



FINLEY

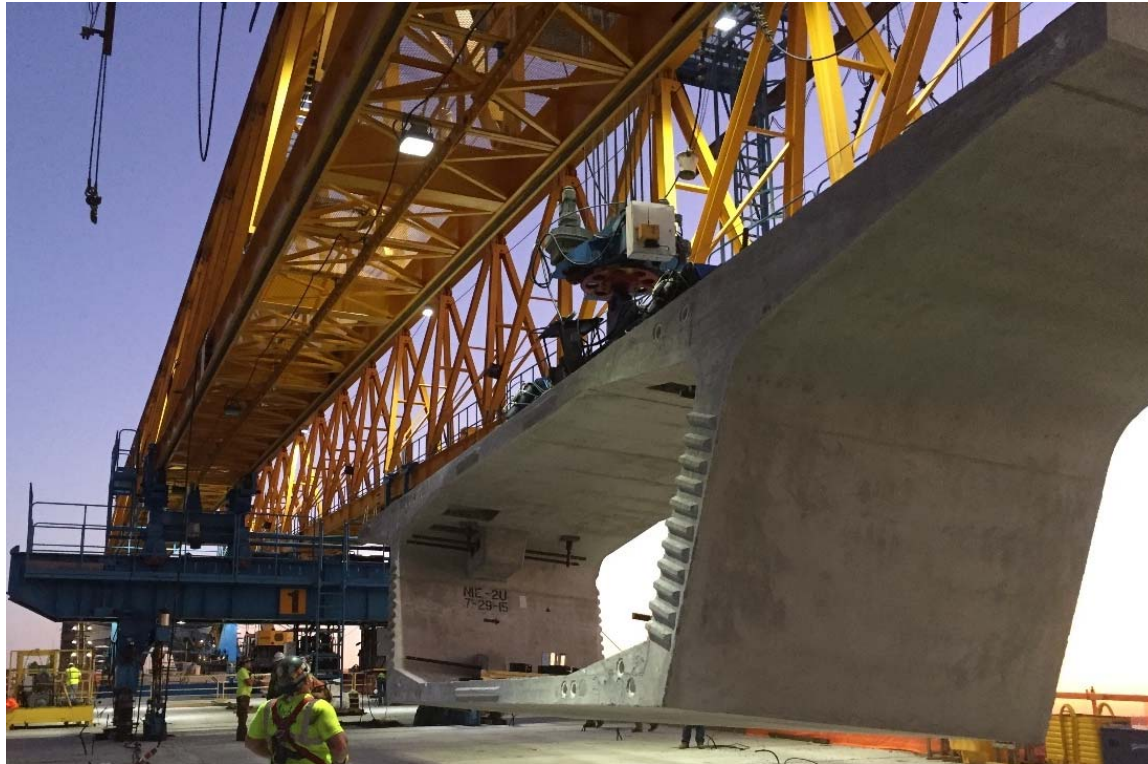
WWR within Precast Segmental Bridges
Fall 2019 Wire Reinforcement Institute
Ivan Liu, P.E.



Introduction

Ivan Liu, P.E. – Bridge Engineer at FINLEY Engineering Group

- Structural engineering graduate from Texas A&M University
- 6+ years in Bridge Design and Construction Industry with FINLEY
- Majority of project work in complex concrete bridge structures



Presentation Topics

- Introduction to precast segmental bridges
- Project example of welded wire reinforcement
- Precast box girder reinforcement
- WWR implementation in design and construction
- Impact for precast bridge construction

Precast Segmental Bridges

What are Precast Segmental Bridges?



Precast Segmental Advantages

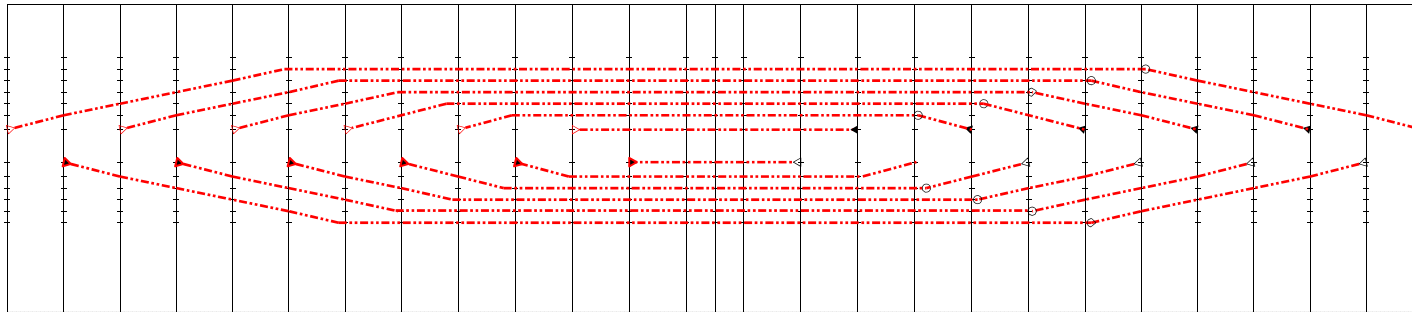
Advantages over conventional bridges -

- Accelerated bridge construction
- Longer spans vs. FIB spans
- Aesthetics
- Casting Efficiency vs. Cast-in-place segmental

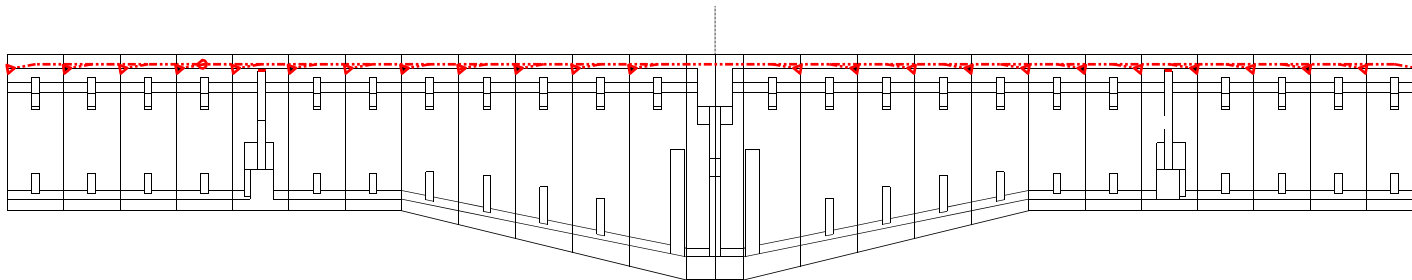


Design and Construction Requirements

What is generally considered during design?



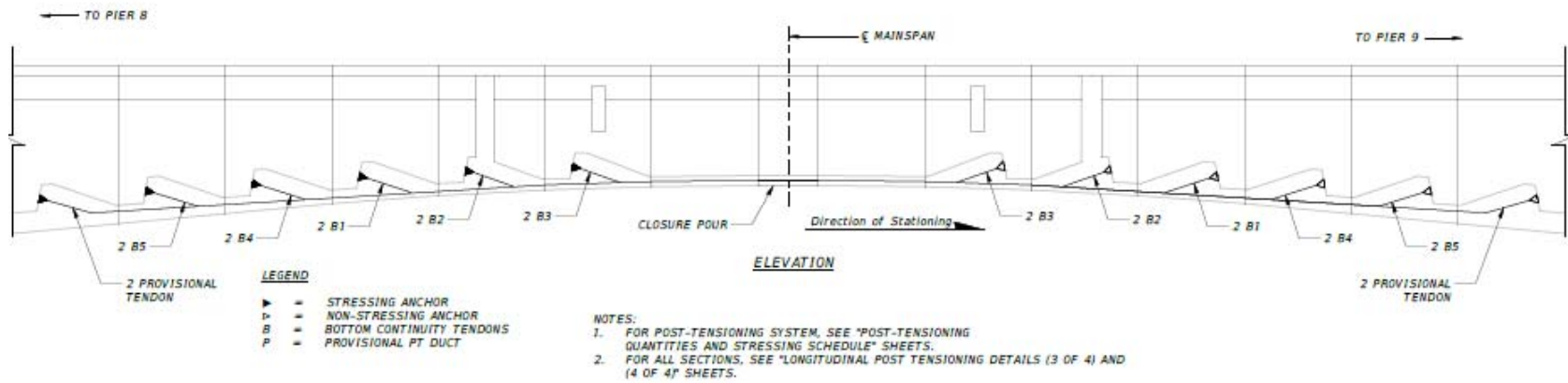
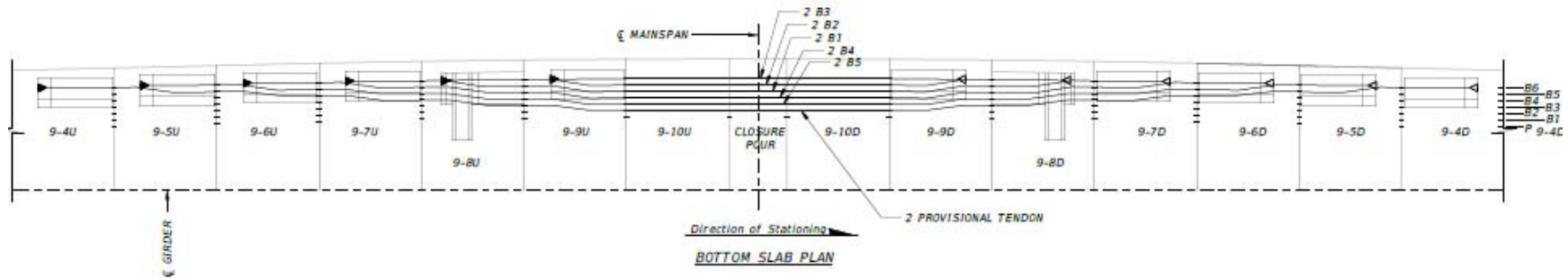
PLAN
SCALE: N.T.S



ELEVATION
SCALE: N.T.S

Design and Construction Requirements

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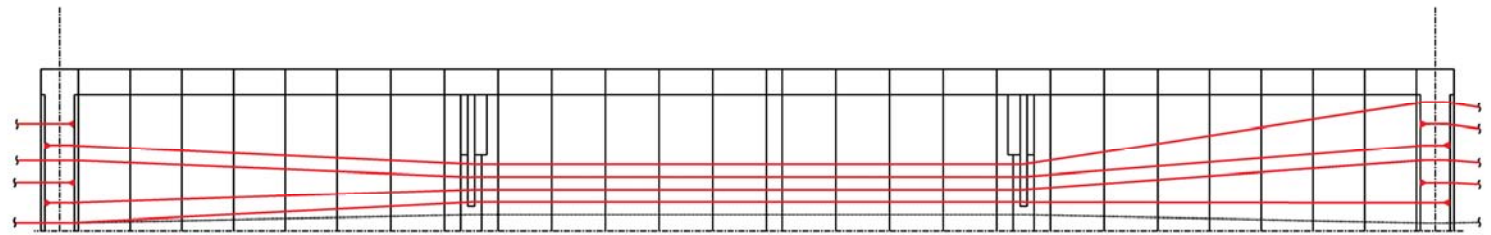
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PLAN



ELEVATION

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Design and Construction Requirements

What is generally considered during construction?



Precast Segment Erection by Crane

- Non-linear construction sequence
- Use with support towers



Precast Segment Erection by Gantry

- Two-leg or three-leg support configurations
- Alternative for lack of ground-level accessibility.



Span by Span Precast Erection

- Linear construction sequence
- Precast segments delivered from ground-level



Casting of Segments

- Multiple casting cells with short-line casting method



Casting of Segments



Casting of Segments



Conventional Cage Fabrication

- Templates or jigs made for single bar assembly



Conventional Cage Fabrication



Conventional Cage Fabrication

- Example of precast column members



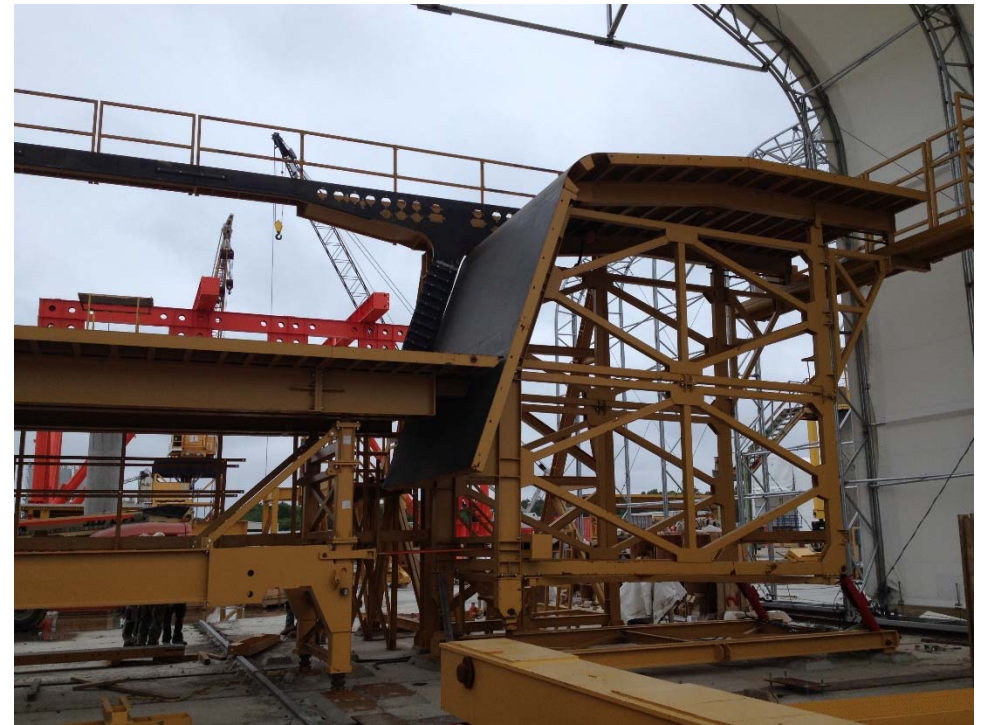
Precast Segment Formwork

- Steel formwork panels
- Interchangeable components for casting details



Precast Segment Formwork

- Outer and inner core forms are adjustable for variations in concrete dimensions



Precast Segment Formwork

- Interchangeable form panels for blisters or bulkheads



Casting Yards

- Storage of segments for erection
- Multiple casting cells at the yards



Road 431- Tel Aviv, Israel

Project description:

- Build – Operate – Transfer Project (June 2009 Completion)
- Owner – Netivay Hayovel Ltd.
- Contractor – Cebus Rimon Industrialized Construction Ltd.

- 6 Precast Segmental Bridges
- 12.5m deck width, 30 to 66m spans, 18,000 sqm total deck area
- First use of External Post-Tensioning Tendons in Israeli Bridge Structure

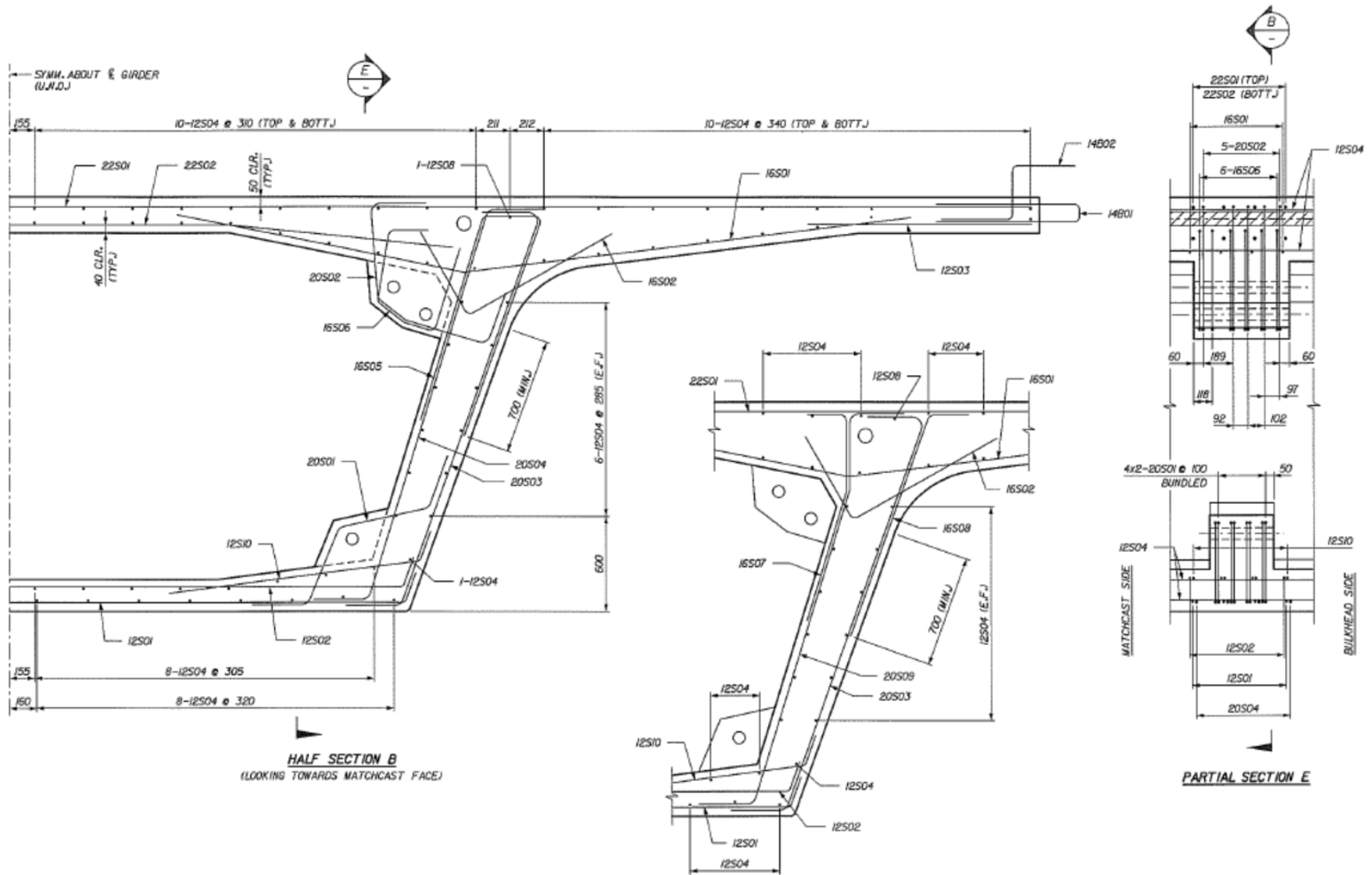


Road 431- Tel Aviv, Israel

- Bottom and top slab deformed welded rebar layers



Road 431- Tel Aviv, Israel



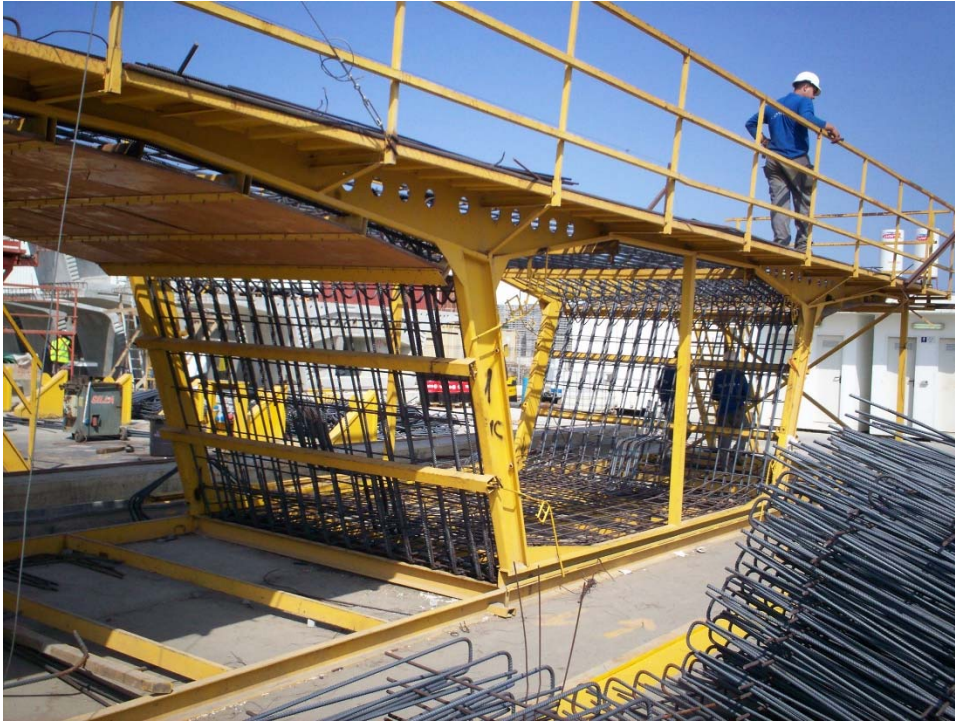
Road 431- Tel Aviv, Israel

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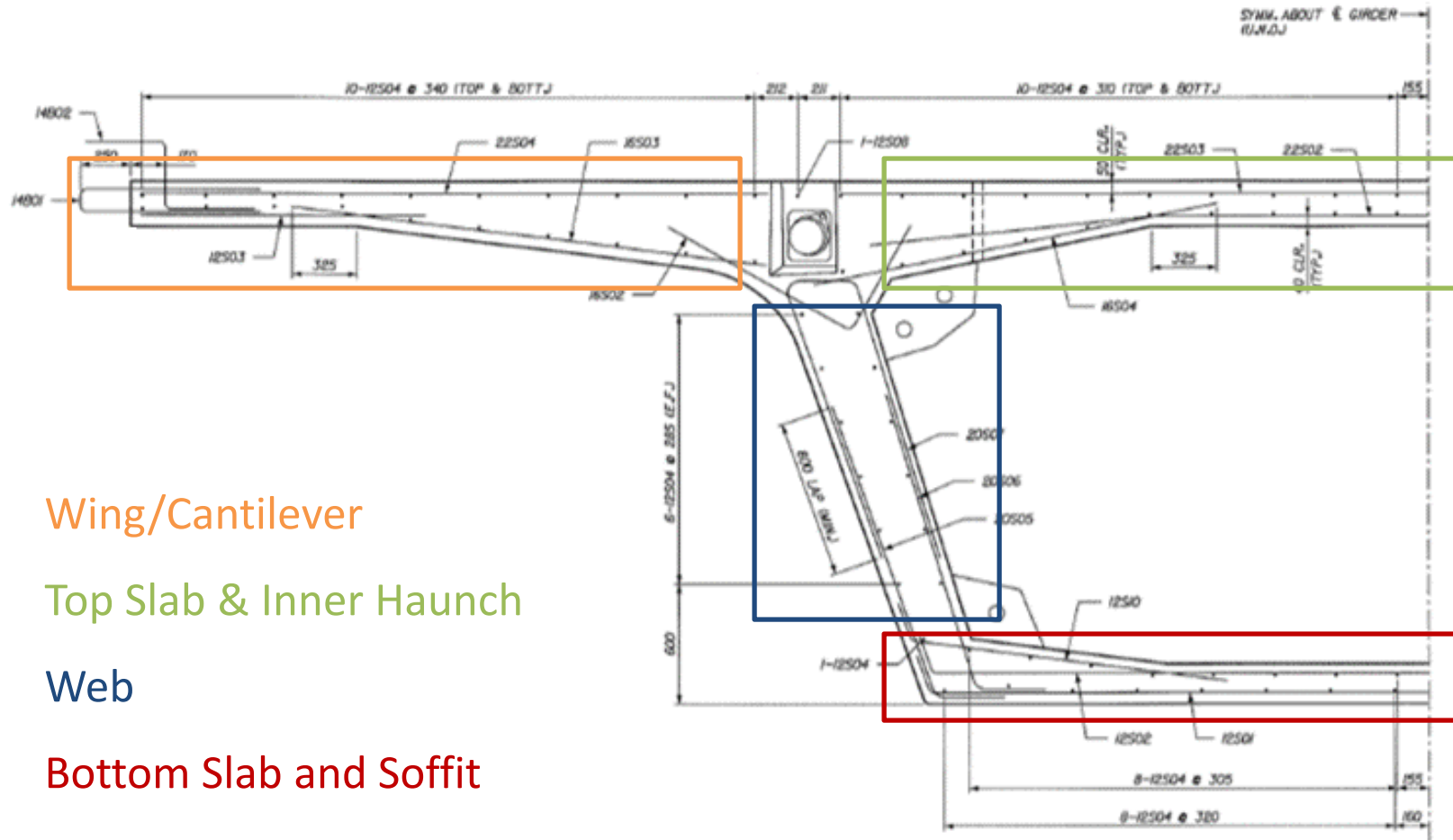
Road 431- Tel Aviv, Israel

- Cage fabrication with the welded rebar layers
- 6 hrs of labor for U.S. standard cage vs. 4 hrs for Israel using WWR



Reinforcement Design & Details

What makes up reinforcement in box girders?



- Wing/Cantilever
- Top Slab & Inner Haunch
- Web
- Bottom Slab and Soffit

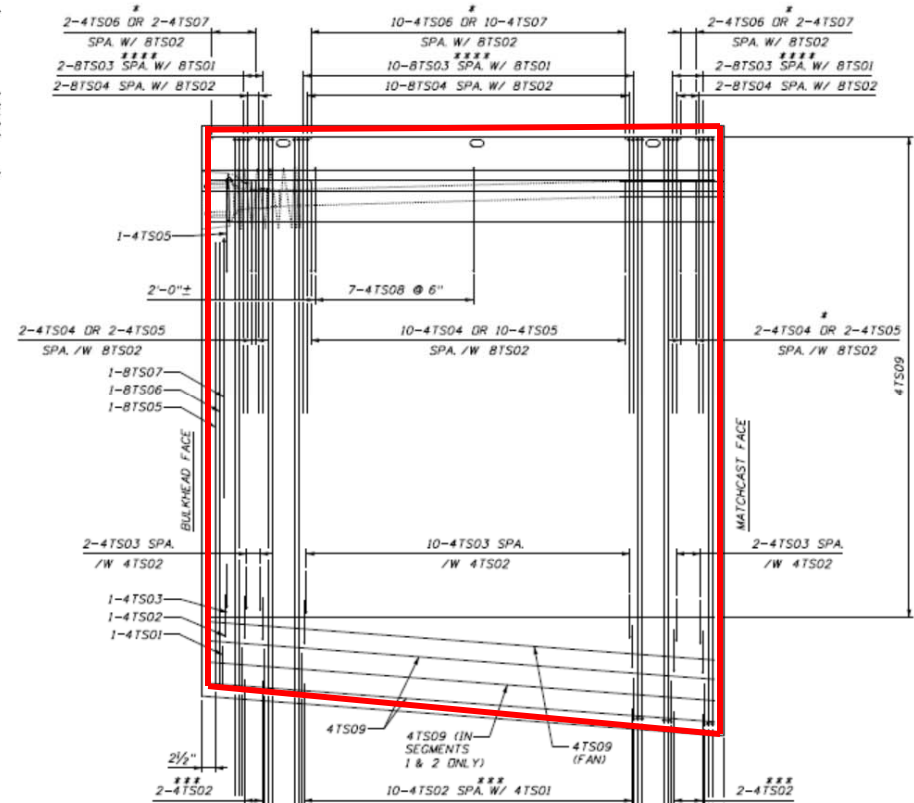
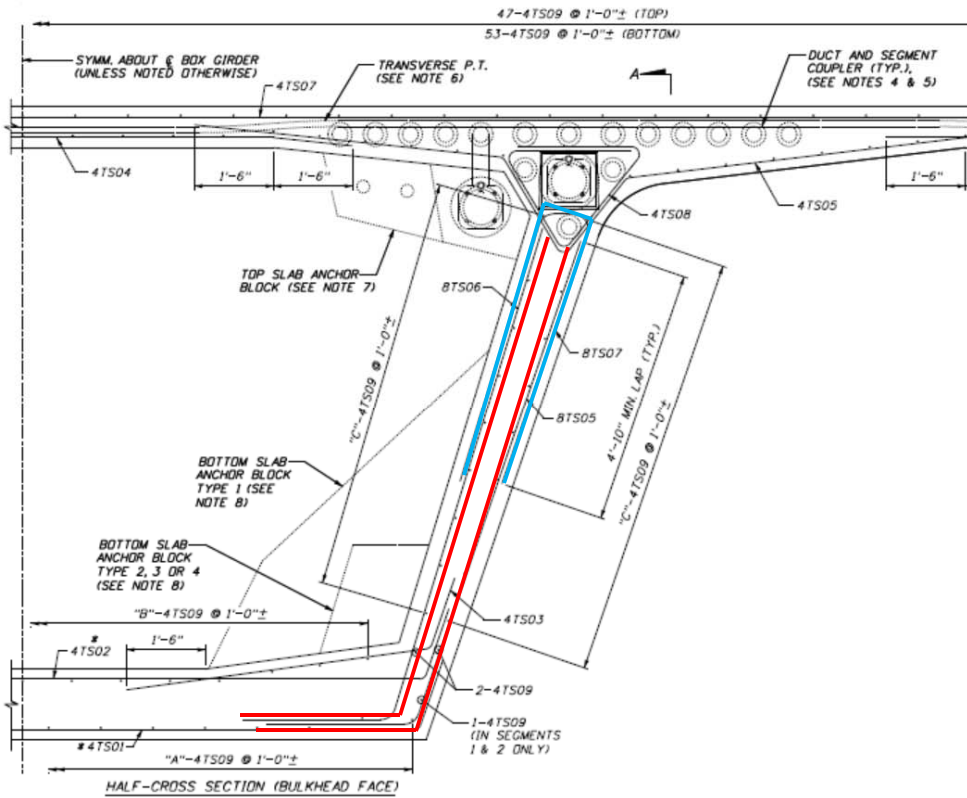
Rebar Patterning

Key considerations for Rebar patterns and design for precast:

- Consistent Size Spacings
- Minimize unique bar shapes
- Rebar congestion
- Cage Constructability
- Segment Height and Curvature Geometry

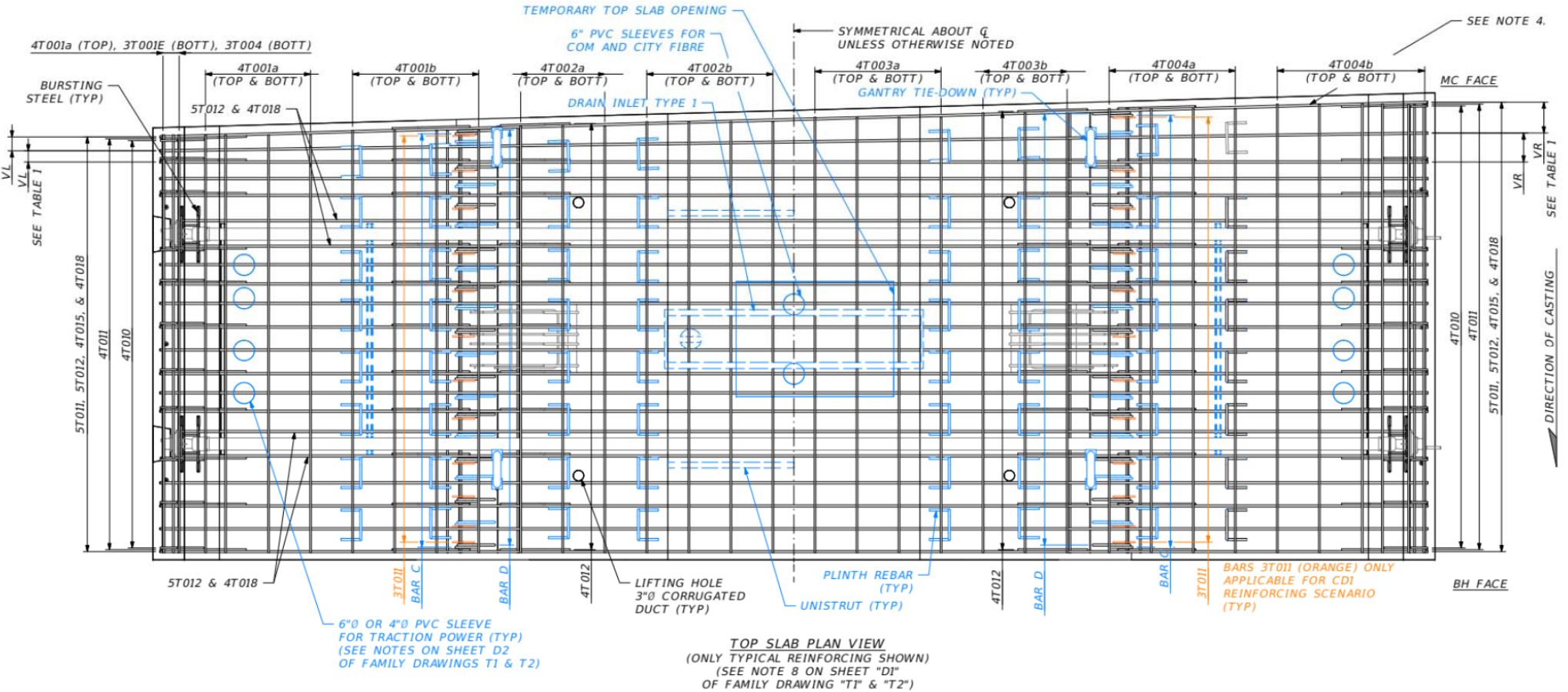
Varying Concrete Dimensions

Rebar considerations for varying concrete dimensions?



Varying Concrete Dimensions

Rebar considerations for varying concrete dimensions?



Road 431- Tel Aviv, Israel

- Casting procedures for Rd. 431 segments



WWR Implementation

Where and How to incorporate WWR?

- Top slab and Bottom slab reinforcement
- Cantilever wings for constant width decks
- Slab rebar generally for temperature and shrinkage
- Take advantage of higher grade steel for rebar congestion
- Advantageous for tangent or high-radius bridge geometry



Industrialization Advantages

- Process, Quality Control, and Organization



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Industrialization Advantages

- Efficiency and speed for construction
- Poor casting equals major delays



Complex Bridge Applications

What are the limitations on WWR in the US for complex bridges?

- Minor applications currently used for DOT and Federal projects
- Little to no project used of WWR for complex bridge components
- Limited fatigue studies for welded wire reinforcement
- Engineer's perception of welding rebar
- Variation in concrete geometry for precasting

Project Impact

What would be the impact on precast bridge design and construction?

- Accelerate precasting operations
- Quality control
- Lower fabrication costs
- Standardization of design rebar patterns
- High ceiling for design capacity

Why not in the U.S. for Precast Segmental Bridge?



Questions?



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