Design and Construction of the SR 99 Atlantic Street Bypass

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Overview

- Underpass or Overpass?
- Complex Geometry and Architecture
- Superstructure Types
- Substructure Design
- Innovative Falsework System
- Construction Sequence
- In-span Hinges
- Challenges and Lessons Learned
- Construction Photos
- Time Lapse Video of Construction
- Project Credits
The Problem...
The Solution…

Elevation View:
Showing the view looking north from SR 99

SR 99 ALASKAN WAY SOUTH & COLORADO AVENUE SOUTH OVER 99
Cast-In-Place Box Girder Section
Substructure

- Twenty 9’-2” diameter shafts used at all interior piers
- Six 6’-6” diameter shafts used at the three abutments
- All Piers except 15 and 16 use 5’-6” square columns
- Piers 15 and 16 use 5’-6” diameter columns; will be enclosed by precast architectural panels
- Nominal shaft capacities at the strength limit state range from 2350 tons Pier 1 to 5000 tons at Pier 16
- Falsework piles driven to an ultimate bearing resistance of 110 tons.
Seismic Modeling

- Seismic design provides an essentially elastic superstructure and a ductile substructure
- Modeling uses cracked section properties, soil/structure interaction to determine maximum column displacement demands
- Pushover analysis is performed to determine displacement capacities
- Small hinges use transverse stops and longitudinal restrainers
- Large hinge allowed to “float” on multi-rotational disc bearings
Substructure Details
Falsework

- Falsework system utilizes steel driven piles and mudsills
- Supports are wedged at the base with wood
- Deck is built flat; Geofoam is used to form superelevation, haunches and other geometric irregularities of the soffit
- Settlement is monitored at every stage
- Trusses used to brace exterior web
Hinges

- Four in-span hinges are used between adjacent frames.
- Three “small” hinges connect the tub spans to the box girder frames.
- A large hinge near Pier 16 connects the box girder frames together.
- Designed for PT anchorage, load transfer, future bearing replacement.
- Due to the shallow depth, this became the most congested areas to construct.
- Due to deviation of the tendons at tight radii, a large amount of steel was required to confine the tendons.
Small Hinge Design

- Tub spans are supported by the box girder bearing seat. Seats are fully post-tensioned.
- Inspection and replacement are allowed by discontinuous design of seats.
- Size of seats allow load distribution and room for jacks to allow for bearing replacement.
- Lateral stops engage the top tongue of the tub spans.
- Sliding fabric pad bearings are used.
- Longitudinal restrainers engage the hinge diaphragms.
- Piers 5 and 6 from Frame 2 are supported by the Pier 16 hinge diaphragm
- Both bearing seats are post-tensioned with bar tendons for a fully post-tensioned design
- Disc bearings are used at each Pier to allow the two frames to move independently
- Three jacking blocks are provided for future bearing replacement
Large Hinge

- Bearing ends of Piers 5 and 6 are post-tensioned as well.
- Busy details with two way post-tensioning and crossbeam reinforcement.
- Due to limited width, the Frame 2 side diaphragm is concentrically post-tensioned.
Challenges

- Multiple design challenges
  1. Shallow Box
  2. High curvature
  3. Inflexible foundation plan
  4. Short timeline
- Construction challenges
  1. PT tendon adjustments
  2. Adjacent projects
  3. Aggressive schedule
Design Credits

- Tim Moore – Design Supervisor
- Eric Schultz – Lead Designer
- Munindra Talukdar – Substructure Design
- Nick Rodda – CIP PT Box Design
- Eric Schultz
- Jed Bingle – Precast Tub Design
- Michael Bressan
- Elena Gunis
- Diane Avery
- Dan Puryear – Drafting Support
- Adam Evans
- Justin Nettle
- Lou Tran – PT Box Checking
- Anthony Mizumori – Precast Fascia Panels
Construction Credits

• Paul Johnson – WSDOT Project Engineer
• Kevin Hepler
• Adam Fisher
• Brandon Humphrey

WSDOT Inspectors

• Guy F. Atkinson – Prime Contractor
• Gerdau – Sub-Contractor (Rebar)
• Schwager Davis – Sub-Contractor (Post-Tensioning)

• Engineer’s Estimate - $35.6 Million
• Low Bidder - $29.4 Million (17.6% Below)