



St. Croix
CROSSING

3D Modeling Applications for the St. Croix River Crossing Project

3D Design and Modeling for
Highway Structures Conference
April 14, 2015





Presentation Overview

- Project Background
- Extradosed Structure 101
- Schedule
- 3D Model Development and Usage
 - Design Aid
 - Visual Quality
 - Public Involvement
 - 4D Schedule
- Current Construction Status



St. Croix
CROSSING

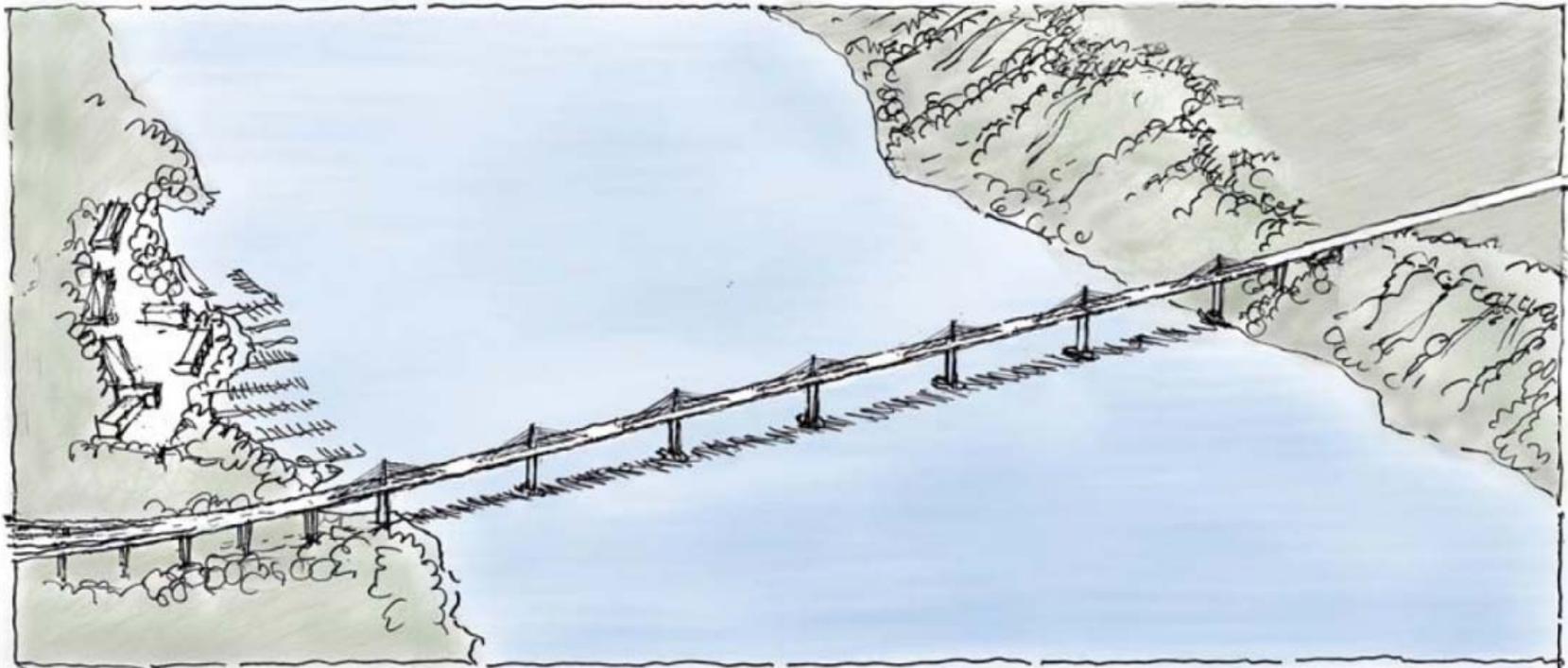
St. Croix Crossing Project Area





Project Background - History

- SFEIS identified several important areas of concern for design:
 - visibility of bridge
 - height of towers
 - number of piers in the river
 - the effects of the piers on the natural environment, wildlife, aquatic life, MN wetlands, and the WS bluffs
- An extradosed solution was identified as the **Preferred Alternative** bridge type





The New St. Croix Crossing



St. Croix Crossing project

Aerial view looking west toward Sunnyside Marina

This photo simulation is based on designs available in June 2013.
It does not necessarily represent the final appearance.



The New St. Croix Crossing



St. Croix Crossing project

Aerial view looking west toward Xcel King power plant

This photo simulation is based on designs available in June 2013
It does not necessarily represent the final appearance.



The New St. Croix Crossing





St. Croix
CROSSING

Roadway View





Extradosed Bridges

- Relatively new bridge form – 1988 France
- First was constructed in Japan in 1994
- More than 100 worldwide, mostly in Japan
- Very new form to North America
- Selected to address specific site constraints
- Similar to cable stay and segmental box



Extradosed Bridges



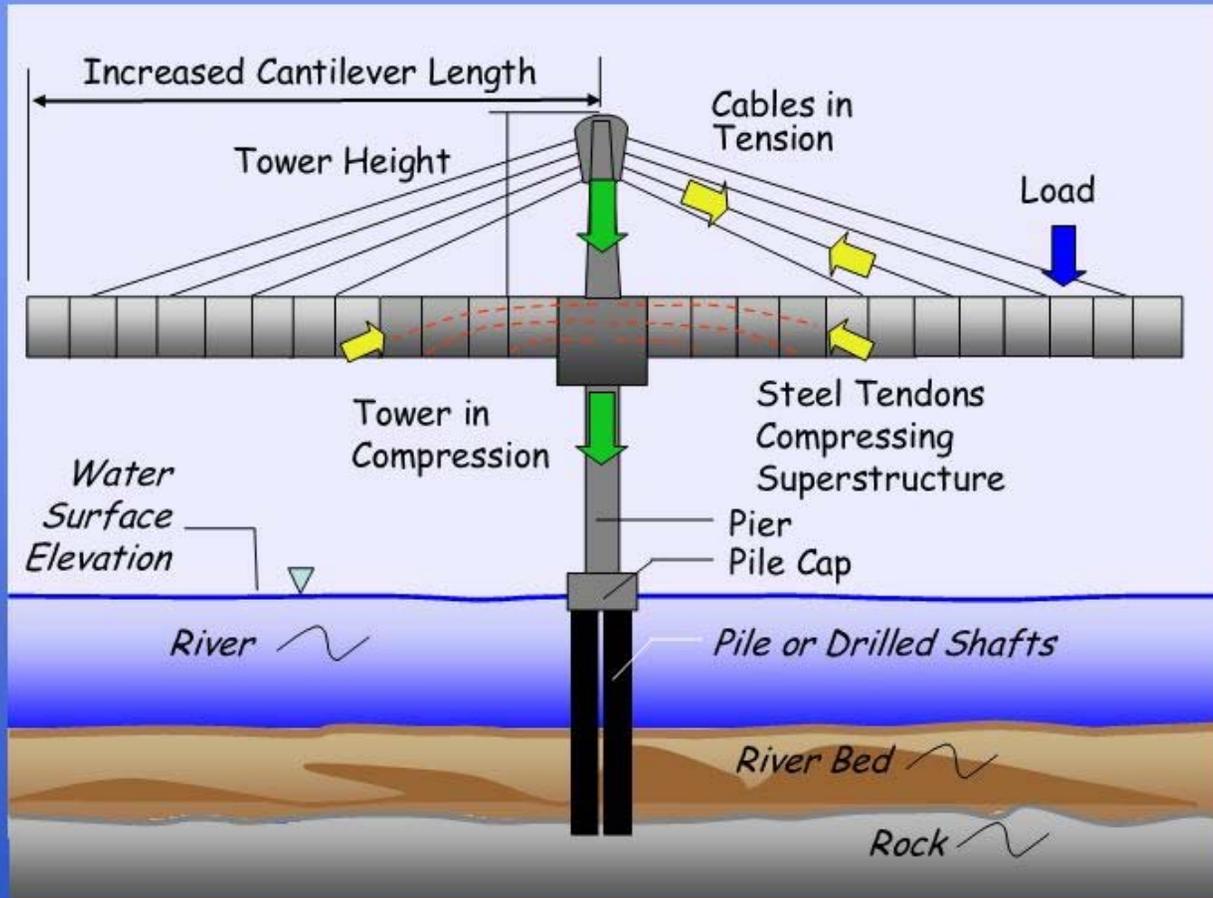
Pearl Harbor Memorial - New Haven, CT
515' (157 m) main span – under construction

First in United States



St. Croix
CROSSING

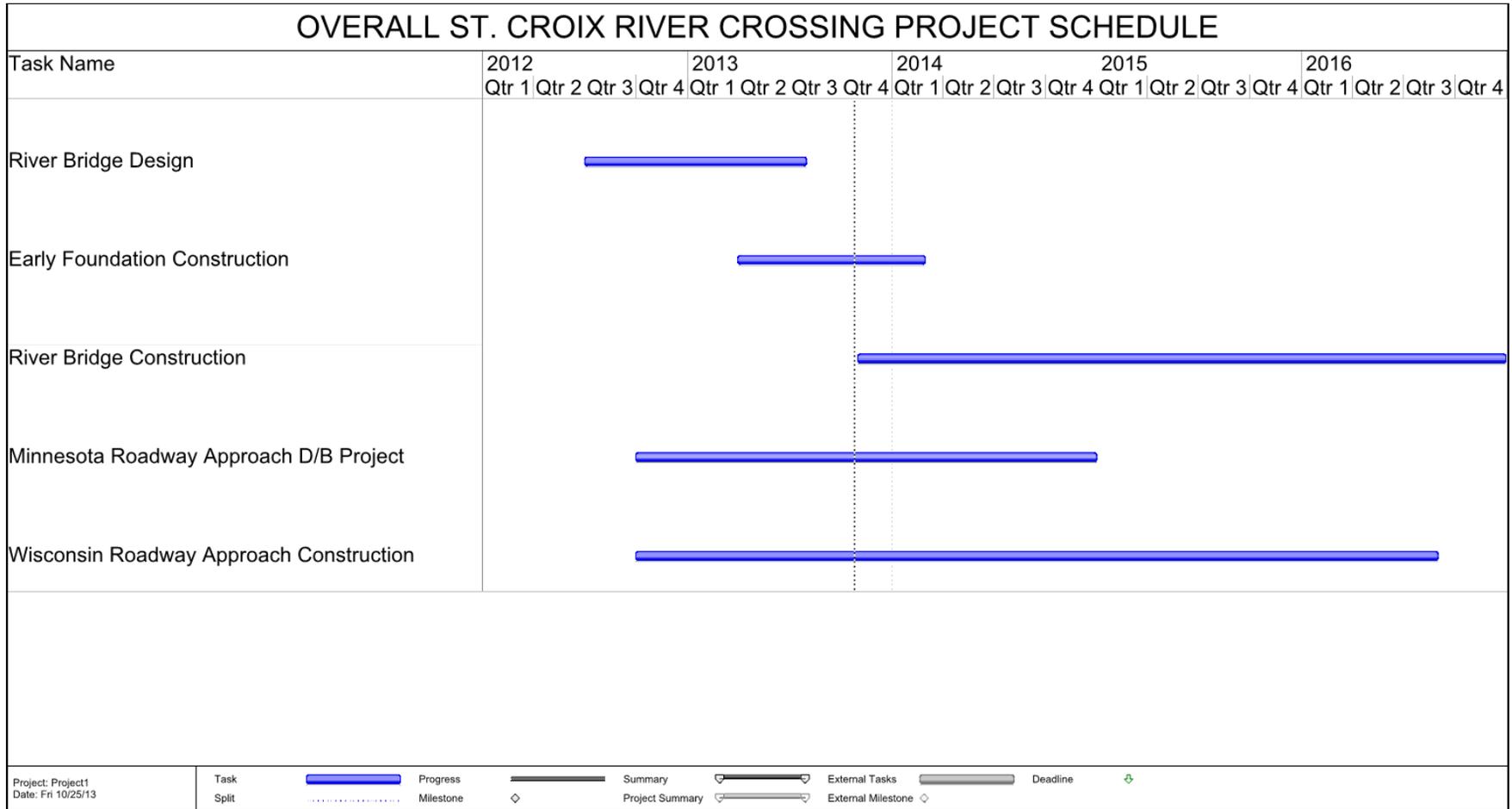
Extradosed Bridges



Extradosed Concrete Box Girder



Schedule





3D Model Development and Usage

- Started with original model developed in preliminary and conceptual design phase
- 3D Studio Max
- Model Usage – integrated effort
 - Optimization Efforts and Design Aid
 - Visual Quality – Renderings and VQ Committee
 - Public Involvement – Photo-Simulations and Fly-Thru
 - 4D Schedule



Design Optimization



- Baseline 450' Spans
- 7 extradosed piers, 6 in water

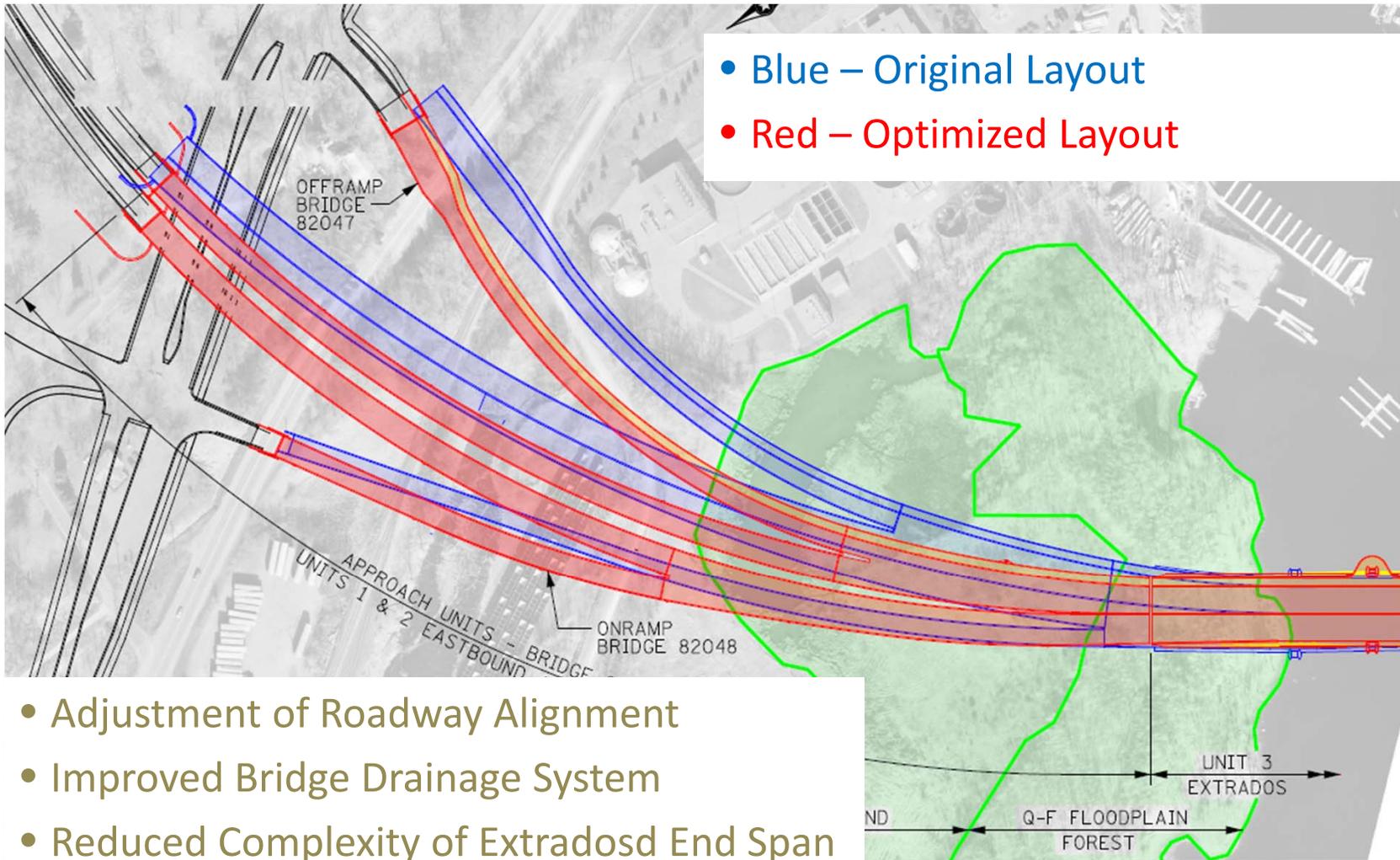


Design Optimization



- Spans increased from 480' to 600'
- Elimination of two extradosed piers
- 5 extradosed piers, all in water
- Conventional pier on WS bluff slope

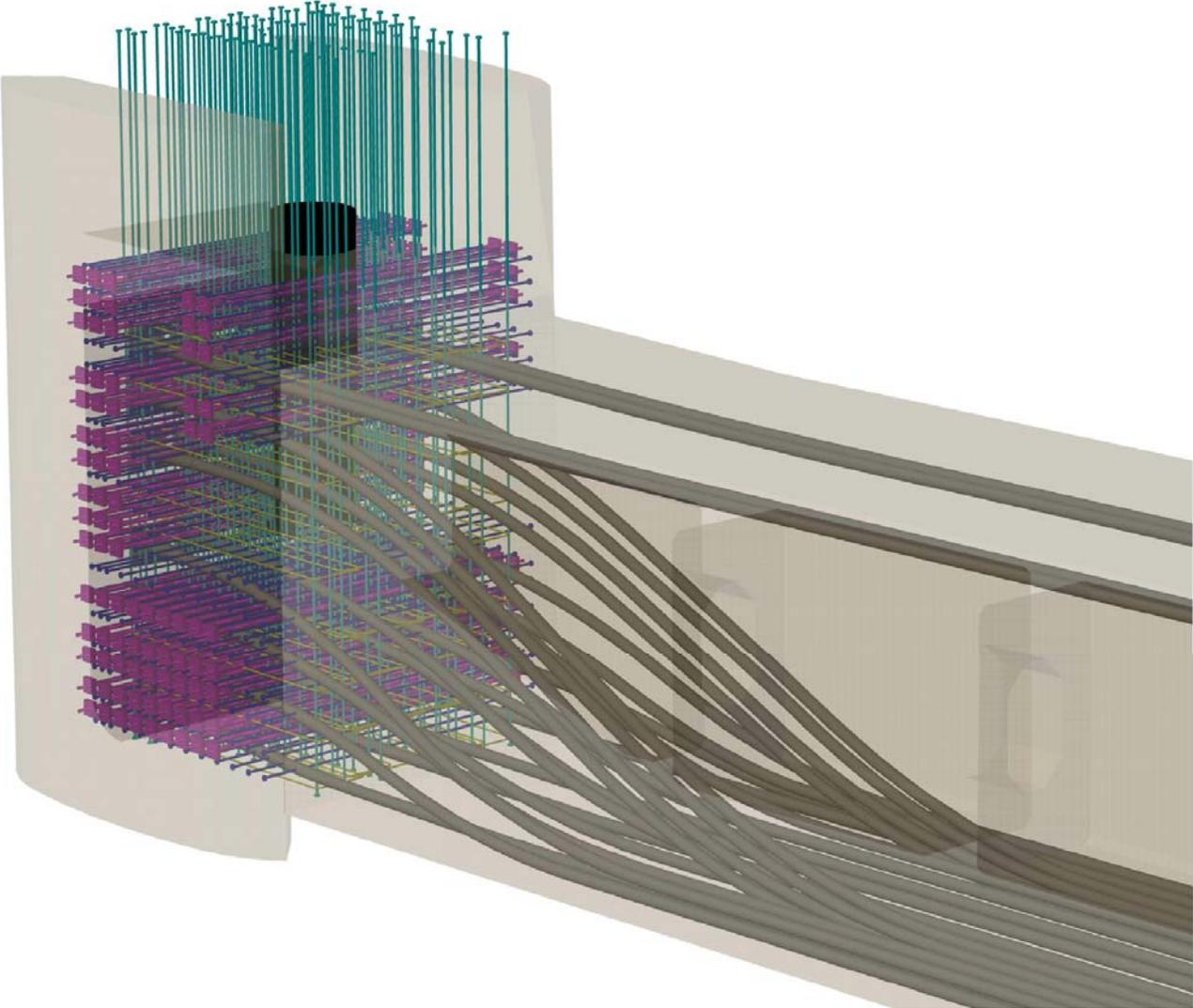
Design Optimization



- Adjustment of Roadway Alignment
- Improved Bridge Drainage System
- Reduced Complexity of Extrados End Span



3D Model - Crossbeam



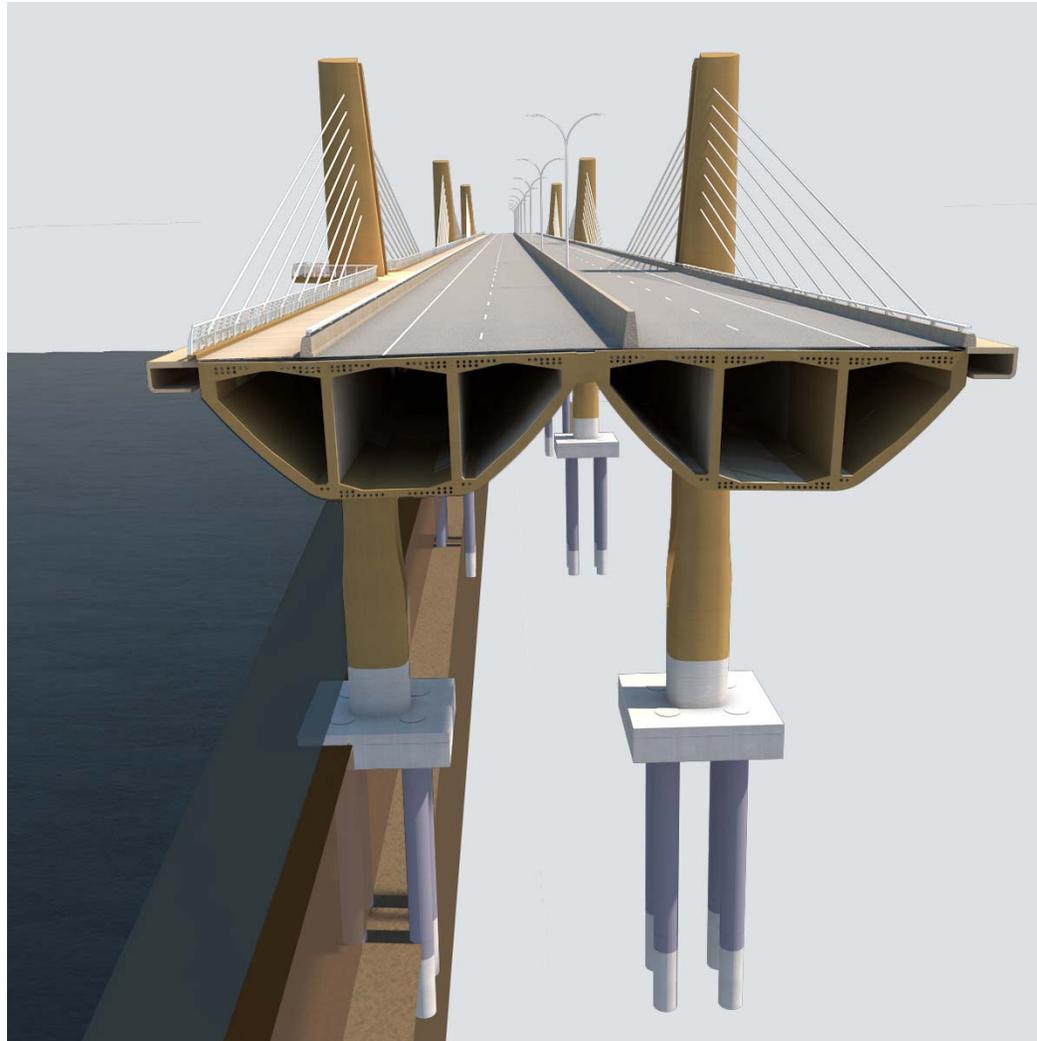


4D Schedule

- Utilized 3D Studio Max Model and Synchro
- Early Foundation
- Full Bridge
- Wisconsin Bluff
- Tower Vignette
- Contractors Schedule Review

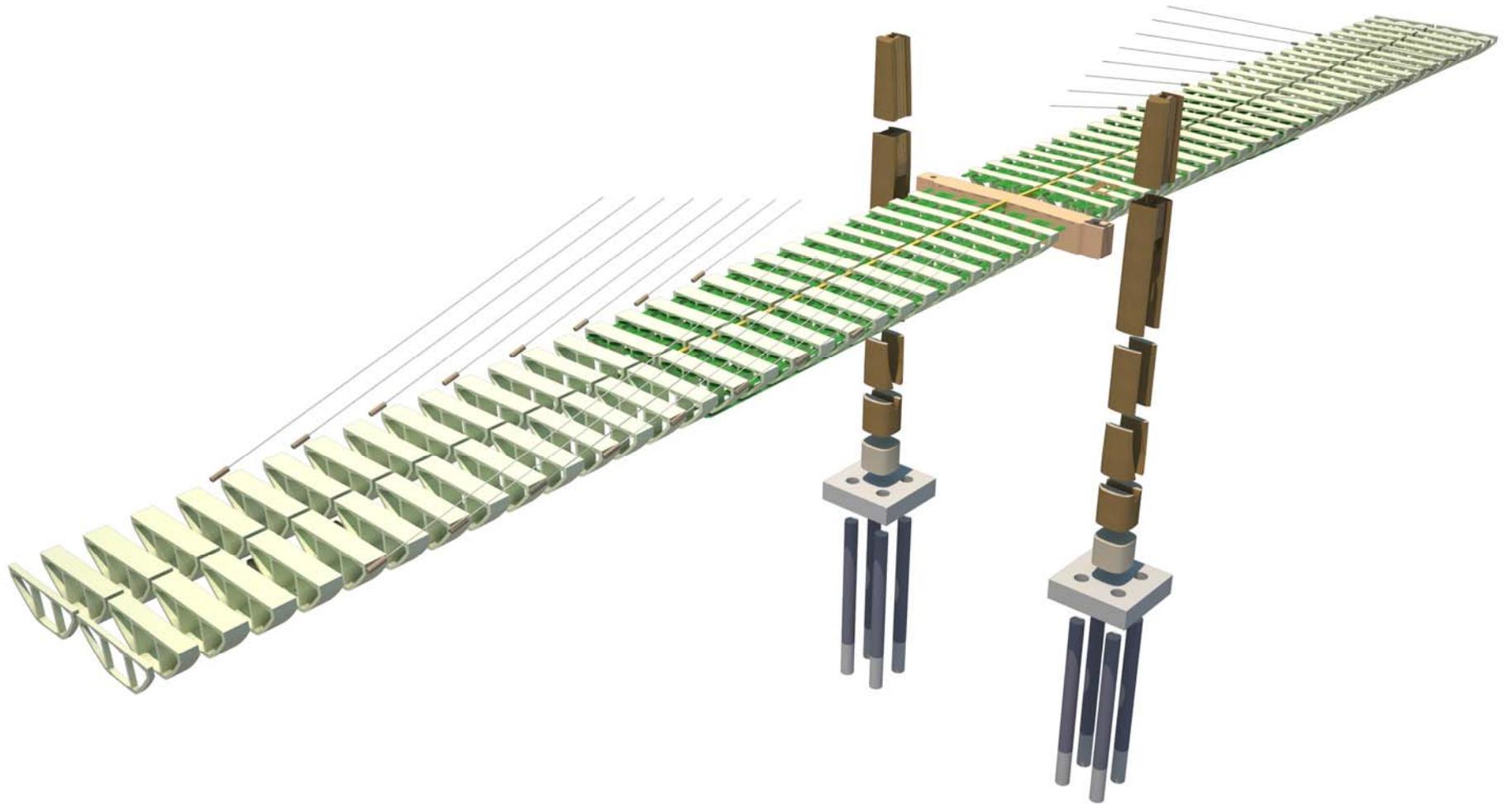


3D Model Development and Usage



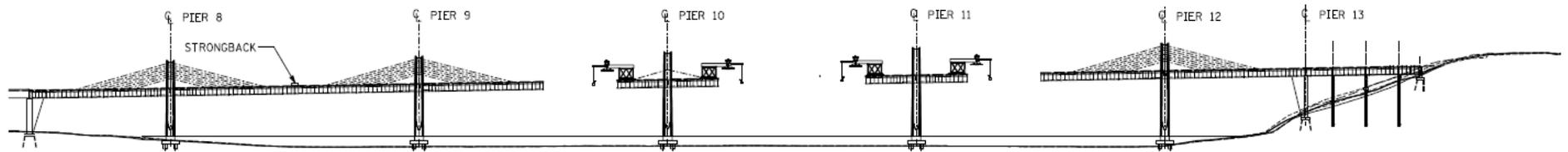
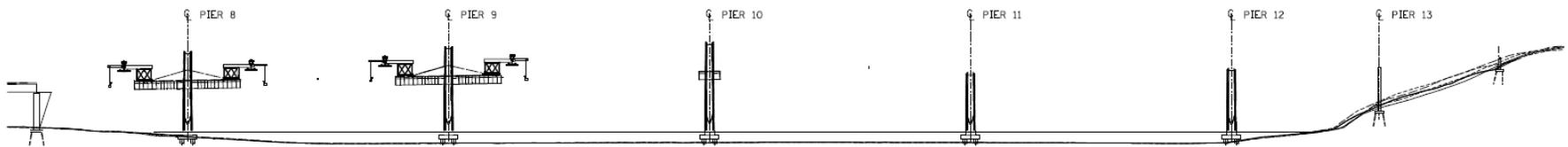


3D Model Development and Usage

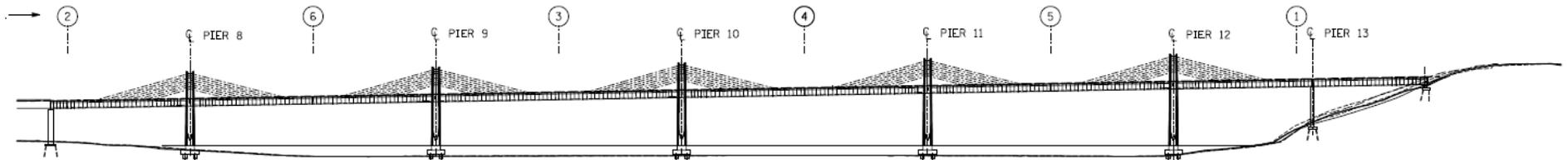




Construction Sequencing



STAGE 5



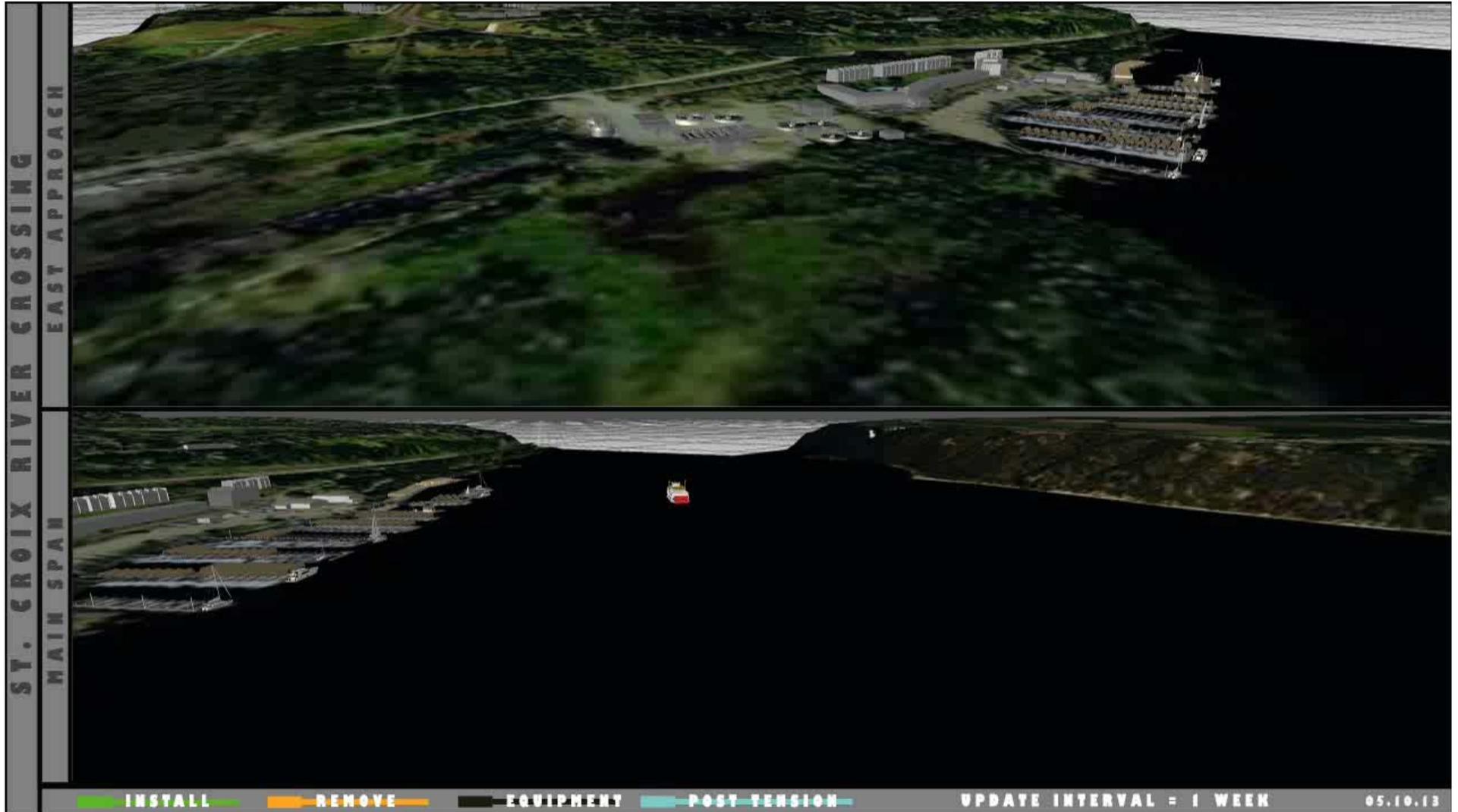


4D Schedule - Early Foundation

ST. CROIX RIVER CROSSING - EARLY FOUNDATION	OVERALL MATERIAL ONLY				PIER 12
OVERALL EQUIPMENT	OVERALL MATERIAL ONLY				PIER 11
					PIER 10
					PIER 9
					PIER 8

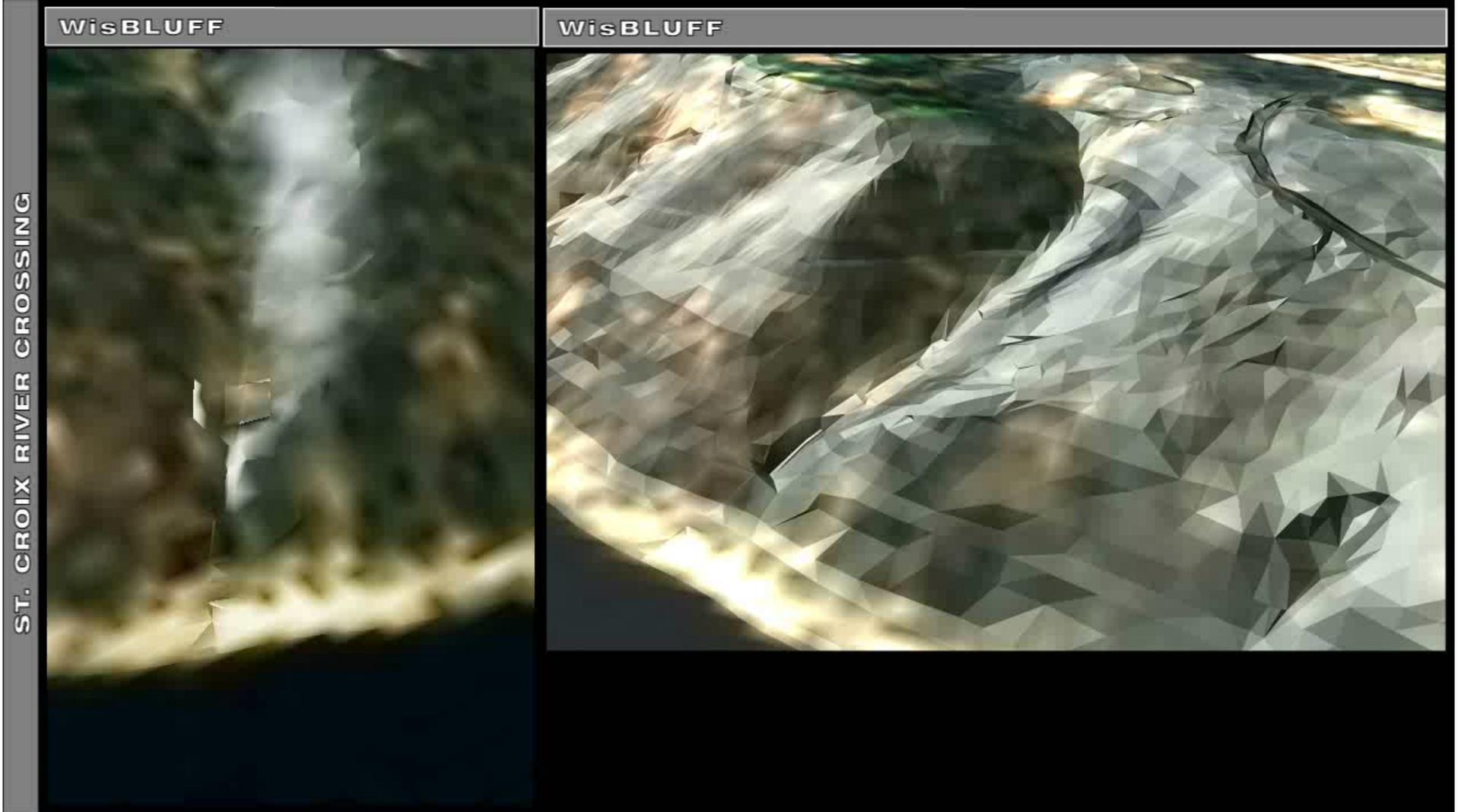


4D Schedule - Full Bridge



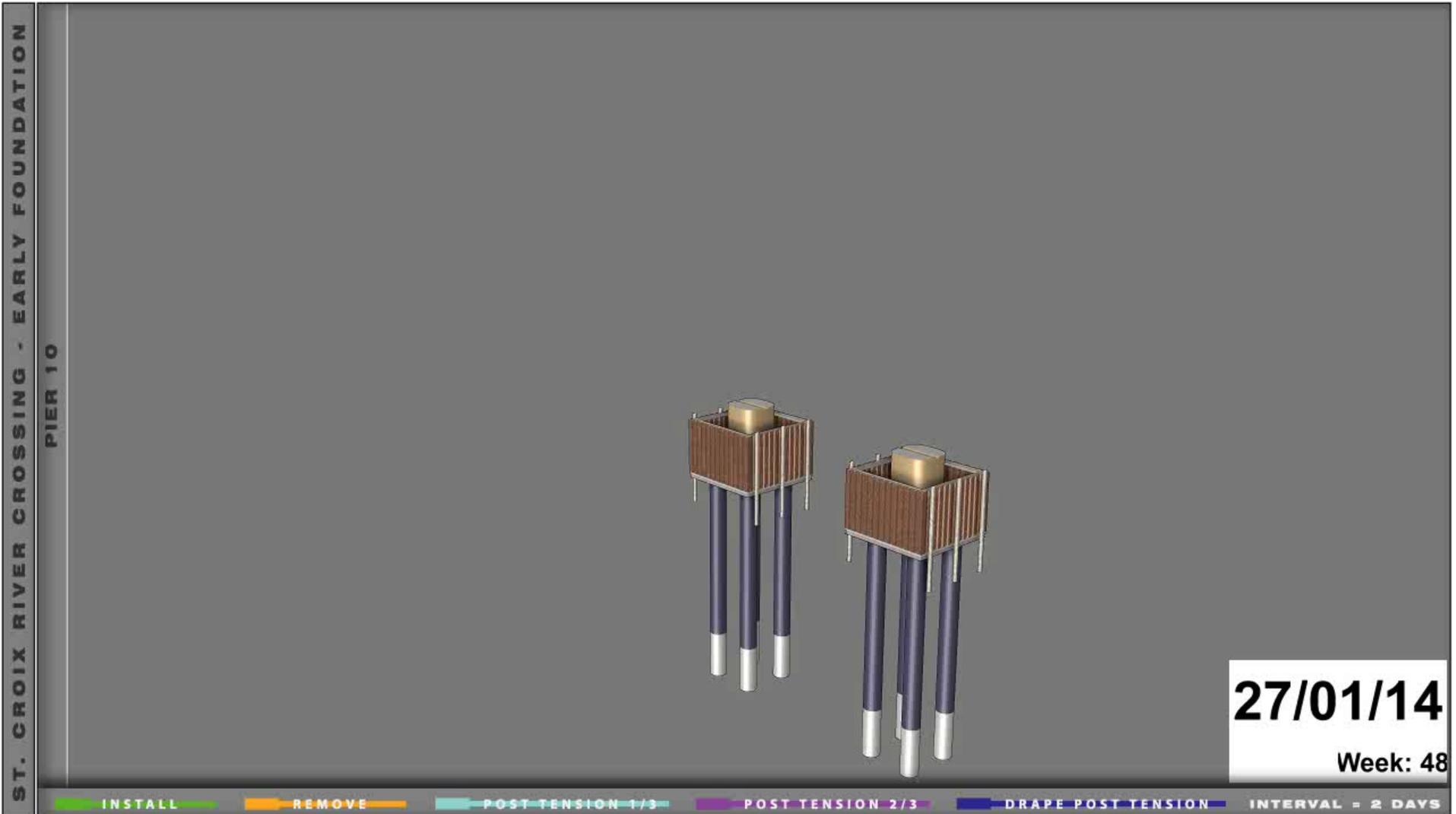


4D Schedule - Wisconsin Bluff





4D Schedule - Tower Vignette



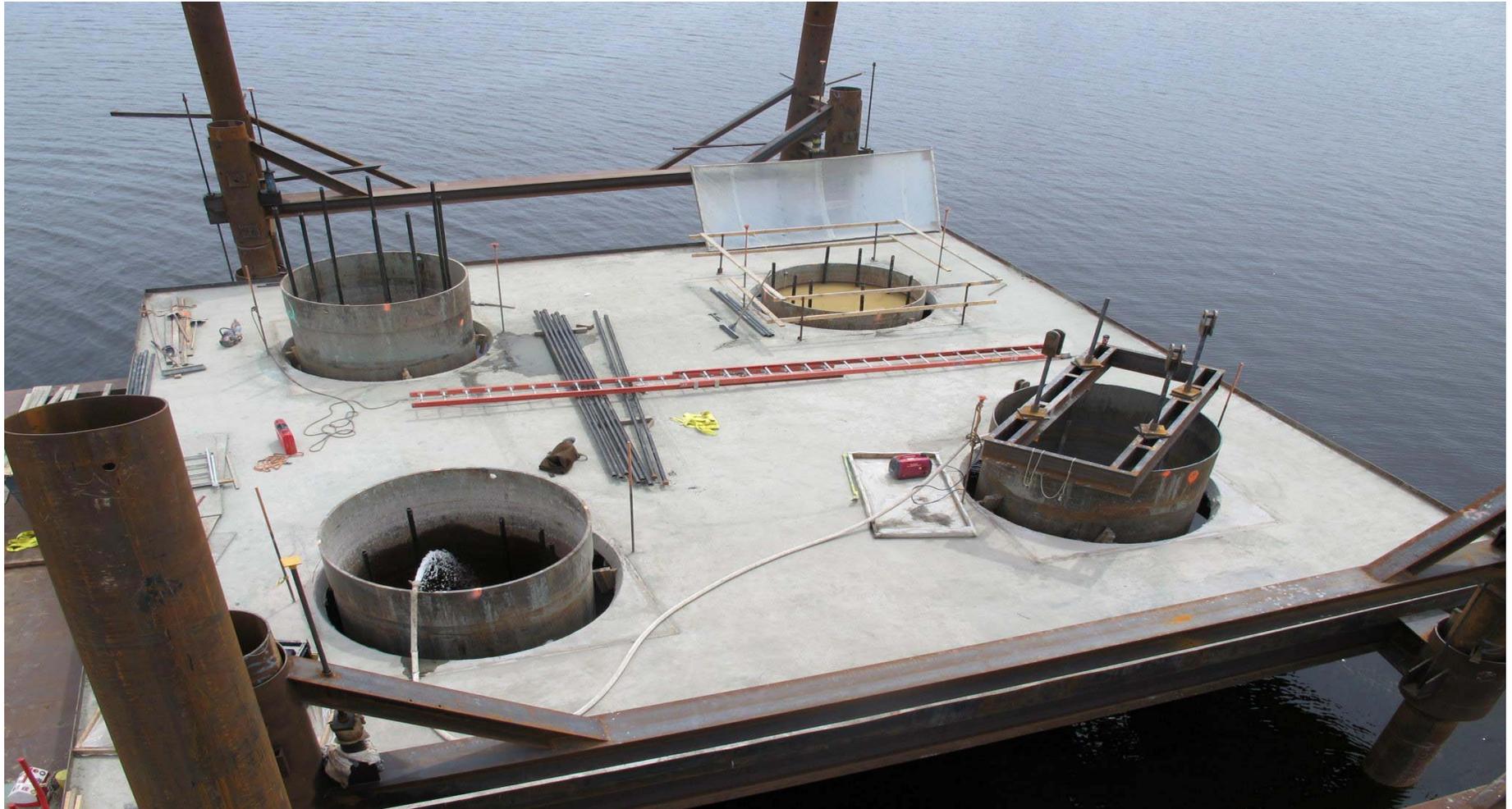


4D Schedule - Contractors Schedule





Early Foundations





Early Foundations





St. Croix
CROSSING

Current Construction





St. Croix
CROSSING

Current Construction





St. Croix
CROSSING

Current Construction





Current Construction





Current Construction





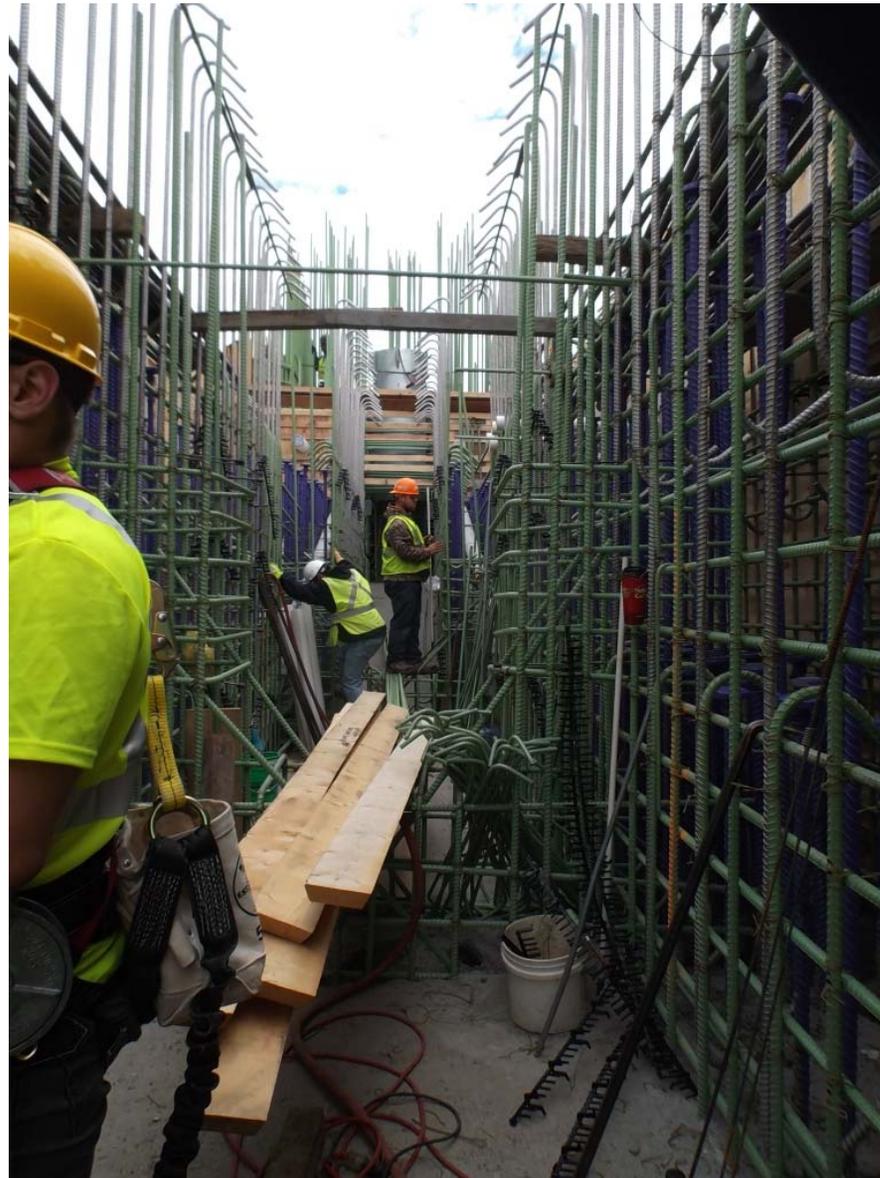
St. Croix
CROSSING

Current Construction





Current Construction





St. Croix
CROSSING

Current Construction





Current Construction





St. Croix
CROSSING

Current Construction





Current Construction





Current Construction





Segment Dimensions

Approach Segments

- Width of 45' / Depth 10' to 14'
- 338 Segments – weight 90 to 120 tons

River Span Segments

- Width of 50' /Depth 18'
- 656 Segments – weight 140 to 180 tons





St. Croix
CROSSING

Questions?





Project Background - History

The extradosed form would:

- Maximize spans without overpowering the natural setting of the lower St. Croix with tall towers
- Minimize the footprint in the river, the MN wetlands, and on the WS bluff





Visual Quality

Signature Bridge

Community Involvement – Visual Quality Advisory Committee

- Visual Quality Manual (2007)
- Visual Quality Manual Addendum (2011)
- VQAC Meetings During Design Phase (2012)

Design Phase Visual Refinements

- Maintain Architectural Intent



Visual Quality

- An "organic" theme was identified
- Parts intended to look as if they were "found in nature", or "shaped by natural forces"
- Vertical pier forms are "reed-like"
- Girders rounded and tapered "like bones or tree branches"
- Transitions are gradual and smooth
- These commitments set the aesthetic direction
- All design issues were vetted to ensure that the design stayed true to the final EIS and mitigation commitments



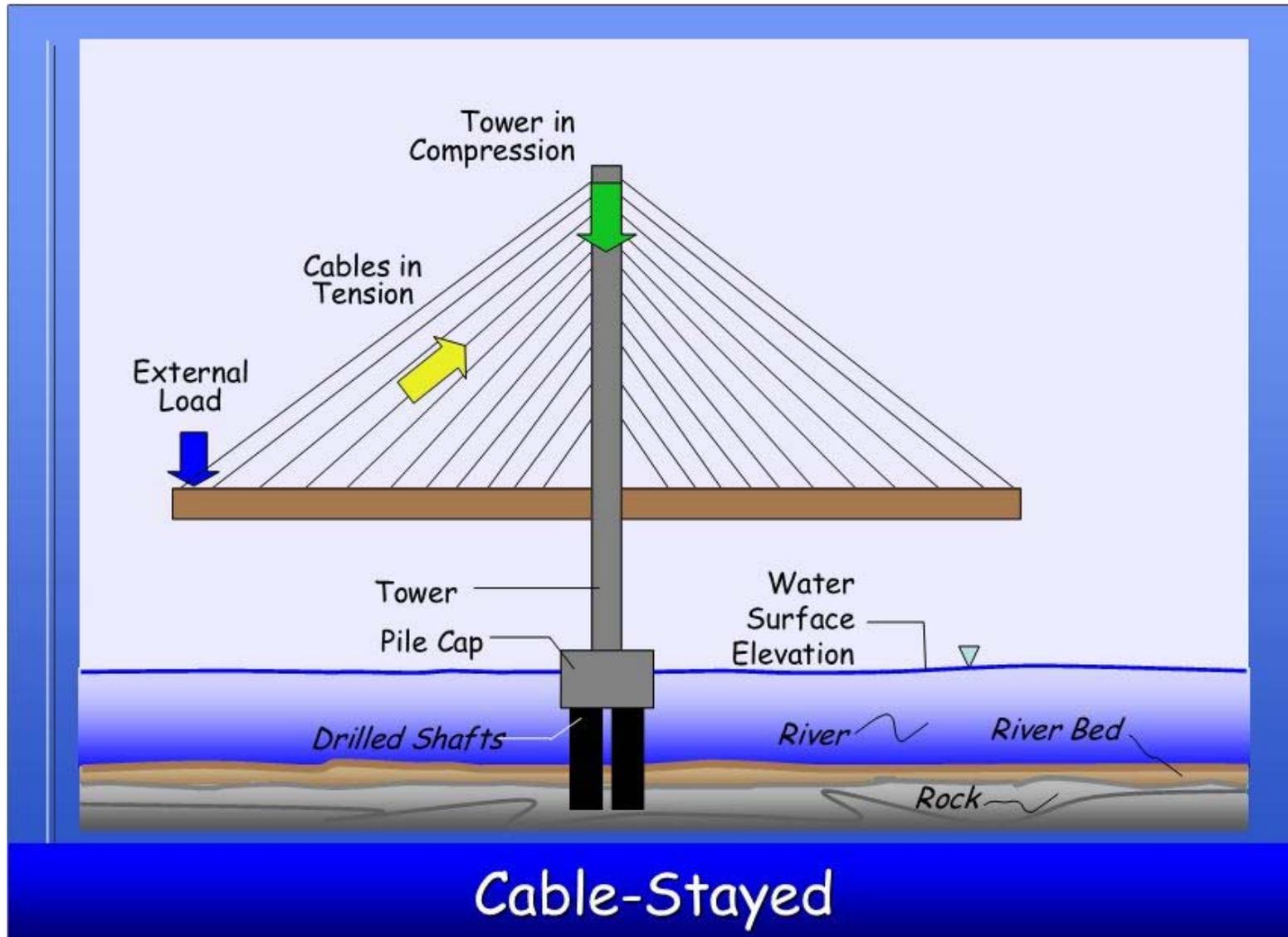
Cable Stay Bridge





St. Croix
CROSSING

Cable Stay Bridge





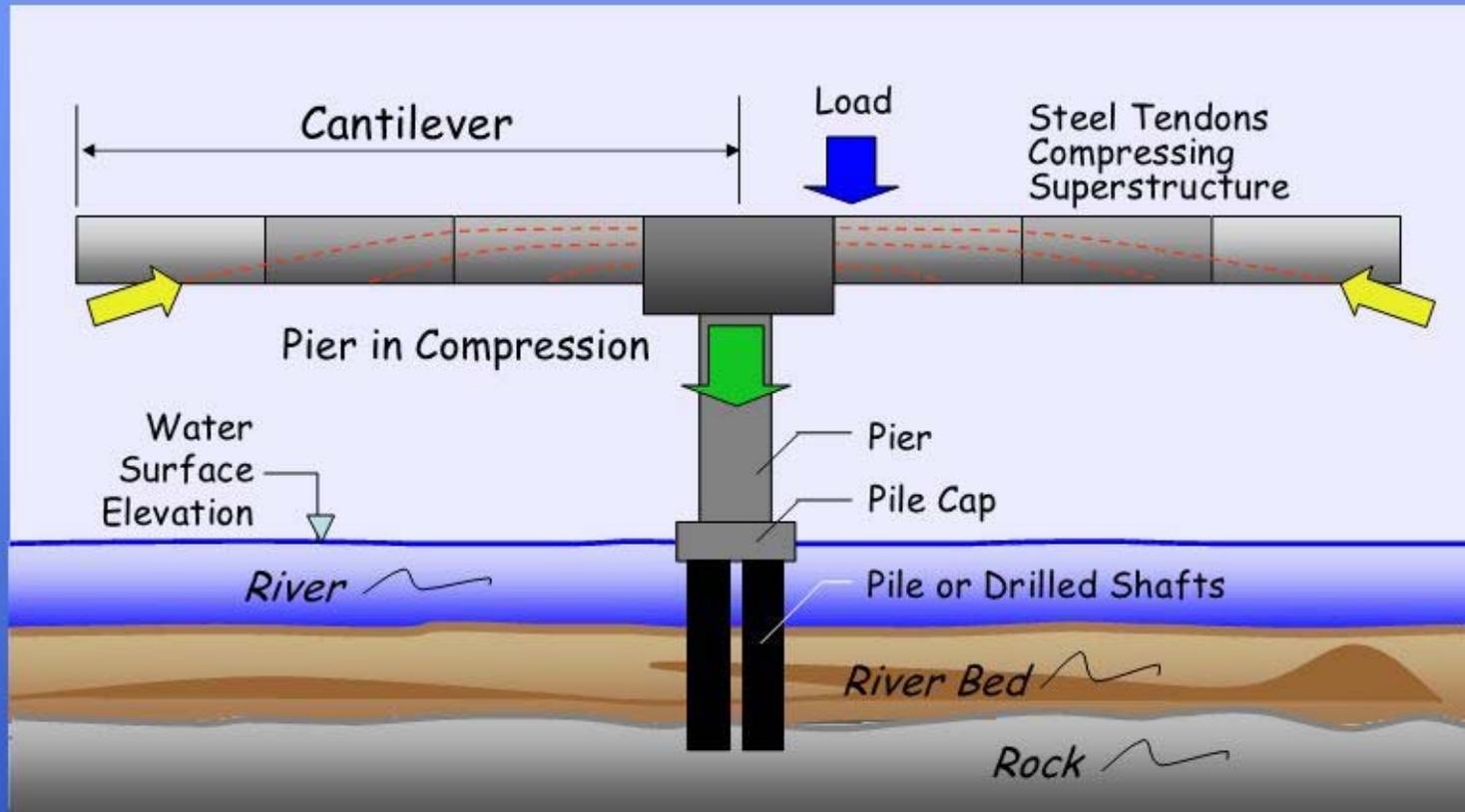
Segmental Box Bridge





St. Croix
CROSSING

Segmental Box Bridge



Segmental Concrete Box Girder



Extradosed Bridges

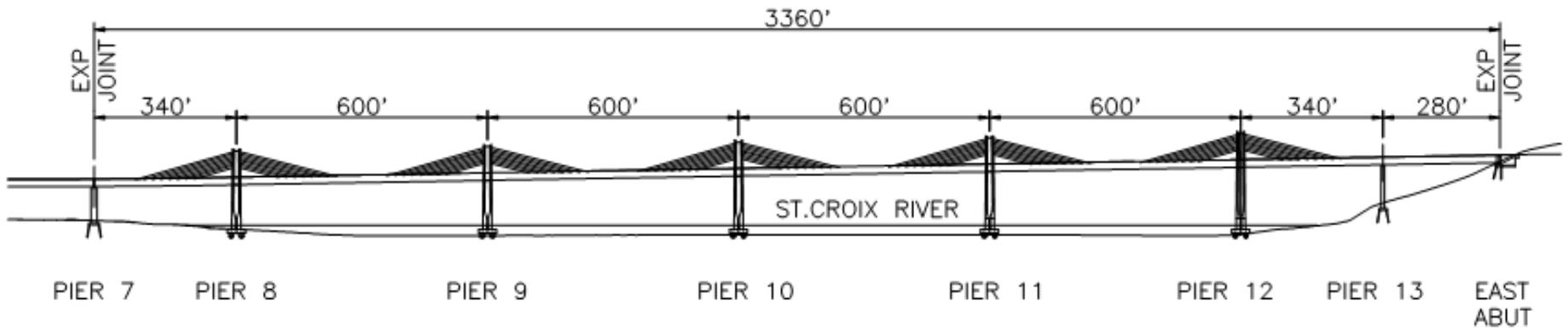


North Arm Bridge – Vancouver, BC
590' (180m) main span - 2008

First in North America



Design Optimization



- Goal was a single structural unit
- Avoid in span joints
- Avoid sliding the deck at end extradosed piers
- Twin leg piers for flexibility
- Serviceability for time dependence and thermal effects