

SPAGHETTI BOWL



Utilizing Multiple Bridge Types to Meet Project Challenges

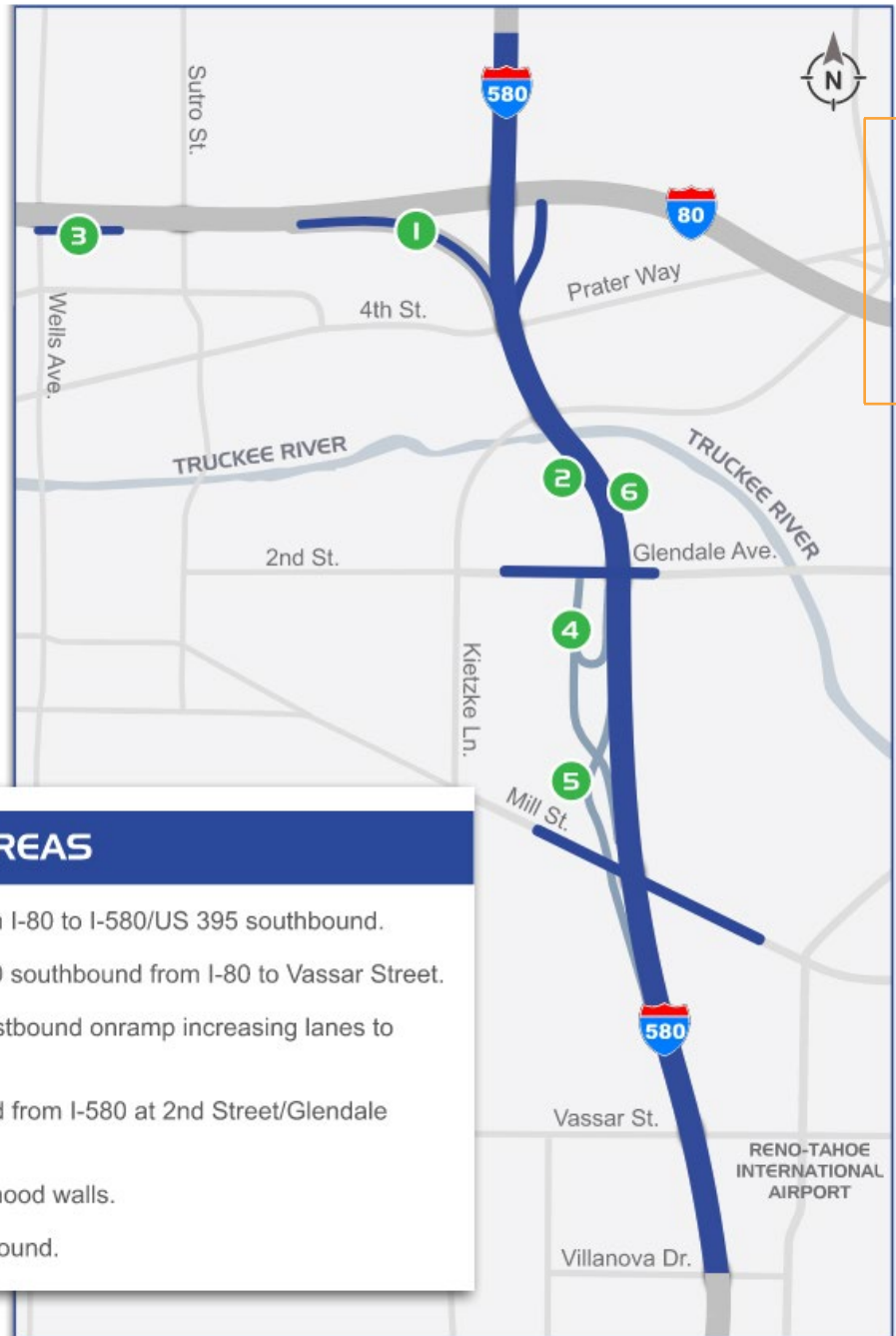
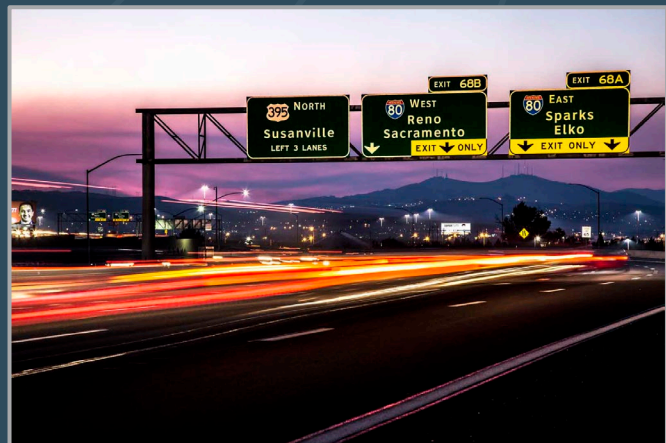
September 7, 2023

Western Bridge Engineer's Seminar



PROJECT GOALS AND SCOPE

- Goals
 - Increased Safety
 - Additional Lanes
 - Reduced Congestion
 - Minimize Cost & Schedule
- Phasing of Project
 - Phase 1 of Several Phases
- Scope
 - Reconstruction of I-580 from I-80 to Villanova St.
 - Improvement Areas shown



COST AND SCHEDULE

Cost

- Total Project Cost \$191M
- Saved \$40M from Anticipated Cost

Schedule

- NTP 1 – 12/2019
- NTP 2 – 4/2020
- Begin Construction – 8/2020
- Substantial Completion – 12/2022

Unsolicited Proposal

- NDOT P3 Process (First Time)



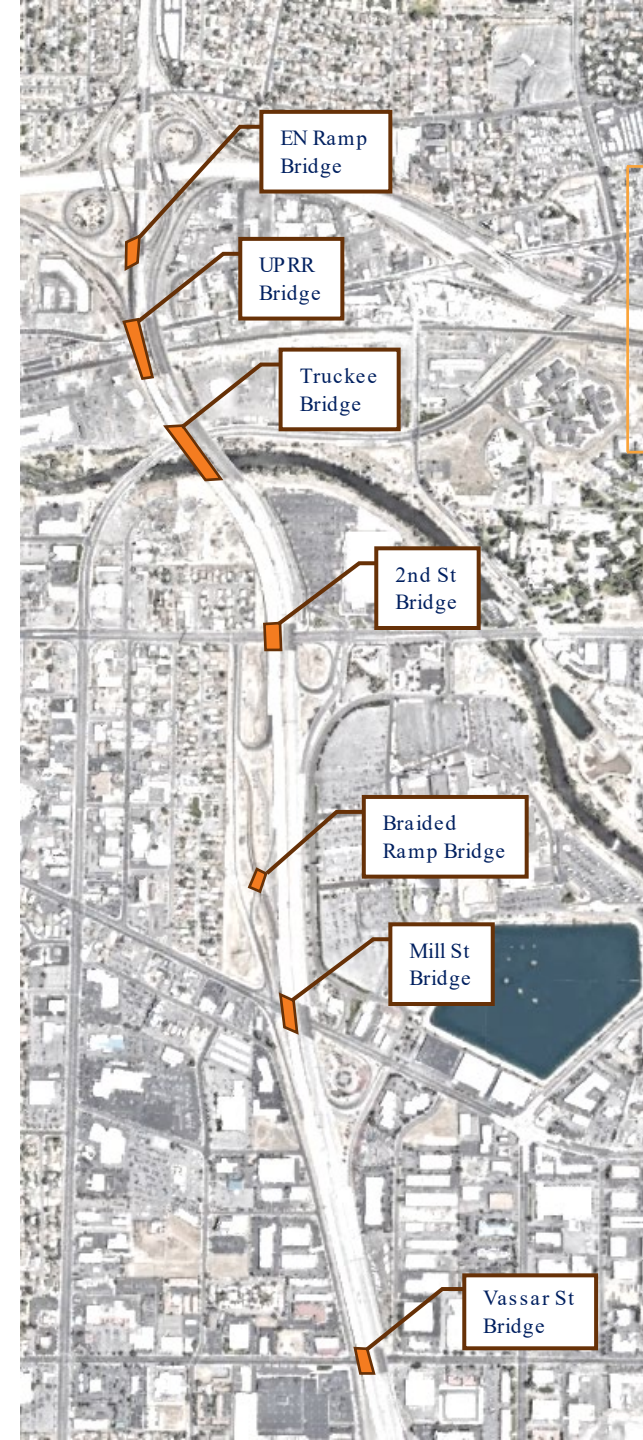
FINISHING SPAGHETTI BOWL XPRESS



ON TIME AND UNDER BUDGET

STRUCTURES ON THE PROJECT

- Bridges
 - See figure
- Walls
 - Cast-in-Place Retaining Walls
 - MSE Retaining Walls
 - Tie Back Retaining Walls
 - Soil Nail Retaining Walls
 - Sound Walls/Visual Screen Walls
 - Post & Panel Neighborhood Walls
- Sign Structures
 - Full Span
 - Butterfly
 - Cantilever
 - DMS
 - Monotube & Truss Types



CONSTRAINTS AT BRIDGE CROSSINGS



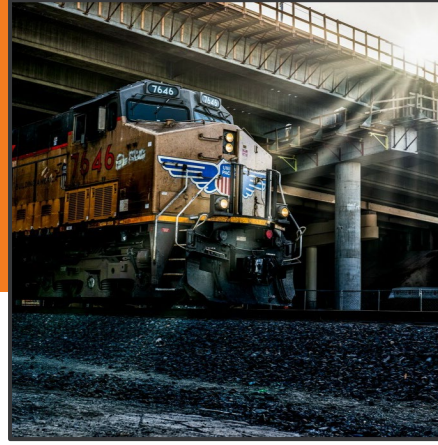
TRUCKEE RIVER

- Environmental Avoidance Area
- Scour



ROADWAYS & TRAILS

- Roadway Crossing at every Bridge
- Horizontal and Vertical Clearances



RAILROAD

- UPRR Requirements
- No Falsework or Shoring at UPRR



WIDENING REQUIREMENTS

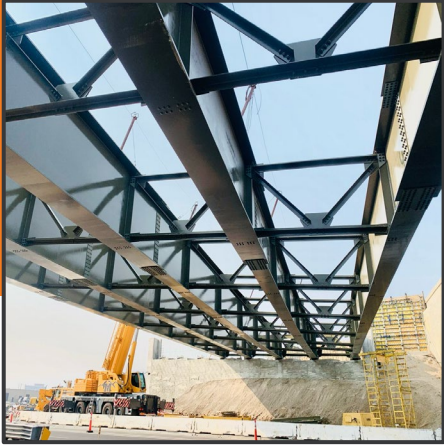
- Stiffness Compatibility
- Maintain Minimum Vertical Clearance



CONSTRUCTABILITY

- Longer Span Lengths
- Lighter Girder Weights
- No Falsework or Shoring Towers

STRUCTURE TYPES USED ON THE PROJECT



WELDED PLATE STEEL GIRDERS

- Haunched Girders used at Truckee
- Both Painted and Weathering Steel



PRECAST/ PRESTRESSED BULB TEE GIRDERS

- UBT50 (UDOT Shape)
- Chorded and Splayed Girders



CAST-IN-PLACE POST-TENSIONED BOX GIRDERS

- Varying Girder Depth
- Splayed Girders



PRECAST/ PRESTRESSED BOX BEAMS

- Adjacent Box Beams with Cast-in-Place Topping



CAST-IN-PLACE 4-SIDED BOX

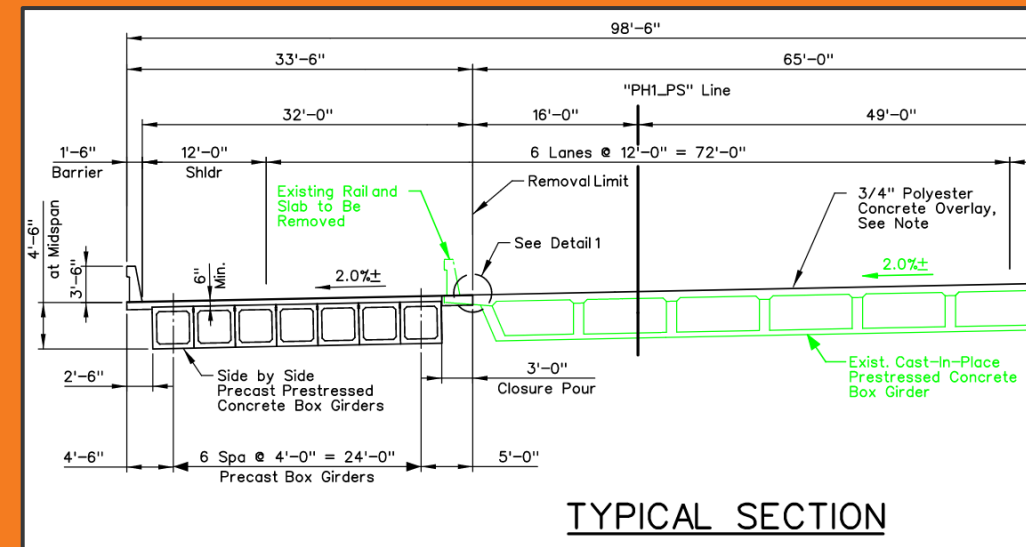
- High Skew Crossing with Over-Built Box
- Top Slab is not the Driving Surface

I-580 SB BRIDGE OVER VASSAR ST

- Layout
 - 115 ft Single Span
 - PC/PS Box Beams
 - Adjacent Beams with 6" CIP Topping
 - Harped Strand
 - Diaphragm-With-Footing Abutment on Spread Footings

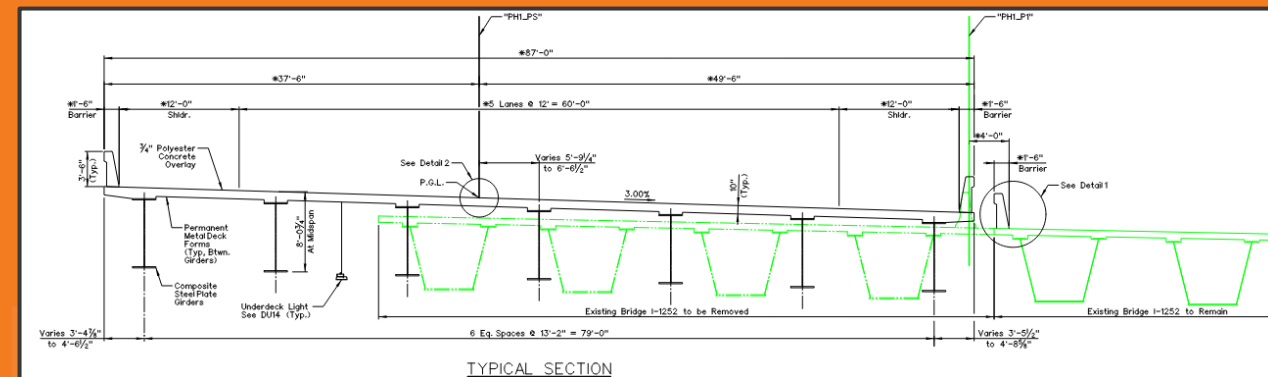
- Constraints
 - Widening Structure
 - Vertical Clearance
 - Span Length to Match Existing
 - Vassar Street to Essentially Remain Open During Construction

- Type Selection
 - Similar Stiffness with Existing CIP Box Girders
 - Shallow Structure Depth to Maintain MVC
 - Minimal Shoring During Construction



I-580 SB BRIDGE OVER MILL ST

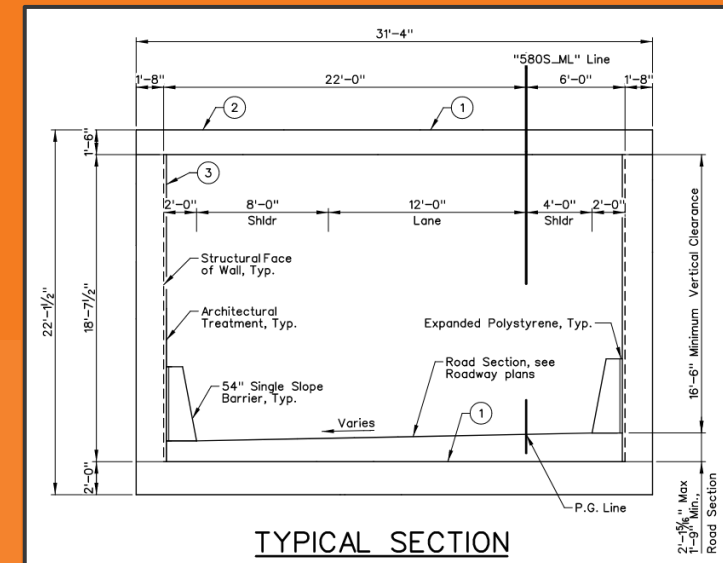
- Layout
 - 186.7 ft Single Span
 - Welded Plate Steel Girders
 - Constant Web Depth
 - Seat-Type Abutments on Drill Shafts
- Constraints
 - Needed to accommodate Wider Roadway and Sidewalk Below
 - Mill Street to Essentially Remain Open During Construction
- Type Selection
 - Tie-Back and Soil Nail Walls added to Accommodate Wider Roadway and Sidewalk
 - No Shoring Required
 - Lighter Girders
 - Longer Span with Shallower Structure Depth
 - Tub Girders more Expensive



TYPICAL SECTION

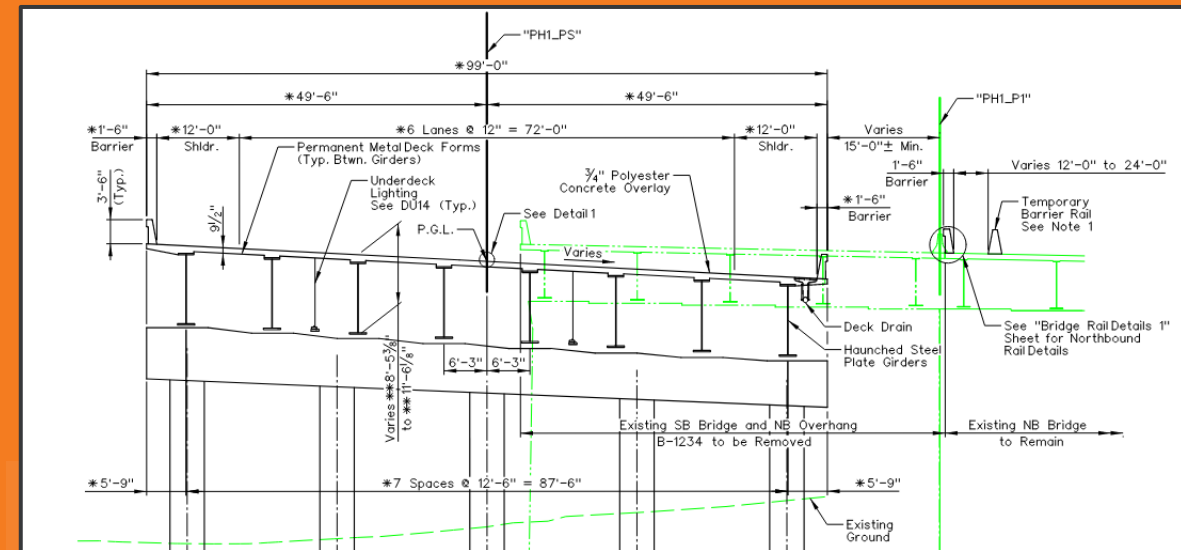
BRAIDED RAMP BRIDGE (I-580 SB OFF RAMP)

- Layout
 - CIP 4-Sided Box
 - 28 ft Clear Span
 - (40 ft Along Control Line)
 - 75 ft Length
 - Top Slab was not Driving Surface
 - Bottom Slab is Foundation
- Constraints
 - Roadway Geometry (Extreme Skew)
- Type Selection
 - Reference Design Showed Multi-Span Structure
 - Roadway Alignments were Revised to Maximize Crossing Angle
 - Shorter Span Structure



I-580 SB BRIDGE OVER KIETZKE LN AND TRUCKEE RIVER

- Layout
 - 444 ft Two Span Bridge
 - 259 ft and 185 ft Spans
 - Welded Plate Steel Girders
 - Weathering Steel
 - Haunched Girders
 - 10.5 ft Max. Web Depth
 - Seat-Type Abutments and Pier on Spread Footings



I-580 SB BRIDGE OVER KIETZKE LN AND TRUCKEE RIVER

- Constraints
 - Truckee River (Environmental Avoidance Area)
 - Pier Footing Below Scour Depth
 - Truckee Pathway and Kietzke Lane
- Type Selection
 - No Shoring Required
 - Lighter Girders
 - Much Longer Span Length



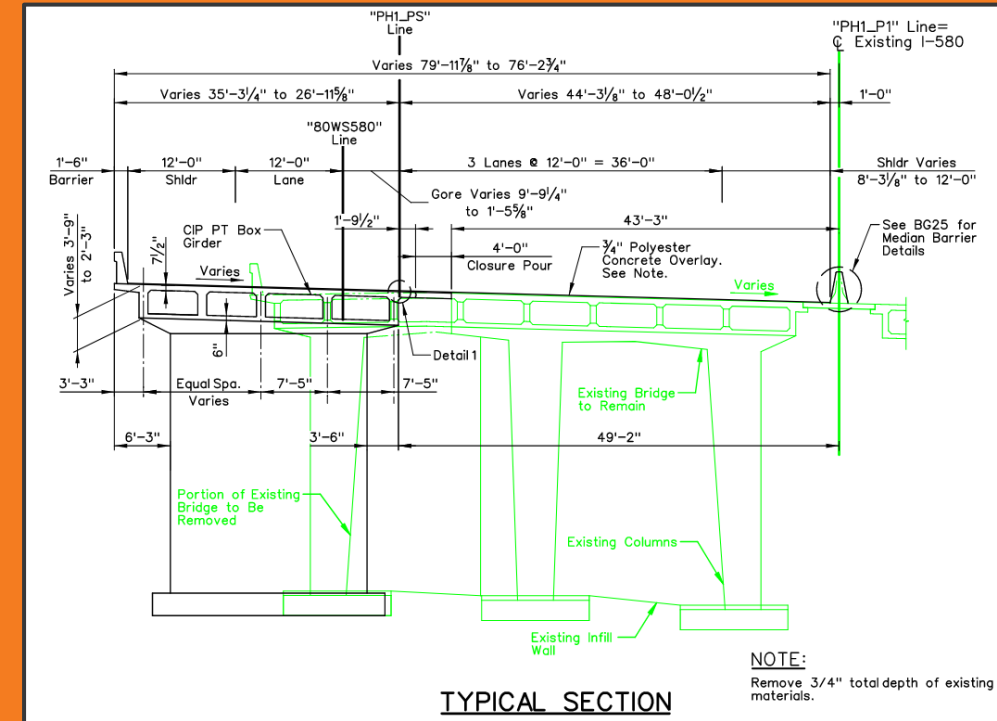
I-580 SB BRIDGE OVER UPRR AND 4TH ST

- Constraints
 - Two UPRR Tracks
 - Future UPRR Track
 - UPRR Access Road
 - 4th Street
 - Similar Bridge Length to Existing
 - Span Lengths to Clear High Pressure Petroleum Line
- Type Selection
 - No Shoring Required
 - Shallow Structure Depth
 - Phased Construction
 - Flexibility with Splayed Girders



I-580 SB BRIDGE OVER EN RAMP

- Layout
 - 140.9 ft Three Span Bridge
 - 36.6 ft, 66.0 ft and 36.6 ft Span Lengths
 - CIP Post-Tensioned Box Girders
 - Varying Web Depth
 - Splayed Girders
 - Seat-Type Abutments on Spread Footings
- Constraints
 - Span Lengths to Match Existing
 - EN Ramp Below
- Type Selection
 - Similar Stiffness to Existing
 - Shallow Girders



Lessons Learned

- Covid
 - Virtual Meetings
 - On-Site for Construction Issues
- Same Team
 - Good relationships with Owner, Oversight, Contractor and Designers
 - Worked through Solutions
- Haunches and Fit
 - Allowing for Field Adjustments
 - Deeper Haunches for Unexpected Camber and Field Tolerances



Questions?



Thank You