Boeing North Bridge in Washington State

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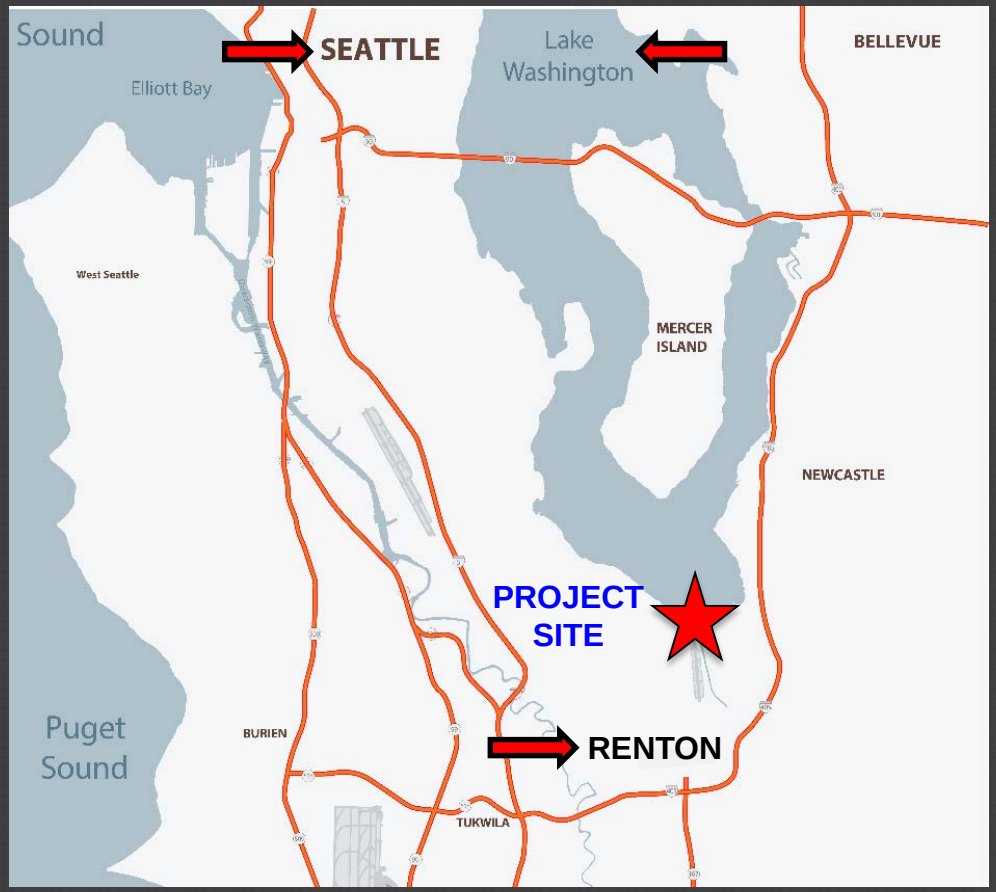
Western Bridge Engineers Seminar
September 2015

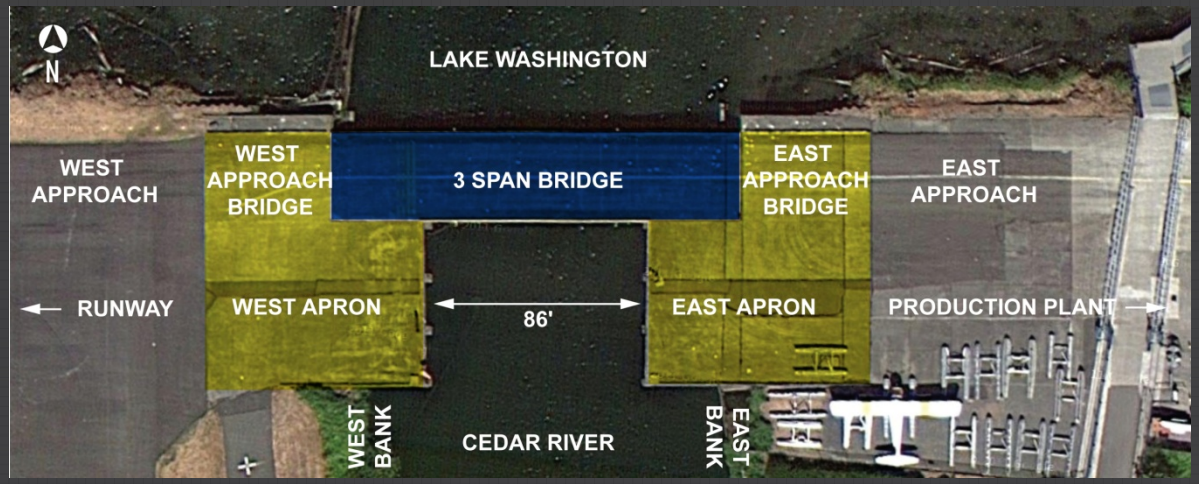
Project Overview - Location

- Located in Renton, WA



Project Overview – Site Layout

Project Overview – Existing Bridge Condition



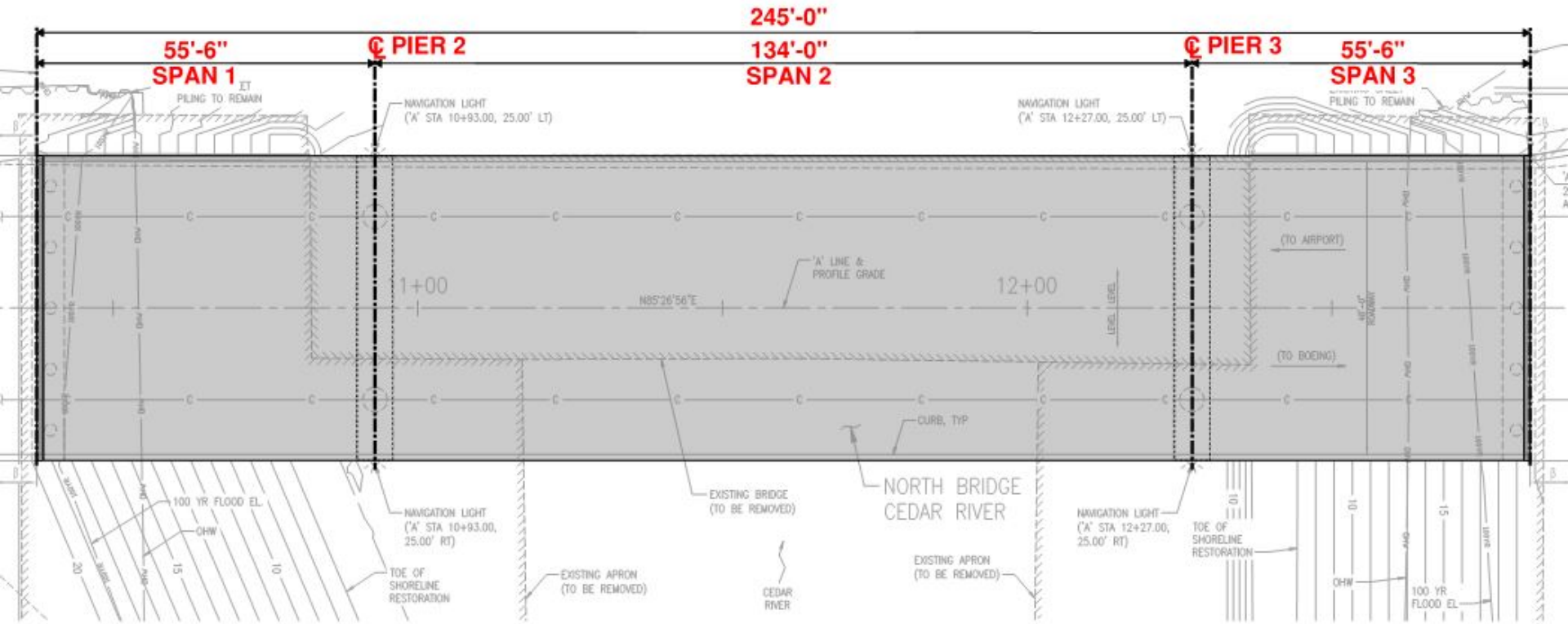
1940 Construction

1969 Construction

- *Bridge Seismically Deficient*
- *Bridge is on critical path for production*
- *Damage or loss poses economic risk*

Project Overview – Replacement Bridge General

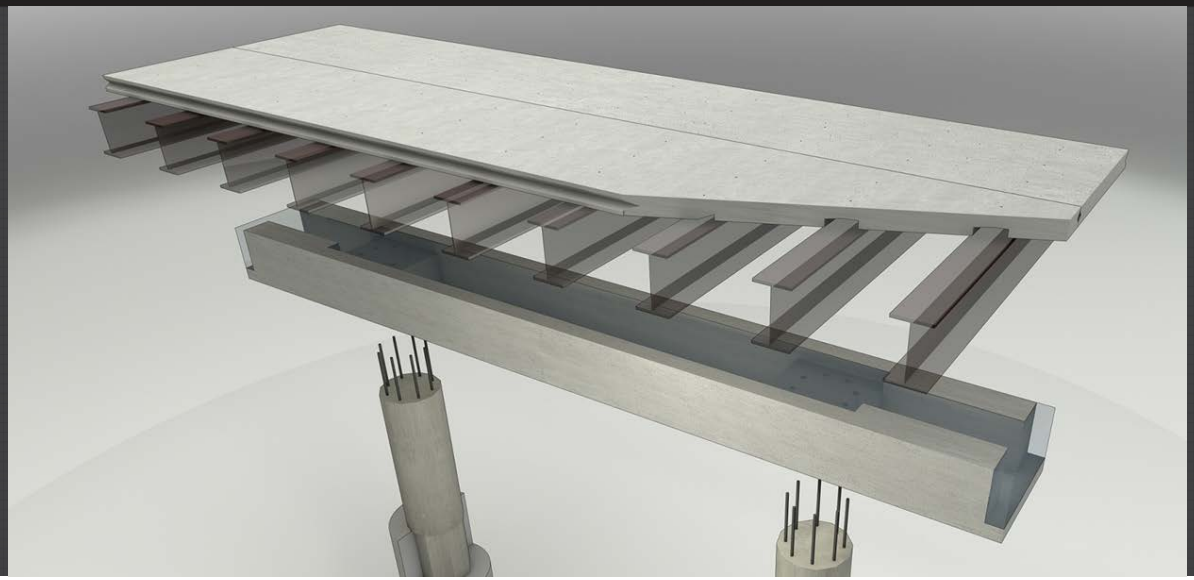
- 3-Span Continuous (245-feet total length)
  - Main Span: 134’-0” | End Spans: 55’-6”

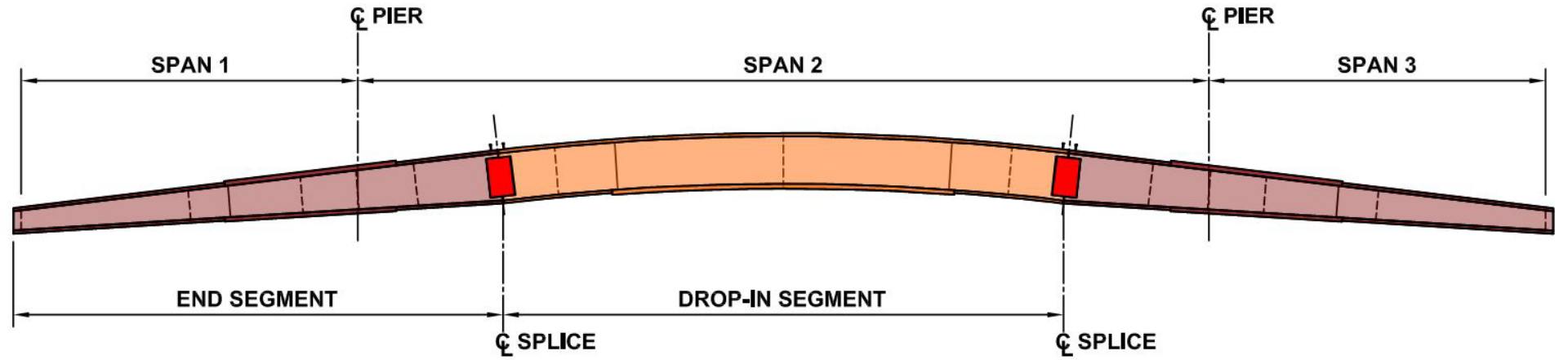


Project Overview – Replacement Bridge General

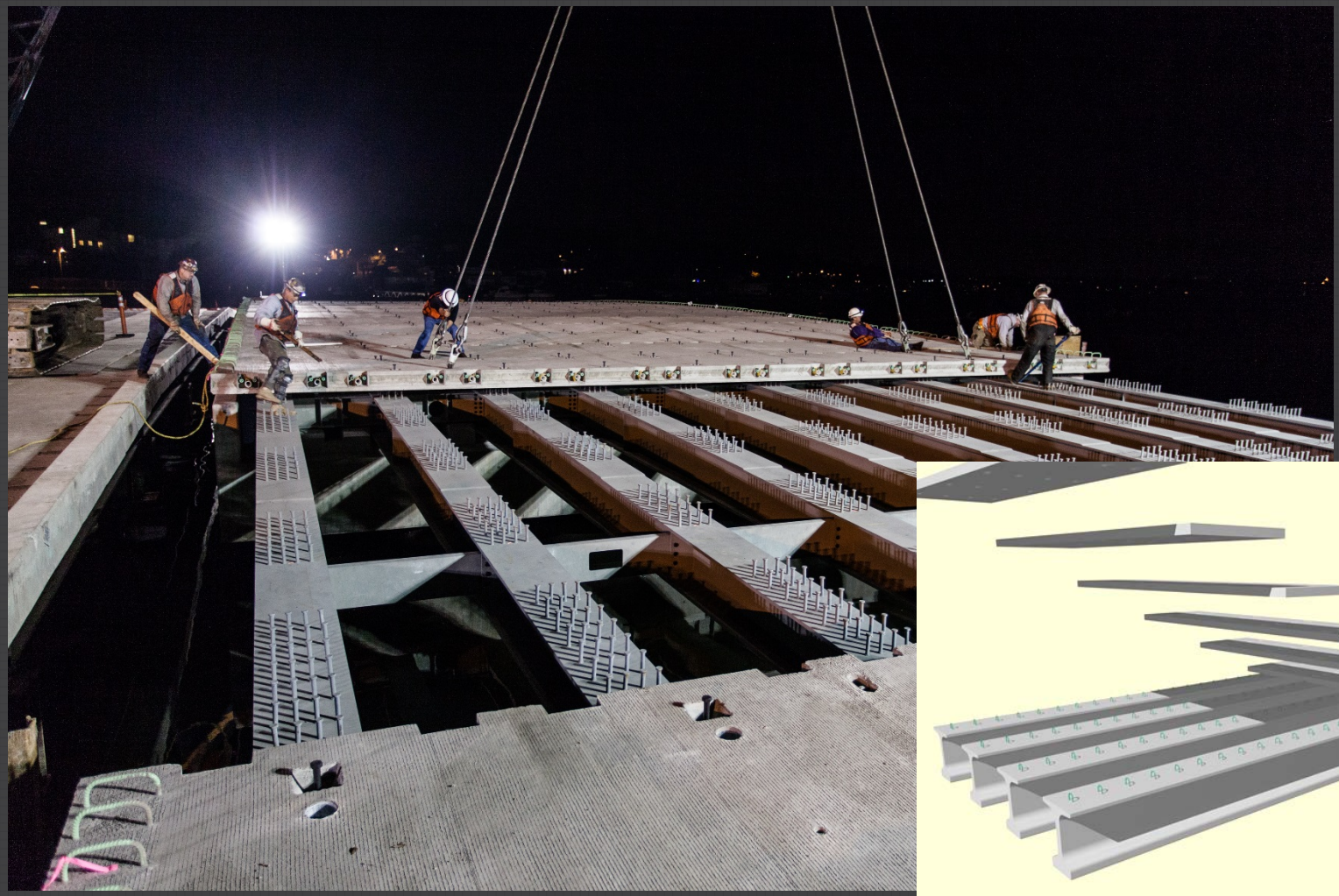
- Prefabricated Bridge Elements
  - Steel Plate Girders
  - Full depth precast deck panels
  - Columns and Crossbeams

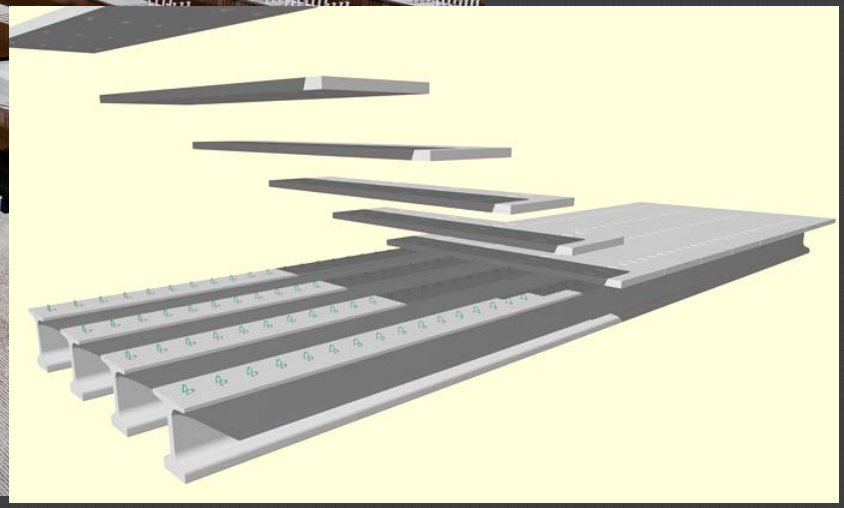
Project Overview – Replacement Bridge Steel Plate Girders



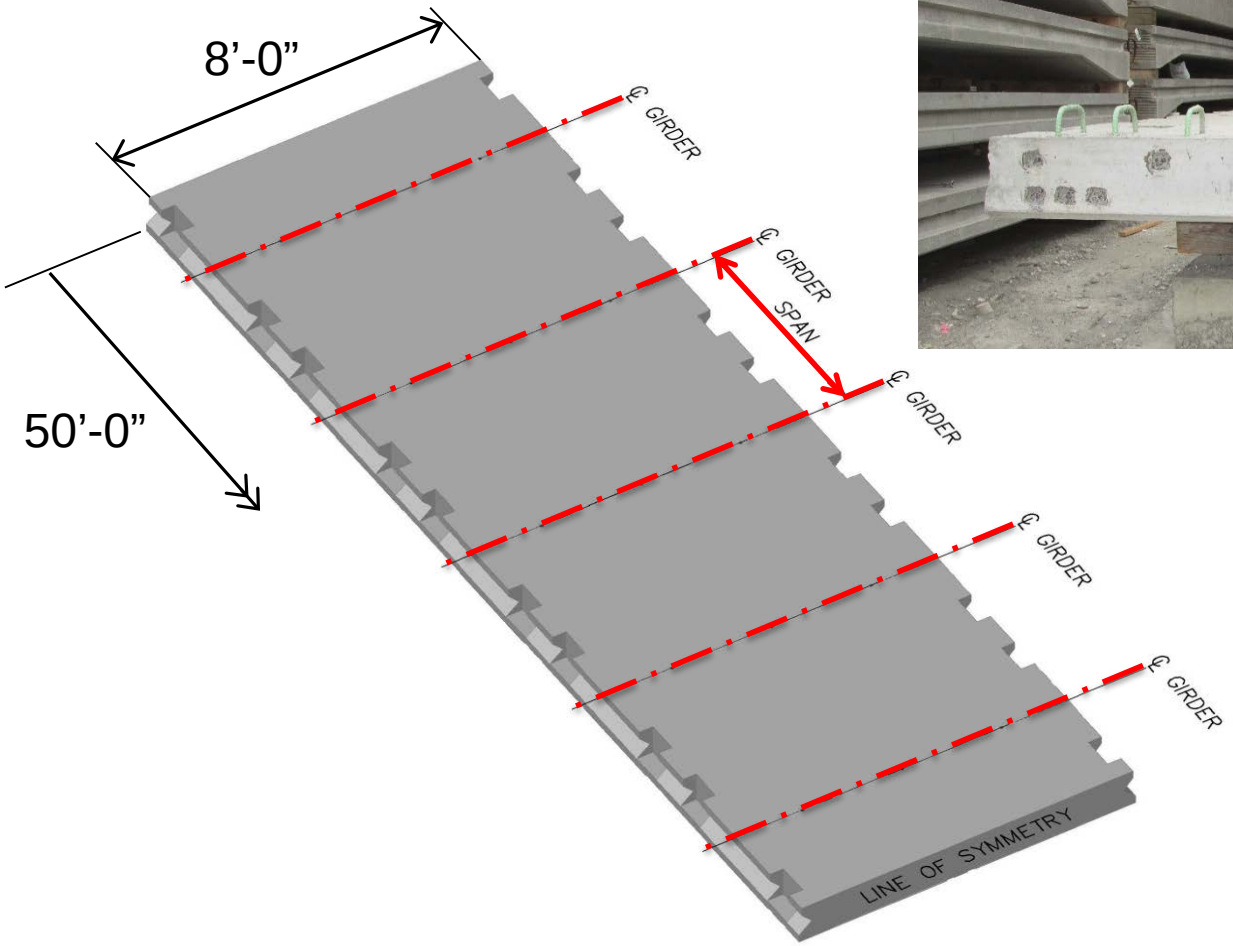


Project Overview – Replacement Bridge
Full Depth Precast Deck Panels

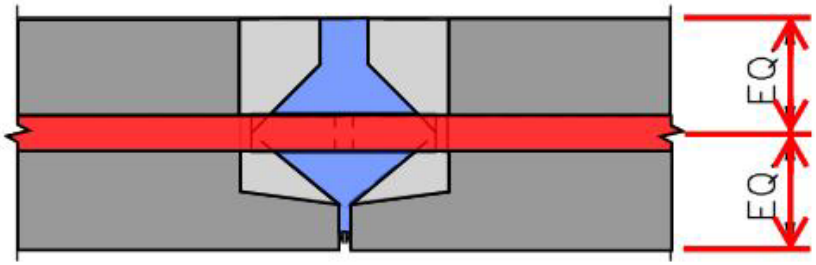


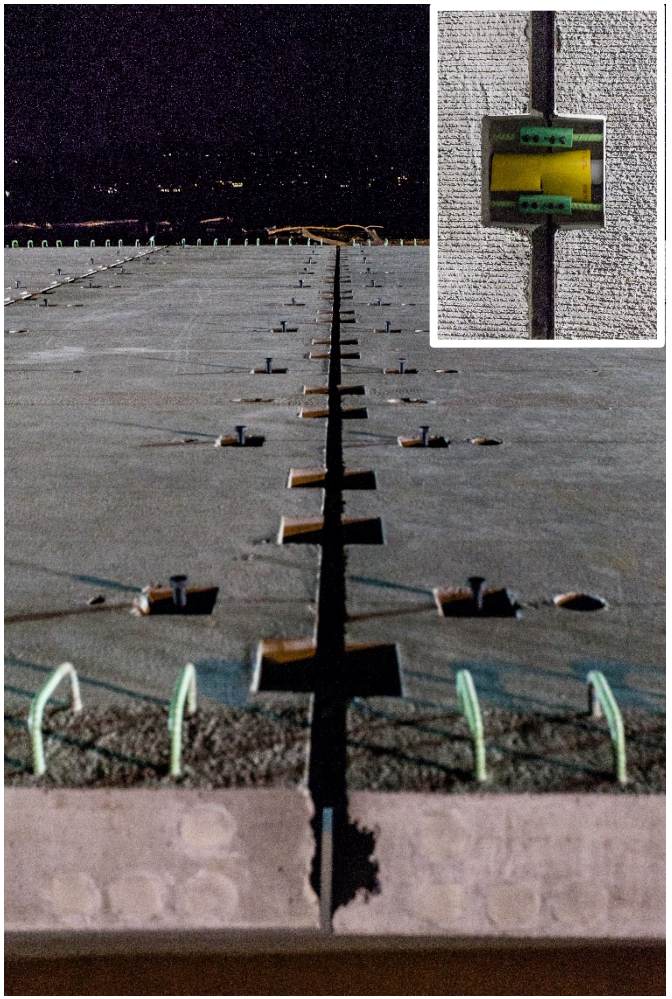


Project Overview – Replacement Bridge
Full Depth Precast Deck Panels

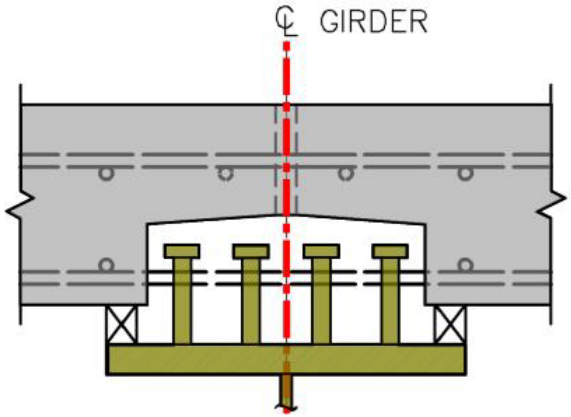


Project Overview – Replacement Bridge
Full Depth Precast Deck Panels





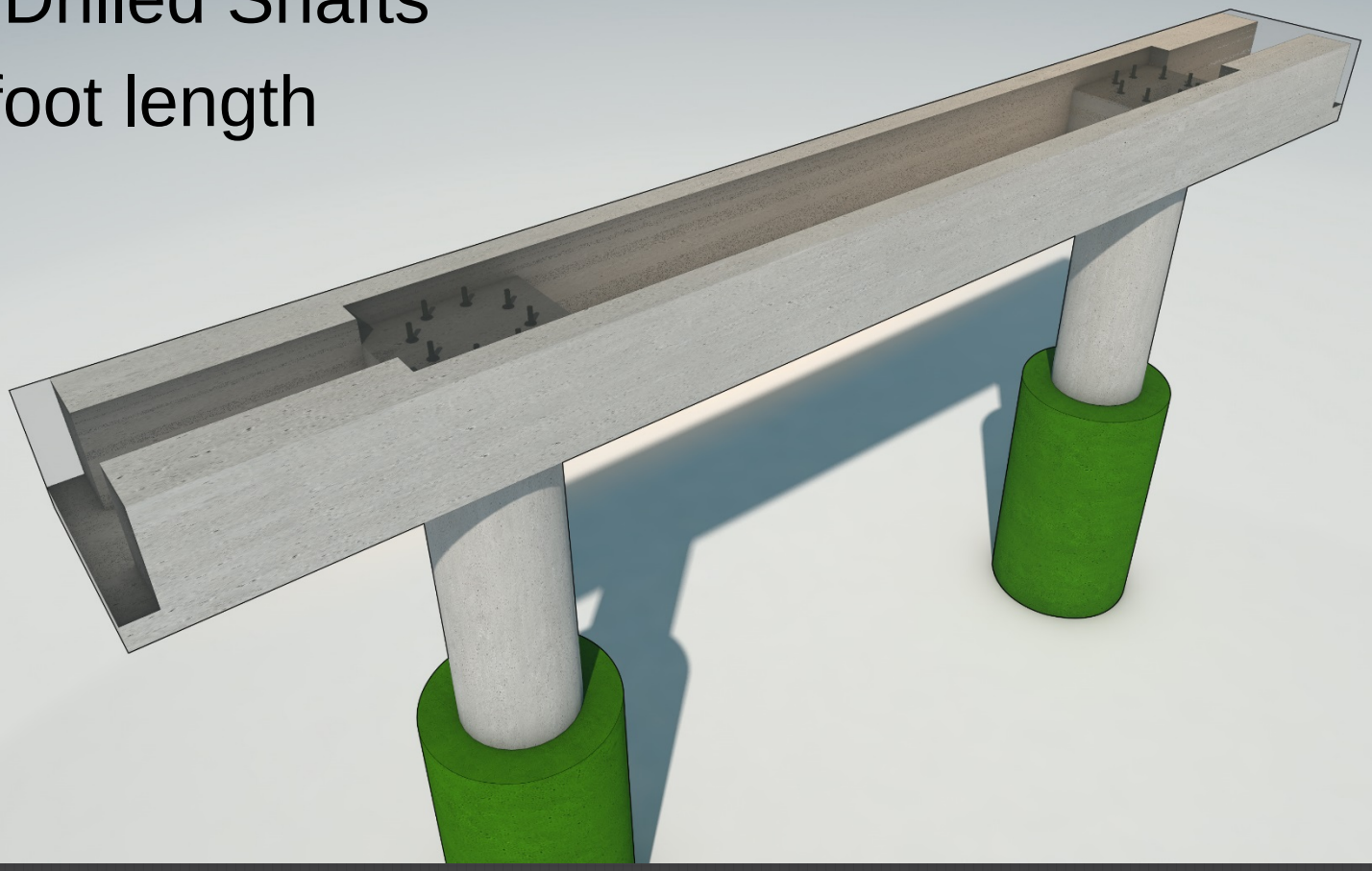
Project Overview – Replacement Bridge
Full Depth Precast Deck Panels



Project Overview – Replacement Bridge Columns and Crossbeams

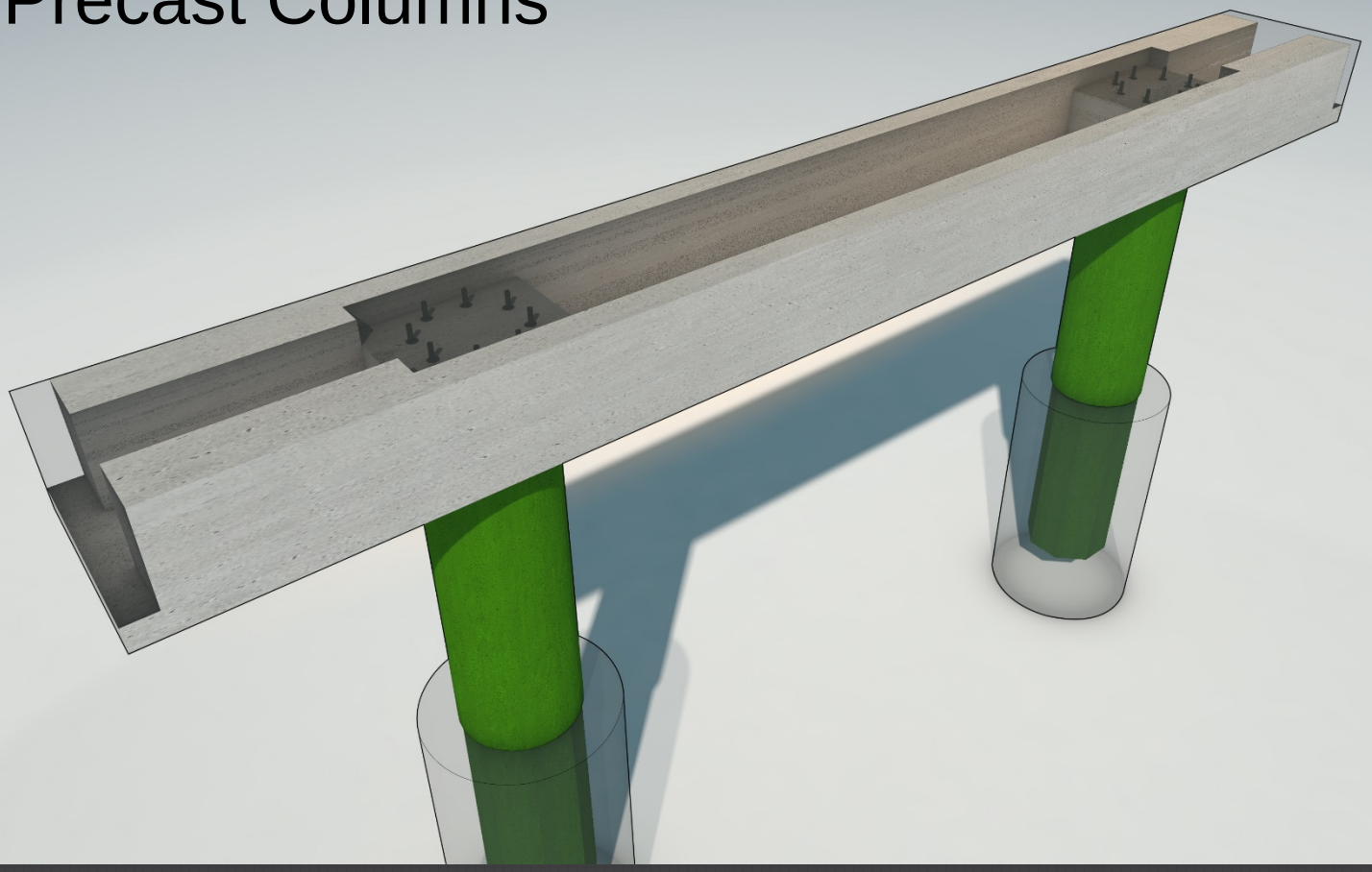
6’-6” Drilled Shafts

150-foot length



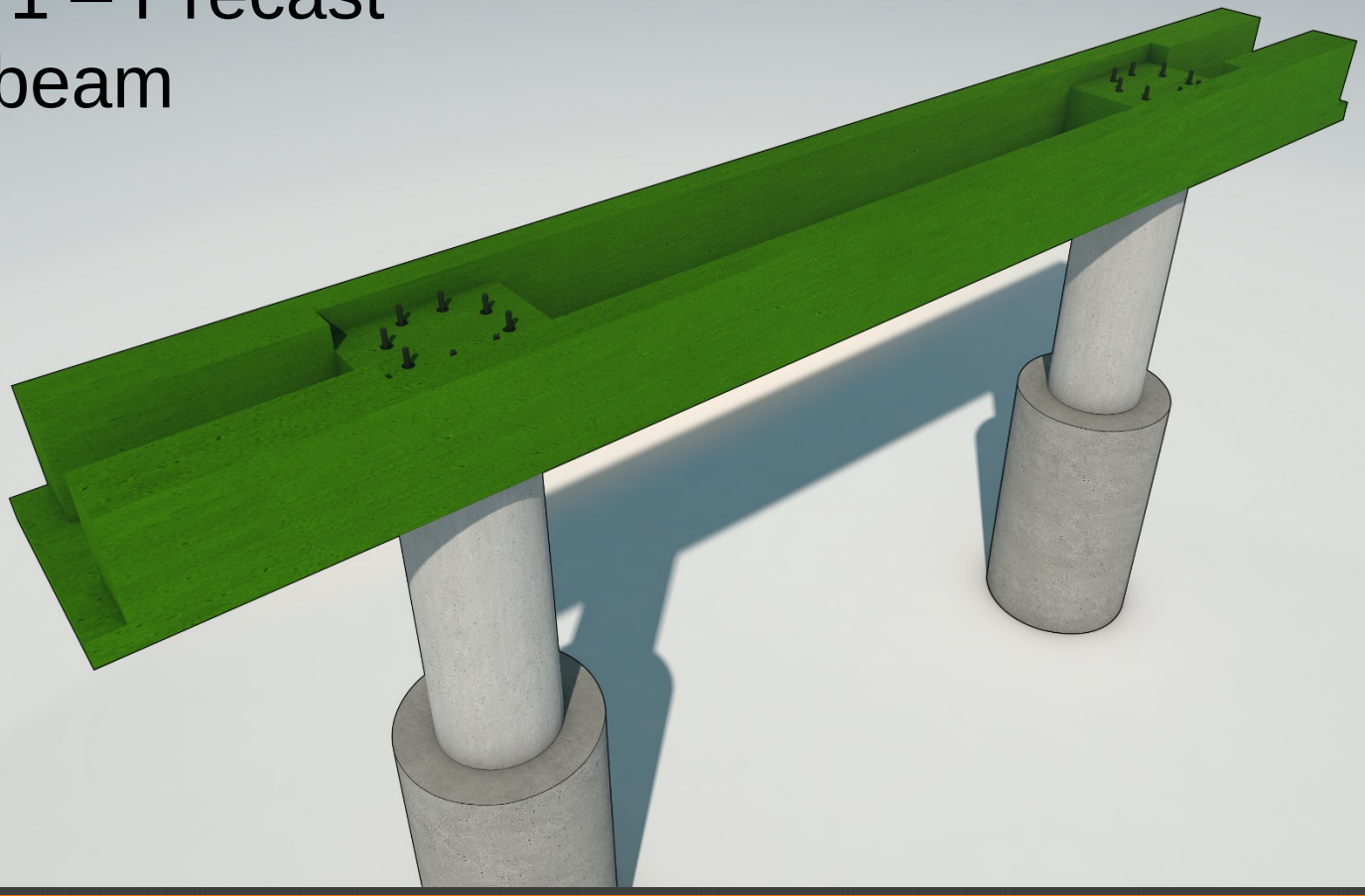
Project Overview – Replacement Bridge Columns and Crossbeams

4’-0” Precast Columns



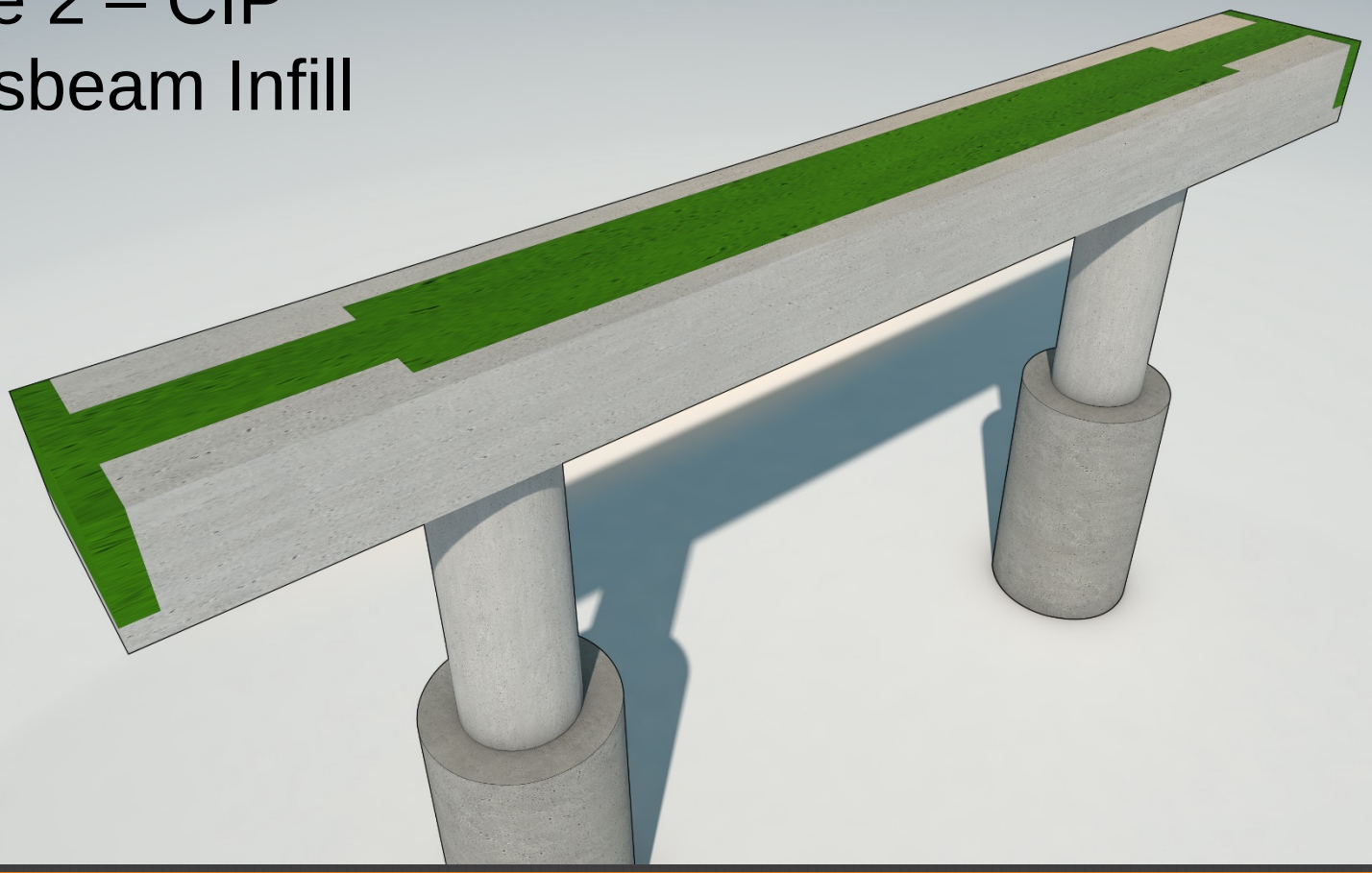
Project Overview – Replacement Bridge Columns and Crossbeams

Stage 1 – Precast Crossbeam



Project Overview – Replacement Bridge Columns and Crossbeams

Stage 2 – CIP
Crossbeam Infill



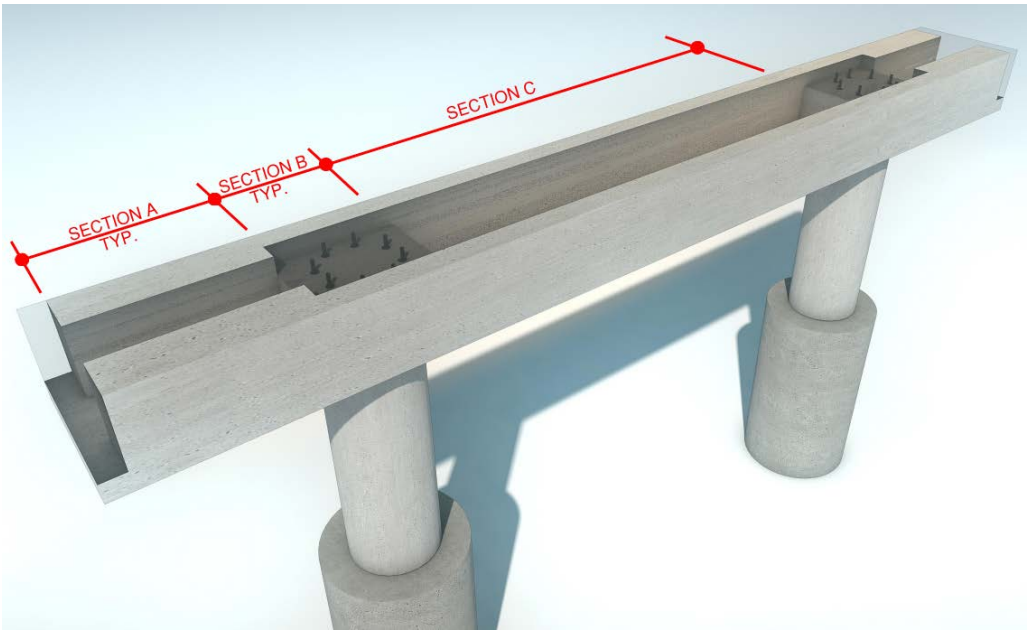
Project Overview – Replacement Bridge Columns and Crossbeams

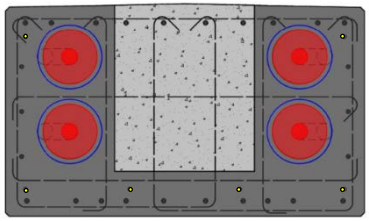
-Straight

Pre-tensioning

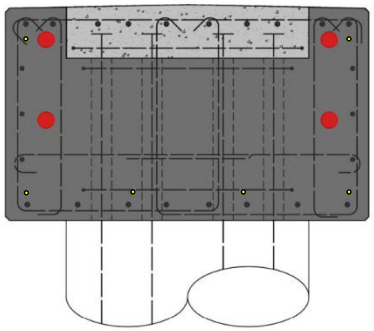
-Draped

Post-tensioning

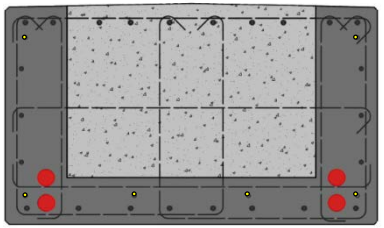




SECTION A

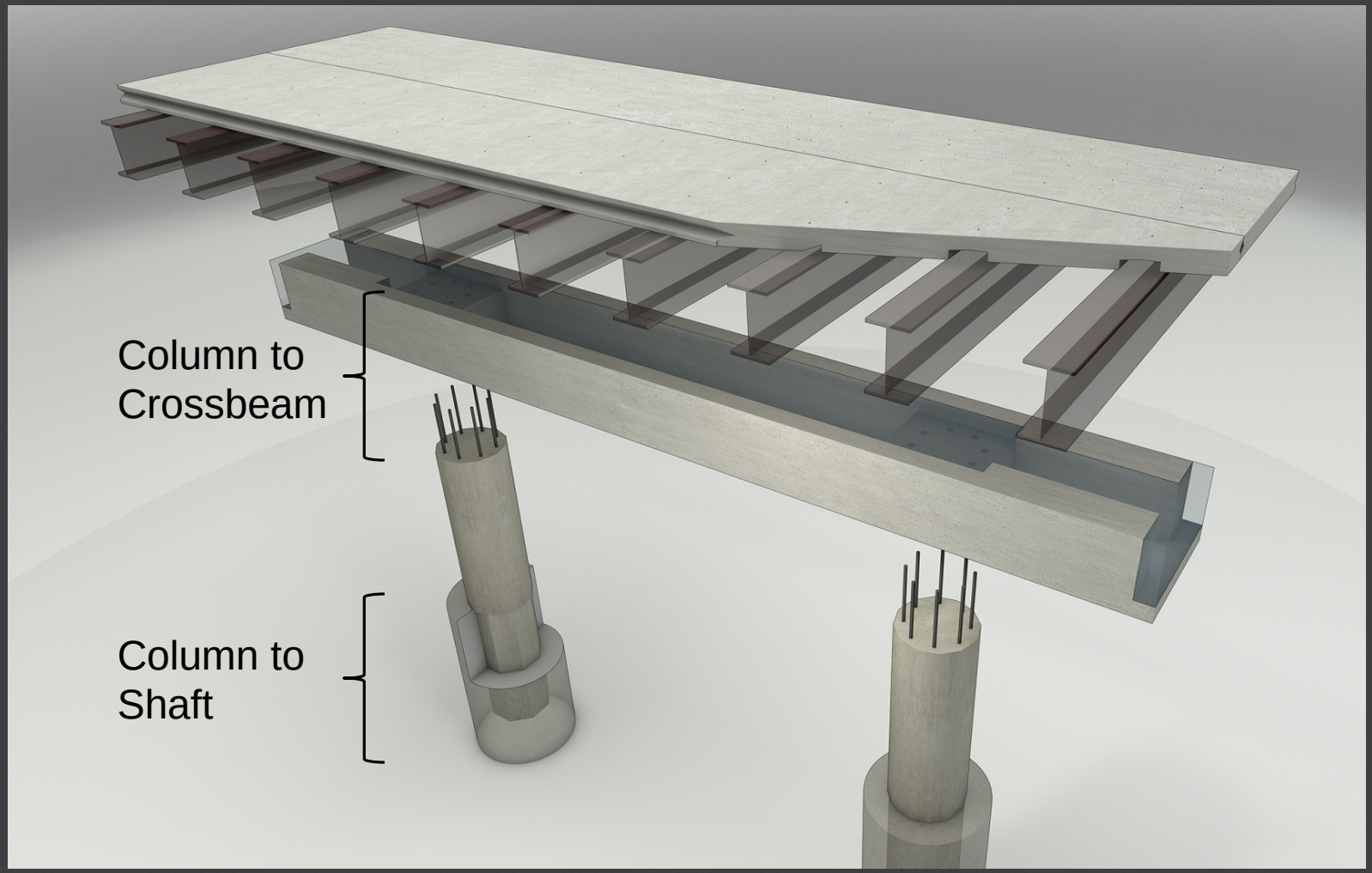


SECTION B

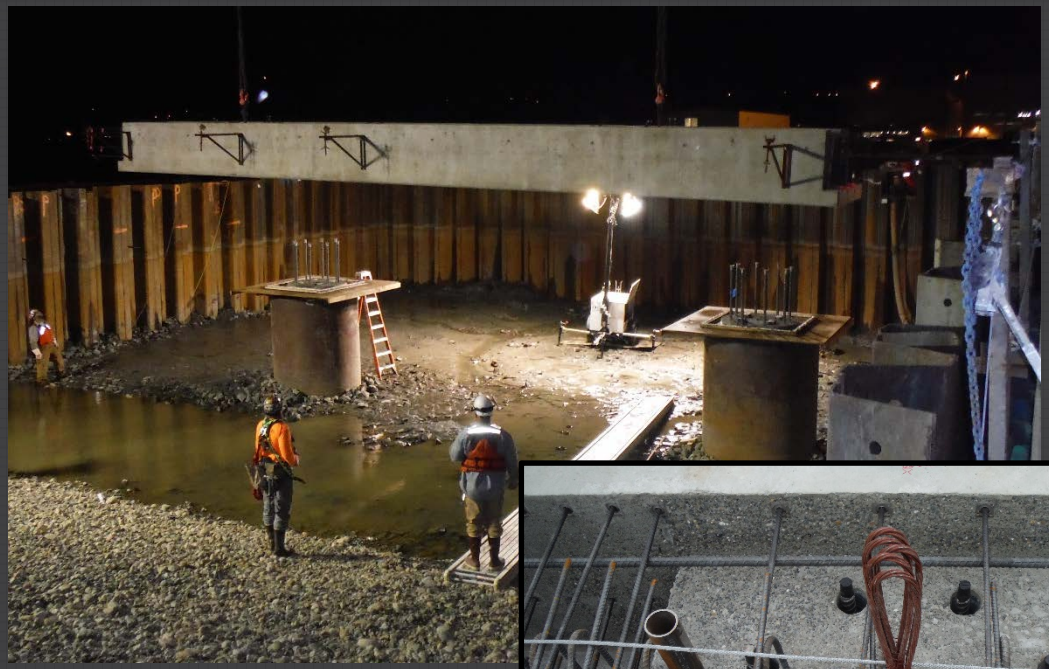


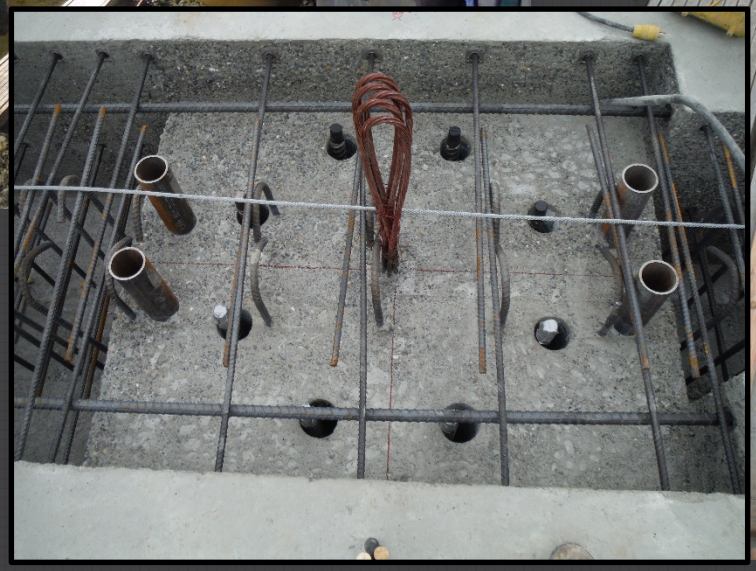
SECTION C

Project Overview – Replacement Bridge
Seismic Resisting Connections

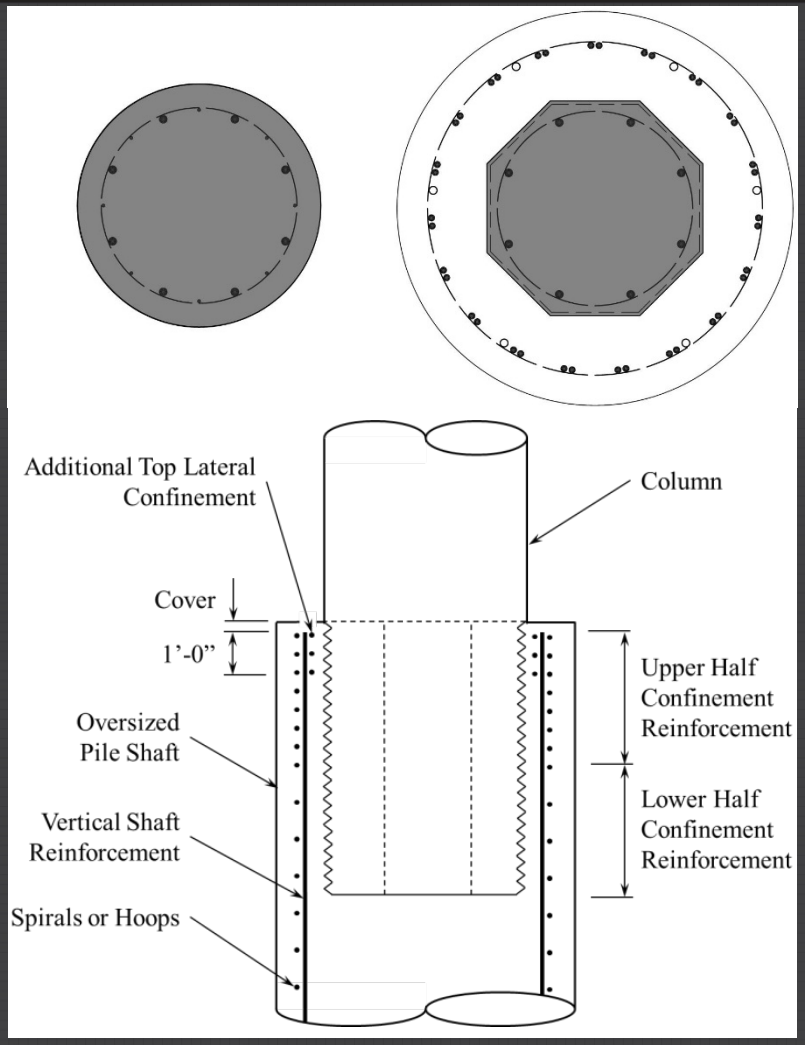


Project Overview – Replacement Bridge Seismic Resisting Connections





Project Overview – Replacement Bridge Seismic Resisting Connections

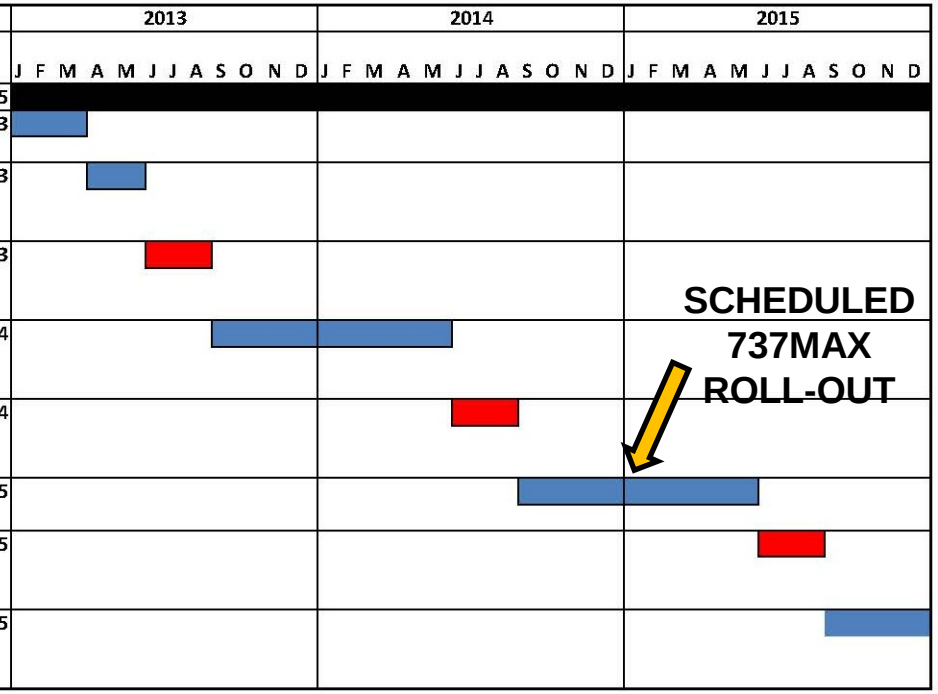


Why ABC?

- Schedule Savings
- Bridge on critical path for 737MAX rollout
- Prefabricated elements
  - Added float to the construction schedule
  - Environmental benefits with reduced CIP concrete over salmon bearing waters

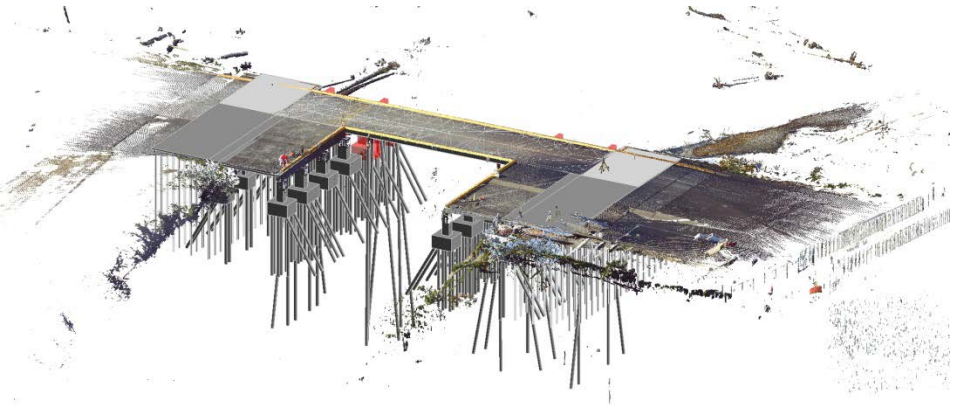
Construction Constraints/Schedule Environmental

Activity ID	Original Duration	Start	Finish
North Boeing Bridge	747	22-Jan-13	2-Dec-15
PRE-CONSTRUCTION Advertise, Bid Award, Mobilize	47	22-Jan-13	27-Mar-13
PRE-FISH WINDOW 1 Demo Existing Bridge Construct Temp Bridge Approach	42	27-Mar-13	24-May-13
FISH WINDOW 1 Construct Temporary Bridge Demolish Portion of Existing Bridge	54	1-Jun-13	15-Aug-13
PRE-FISH WINDOW 2 Demolish Existing Bridge Above OHW Drive Piles Outside OHW	206	15-Aug-13	30-May-14
FISH WINDOW 2 Complete Demo of Existing Bridge Install Work Platforms, Shafts & Crossbeams - New Bridge	55	1-Jun-14	15-Aug-14
PRE FISH WINDOW 3 Complete Construction - New Bridge	200	15-Aug-14	22-May-15
FISH WINDOW 3 Complete Re-grading, Armory & Restoration (East/West) Demolish Temporary Bridge	55	1-Jun-15	17-Aug-15
POST FISH WINDOW 3 Punchlist Final Lanscape	77	17-Aug-15	2-Dec-15

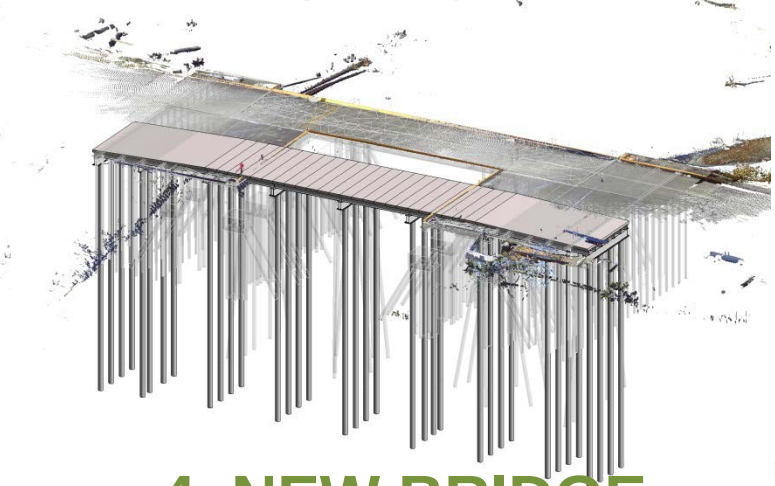


Construction Constraints/Schedule

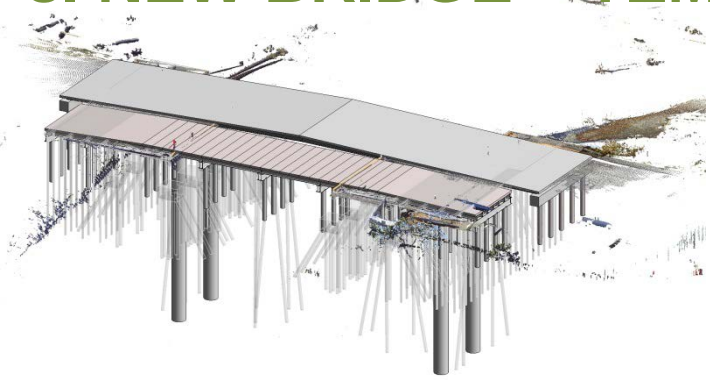
1. EXISTING



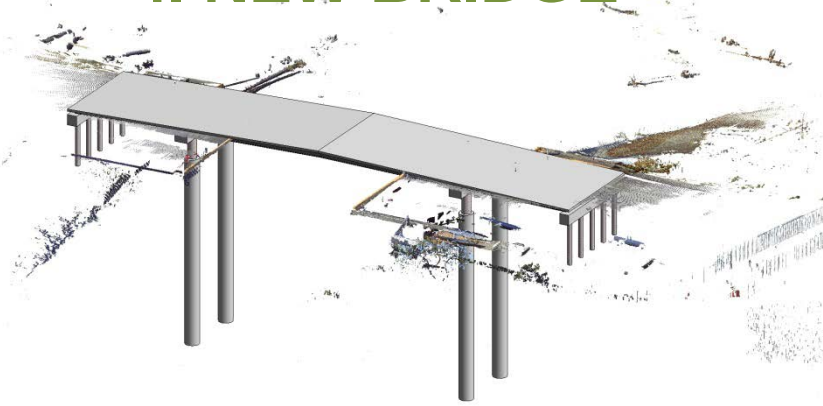
2. EXISTING + TEMP



3. NEW BRIDGE + TEMP

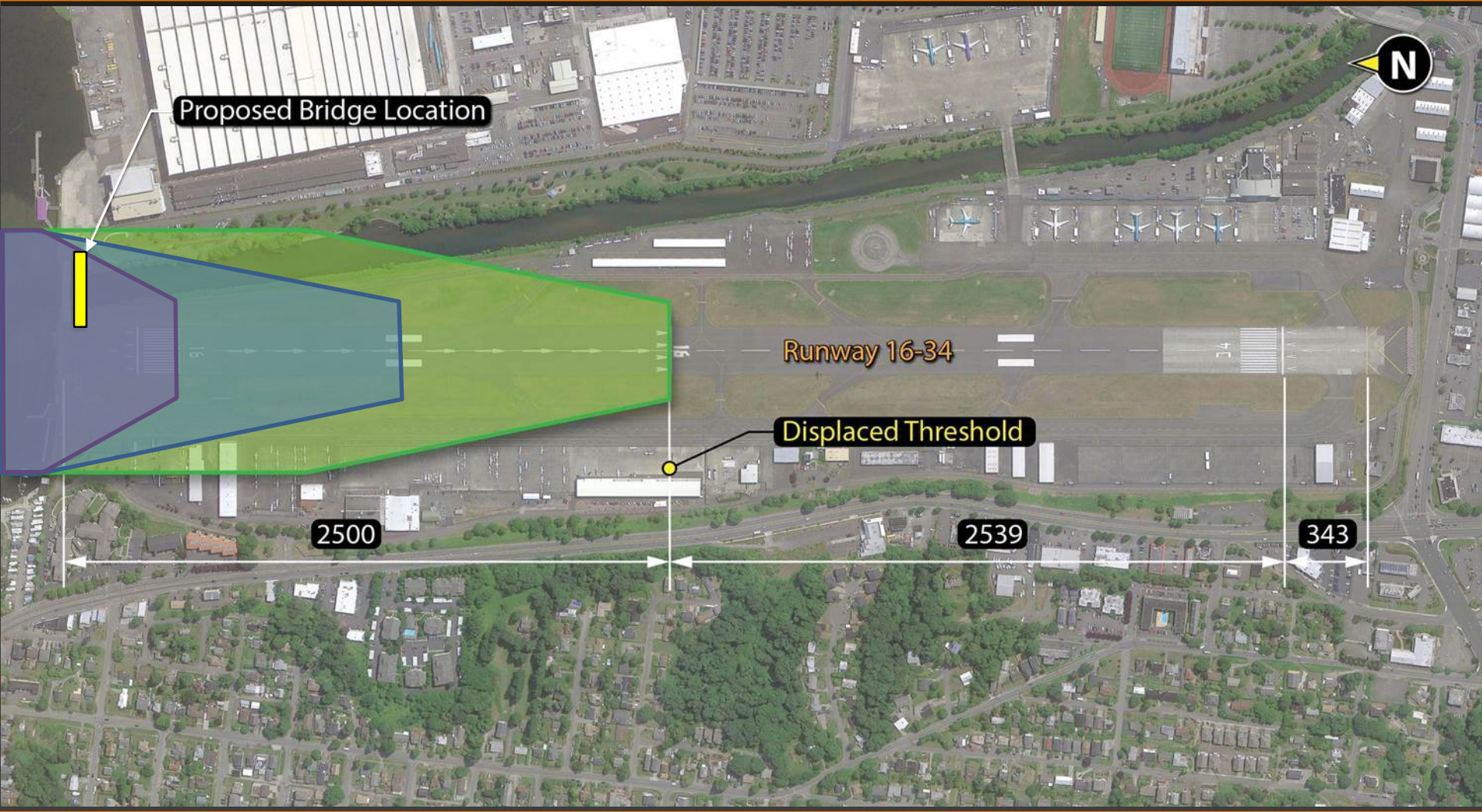


4. NEW BRIDGE



Construction Constraints/Schedule
Boeing Production

Construction Constraints/Schedule
Renton Airport Height Threshold



Construction – Change Proposal

- Slow Start-Up
  - Delayed Permits
  - Coordination (Airport requiring night work)
  - Late commissioning of temporary bridge
- Permit Adjustment
  - Allowed for large cofferdams
  - Allowed for falsework at Piers 2 & 3
  - Contractor submitted a no-cost change proposal to switch substructure to CIP

Construction – Change Proposal

- Change Proposal Details
  - Safety Concerns
  - Quality Concerns
  - Schedule Concerns

Construction - Change Proposal

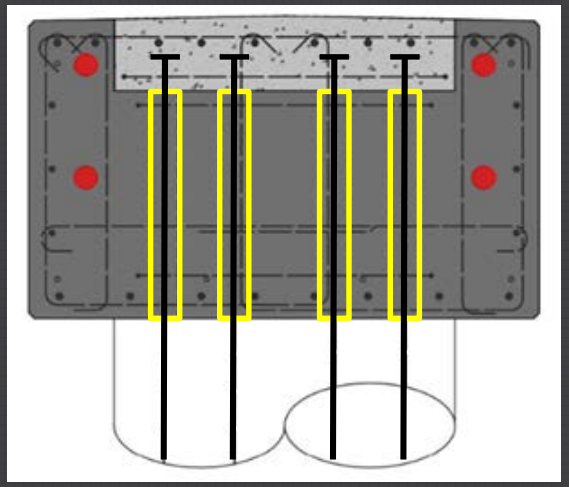
- Safety Concern:

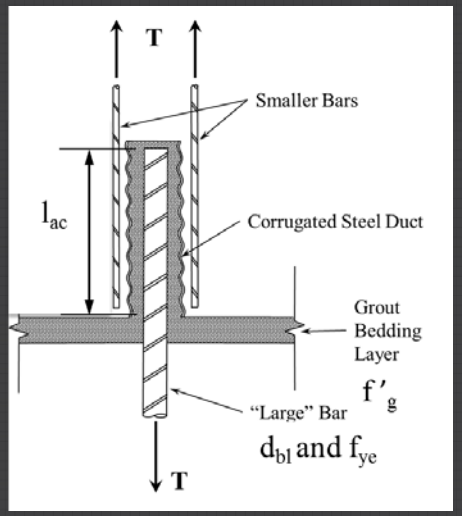
  Setting of precast crossbeam

Construction - Change Proposal

- Quality Concern:

  Grouting, # Joints, Tolerances





Construction - Change Proposal

- Schedule Concern:

  Night work with no time savings

Construction - Change Proposal

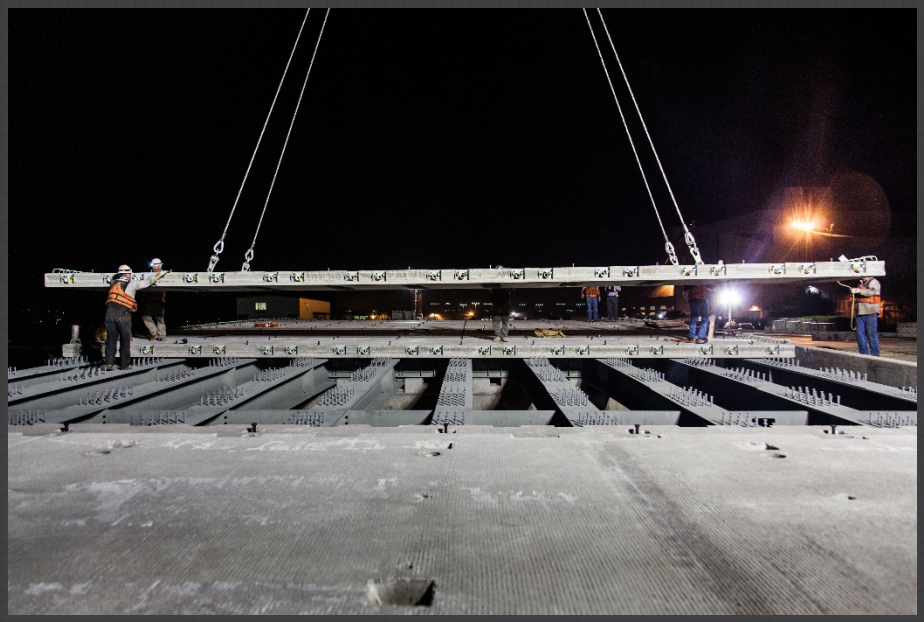
- Schedule Concern:

  Night work with no time savings

- Response:
  - Several opportunities for time savings
  - Crane required regardless

Construction - Precast Deck Panels

- Precast Deck Construction Details
  - UHPC (Ultra High Performance Concrete)
  - Girder Fabrication and Panel Erection



Lessons Learned

- Understand Construction Constraints/Risks
- Cost Savings with Standards & Repetition
- Certified PCI Prefabricator Required?
- Required Equipment Size
- Shift in Construction Philosophy

Questions?

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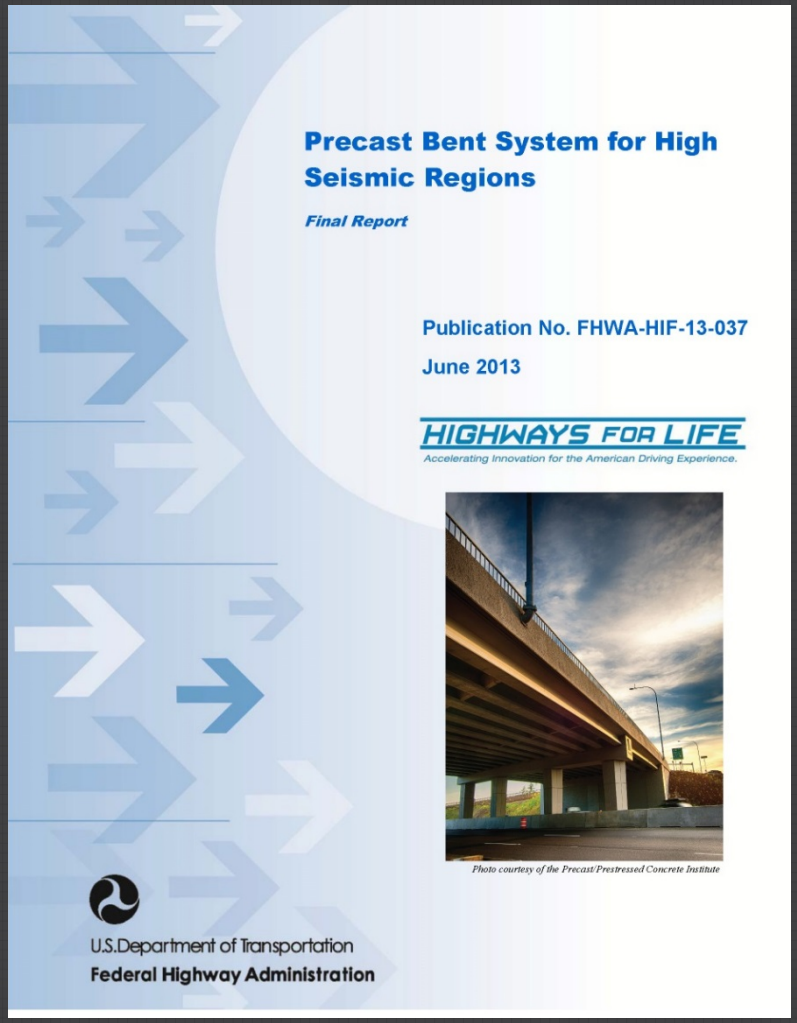
Project Overview – Replacement Bridge Seismic Resisting Connections

- Developed for the FHWA Technology Partnership Program
- Culminated in demonstration project completed by WSDOT.
- Marked excellent collaboration between Owner, Researchers, Designers, Precaster, and Contractor

Project Overview – Replacement Bridge Seismic Resisting Connections

http://www.fhwa.dot.gov/hfl/

- Final Report
- Appendices
  A. Design Specifications
  B. Design Example No. 1
  C. Design Example No. 2
- Testing Report – Spread Footings
- Testing Report – Drilled Shafts



Project Overview – Replacement Bridge Seismic Resisting Connections

- Design Specifications
  - Formatted in AASHTO Guide Spec Language
  - Address design with HfL bent details
- Construction Specifications
  - Material controls
  - Tolerance control
  - Recommendations for contract control