMPLETE NEW NORTHERN SPAN

THE NEW NY BRIDGE



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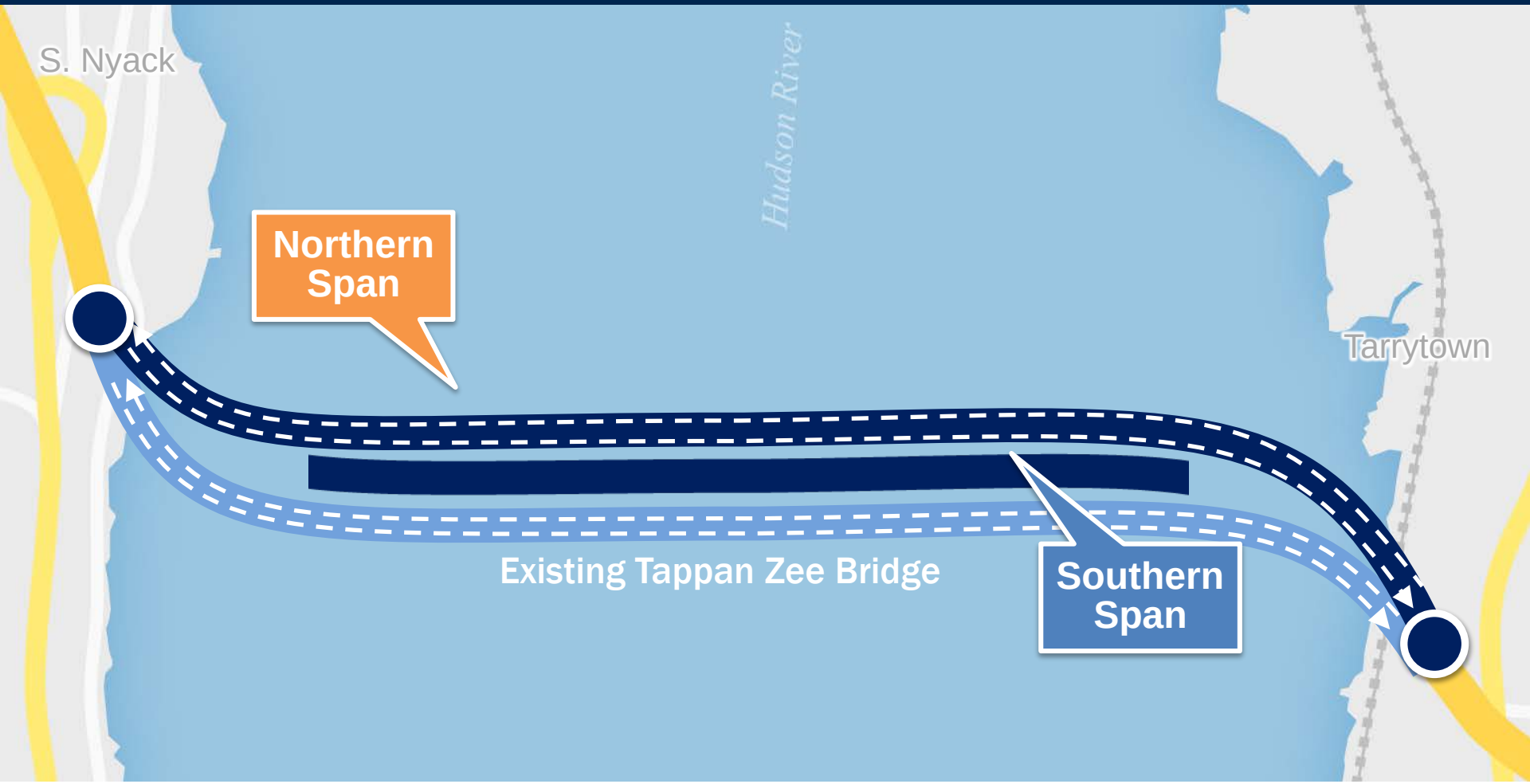
STAGE 2 AND 3:
TRANSFER TRAFFIC TO THE NEW NORTHERN SPAN

THE NEW NY BRIDGE



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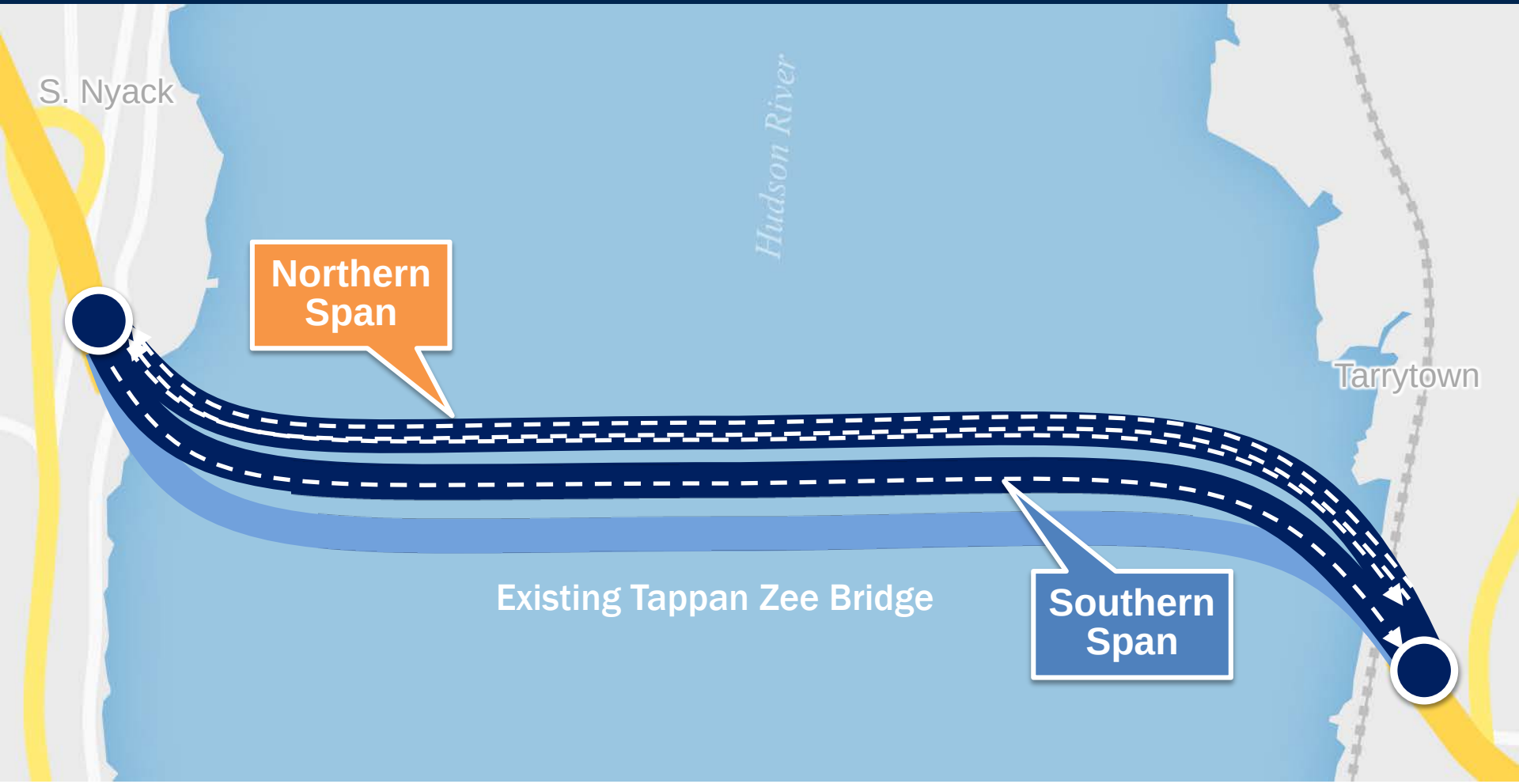
STAGE 4:
COMPLETE SOUTHERN SPAN AND TRANSFER TRAFFIC

THE NEW NY BRIDGE



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COMMUNITY OUTREACH

THE NEW NY BRIDGE

COMMUNITY OUTREACH CENTERS

THE NEW NY BRIDGE

87

287

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Rockland Community Outreach Center
142 Main Street
Downtown Nyack

Office Hours
Monday-Friday: 11 am – 7 pm
Saturday-Sunday: 11 am – 4 pm

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CONSTRUCTION VIEWING PLATFORMS

THE NEW NY BRIDGE

- Rockland
- Nyack Memorial Park
- Piermont Avenue, Nyack

Nyack

Hudson River

MAIN CHANNEL

- Westchester
- Pierson Park
- West Main Street, Tarrytown

Tarrytown

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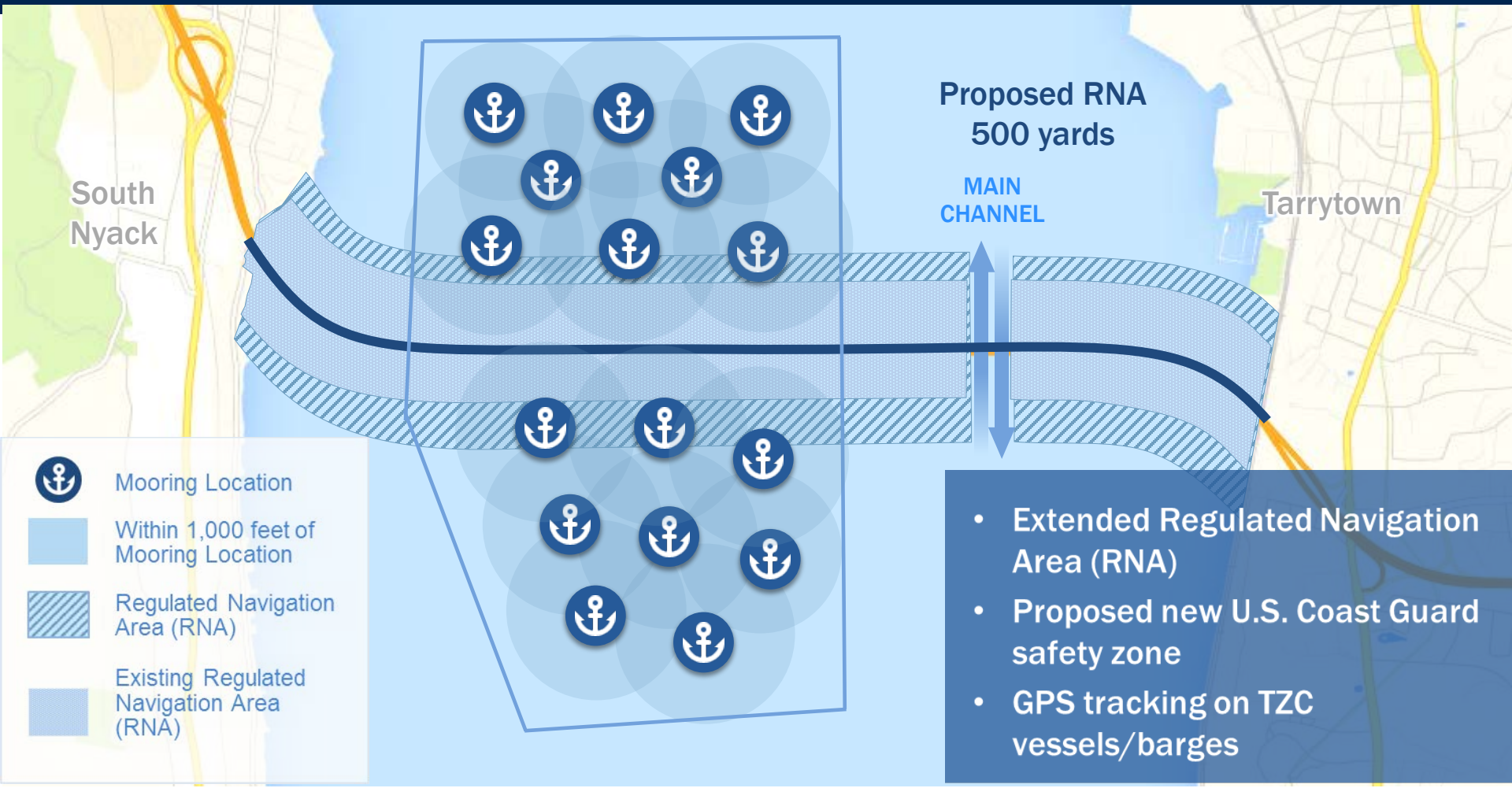
BOATER SAFETY ENHANCEMENTS

THE NEW NY BRIDGE



- Extended Regulated Navigation Area (RNA)
- Proposed new U.S. Coast Guard safety zone
- GPS tracking on TZC vessels/barges

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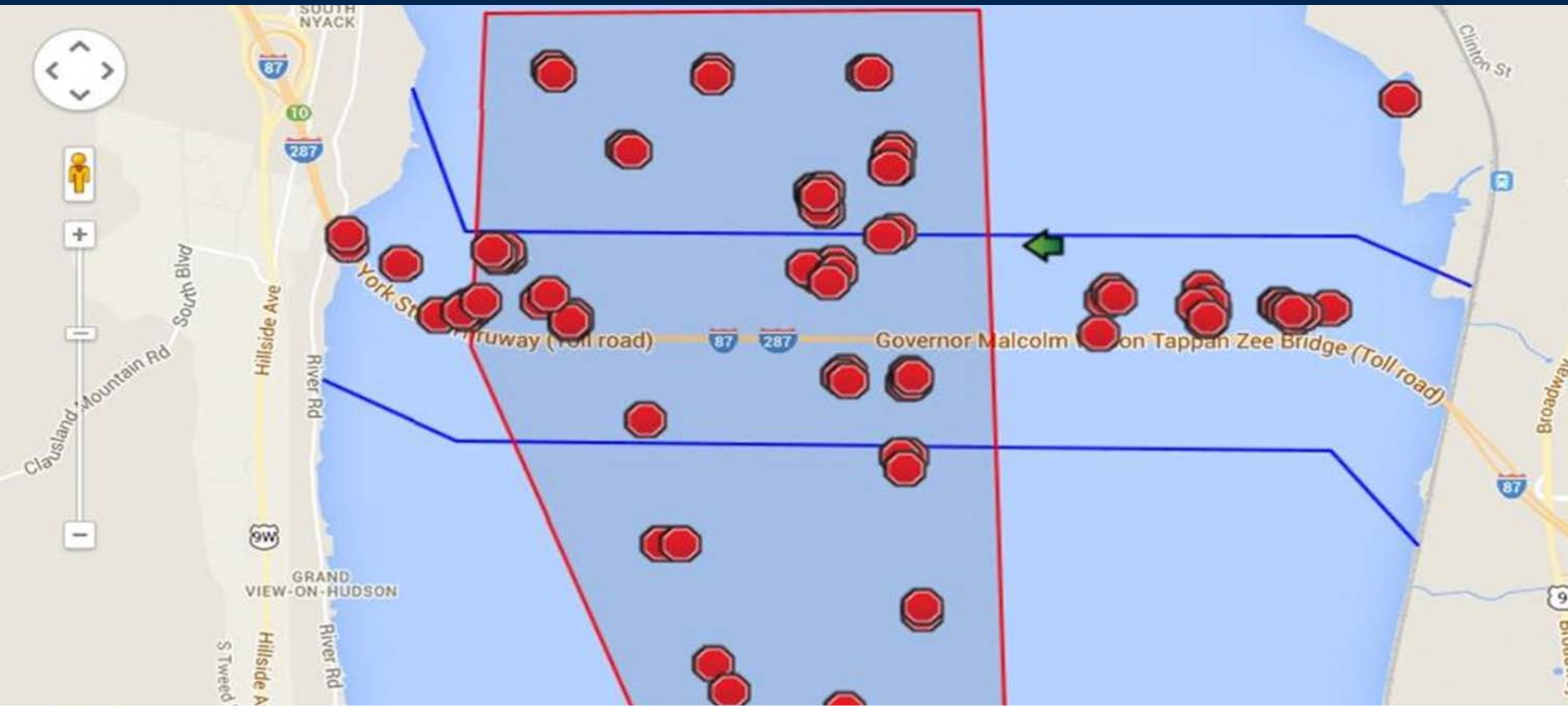
MARINE GPS SYSTEM

THE NEW NY BRIDGE



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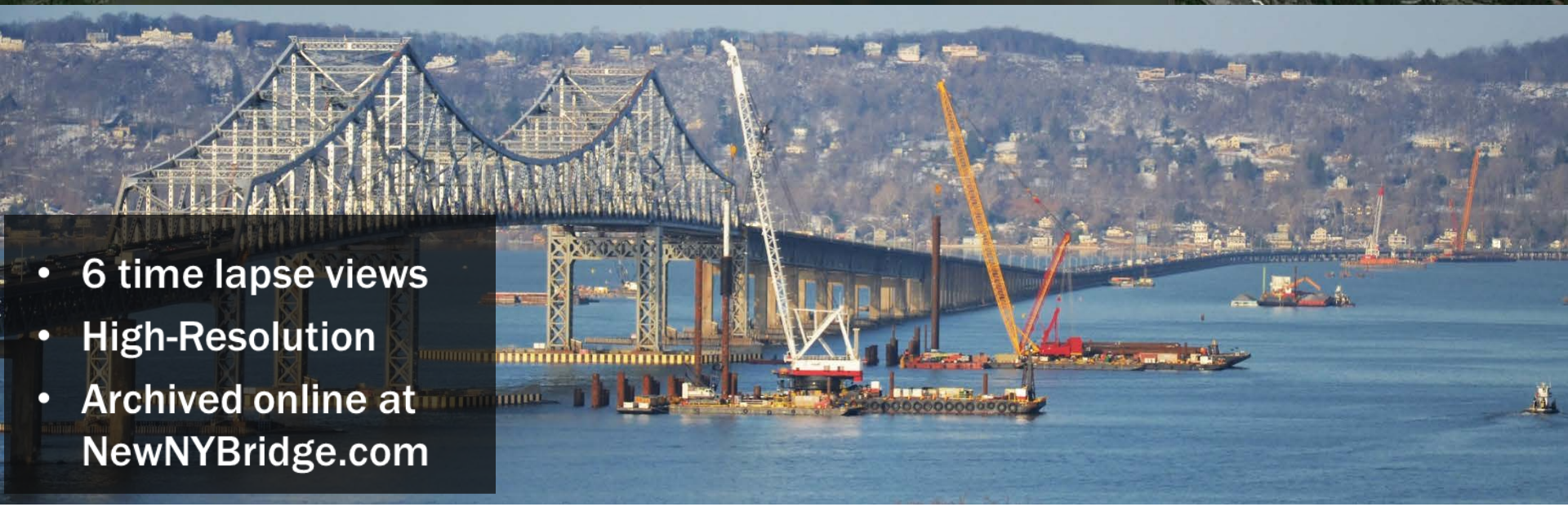
TIME LAPSE CAMERAS

THE NEW NY BRIDGE



- 6 time lapse views
- High-Resolution
- Archived online at NewNYBridge.com

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TIME LAPSE CAMERAS

THE NEW NY BRIDGE

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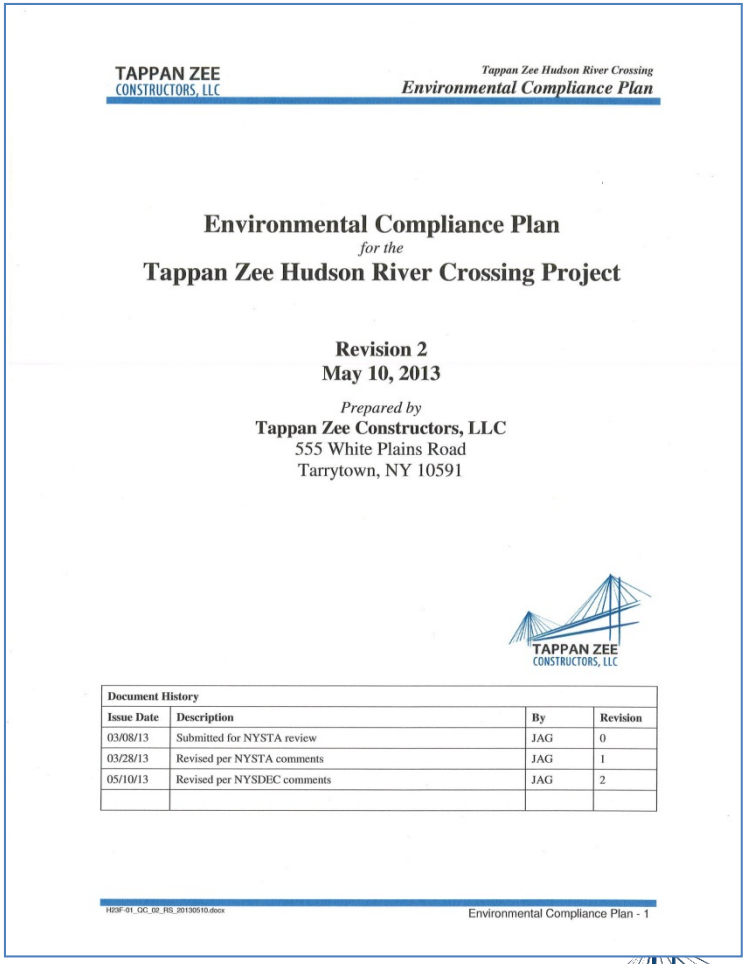
ENVIRONMENTAL COMPLIANCE

THE NEW NY BRIDGE

ENVIRONMENTAL PERFORMANCE COMMITMENTS

THE NEW NY BRIDGE

- 62 Environmental Performance Commitments including:
  - Air and Water Quality
  - Highway Noise and Vibration
  - Underwater Noise
  - Cultural Resources
  - Ecological Monitoring



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Tappan Zee Hudson River Crossing
Environmental Compliance Plan

Environmental Compliance Plan
for the
Tappan Zee Hudson River Crossing Project

Revision 2
May 10, 2013

Prepared by
Tappan Zee Constructors, LLC
555 White Plains Road
Tarrytown, NY 10591

TAPPAN ZEE CONSTRUCTORS, LLC

Document History			
Issue Date	**Description**	**By**	**Revision**
03/08/13	Submitted for NYSTA review	JAG	0
03/28/13	Revised per NYSTA comments	JAG	1
05/10/13	Revised per NYSDEC comments	JAG	2

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Environmental Compliance Plan - 1

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ENVIRONMENTAL INNOVATION

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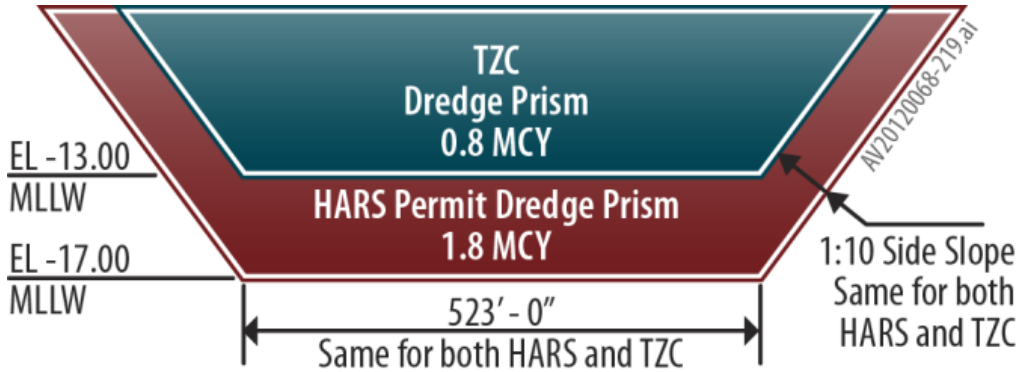
- Integrated design, construction and environmental compliance team
- Solutions included substantially less dredging than other teams:
  - *Shallower draft vessels and tugs*
  - *Smaller dredge prism*



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ENDANGERED SPECIES –
SHORT-NOSED STURGEON

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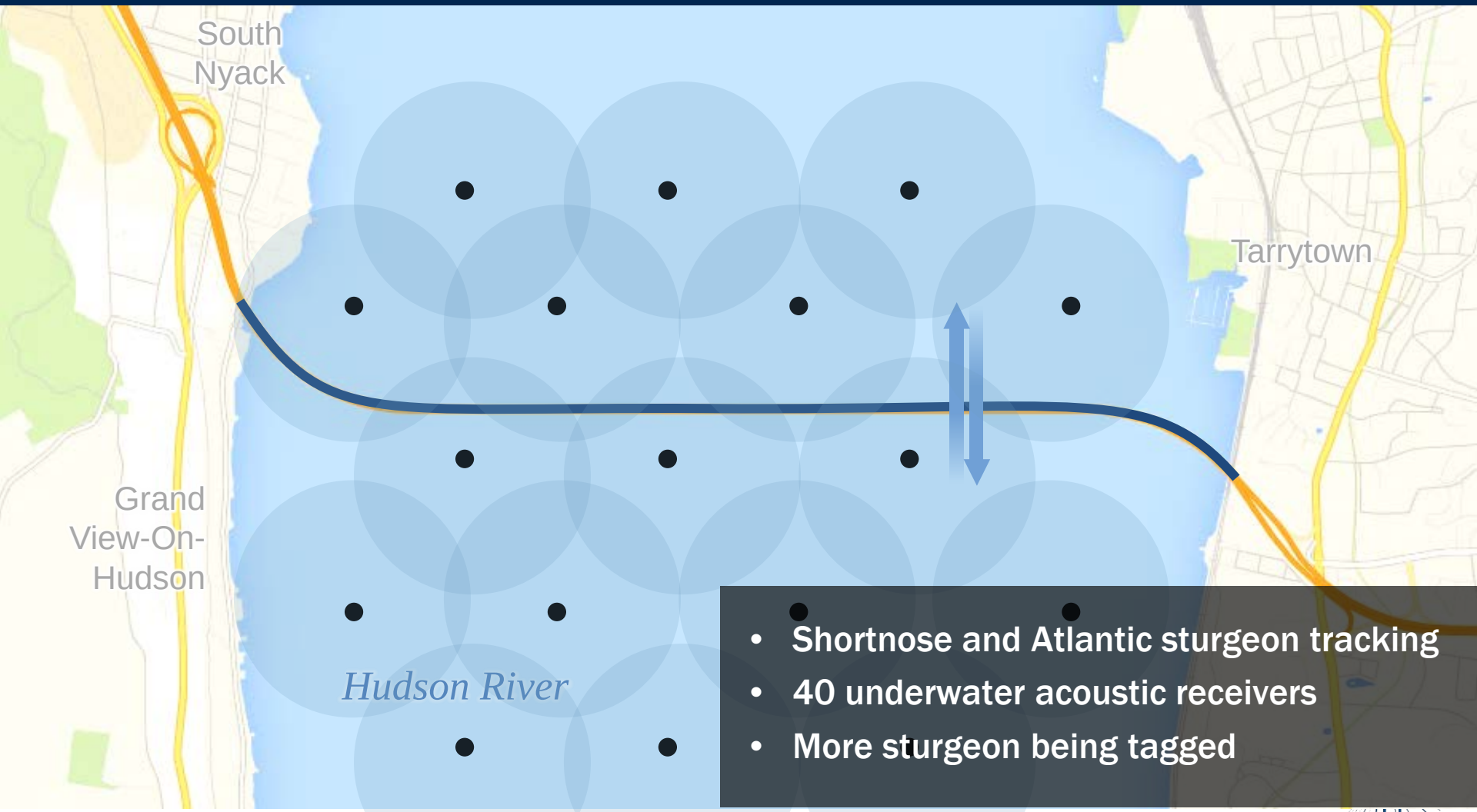
FISH MONITORING

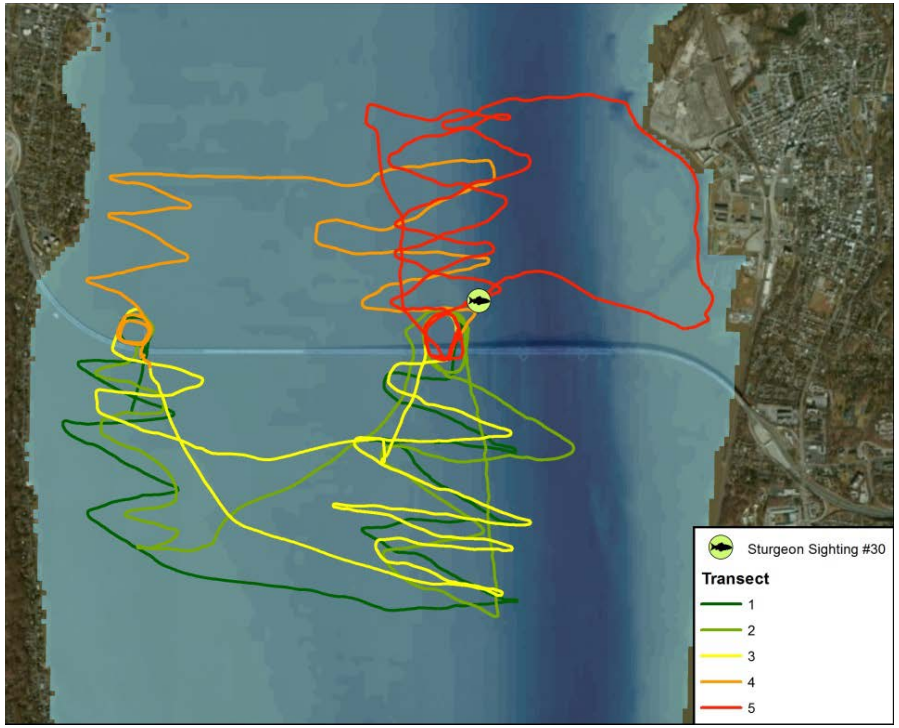


- Shortnose and Atlantic sturgeon tracking
- 40 underwater acoustic receivers
- More sturgeon being tagged

FISH MONITORING

THE NEW NY BRIDGE

- Environmental Performance Commitments:
  - Locally Endangered Fish Species
    - Shortnose and Atlantic Sturgeon
  - Pile Driving
    - 100% coverage of all piles >4-ft
      - Barge and vessel
    - GPS based transects
    - Up to 1 mile north/south
    - Up to one hour after pile driving
    - PIT Tags, Necropsies, Genetic Testing



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UNDERWATER NOISE

THE NEW NY BRIDGE

- Production Pile Monitoring:
  - Monitor piles for impact driving for piles ranging from 4-foot to 6-foot diameters
  - Isopleth ranges (187 dB onset of injury)
  - Confirm compliance with permits
  - Monitor vibratory pile driving for piles ranging from 4-foot to 6-foot diameters

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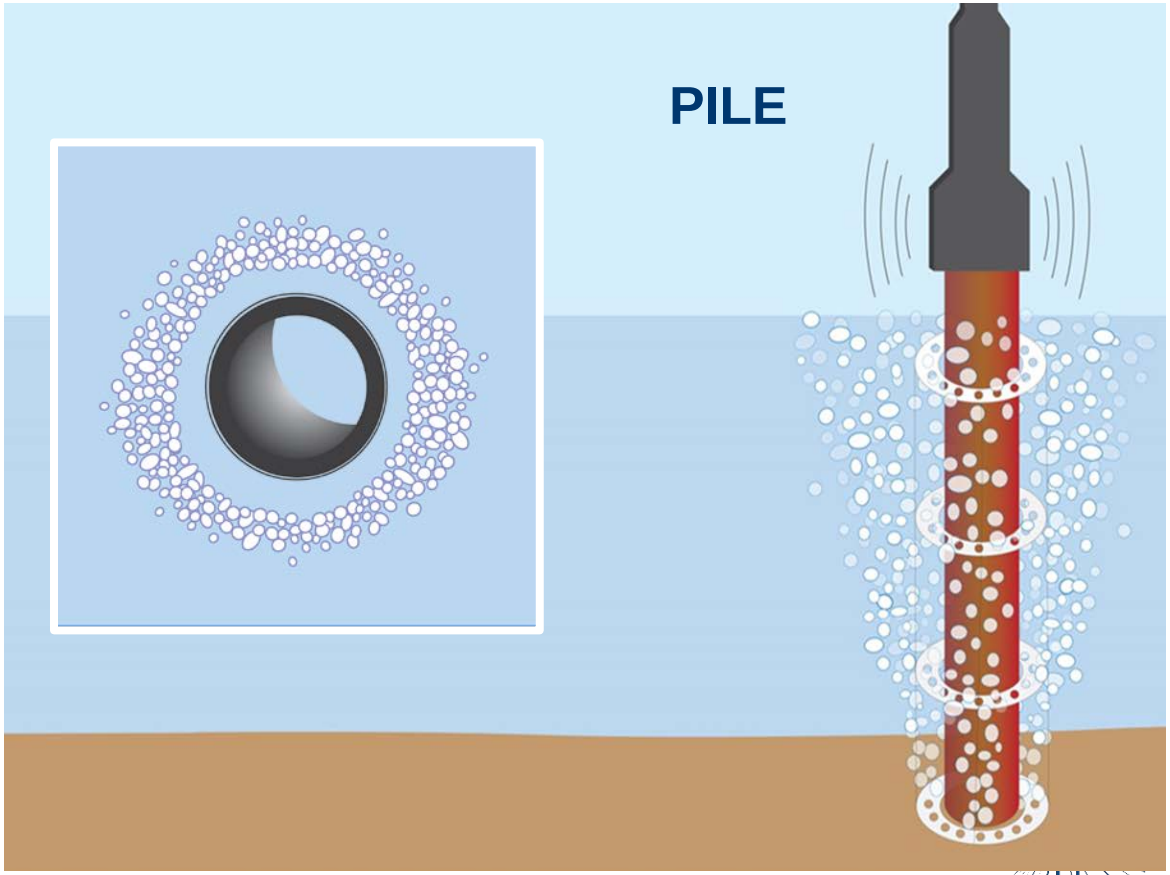
BUBBLE CURTAINS

THE NEW NY BRIDGE

A layer of underwater bubbles surround piles during pile driving and help protect fish and other marine life from sound and vibrations



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BUBBLE CURTAINS

THE NEW NY BRIDGE

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WATER QUALITY

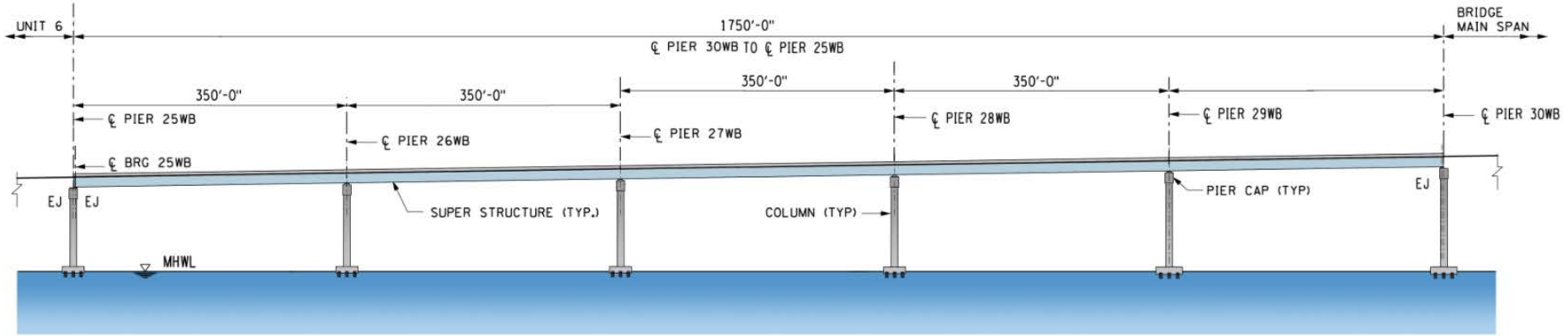
- Environmental Performance Commitments:
  - Whole Water Samples
    - 12 analytes per sample
    - Down-current and background
  - One or Two tides per activity, per day
  - Monitor for visible turbidity
  - Consultation with Stakeholders

APPROACH SPANS

THE NEW NY BRIDGE

APPROACH UNIT CONFIGURATION

THE NEW NY BRIDGE



FEATURE	BENEFIT
• Limited Girder Depth	• Transportation Savings • Elegant Appearance
• Girder-Substringer System	• Weight Savings • Reduced Fabrication Cost
• Conventional Construction	• Available Pool of Skilled Labor
• Seismic Isolation	• Certainty Of Pier Loads • Piers Remain Elastic

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APPROACH UNIT CONFIGURATION

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Precast Deck Panels

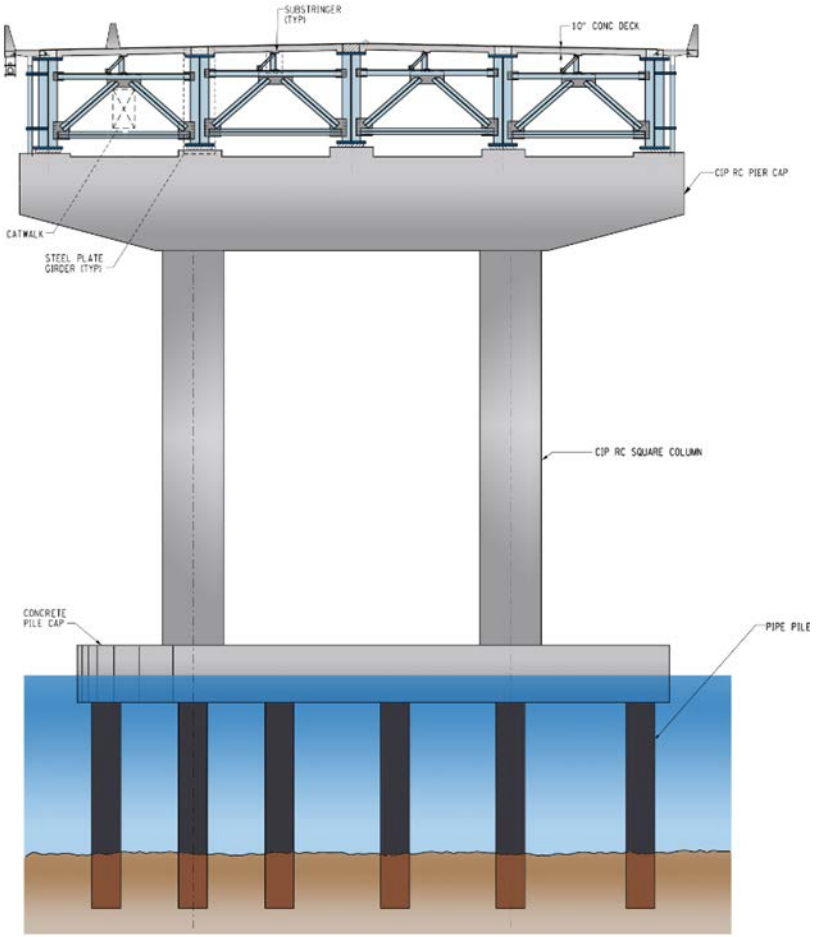
Steel Girder/Stringer

Precast Pier Cap

CIP Columns

Precast Pile Cap

Steel Pipe Piles



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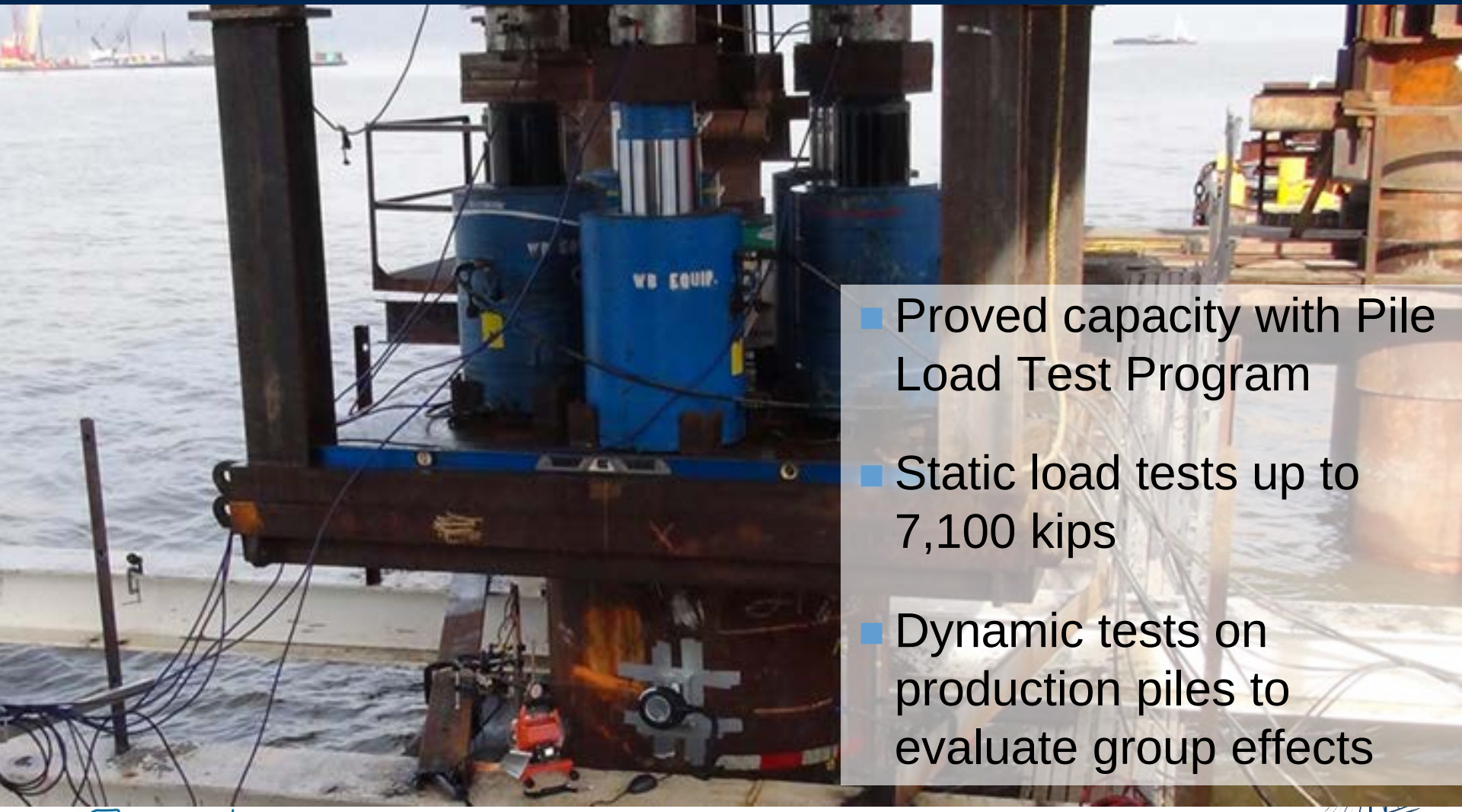
APPROACH FOUNDATIONS

THE NEW NY BRIDGE

FOUNDATION DESIGN APPROACHES

THE NEW NY BRIDGE



- Proved capacity with Pile Load Test Program
- Static load tests up to 7,100 kips
- Dynamic tests on production piles to evaluate group effects

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FOUNDATION DESIGN APPROACHES

THE NEW NY BRIDGE

- 4-ft and 6-ft Diameter Steel Open Pipe Piles
  - End-bearing Piles up to 370 Feet
  - Friction Piles In Deep Clay up to 330 Feet
- Landside
  - Steel H-piles
  - Drilled Shafts (42” dia.)

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FOUNDATION DESIGN APPROACHES

THE NEW NY BRIDGE

- Pile diameter limited to 6 feet for end bearing piles
  - Reduces potential for damage to pile tips due to sloping bedrock
- Drilled Shafts Onshore
  - Severity of rock slope
  - Mitigates noise and vibration impact

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APPROACH SUBSTRUCTURE

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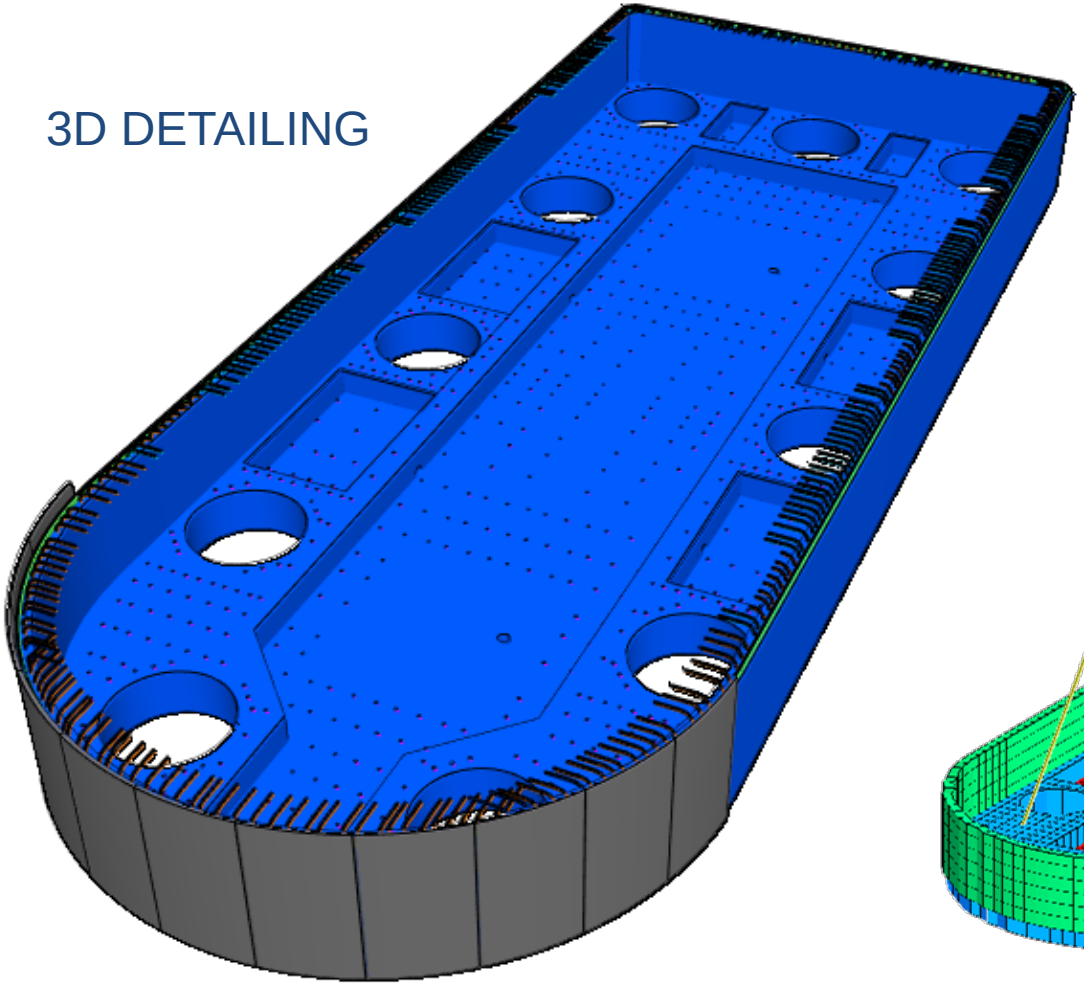
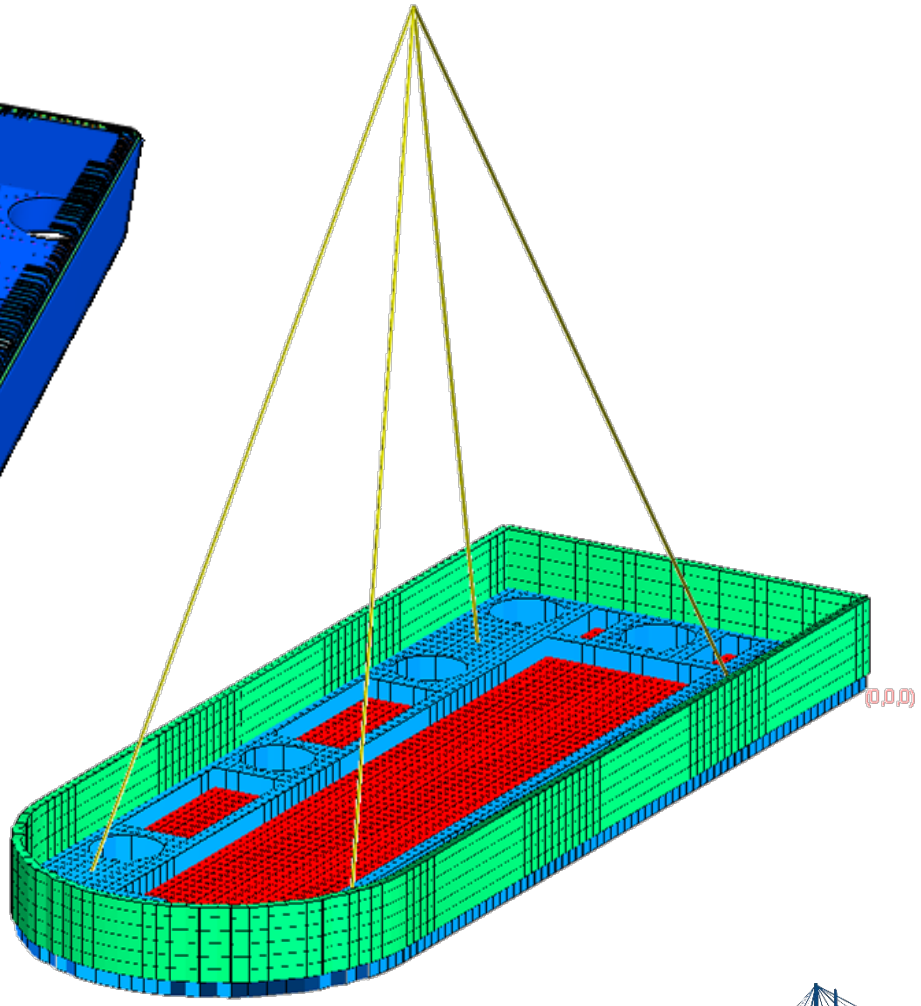
SUBSTRUCTURE DESIGN
PRECAST PILE CAPS

THE NEW NY BRIDGE

3D DETAILING





STRUCTURAL ANALYSIS

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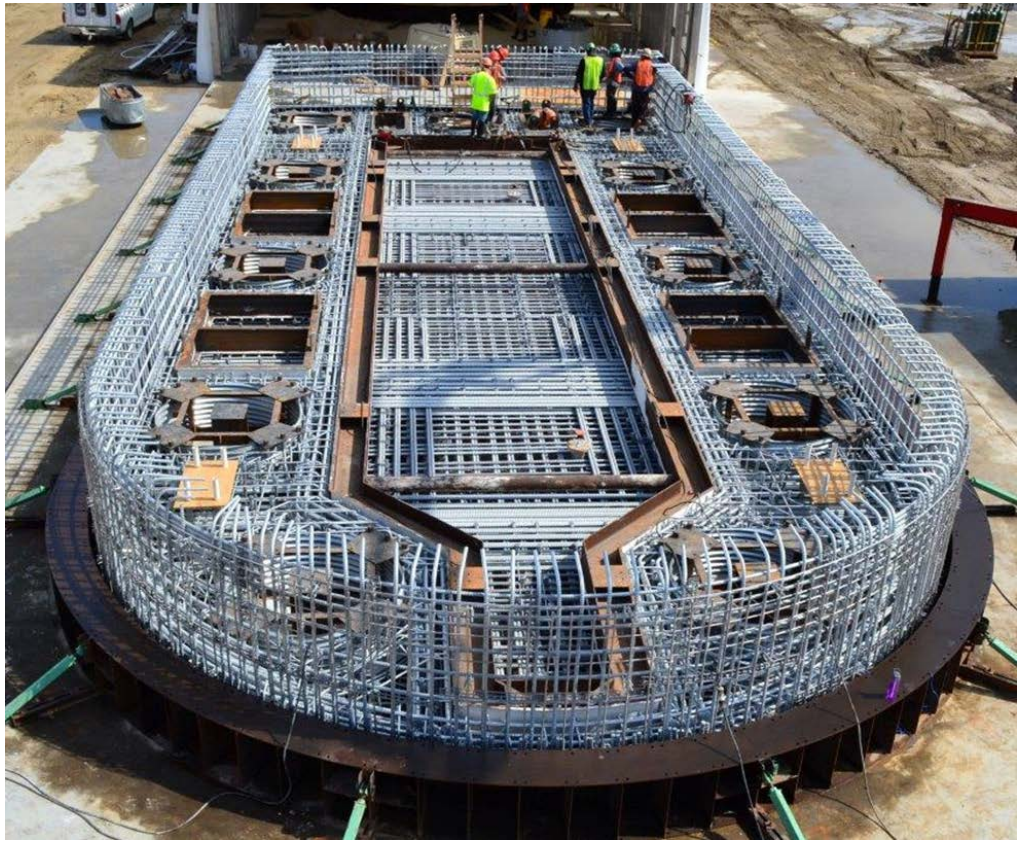
FOUNDATION DESIGN
PRECAST PILE CAPS

THE NEW NY BRIDGE



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REBAR BEFORE INFILL

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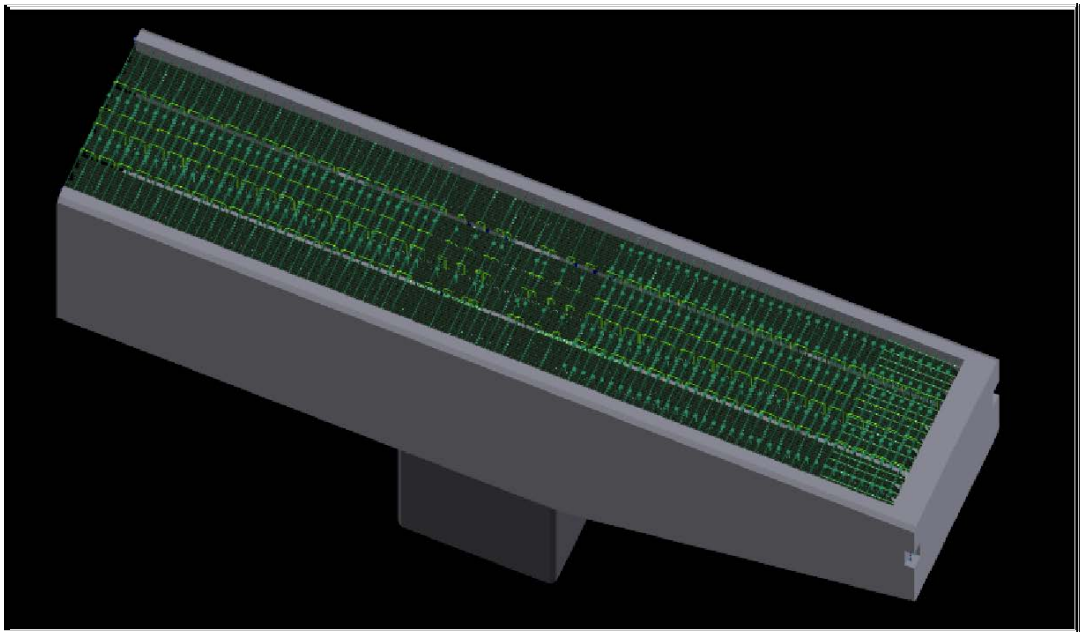
SUBSTRUCTURE DESIGN
PRECAST PIER CAPS

- PRECAST PIER CAP SHELLS
  - Precast shell: 6 ksi concrete (normal weight)
  - CIP pier cap infill: normal weight 5 ksi concrete
  - Grade 75 or 60 galvanized reinforcing steel
  - Prestressing strand: 0.6” dia., 270 ksi, galvanized



TWO-COLUMN PIERS

THE NEW NY BRIDGE

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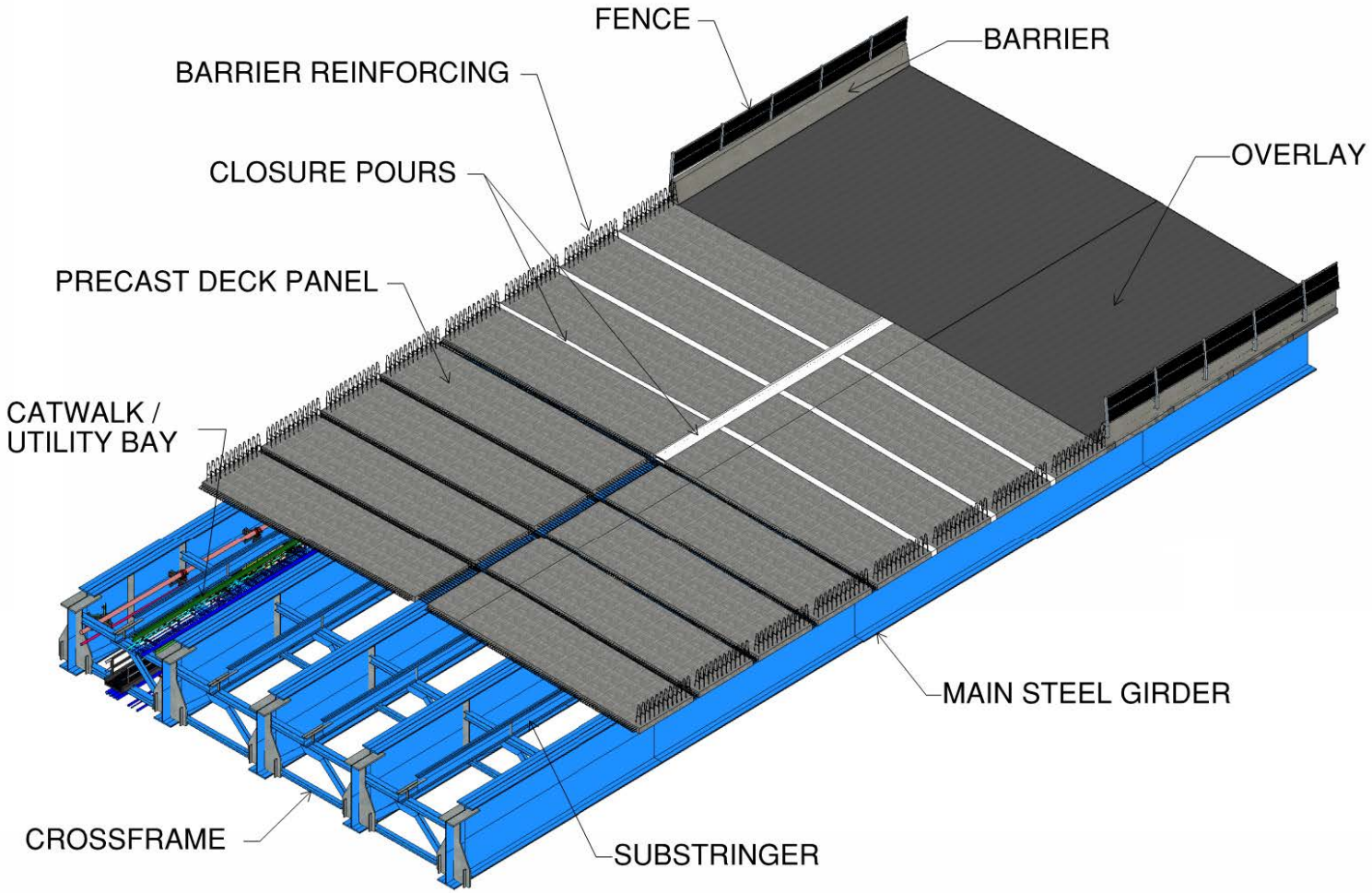
APPROACH SUPERSTRUCTURE

THE NEW NY BRIDGE

APPROACH SUPERSTRUCTURE

THE NEW NY BRIDGE



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TYPICAL GIRDER ELEVATION

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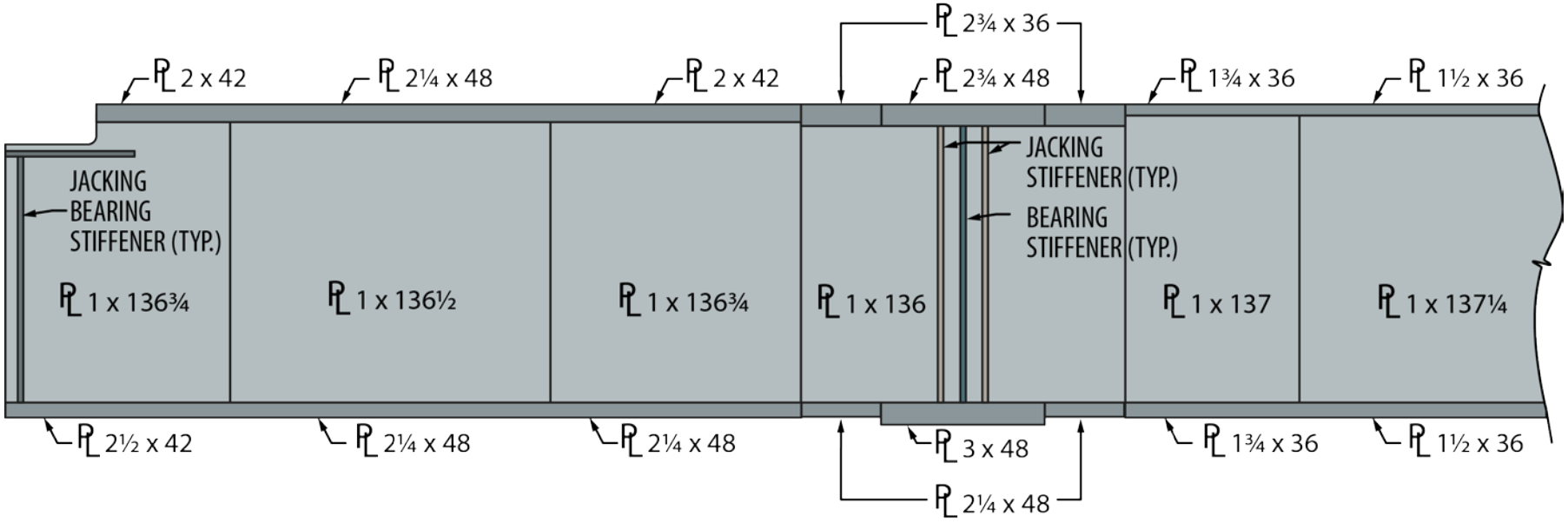

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TYPICAL INTERMEDIATE CROSSFRAMES

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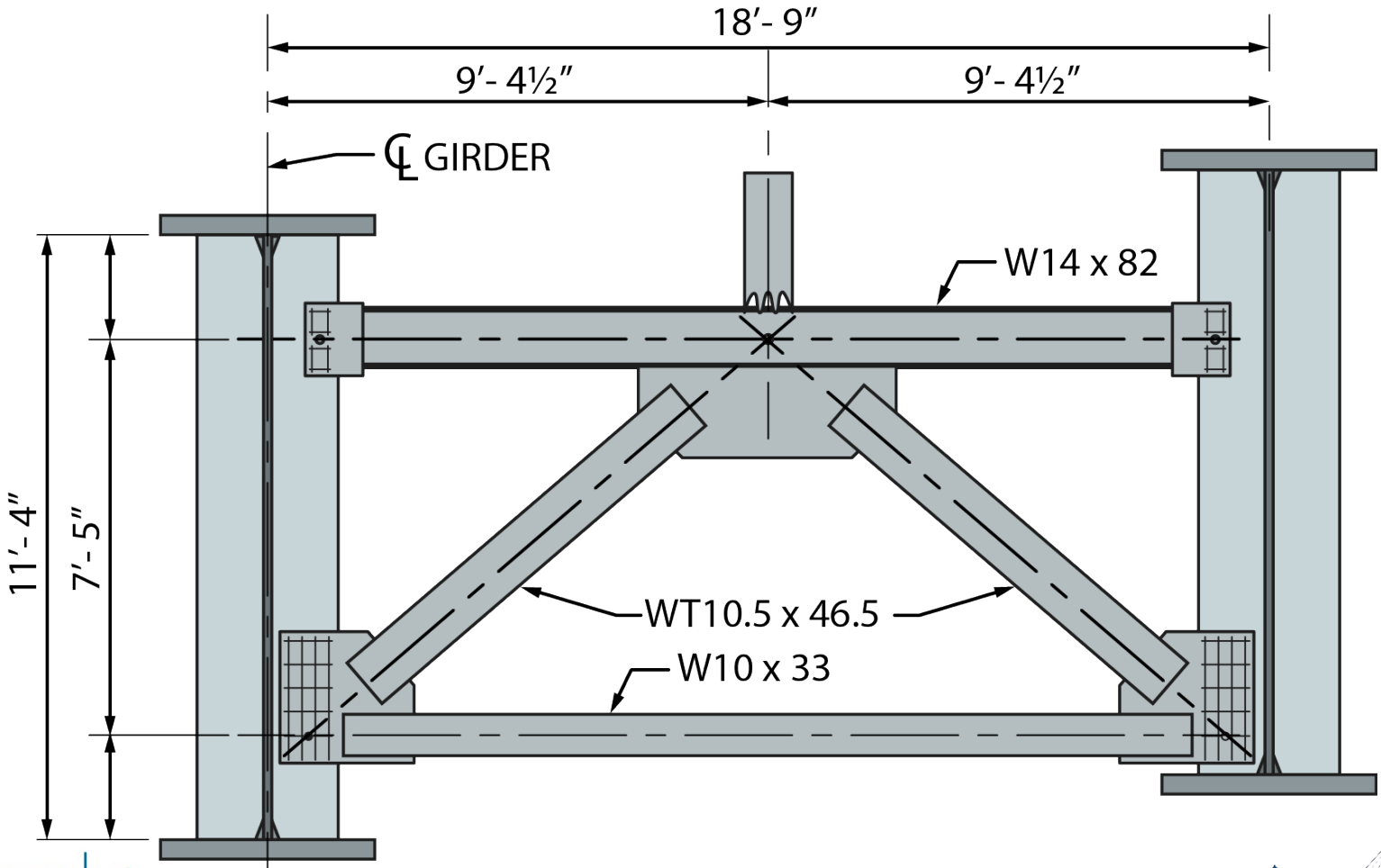

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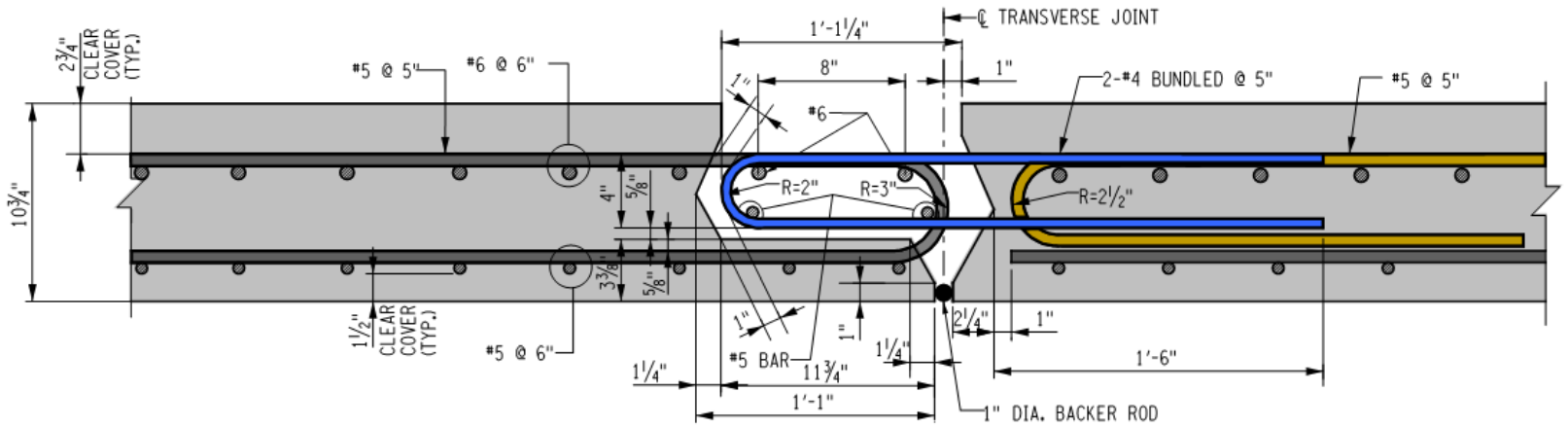
TYPICAL TRANSVERSE DECK JOINT

THE NEW NY BRIDGE



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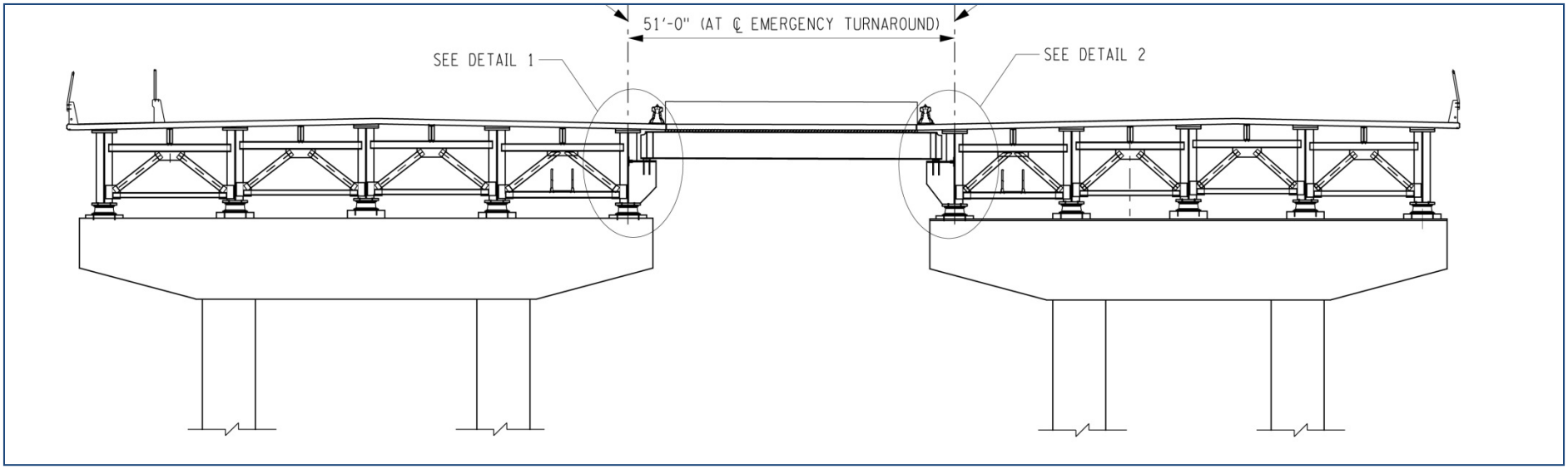
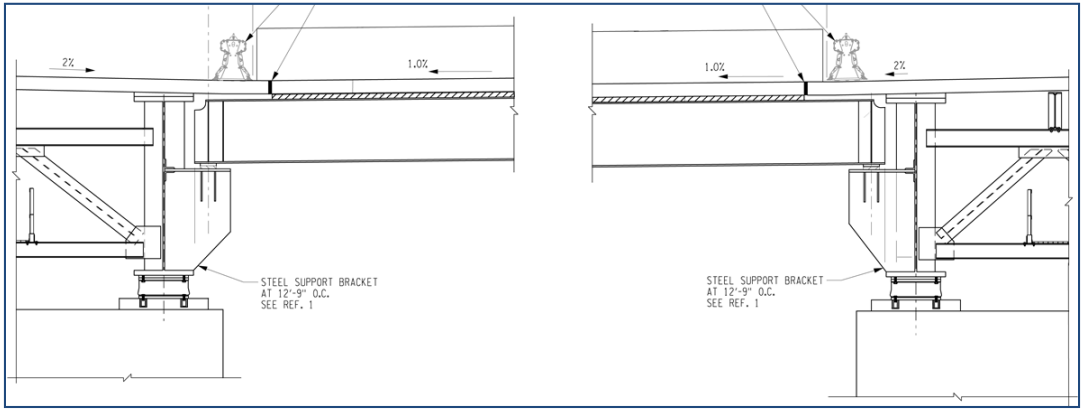
TAPPAN ZEE CONSTRUCTORS, LLC

CROSSOVER BRIDGES

THE NEW NY BRIDGE





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APPROACH CONSTRUCTION

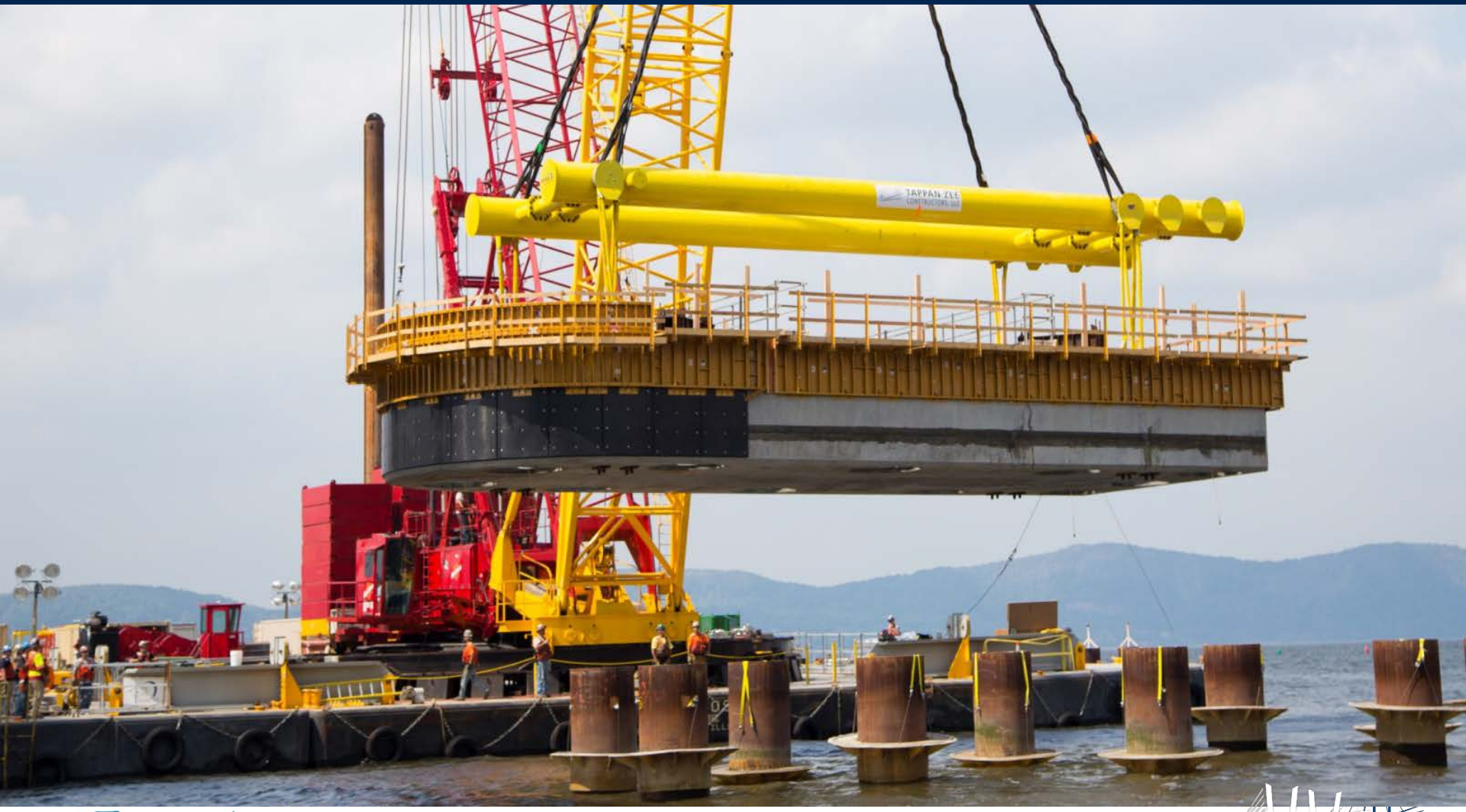
THE NEW NY BRIDGE

TYPICAL PILE DRIVING SETUP

THE NEW NY BRIDGE

PRE-CAST PILE CAP INSTALLATION

THE NEW NY BRIDGE



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TAPPAN ZEE CONSTRUCTORS, LLC

CIP PIER COLUMN CONSTRUCTION

THE NEW NY BRIDGE

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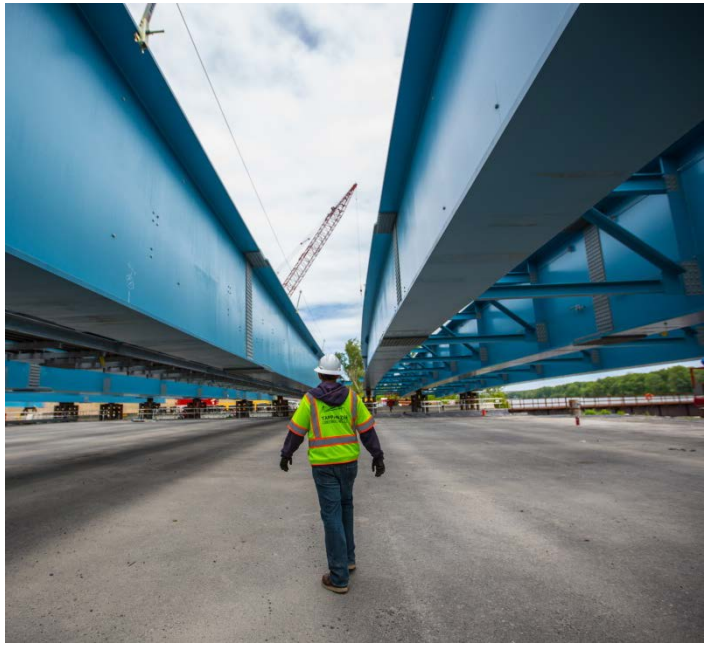
PRE-ASSEMBLY YARD

THE NEW NY BRIDGE

APPROACH SPAN STEEL FABRICATION

THE NEW NY BRIDGE



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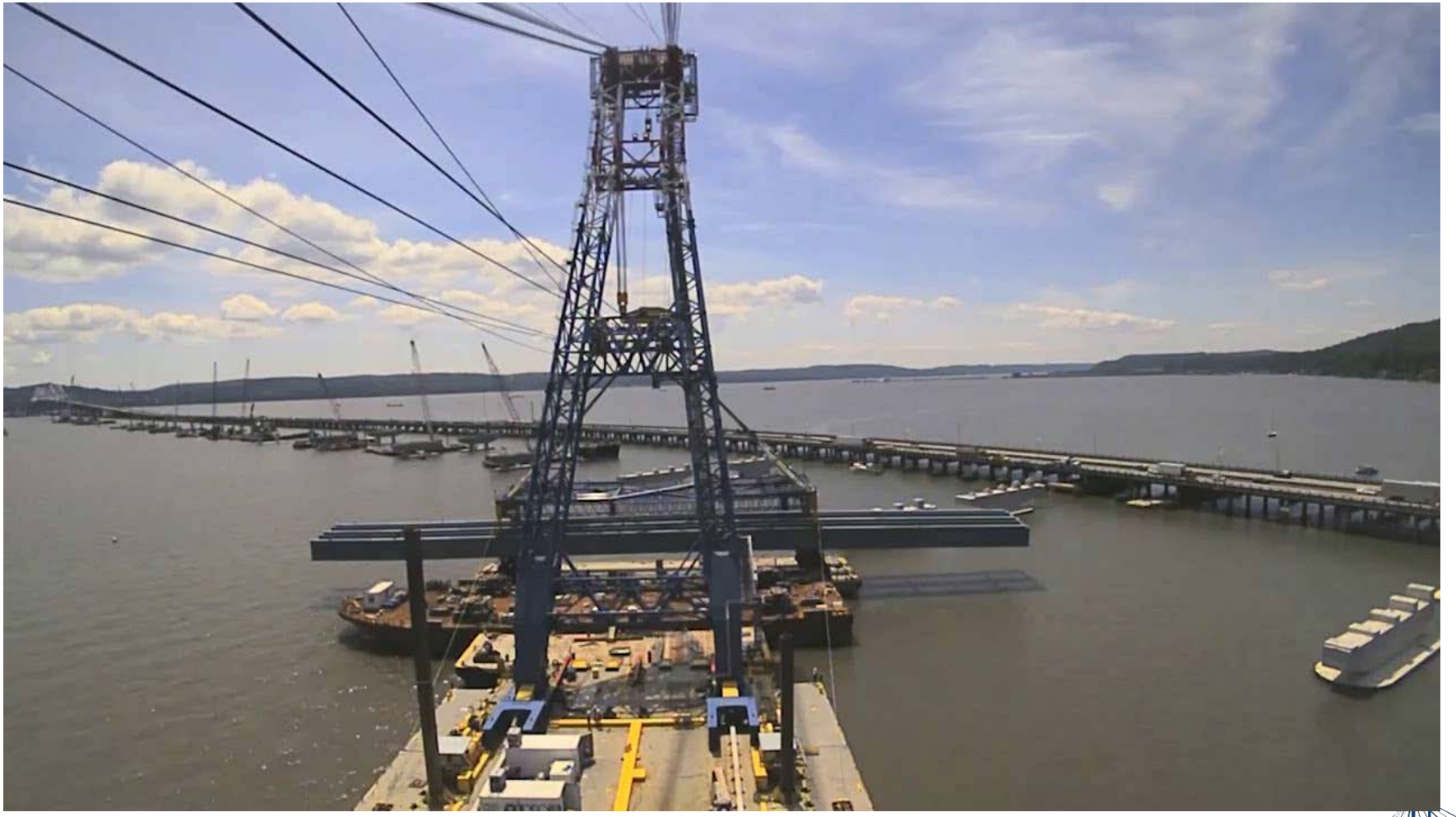
GIRDER ERECTION

THE NEW NY BRIDGE



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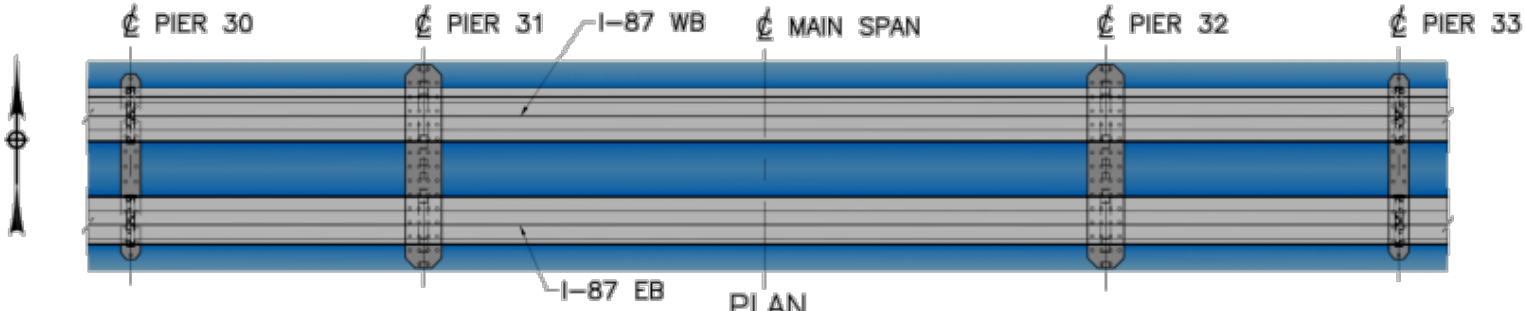
TAPPAN ZEE CONSTRUCTORS, LLC

MAIN SPAN

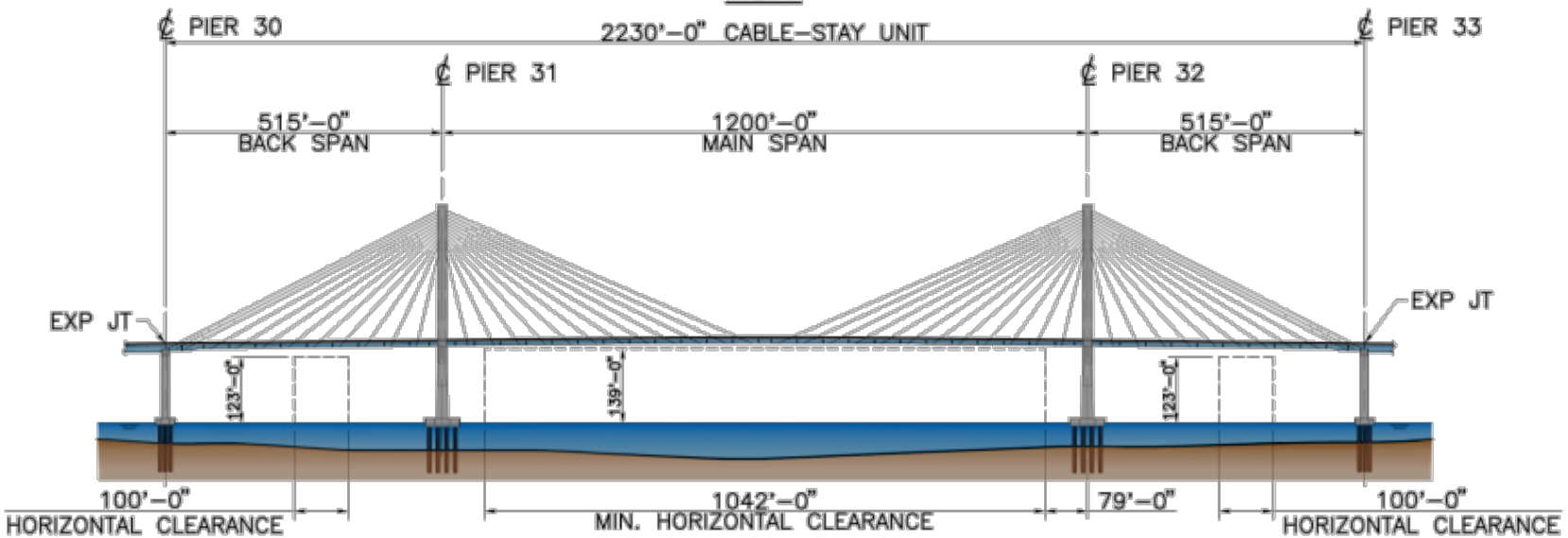
THE NEW NY BRIDGE

GENERAL ARRANGEMENT

THE NEW NY BRIDGE



PLAN



ELEVATION

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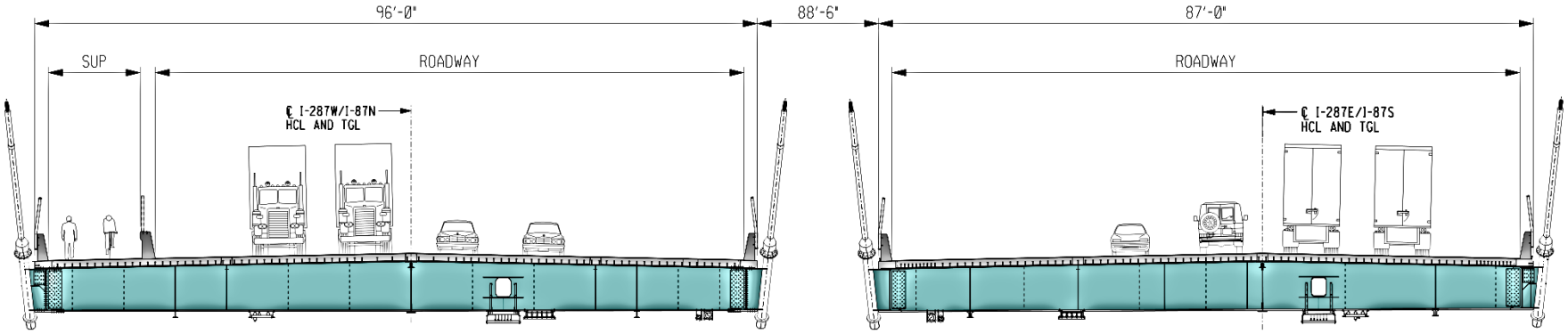
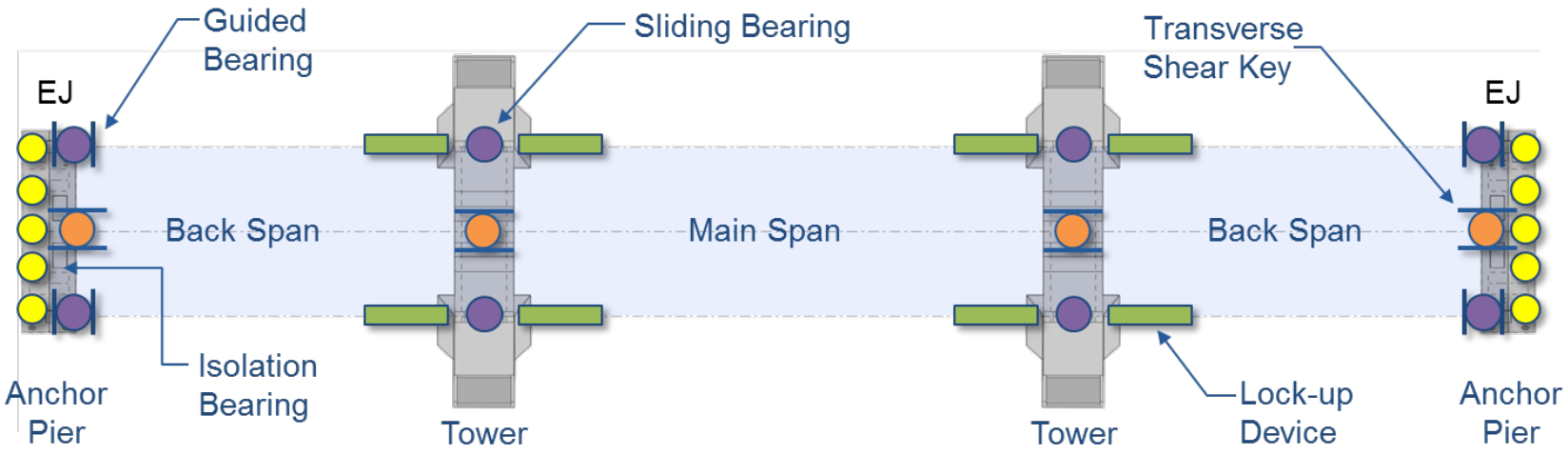
TAPPAN ZEE CONSTRUCTORS, LLC

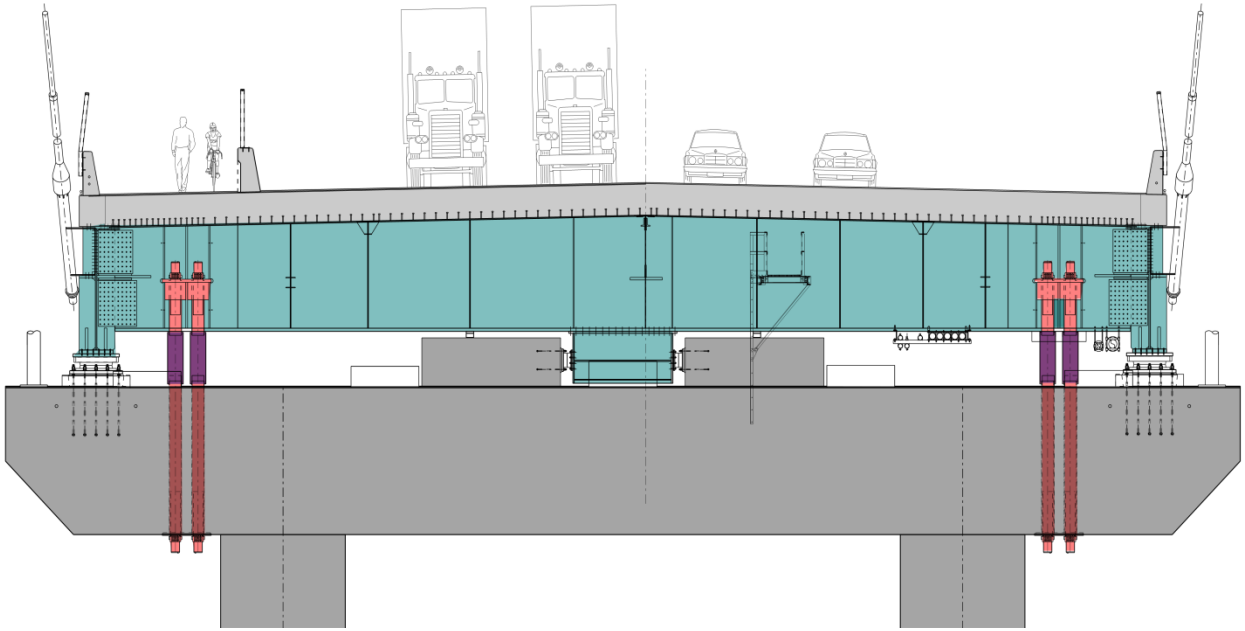
DECK SECTIONS

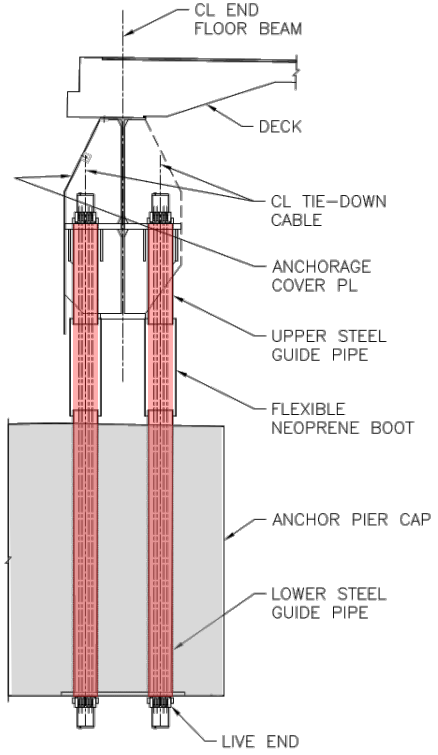


ARTICULATION



PLAN VIEW




CL END
FLOOR BEAM
DECK
CL TIE–DOWN
CABLE
ANCHORAGE
COVER PL
UPPER STEEL
GUIDE PIPE
FLEXIBLE
NEOPRENE BOOT
ANCHOR PIER CAP
LOWER STEEL
GUIDE PIPE
LIVE END

NEW YORK STATE OF OPPORTUNITY. Thruway Authority

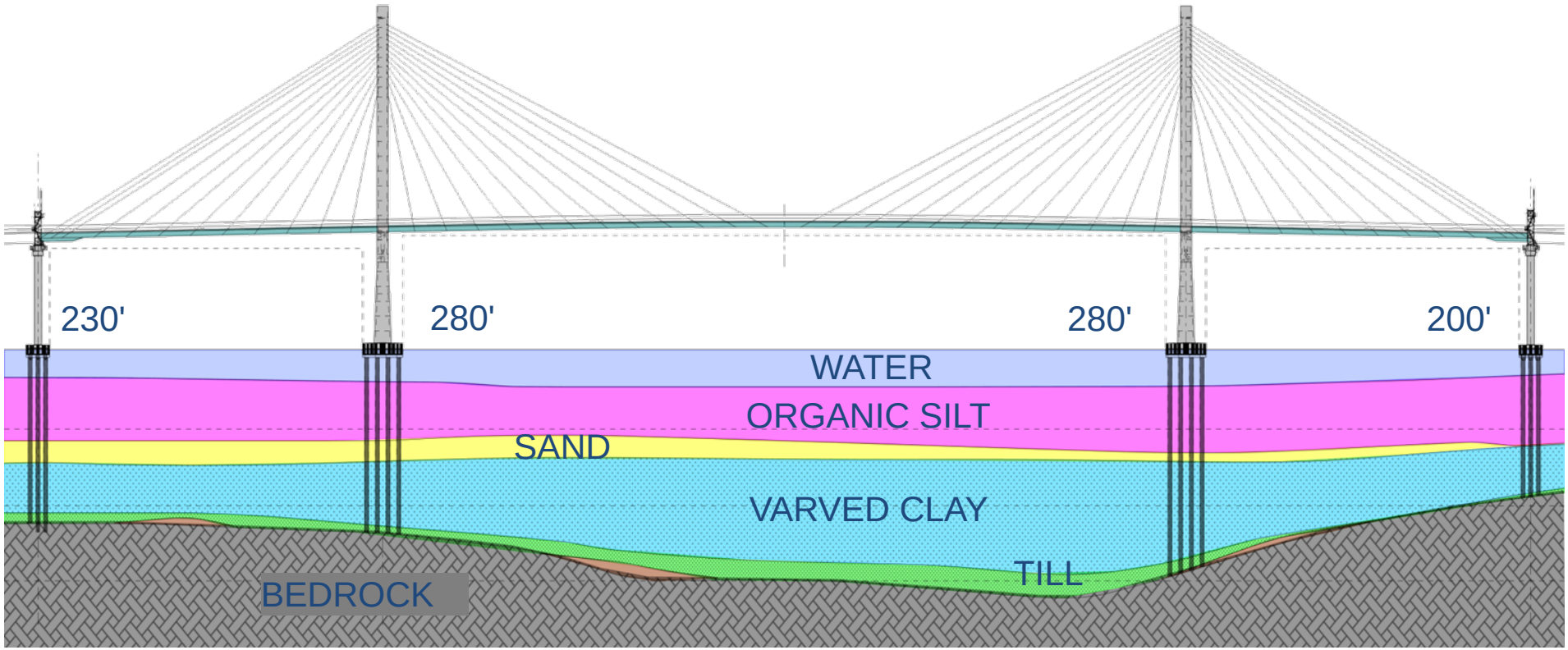
TAPPAN ZEE CONSTRUCTORS, LLC

MAIN SPAN FOUNDATIONS

THE NEW NY BRIDGE

FOUNDATIONS

THE NEW NY BRIDGE



NEW YORK STATE OF OPPORTUNITY. Thruway Authority

TAPPAN ZEE CONSTRUCTORS, LLC

FOUNDATIONS

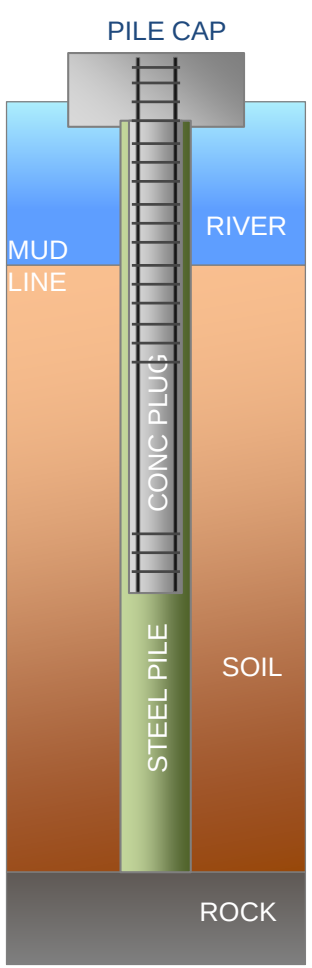
THE NEW NY BRIDGE

6-ft Diameter Driven Steel Open Pipe

- A572 Gr. 50, 1" wall
- Reinforced tip for driving
- CJP field splice
- 7100 kip load test capacity

Reinforced Concrete Plug

- 125' to 140' long
- #18 bar, Gr. 75



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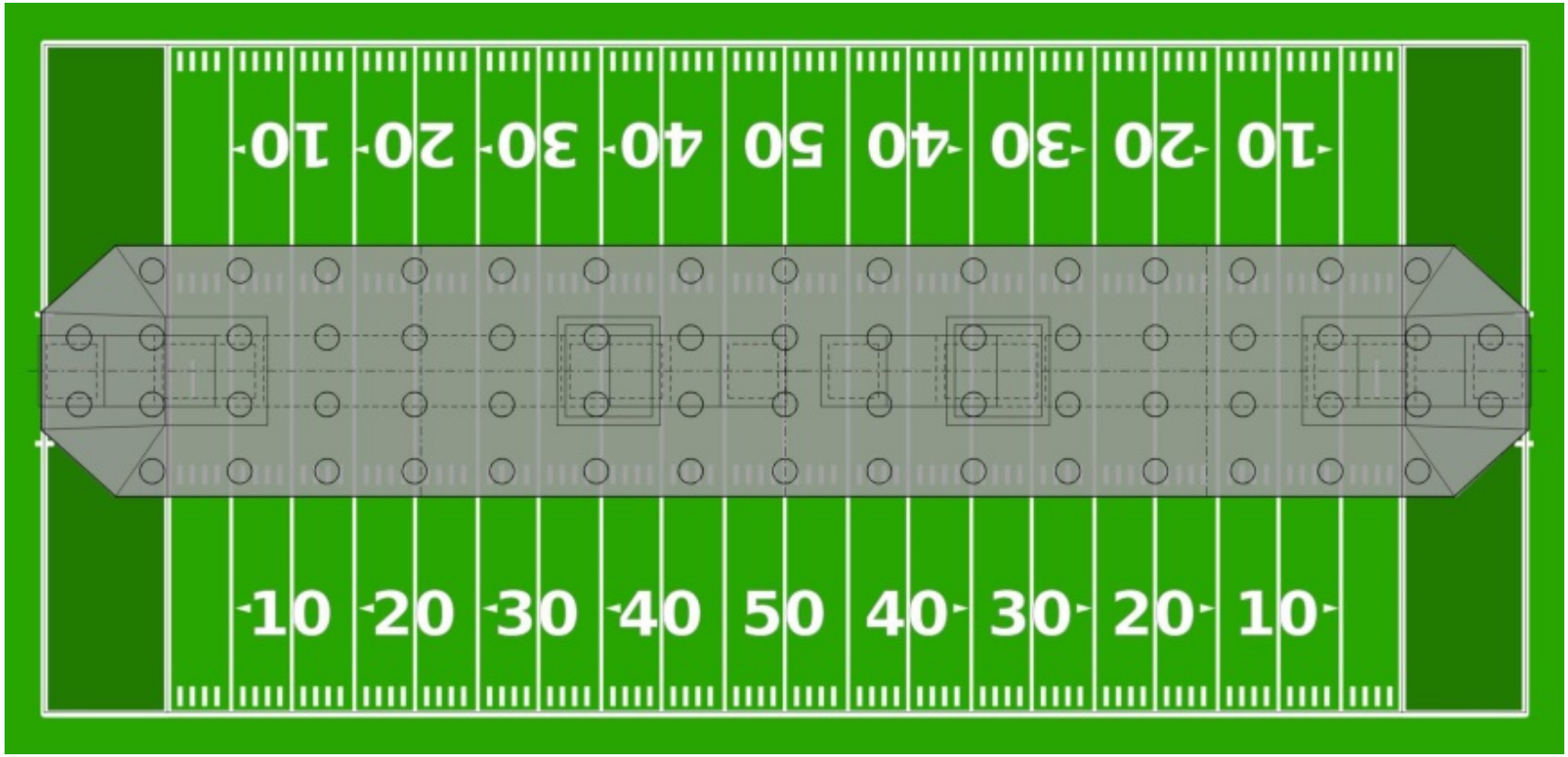
TAPPAN ZEE CONSTRUCTORS, LLC

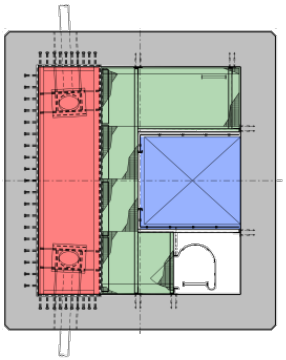
FOUNDATIONS



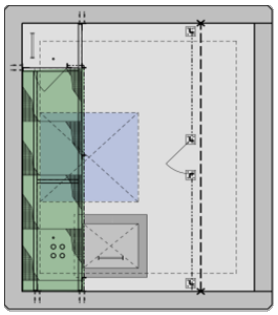
MAIN SPAN SUBSTRUCTURE

THE NEW NY BRIDGE

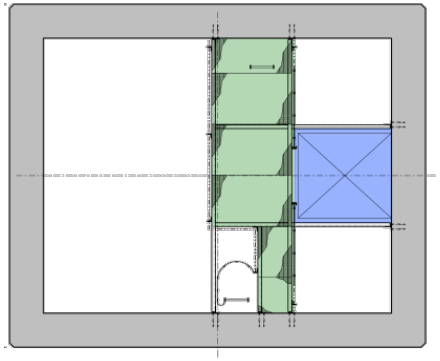
TOWERS



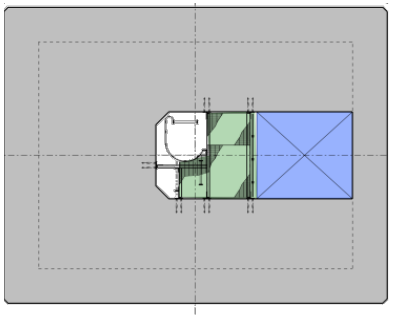
Cable Anchorage



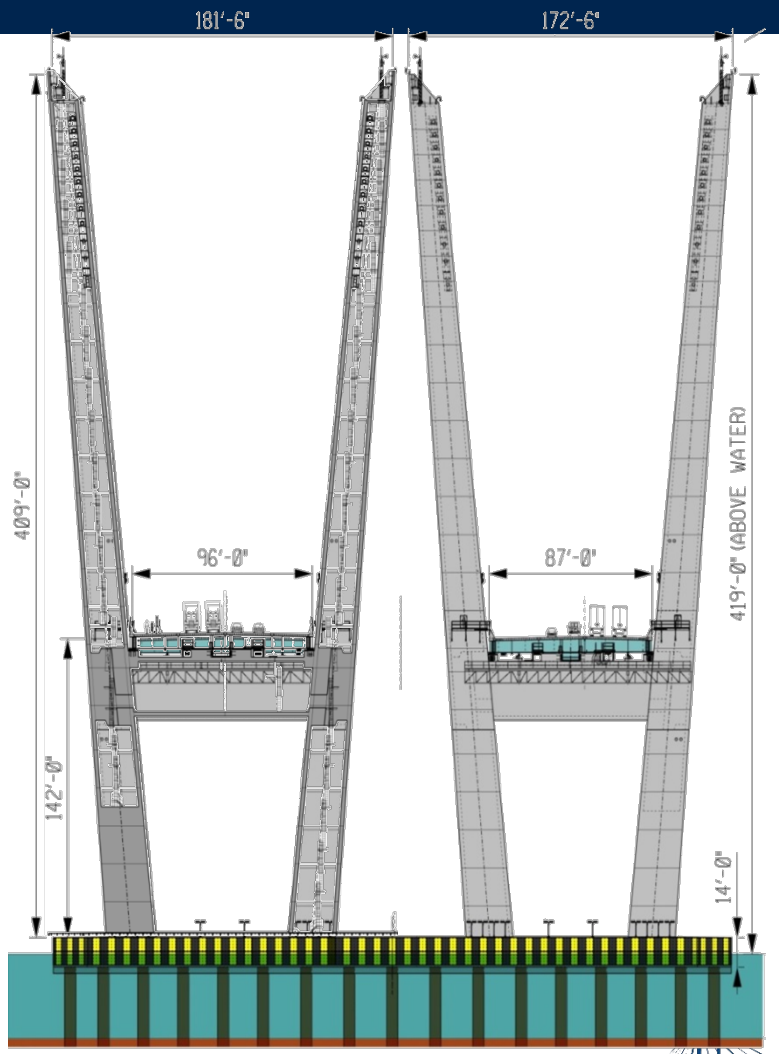
Tower Top



Tower Base



Cross Beam



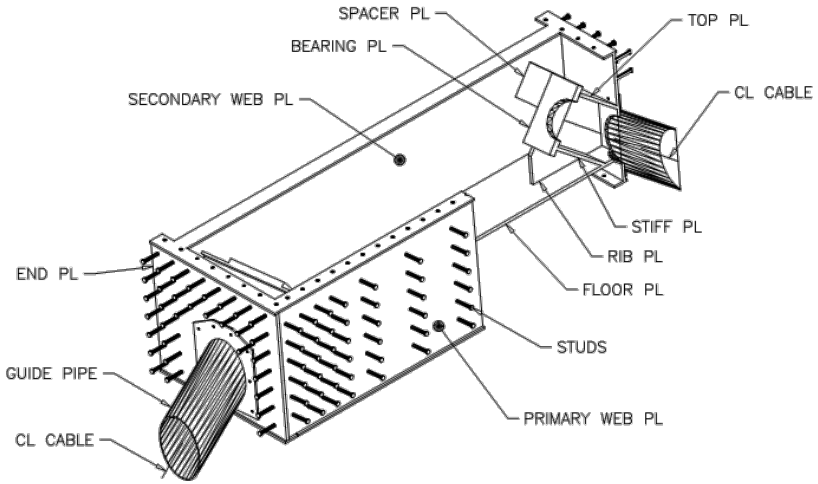
THE NEW NY BRIDGE

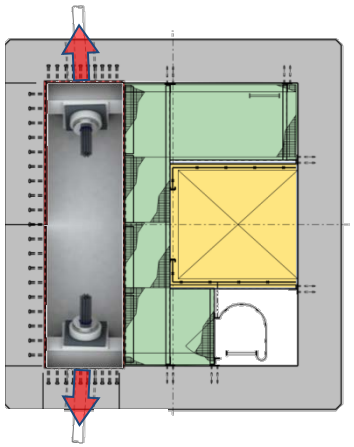
NEW YORK STATE OF OPPORTUNITY. Thruway Authority

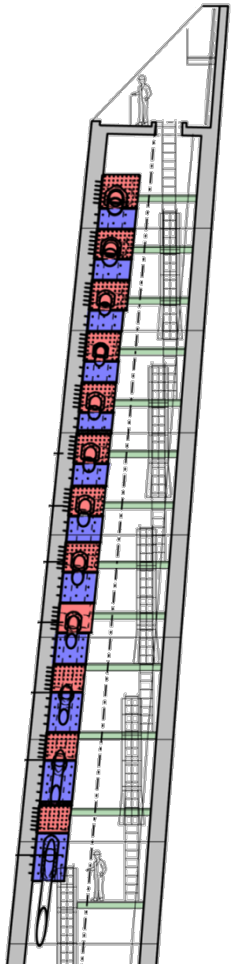
TAPPAN ZEE CONSTRUCTORS, LLC

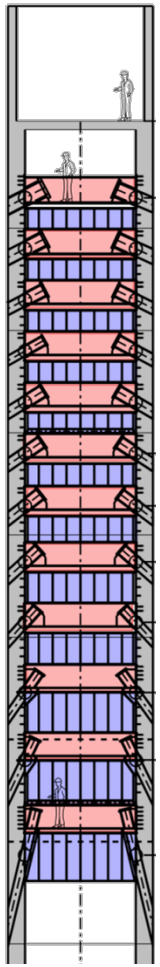
TOWER CABLE ANCHORAGES

THE NEW NY BRIDGE









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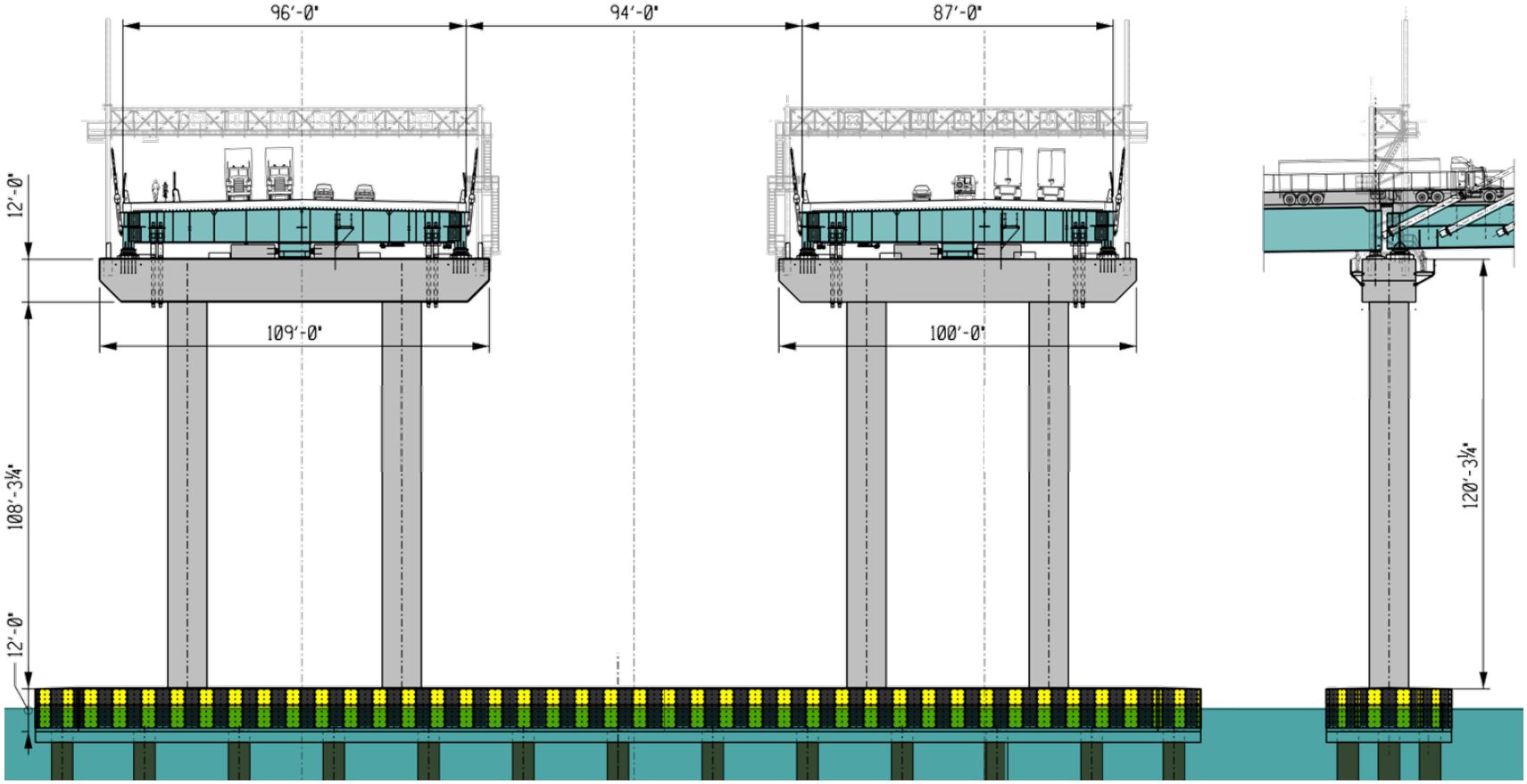
TAPPAN ZEE CONSTRUCTORS, LLC

ANCHOR PIERS

THE NEW NY BRIDGE



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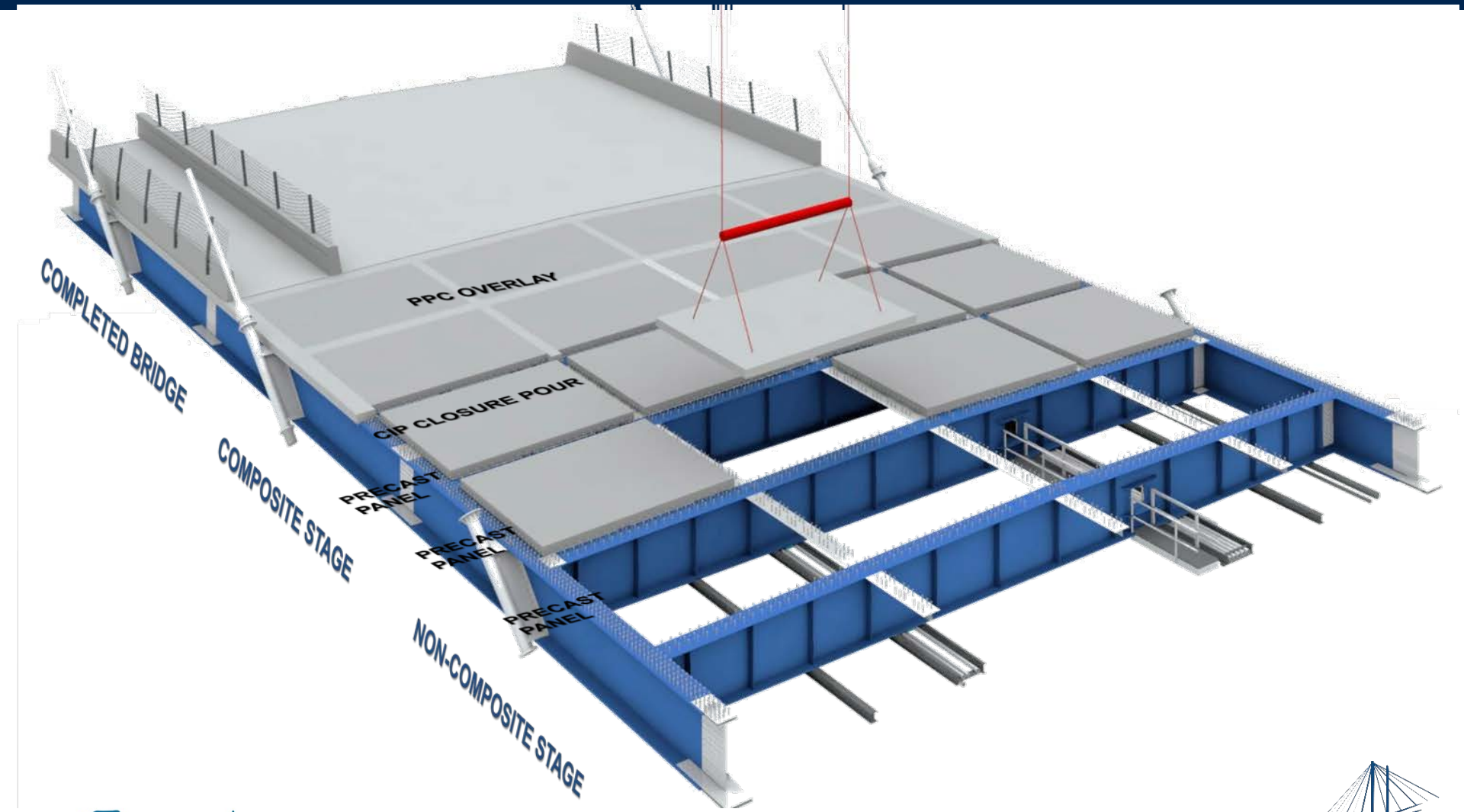
TAPPAN ZEE CONSTRUCTORS, LLC

MAIN SPAN SUPERSTRUCTURE

THE NEW NY BRIDGE

SUPERSTRUCTURE

THE NEW NY BRIDGE



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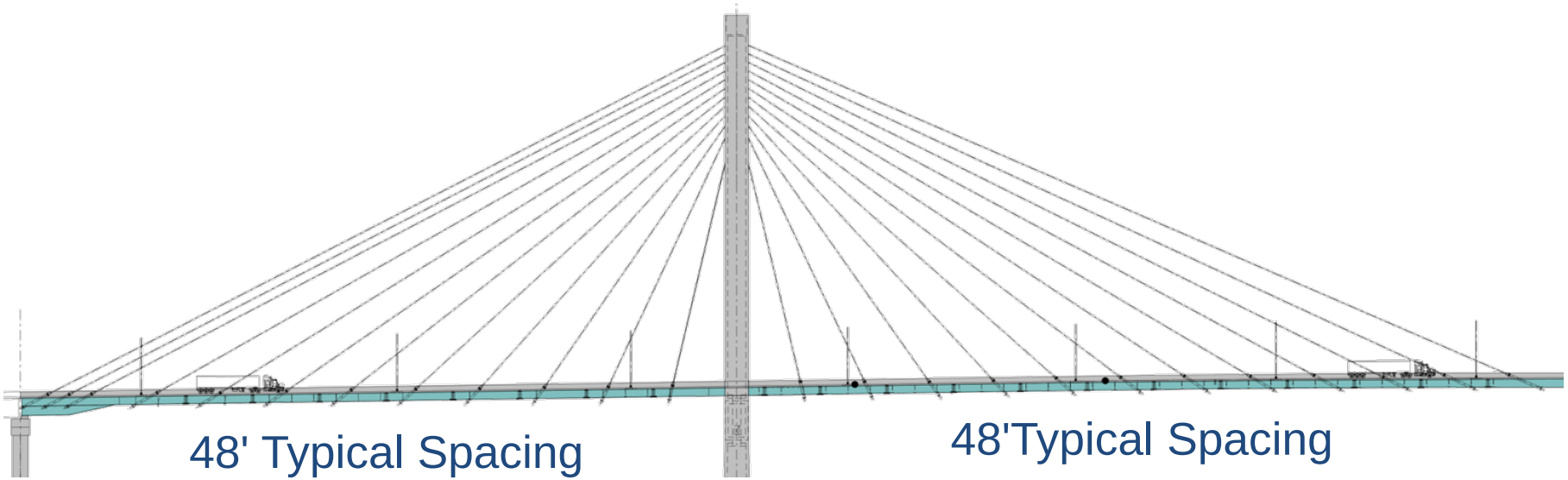
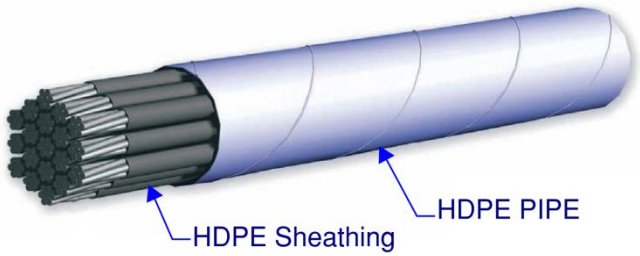
TAPPAN ZEE CONSTRUCTORS, LLC

STAY CABLES



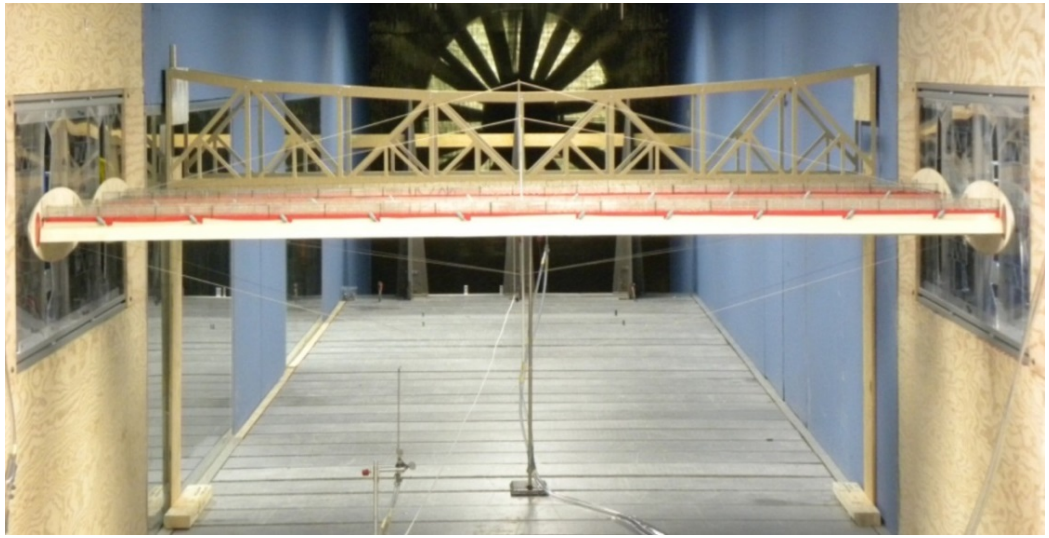
- 192 cables (both bridges)
  - Longest cable ~575'
  - 14 miles of HDPE pipe
  - 700 miles of strand

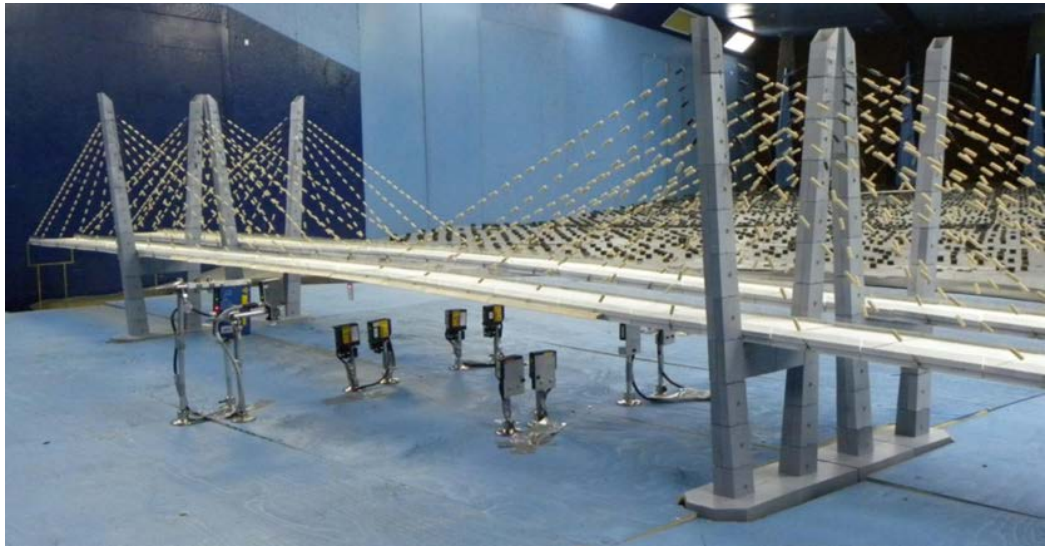


AERODYNAMICS – SECTION and AEROLASTIC MODEL TESTS

THE NEW NY BRIDGE

- Static force coefficients:
  - Lift, drag and torsion
- Assess stability
  - flutter and vortex-induced oscillation
- Buffeting response
- Aerodynamic treatments
  - Fairings, baffle plates
- Measure structural responses





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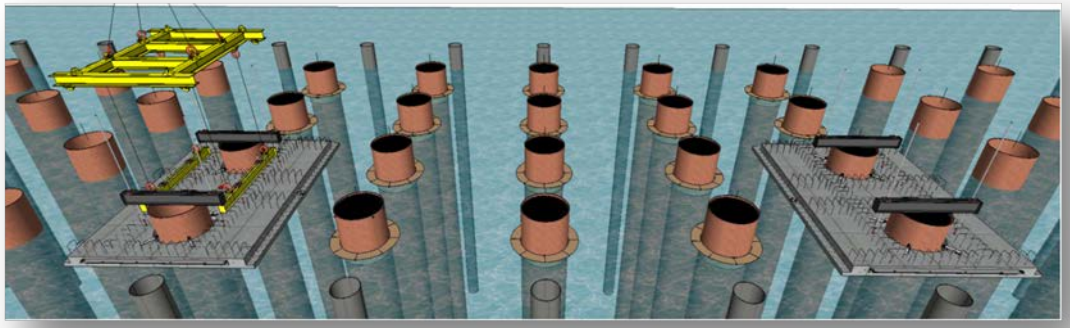
MAIN SPAN CONSTRUCTION

THE NEW NY BRIDGE

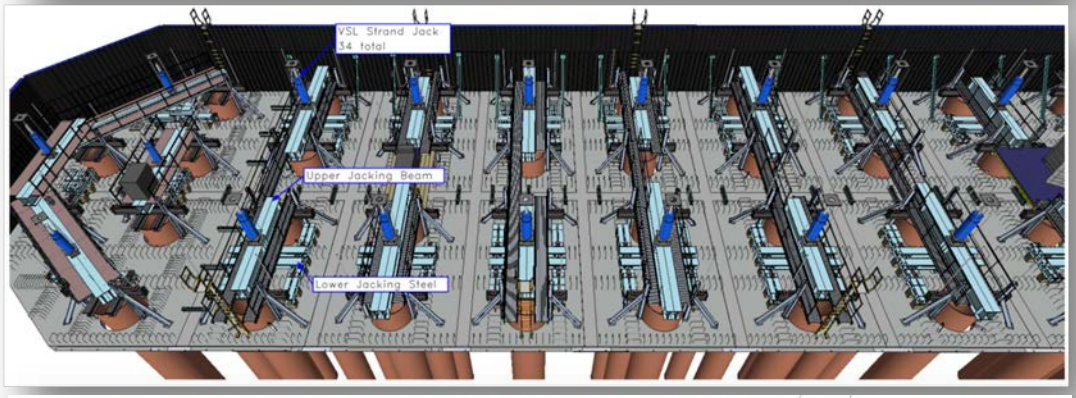
PILE CAPS – PRECAST SOFFITS

THE NEW NY BRIDGE

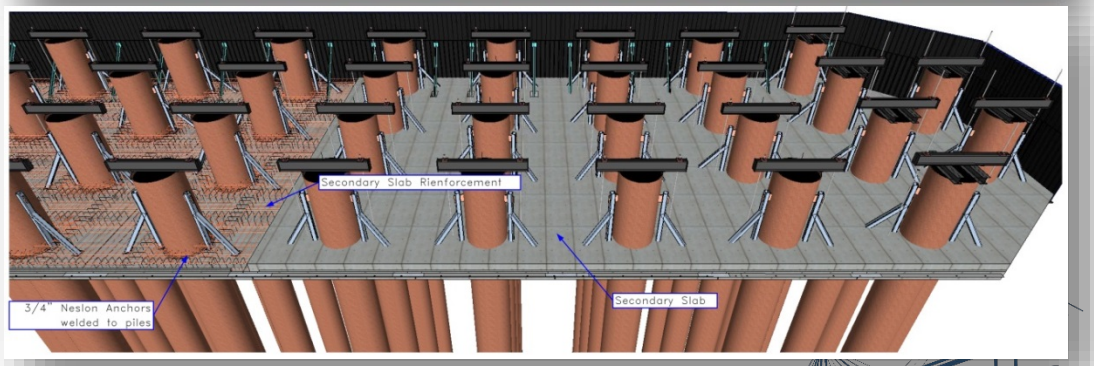
- Hang precast panels



- Stitch panels with CIP closure pours
- Install slide forms
- Lower into water with strand jacks



- Cast seal around piles
- Install uplift bracing
- Dewater
- Cast secondary slab



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SOFFIT SYSTEM CONSTRUCTION

THE NEW NY BRIDGE

NEW YORK STATE OF OPPORTUNITY. Thruway Authority

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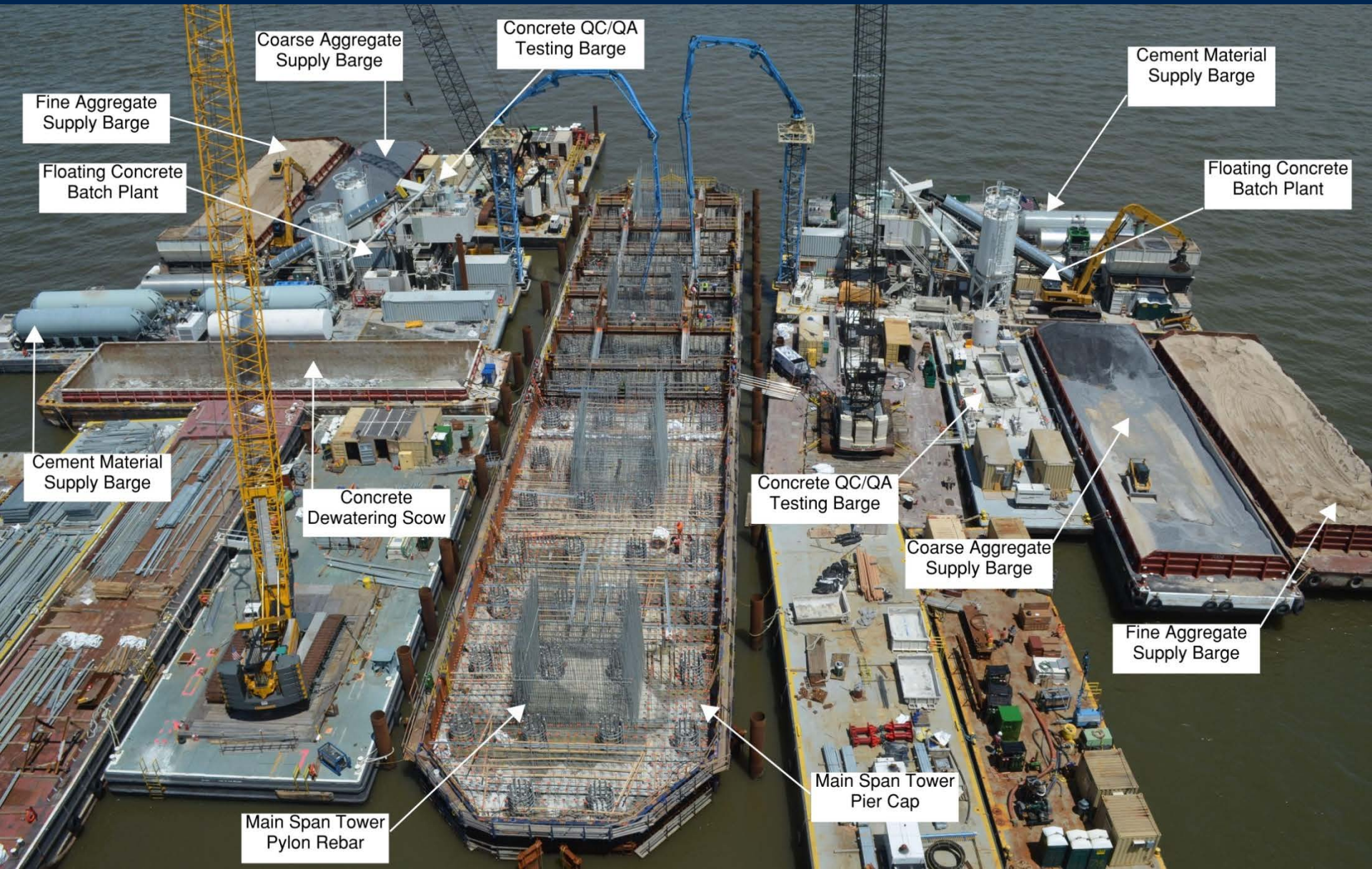
MAIN SPAN PILE CAP CONSTRUCTION

THE NEW NY BRIDGE



TOWER CONSTRUCTION SEQUENCE

THE NEW NY BRIDGE

NEW YORK STATE OF OPPORTUNITY. Thruway Authority

TAPPAN ZEE CONSTRUCTORS, LLC

FACILITIES

THE NEW NY BRIDGE

NYSTA MAINTENANCE FACILITY

THE NEW NY BRIDGE

NEW YORK STATE OF OPPORTUNITY. Thruway Authority

TAPPAN ZEE CONSTRUCTORS, LLC

NYSTA MAINTENANCE FACILITY

THE NEW NY BRIDGE

NEW YORK STATE OF OPPORTUNITY. Thruway Authority

TAPPAN ZEE CONSTRUCTORS, LLC

NYS POLICE FACILITY

THE NEW NY BRIDGE

NEW YORK STATE OF OPPORTUNITY. Thruway Authority

TAPPAN ZEE CONSTRUCTORS, LLC

NYS POLICE FACILITY

THE NEW NY BRIDGE

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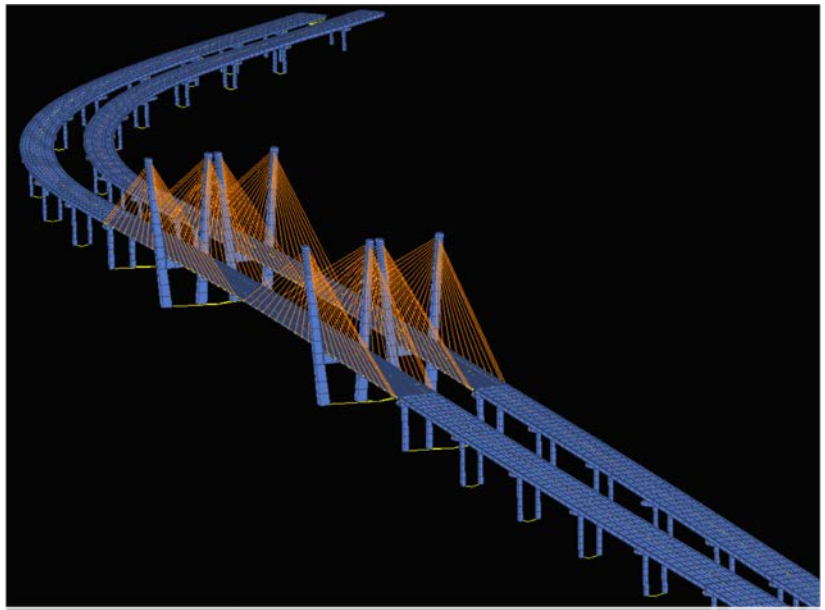
TAPPAN ZEE CONSTRUCTORS, LLC

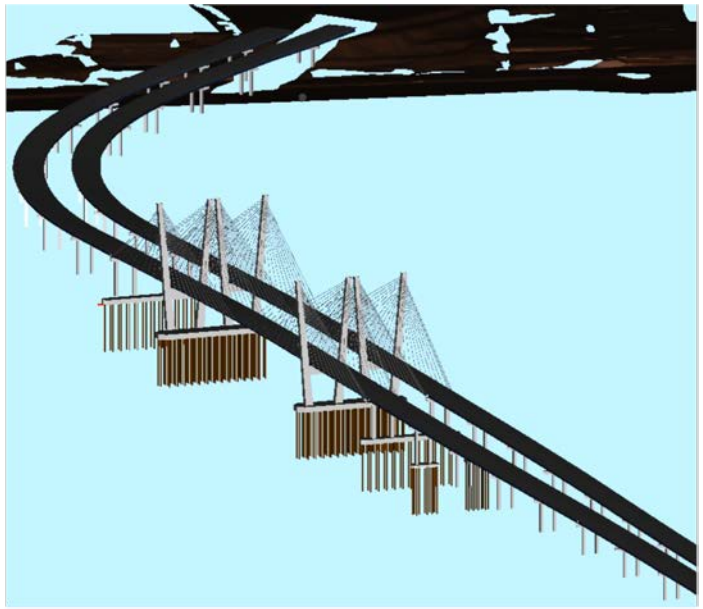
BrIM

THE NEW NY BRIDGE

BrIM / DATABASE

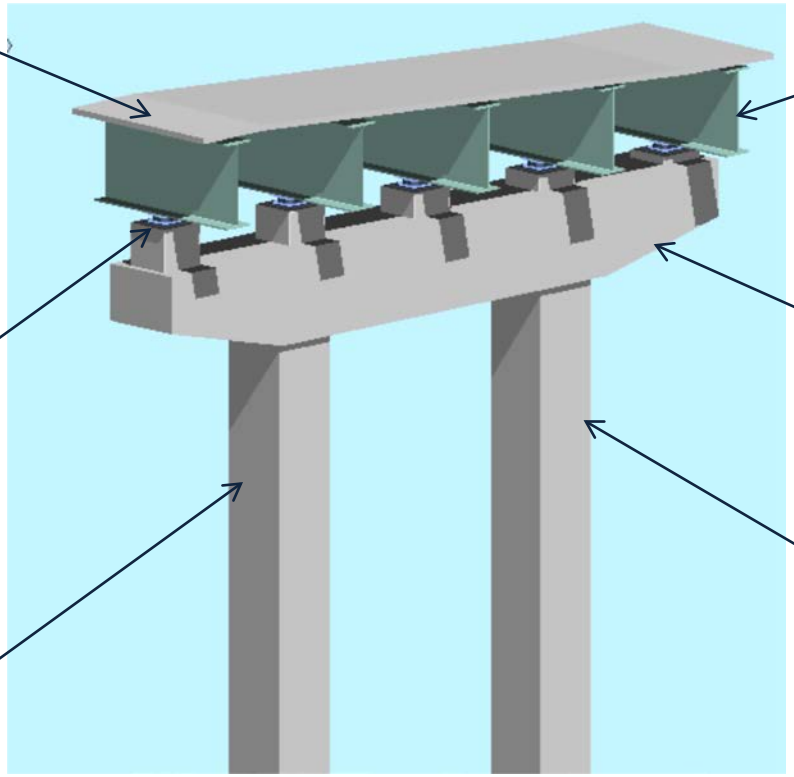


RM Bridge



3D Microstation

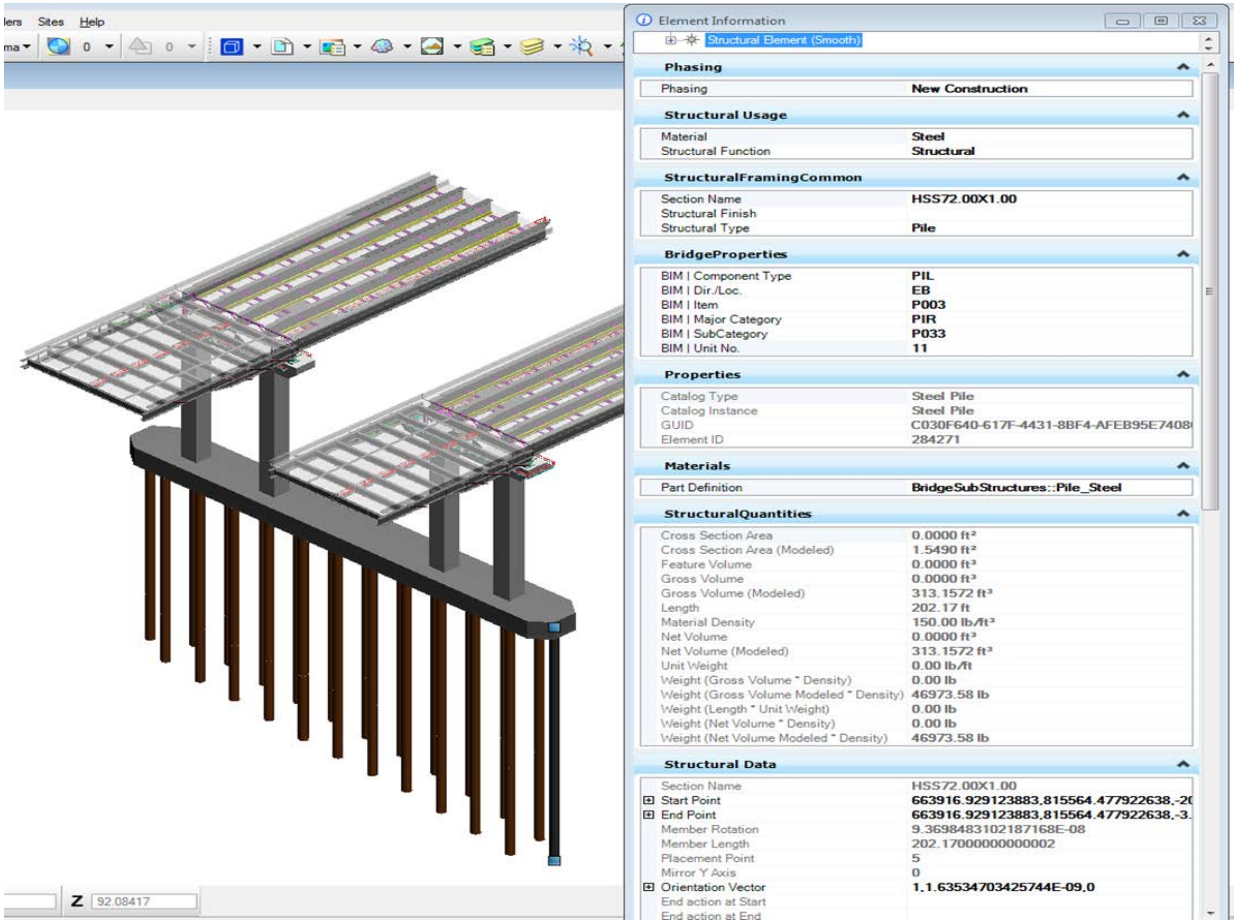
BrIM / DATABASE



BrIM / DATABASE

THE NEW NY BRIDGE

Additional Attributes BrIM Model Deliverables



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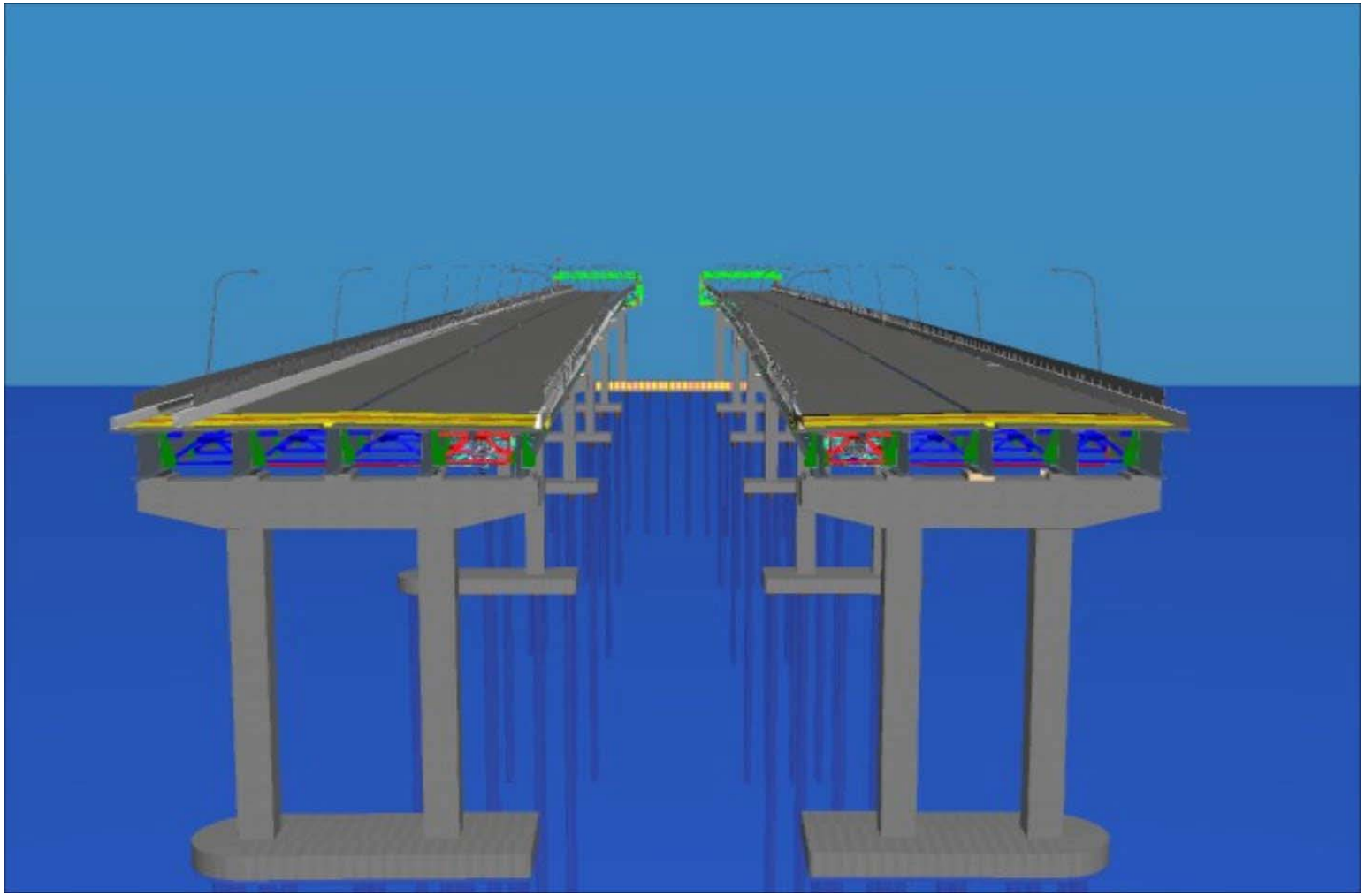
BrIM Model

THE NEW NY BRIDGE



NEW YORK STATE OF OPPORTUNITY. Thruway Authority

TAPPAN ZEE CONSTRUCTORS, LLC

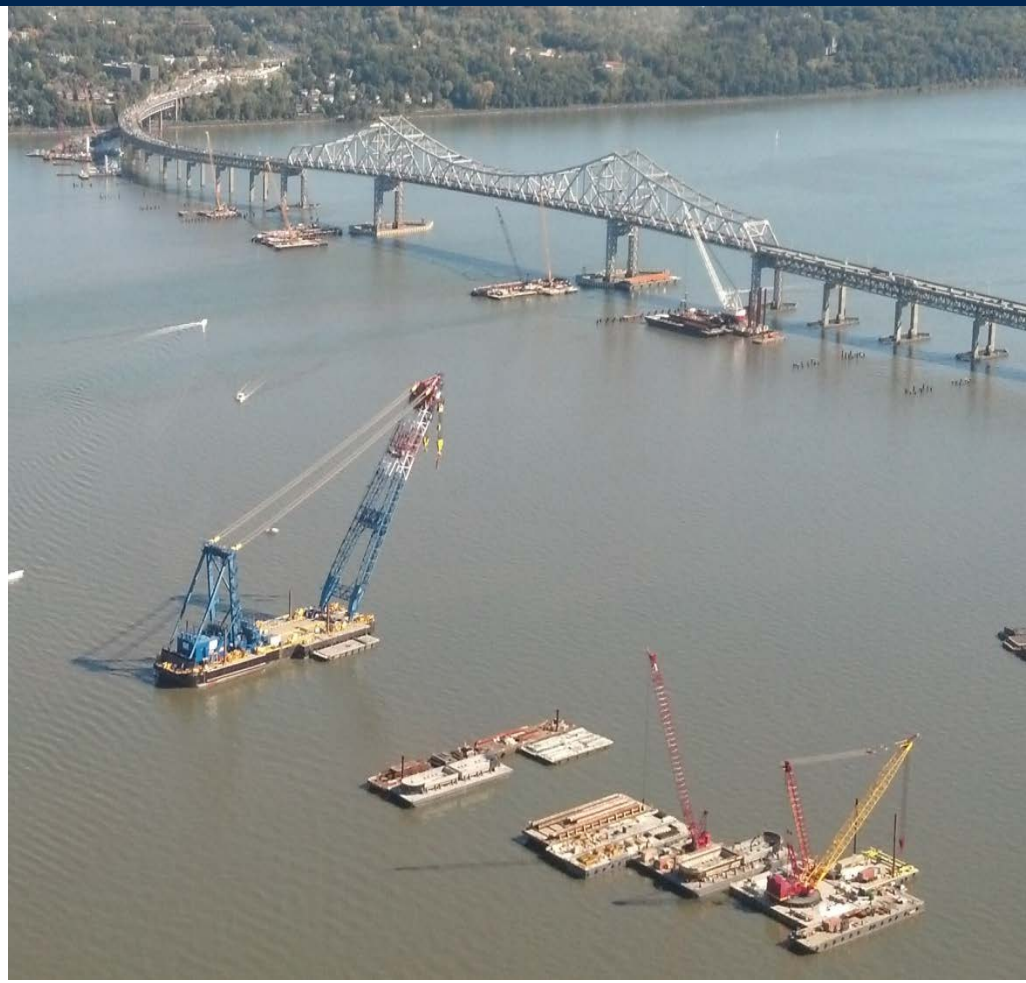
PROJECT LOOK-AHEAD

THE NEW NY BRIDGE

DESIGN STATUS

THE NEW NY BRIDGE

- Overall design team
  - 35 firms in 5 countries
  - 21 Disadvantaged Business Entities
  - 16,000 hours per week (peak)
  - 900,000 labor-hours to date
- Design Schedule
  - 18 months
  - 733 deliverables including 118 RFC packages
- Reached substantial completion
- Shifted from design to construction support



NEW YORK STATE OF OPPORTUNITY. Thruway Authority

TAPPAN ZEE CONSTRUCTORS, LLC

2015 CONSTRUCTION ACTIVITIES

THE NEW NY BRIDGE

- Complete Stage 1 Permanent Pile Installation
- Continue Pile Cap Installation
- Construct Vertical Piers and Main Span Towers
- Continue Approach Steel Erection
- Construct New Retaining Walls and Permanent Noise Barriers
- Continue Construction at Landings

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TAPPAN ZEE CONSTRUCTORS, LLC


THANK YOU