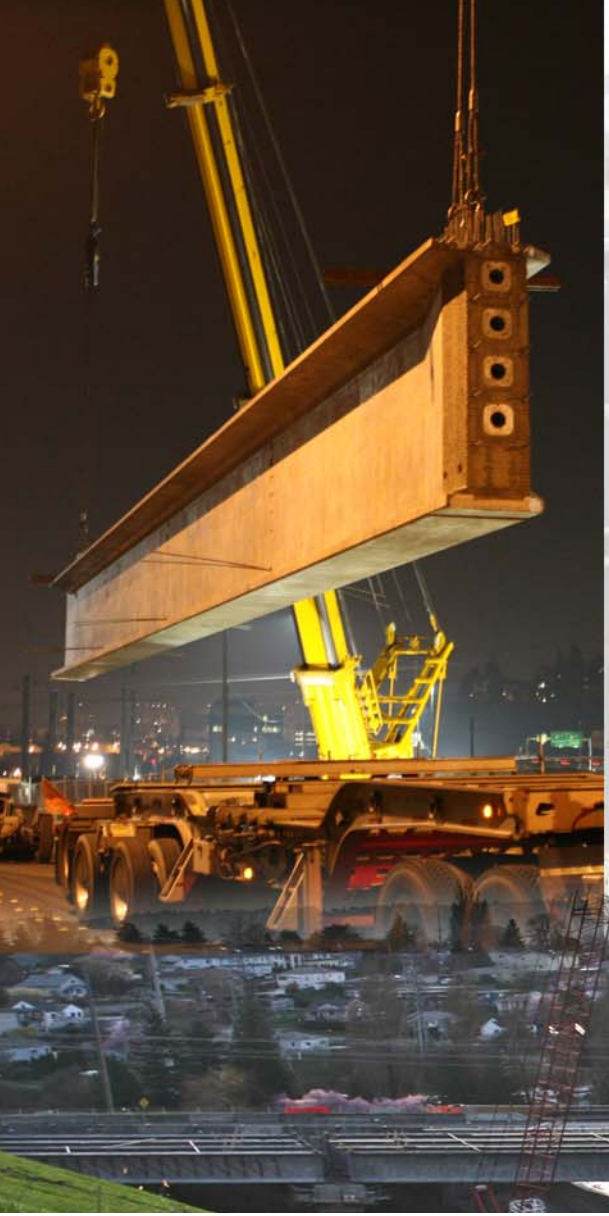


Benson Road Bridge Replacement

Maximizing Efficiency and Minimizing Impacts in a Design-Build Environment

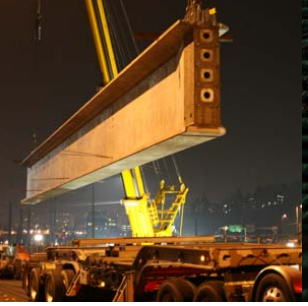
Hong Guan, PhD, PE
Paul Guenther, PE, SE

September 26, 2010

I-405 CORRIDOR DESIGN-BUILDERS
An Integrated Transportation Solution

Associated Firms:
CH2M HILL
Gary Merlino Construction Co.
Mowat Construction Co.

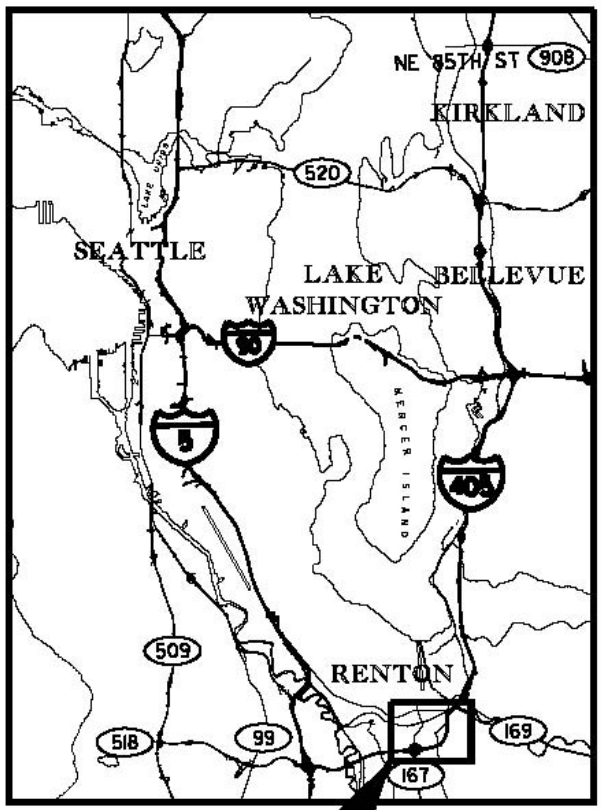
Washington State Department of Transportation

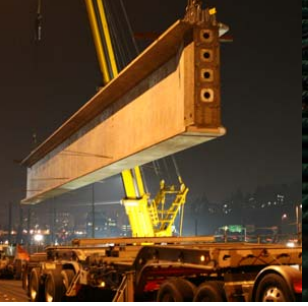


Presentation Agenda

- Project Overview
- Description of WF100PTG Super Girders
- Design Challenges
- Construction Challenges

I405 - I-5 to SR-169 Stage 2 Widening
Project Location Map





I405 - I-5 to SR-169 Stage 2 Widening

Project Overview

- $83 Million Design-Build Project on I-405 in Renton, WA
- 2 miles of Mainline Widening
- Bridge Replacement (Benson Road)
- Half-Diamond I/C at Talbot Road/SR 167
- New Off-Ramp Bridge
- 200,000 Yards of Earthwork
- 6,000 feet of Retaining Walls
- 3,000 feet of Noise Walls

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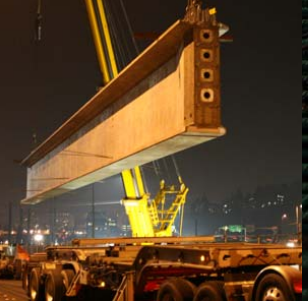
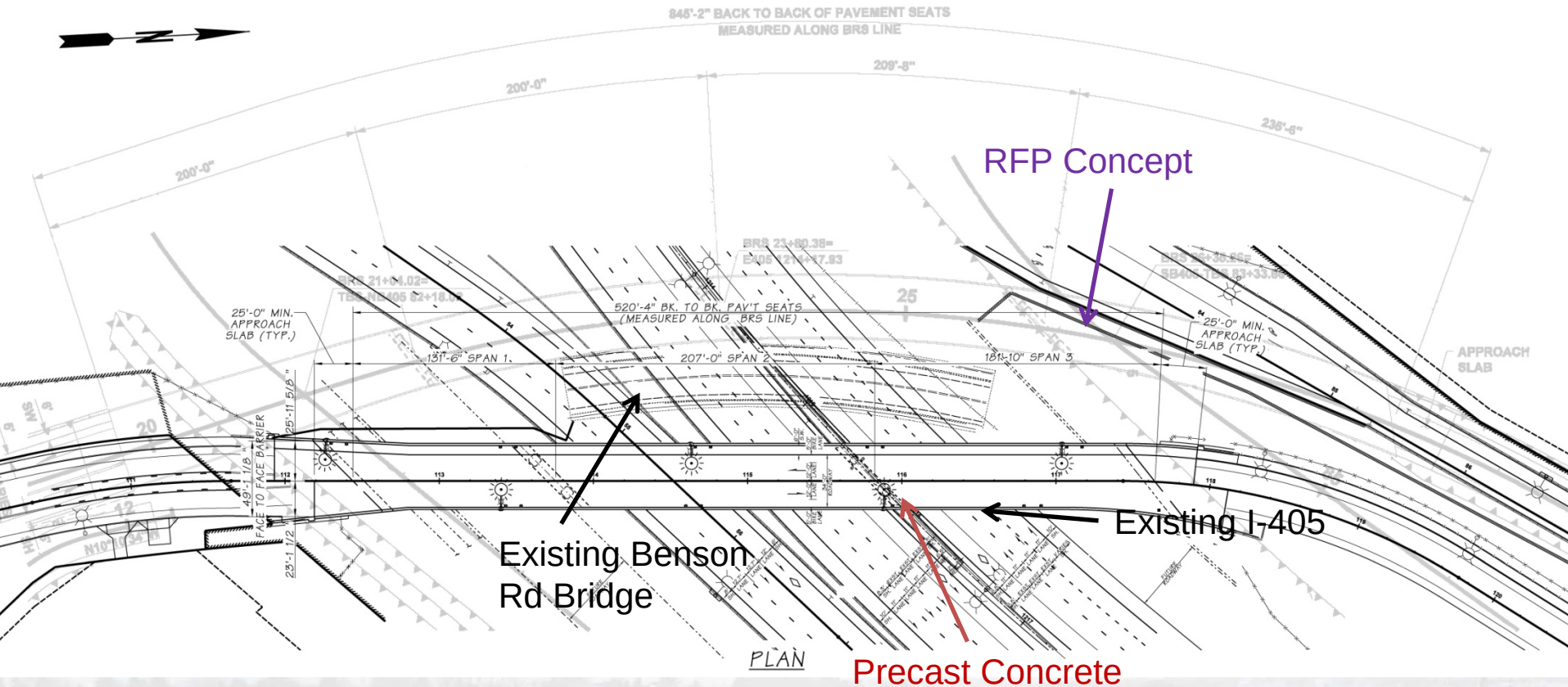


Benson Road Bridge Replacement

Conceptual Design



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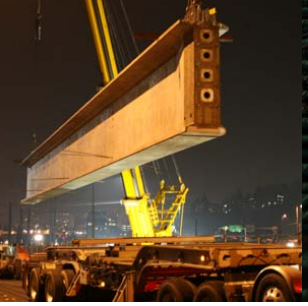
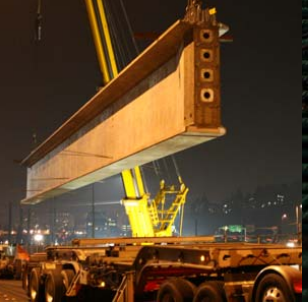


Benson Road Bridge Replacement

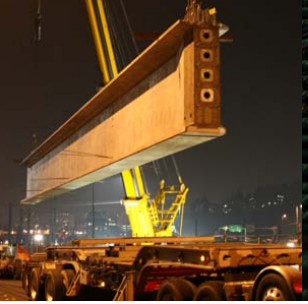
Precast Concrete Option Benefits

- Reduced Construction Cost
  - 8000 SF less deck area
  - $5 million cost saving
- Lower Maintenance and Inspection Cost
- Less Lead Time for Material Procurement
- Reduced Impacts to Travelling Public
  - Reduced direct impacts to traffic over I-405 by approximately 2 month



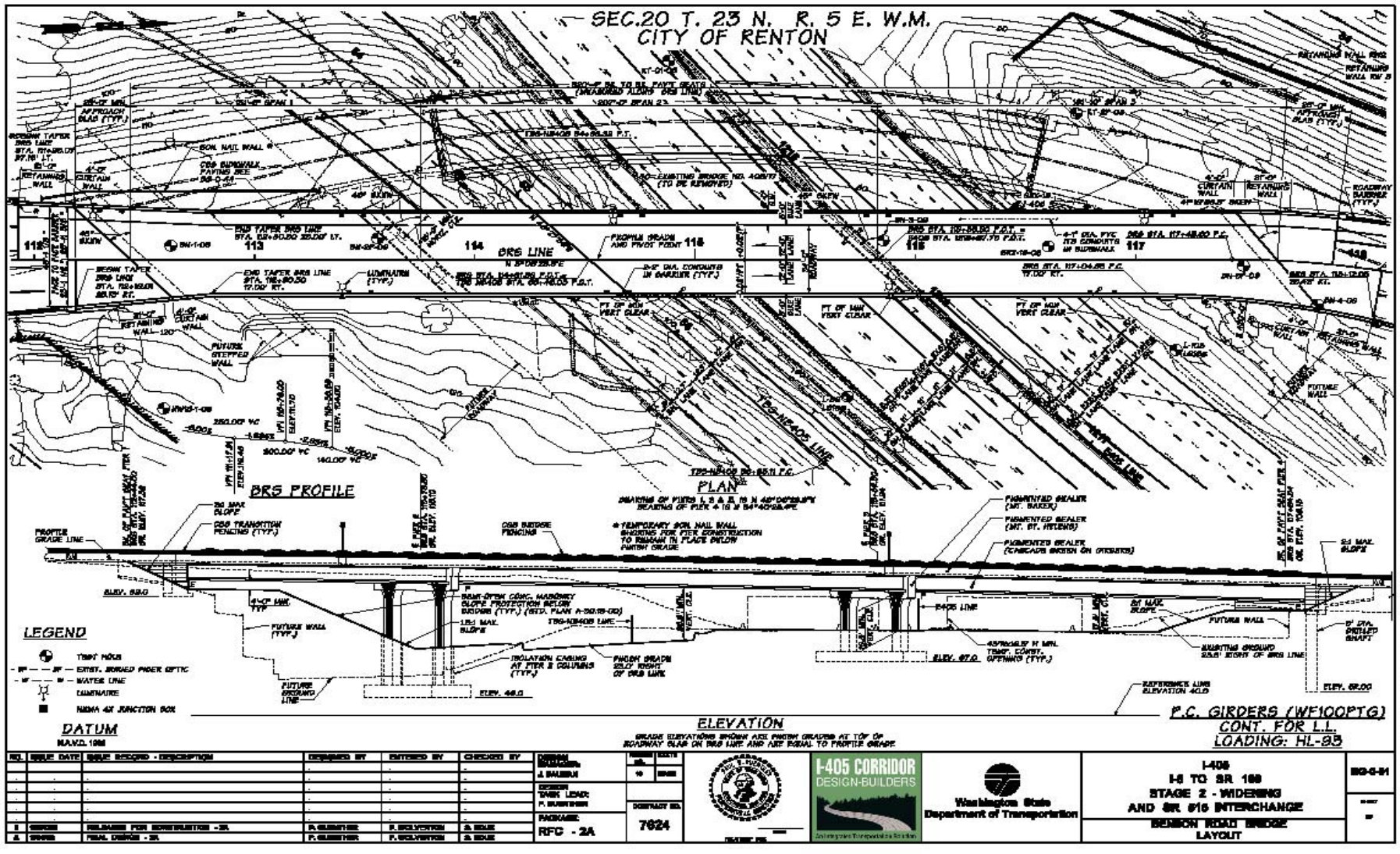
Benson Road Bridge Replacement

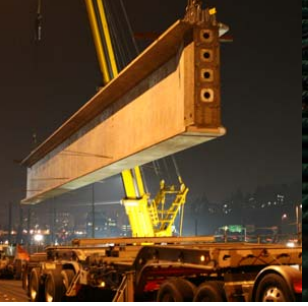
- Bridge Features:
  - 520 foot long, 3-span spliced prestressed girders
  - 2 Lanes plus bike lanes and sidewalk
  - Spans of 132, 207, and 182 feet
  - Tangent alignment with skews and flares
  - Multi-columns bents on spread footings
  - One abutment on shafts



Benson Road Bridge Replacement

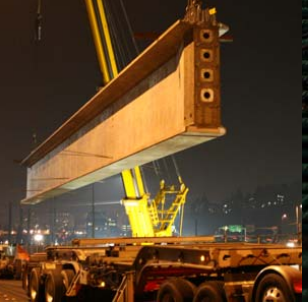
Plan and Elevation





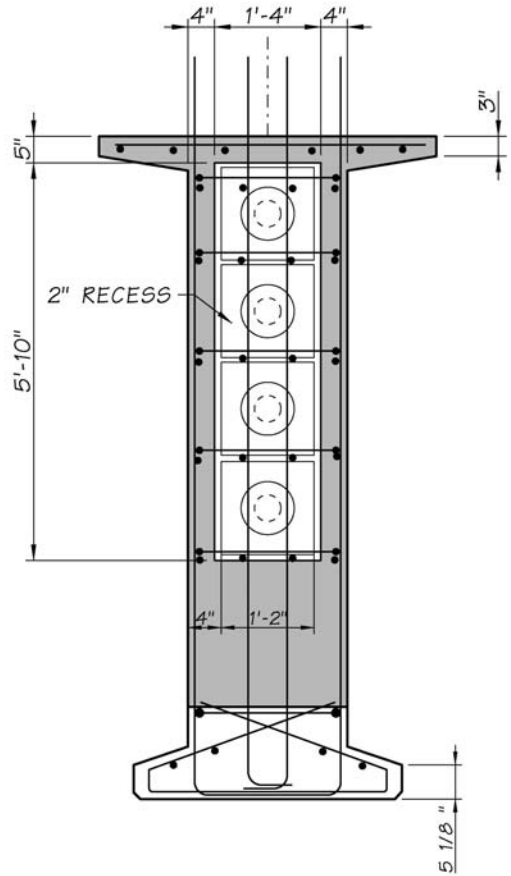
Benson Road Bridge Replacement

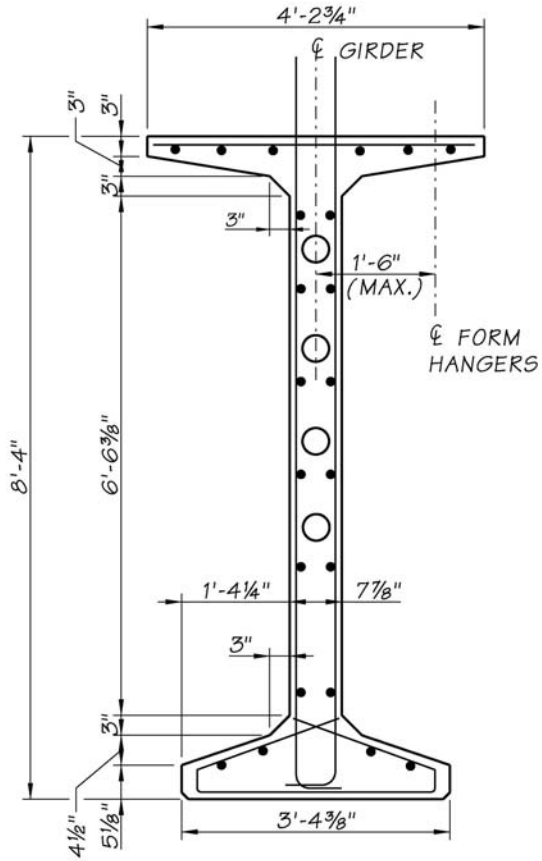
- Unique Design Elements
  - WF100PTG Spliced, Post-Tensioned Girders (1st use of largest constant depth PS girders in the State of Washington)

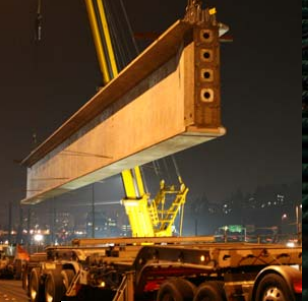


Benson Road Bridge Replacement

WF100PTG Precast Girder

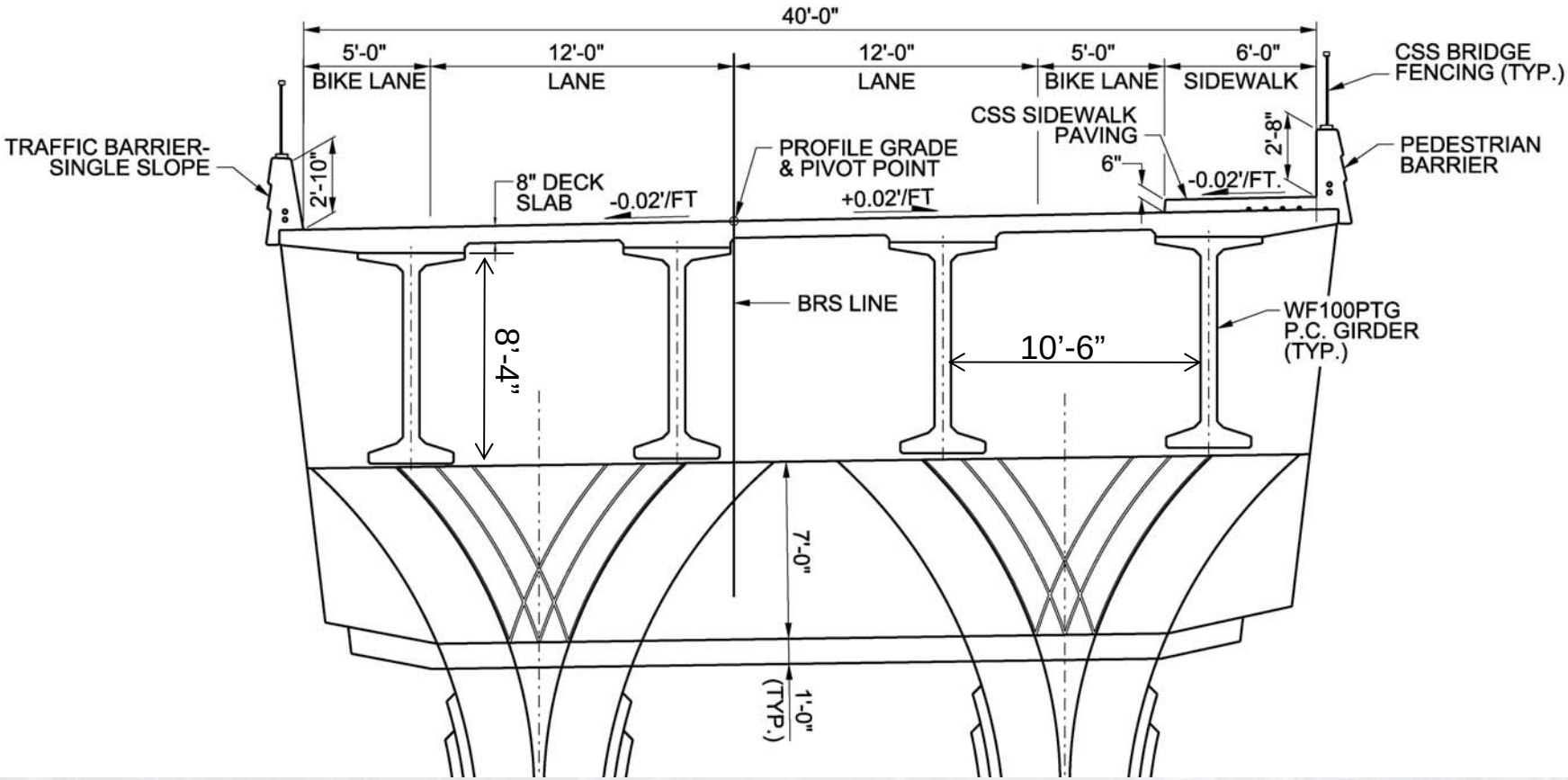


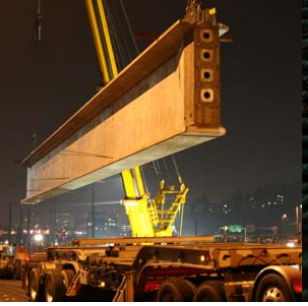




Benson Road Bridge Replacement

Typical Cross Section

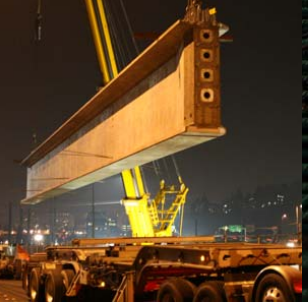




Benson Road Bridge Replacement

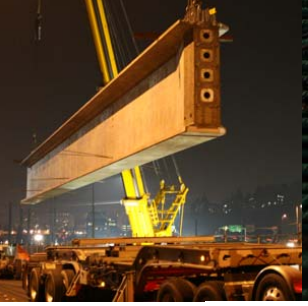
Girder Optimization

- Switching from WF83PTG to WF100PTG
  - Reduced number of girder lines from 6 to 4
  - Reduced number of girder segments from 30 to 20
  - Reduced superstructure cost by ~$200,000
  - Reduced work over I-405, minimizing interruption to traffic (two nights of “rolling slowdowns”)



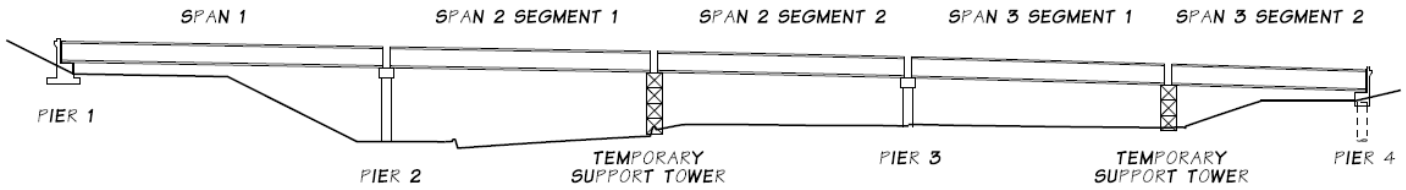
Benson Road Bridge Replacement

- Unique Design Elements
  - WF100PTG Spliced, Post-Tensioned Girders (1st use of largest constant depth PS girders in the State of Washington)
  - Fully-Composite PT Design

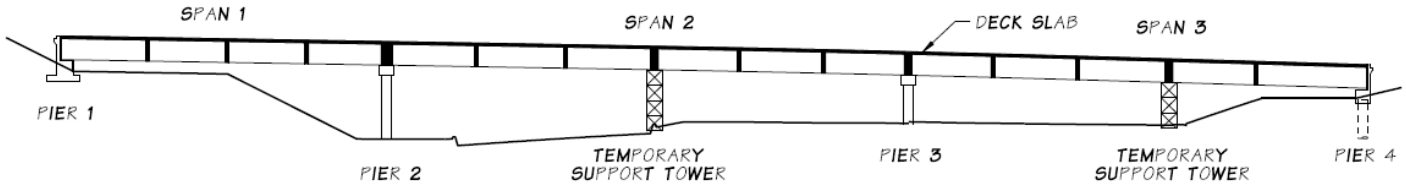


Benson Road Bridge Replacement

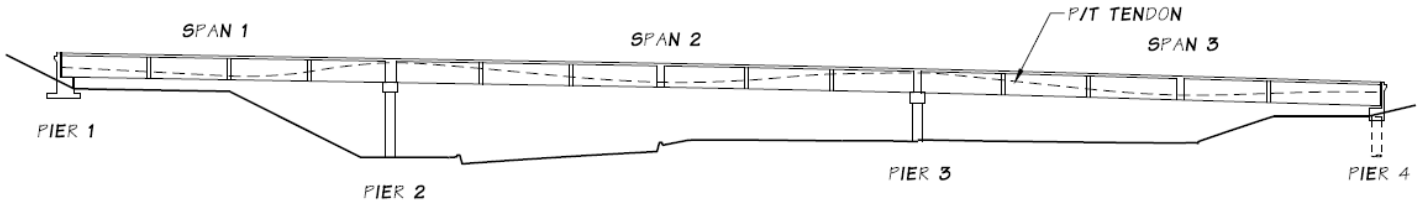
Construction Sequence



STAGE 1 - ERECT GIRDER SEGMENTS



STAGE 4 - PLACE DIAPHRAGMS, CLOSURE POURS, AND DECK



STAGE 6 - STRESS P/T TENDONS, REMOVE TEMPORARY SUPPORT TOWERS

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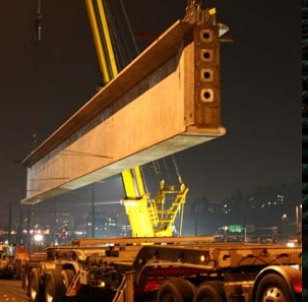
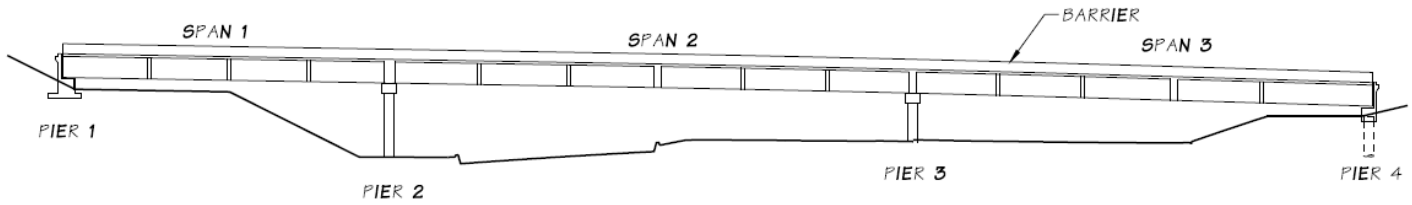
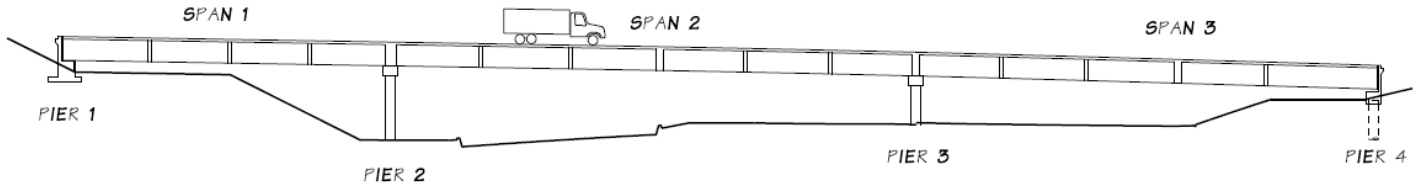


Benson Road Bridge Replacement

Construction Sequence



STAGE 8 - PLACE END DIAPHRAGMS, BARRIERS AND SIDEWALK



STAGE 10 - OPEN BRIDGE TO LIVE LOAD

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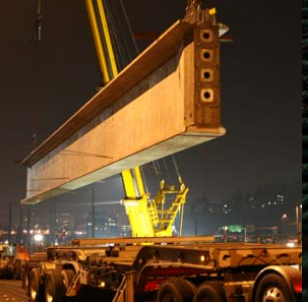
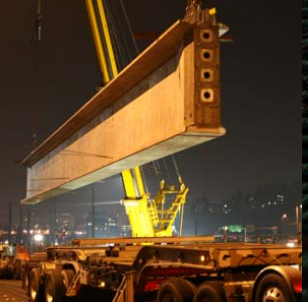


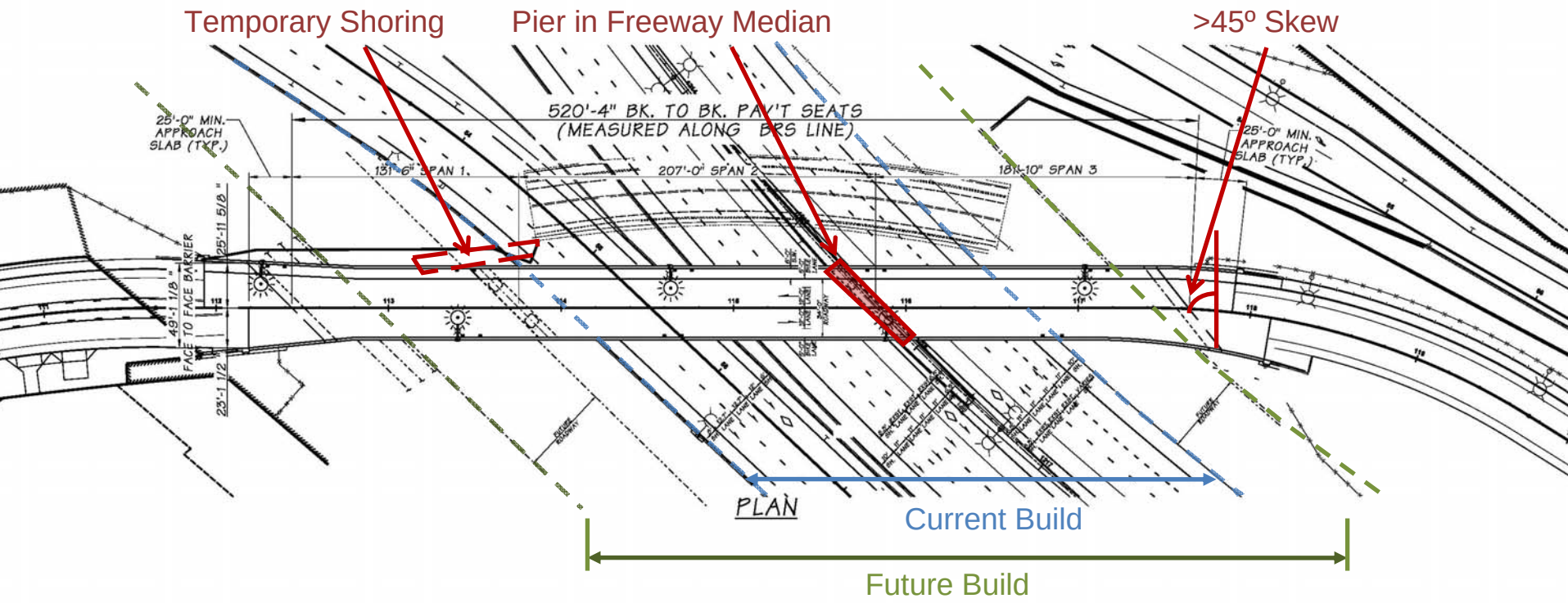
Benson Road Bridge Replacement

- Design Challenges
  - Fast-Track Schedule (6 months)
  - Limited Pier Locations/Long Spans
  - Compatible with Future Ramp and Widening
  - Live Load Distribution/Skews/Flares
  - New WSDOT 1000-year Displacement Based Seismic Design Criteria
  - Complex Integral Analysis



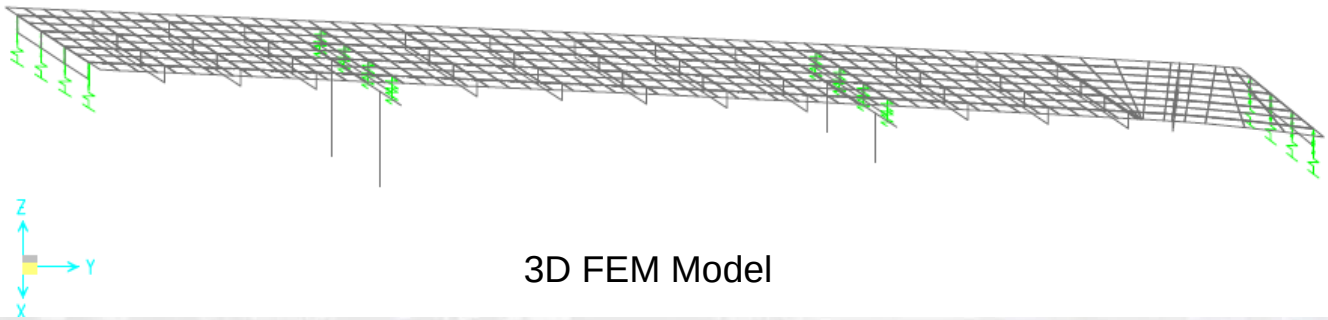
Benson Road Bridge Replacement

Design Challenges

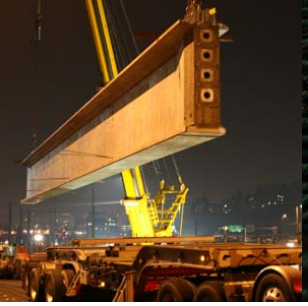


Live Load Distribution Factor and Skew

- Girder Size Exceeds Range of AASHTO Equation
- 3D Model Used to Evaluate Live Load Distribution Factors
- Evaluate Skew Effects on Expansion Joints

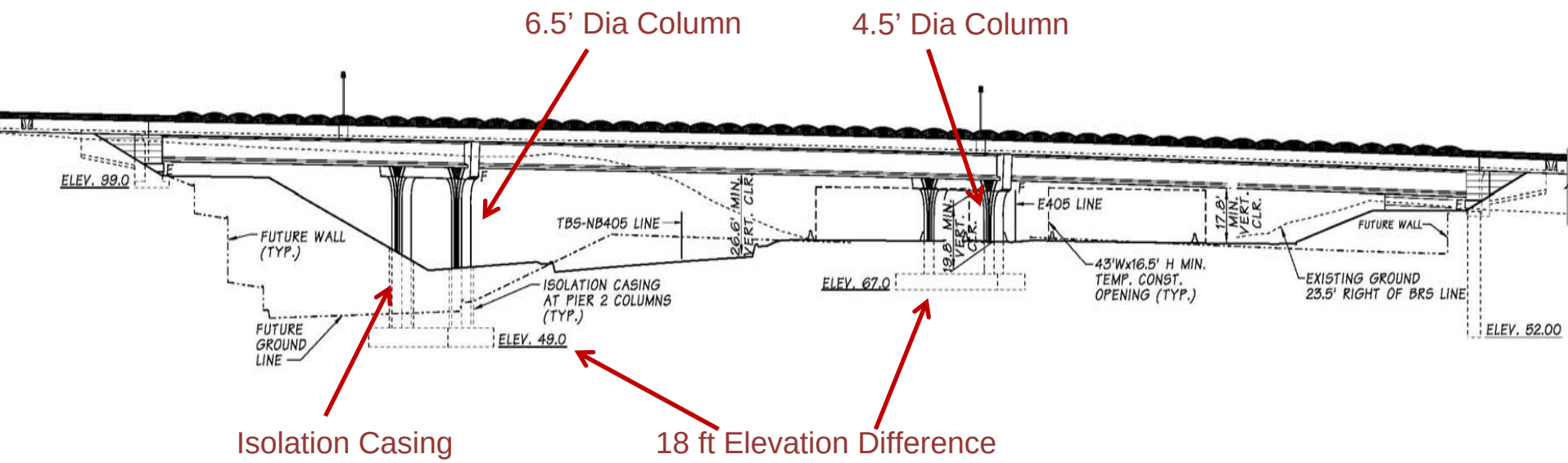


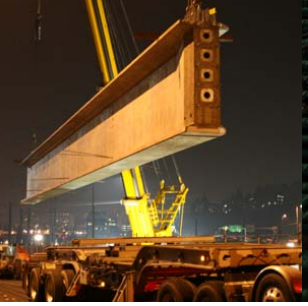
3D FEM Model



Benson Road Bridge Replacement

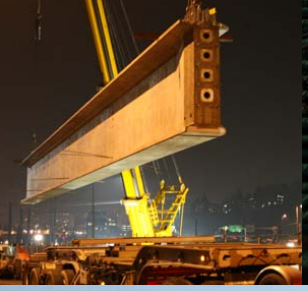
Design Challenges





Benson Road Bridge Replacement

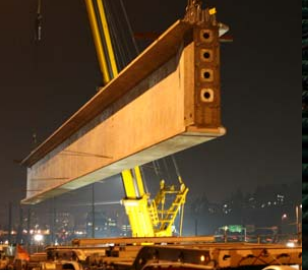
- Construction Challenges
  - Deep Foundation Cuts
  - Fabrication, Transportation and Erection of Deep Precast Girders
  - Girder Closure Pours
  - Deck Forming
  - Construction of Pier in Median of I-405
  - End-to-End Continuous Deck Pour
  - Aesthetic Components



Construction Considerations

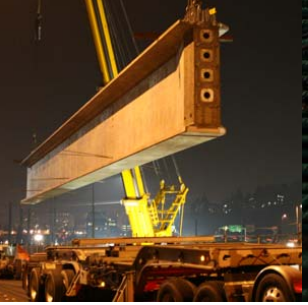
Temporary Shoring

Pier Construction



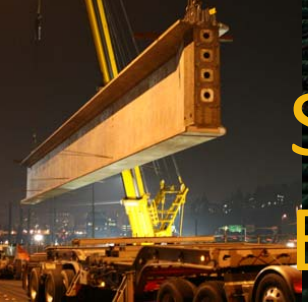
Pier Construction

Median Pier Construction



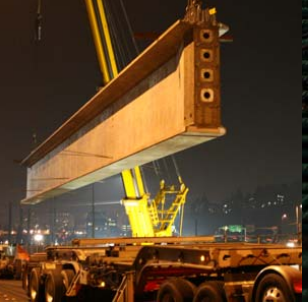
Super Girder Fabrication

- More difficult worker access/fall protection
- Girder lifting and handling
- Higher concrete strengths/curing
- Bed turnover

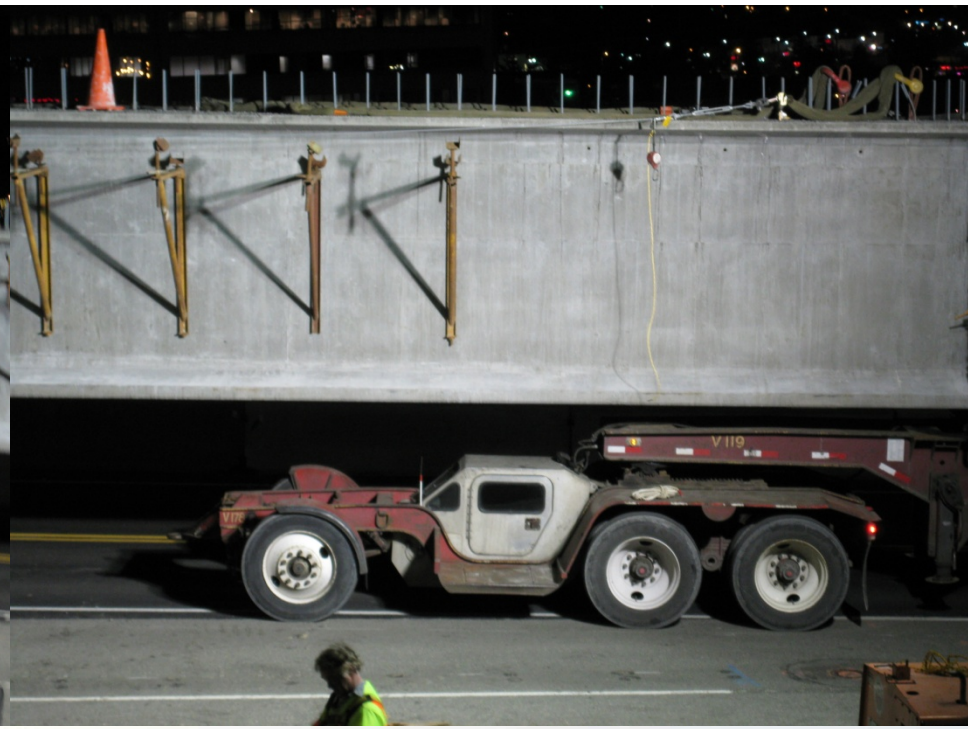


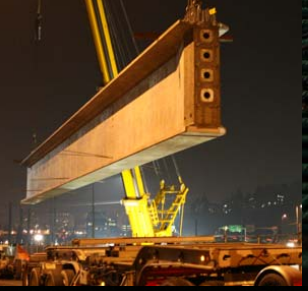
Super Girder Transportation and Erection

- Longer and heavier segments
- Specialized trucking requirements
- Larger cranes needed for erection
- Existing bridge clearances
- Route planning

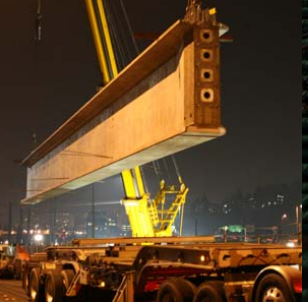


Super Girder Trucking



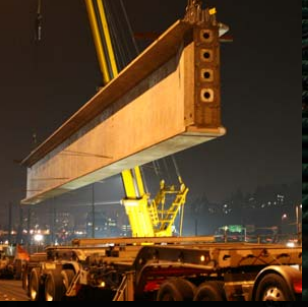


Super Girder Trucking



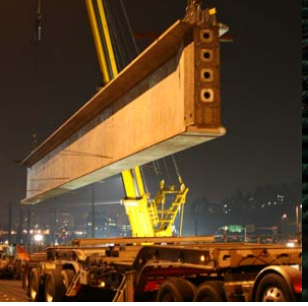
Super Girder Erection

650 Ton Wheeled Crane



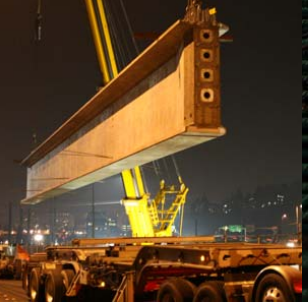
Super Girder Erection

Temporary Bents

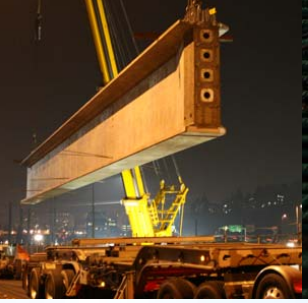


Closure Pours, Deck Forming, and Diaphragms

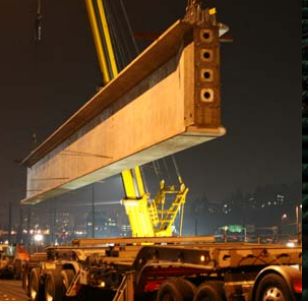
- Everything Gets Bigger
  - Access/Safety Deck
  - Closure pours
  - Larger deck overhangs
  - Diaphragms



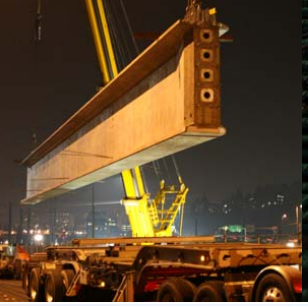
Super Girder Closure Pours



Deck Overhangs and Diaphragms

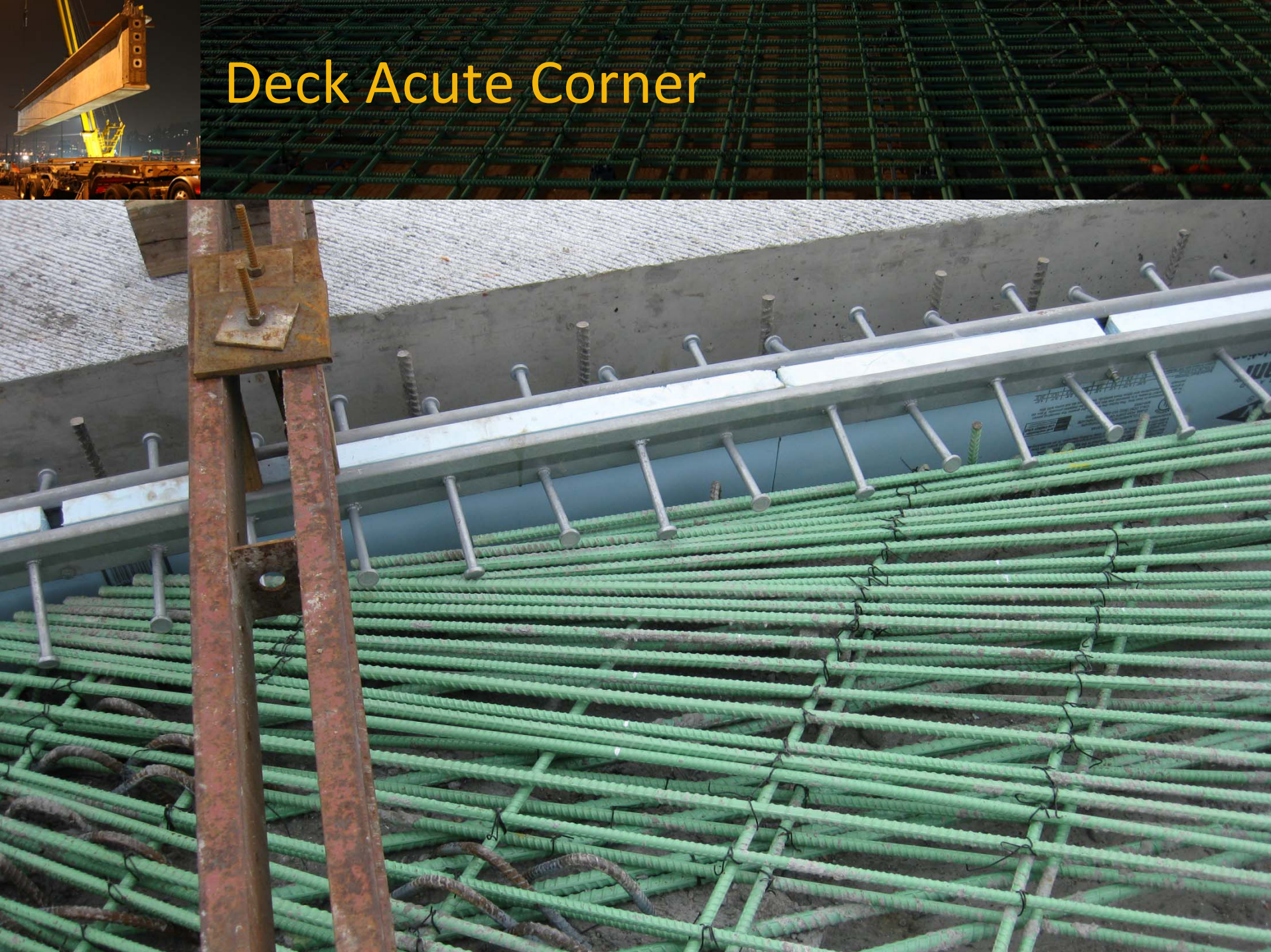


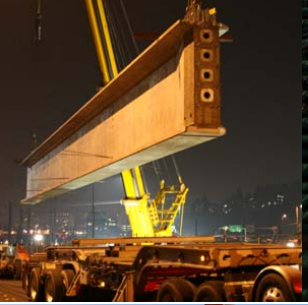
Bridge with All Girders Erected



Deck Rebar Placement

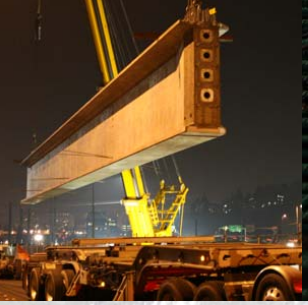
Deck Acute Corner





Deck Concrete Placement

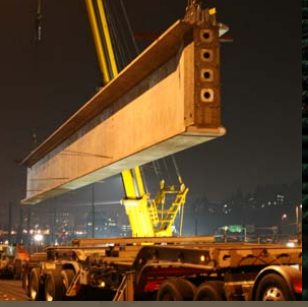
Post-Tensioning Operation



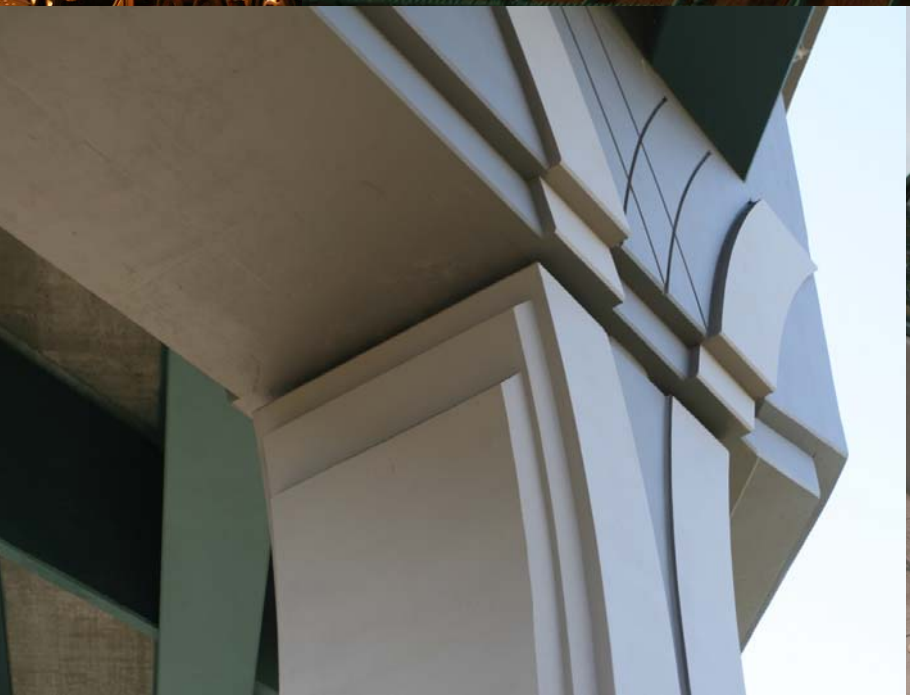
Resetting Bearings

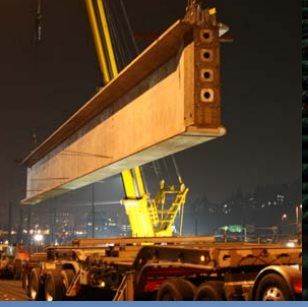
CH2MHILL

Completed Bridge with Barrier

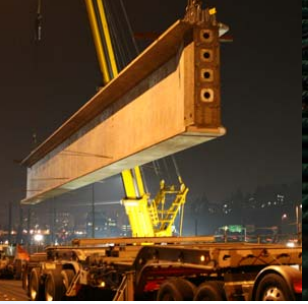


Aesthetic Details

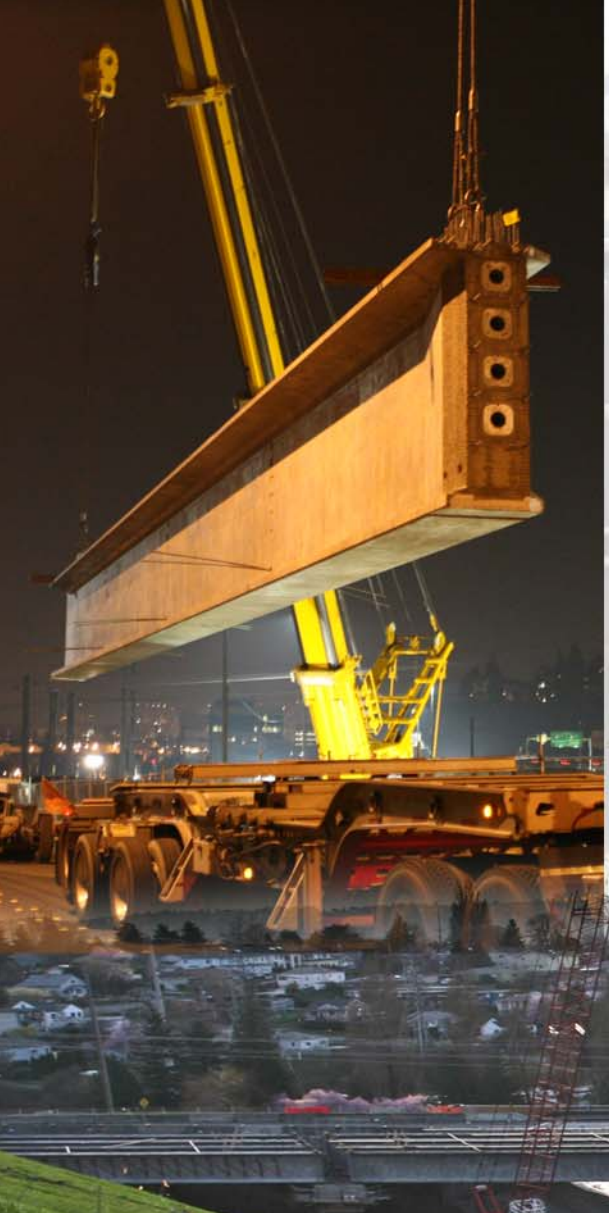




Completed Bridge



Completed Bridge



Benson Road Bridge Replacement

Acknowledgements

Owner: Washington Department of Transportation

Design-Builder: I-405 Corridor Design-Builders

Thank You

Questions?

I-405 CORRIDOR DESIGN-BUILDERS
An Integrated Transportation Solution

Associated Firms:
CH2M HILL
Gary Merlino Construction Co.
Mowat Construction Co.

Washington State Department of Transportation