

JACOBS®



ILLINOIS TRANSPORTATION
AND HIGHWAY ENGINEERING
CONFERENCE

A blue arch graphic with three vertical supports, resembling a bridge structure, positioned above the text.

THE OHIO RIVER
BRIDGES

P3 & Design-Build

**101st Annual THE Conference
February 25th, 2015**

Speaker:

Andrew Gensch, P.E.

Presentation Outline

- **Ohio River Bridges Project Overall Discussion**
 - Downtown Crossing and East End Locations
 - Program Goals
 - Cost
 - Schedule
- **Downtown Crossing**
 - Project Overview/Facts, Teams, Delivery Method
 - Sections 1, 2, and 3 – Overview, Technical Highlights, Challenges/Solutions
- **East End Crossing**
 - Project Overview/Facts, Teams, Delivery Method
 - Sections 4, 5, and 6 – Overview, Technical Highlights, Challenges/Solutions

Project Location – Louisville, Kentucky



East End Crossing

Downtown Crossing

Project Goals

- **Provide regional redundancy for Ohio River Crossings (Both Projects)**
- **Add additional crossing over the river east of Louisville (East End)**
- **Provide by-pass around downtown Louisville for traffic to I-65 north and east (East End)**
- **Upgrade the outdated “spaghetti junction” intersection downtown Louisville (Downtown Crossing)**
- **Rehabilitate existing JFK bridge (Downtown Crossing)**
- **Construct C-D system north of river in Indiana (Downtown Crossing)**

Project Delivery Methods

- **Downtown Crossing – Design Build**
 - Design and construction services are contracted by a single entity - DBT
 - Teaming Agreement
 - RFQ Submission
 - Shortlist
 - Prelim Design and Estimate
 - Contract Award Based on Price and Technical Score
 - Project Execution
- **East End – Public Private Partnership (P3, or PPP)**
 - Operation and Maintenance
 - Warranty Period
 - Flow Down provisions from agreements between Design Builder and Concessionaire
 - Interaction with the project owner – limitations
 - The review cycle – Concessionaire has a say!

Project Cost

Total Project Costs in Year of Expenditure Dollars (in millions)			
Project Segment	2012 IFP	2013 Update	Difference
Downtown Crossing			
Section 1 - Kennedy Interchange	659.8	586.4	(73.4)
Section 2 - Downtown Bridge	357.8	323.2	(34.5)
Section 3 - Downtown IN Approach	197.7	182.9	(14.8)
Kentucky Other Costs	92.3	176.2	83.9
Total Downtown Crossing	1,307.6	1,268.7	(38.9)
East End Crossing			
Section 4 - KY East End Approach	737.6	500.7	(236.8)
Section 5 - East End Bridge	284.4	247.5	(36.9)
Section 6 - IN East End Approach	196.1	218.7	22.6
Indiana Other Costs	58.2	108.7	50.5
Total East End Crossing	1,276.3	1,075.7	(200.6)
PROJECT TOTAL	2,583.9	2,344.4	(239.5)

- (1) Totals may not sum due to rounding.
- (2) Other Costs include project-wide costs that are not specific to individual project sections and include such costs as those incurred for historic mitigation and enhancements (not tied to any particular section), project development, general engineering and other professional fees and administrative expenses. Kentucky's share of project-wide costs is shown as part of the Downtown Crossing expenditure and Indiana's share of project-wide costs is shown as part of the East End Crossing expenditure.
- (3) Project costs do not include financing and interest costs, addressed in Chapter 4.

Project Schedule

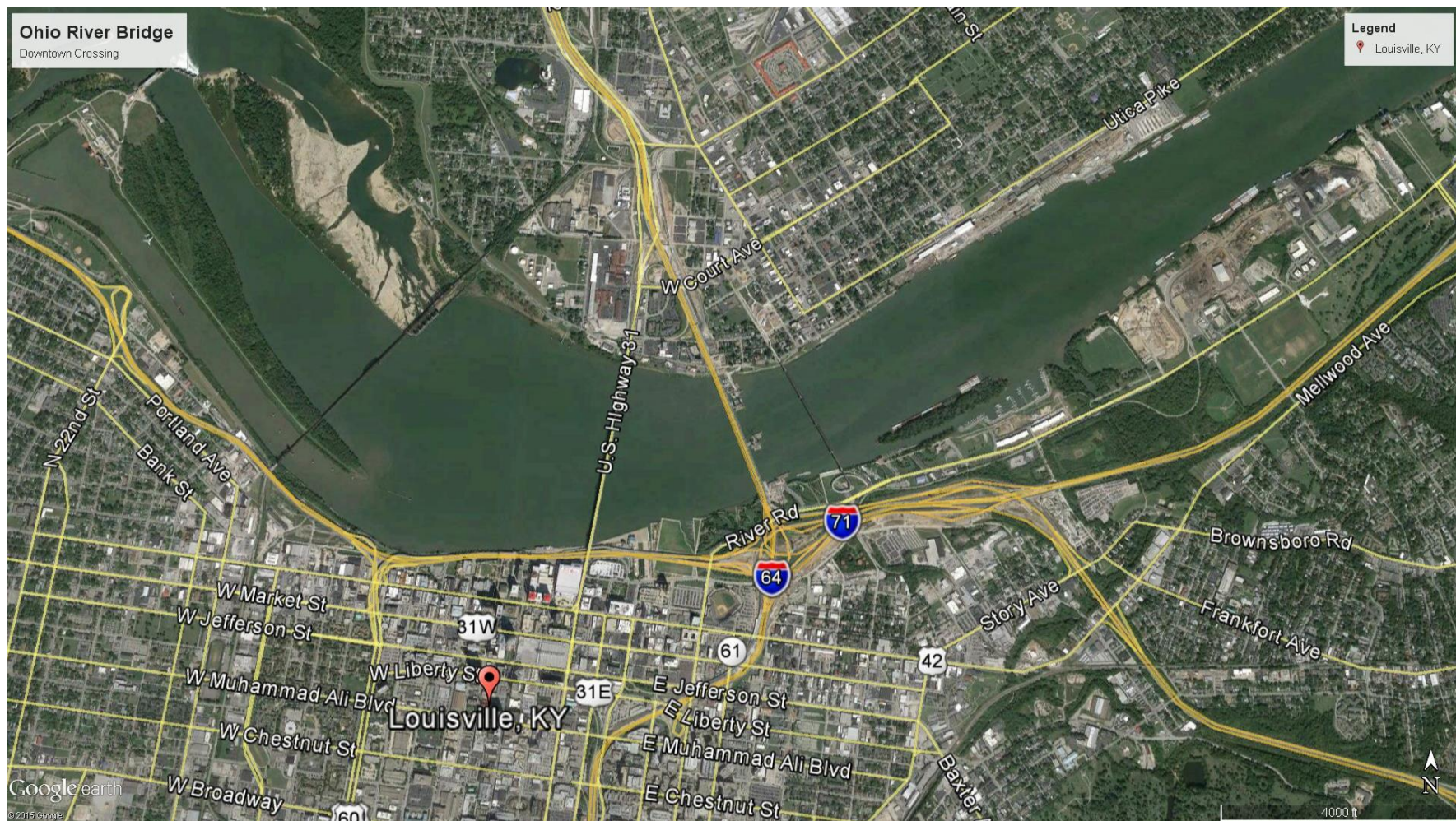
State Fiscal Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Downtown Crossing																
Environmental	Update - June 2012								IFP							
Design	Update - July 2015										IFP					
Right-of-Way					Update - March 2015						IFP					
Utilities									Update - April 2016				IFP			
Construction									Update - April 2017						IFP	
Other *	Update - June 2019**															
East End Crossing																
Environmental	Update - June 2012								IFP							
Design	Update - October 2016										IFP					
Right-of-Way		Update - June 2014						IFP								
Utilities									Update - June 2014				IFP			
Construction									Update - February 2017						IFP	
Other*	December 2018**															

*Includes state costs for toll system, project-wide mitigation, and oversight costs. **IFP did not include Other category.

Downtown Crossing – Design Build



Downtown Crossing Location – Louisville, Kentucky



Downtown Crossing Project Facts/Overview

- Section 1 - Reconfigure Spaghetti Junction (I-64, I-65 and I-71) (Blue)
- Section 2 - Build a new I-65 bridge with six northbound lanes (Yellow)
- Section 2 - Rehab Kennedy Bridge (I-65) with six southbound lanes (Yellow)
- Section 3 - Reconfigure Indiana roadway and bridge approaches (Red)
- Project Cost \$1.27B



Downtown Crossing Project Team

Design Build Team:



Owner:



• Design Team

- **JACOBS®** - Management, Structures, Geotechnical, MOT, River Hydraulics
- **Applied Research Associates** – Bridge Security
- **Buckland and Taylor** – Cable Stay Designer
- **Earth Exploration** - Geotechnical
- **GRW** – Lighting, Electrical, Utilities
- **International Bridge Technologies** – Independent Bridge Check
- **Linebach Funkhouser** – Contaminated Materials
- **MacDonald Architects** – Bridge Lighting Aesthetics
- **Clough, Harbour & Associates (formerly RW Armstrong)** – Section 3 Road, Drainage, Structures
- **Rowan, Williams, Davies, and Irwin (RWDI)** – Wind Engineering
- **Stantec** – Section 1 Bridges, Drainage, Roadway – Project Wide Aesthetics

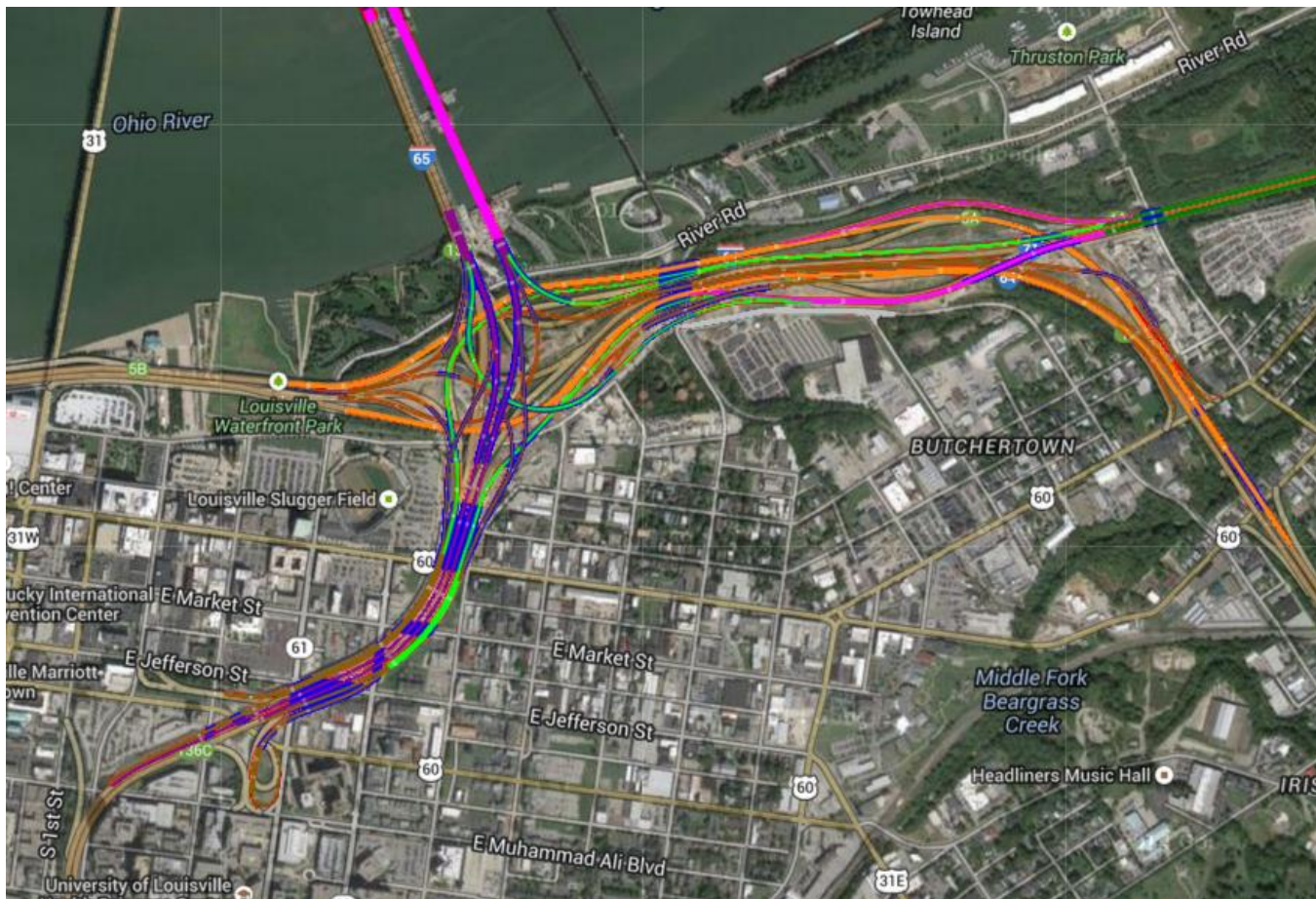
Downtown Crossing Design Offices

- **Project Office**
- **Section 1**
 - St. Louis
 - Lexington
 - Louisville
- **Section 2**
 - Seattle/Vancouver
- **Section 3**
 - Indianapolis
 - St. Louis



Downtown Crossing – Section 1 Overview

- Downtown Louisville at the intersection of I-64, I-65, and I-71
- 48 permanent bridges, 3 temporary, 30 walls, 25 ramps



Downtown Crossing – Section 1 Technical Highlights

- **Multiple stages of MOT**
- **Complex geometry with 3 intersecting interstates, multiple fly over bridges**
- **Limited ROW to the south on I-65, staged bridge construction**



Downtown Crossing – Section 1 Challenges/Solutions

- **Challenge**

- Initial Design – Friction Piles
- Unanticipated subsurface conditions discovered after most substructure design was complete
- First Pile drives made several feet of progress first blows

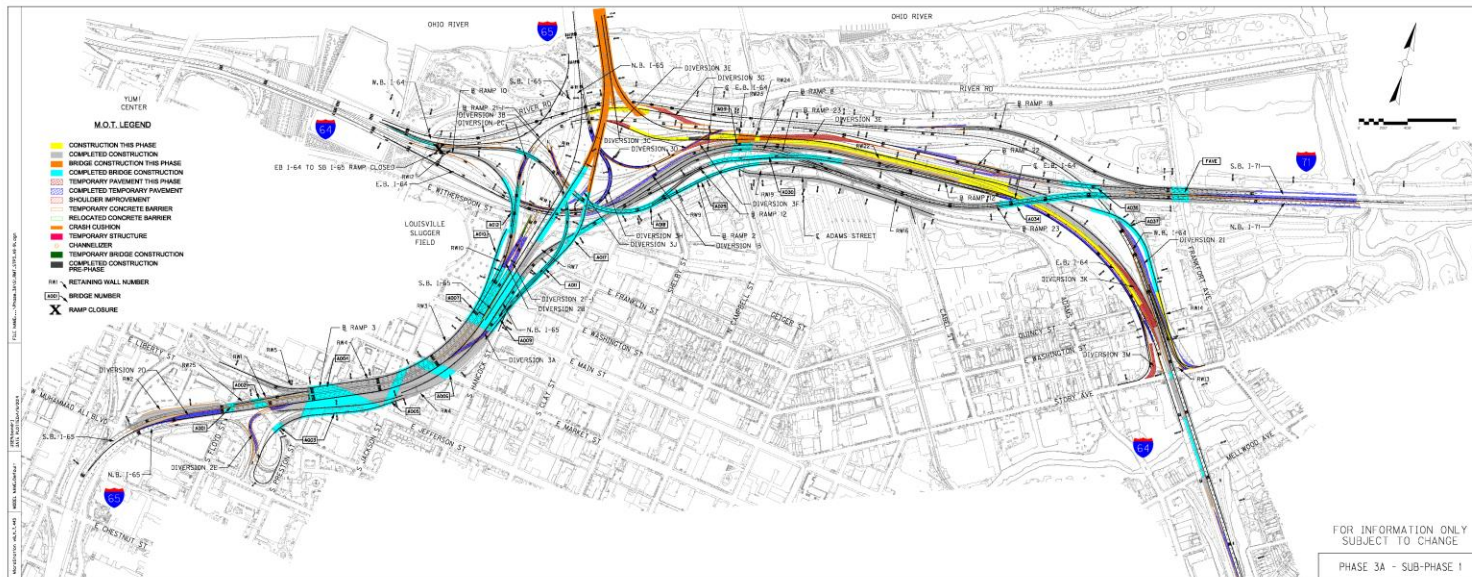
- **Solution**

- Substructure was redesigned
- Fewer, Smaller Piles
- Driven to Rock
- Resulted in Material / Schedule Savings



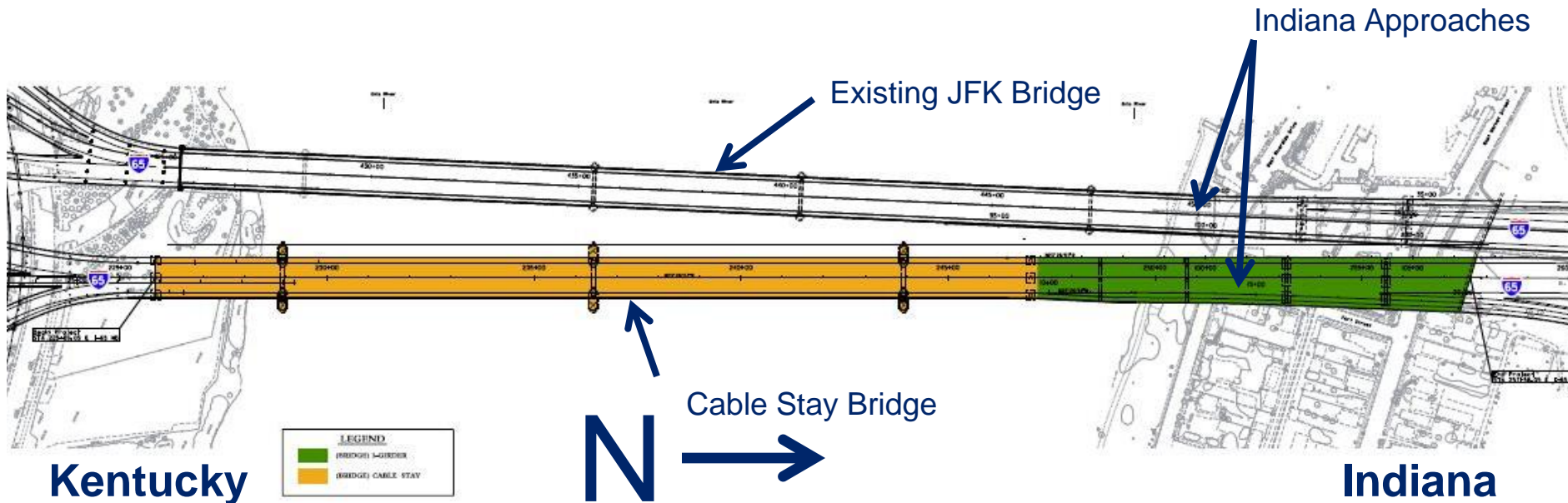
Downtown Crossing – Section 1 Challenges/Solutions

- **Challenge**
 - Complex MOT and Utility Coordination
 - Multiple Stages
- **Solution**
 - MOT Task Force meetings with designer, contractor, owner, interested parties
 - Utilized multiple traffic calming methods
 - Involved local police for traffic enforcement
 - On going revision process to accommodate dynamic construction environment



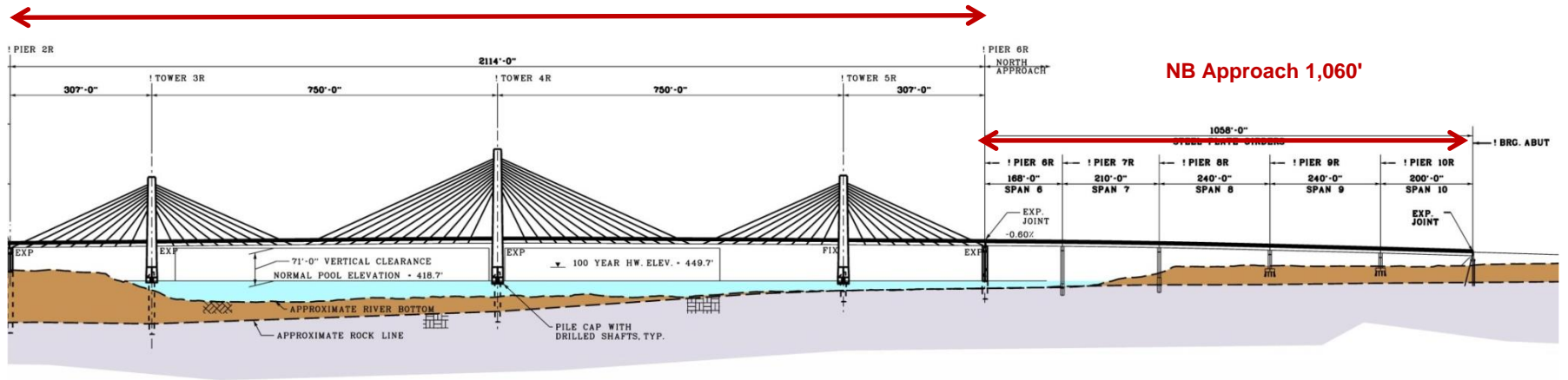
Downtown Crossing – Section 2 Overview

- NB I-65
 - Cable Stay Bridge and Indiana Approach Bridge
- SB I-65
 - Existing Steel Truss JFK Bridge and Indiana Approach Bridge



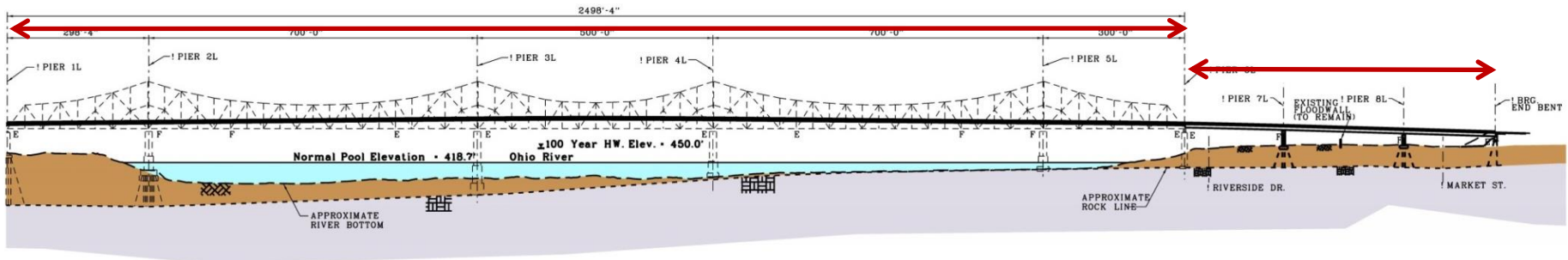
Downtown Crossing – Section 2 Overview

Cable Stayed 2,106'

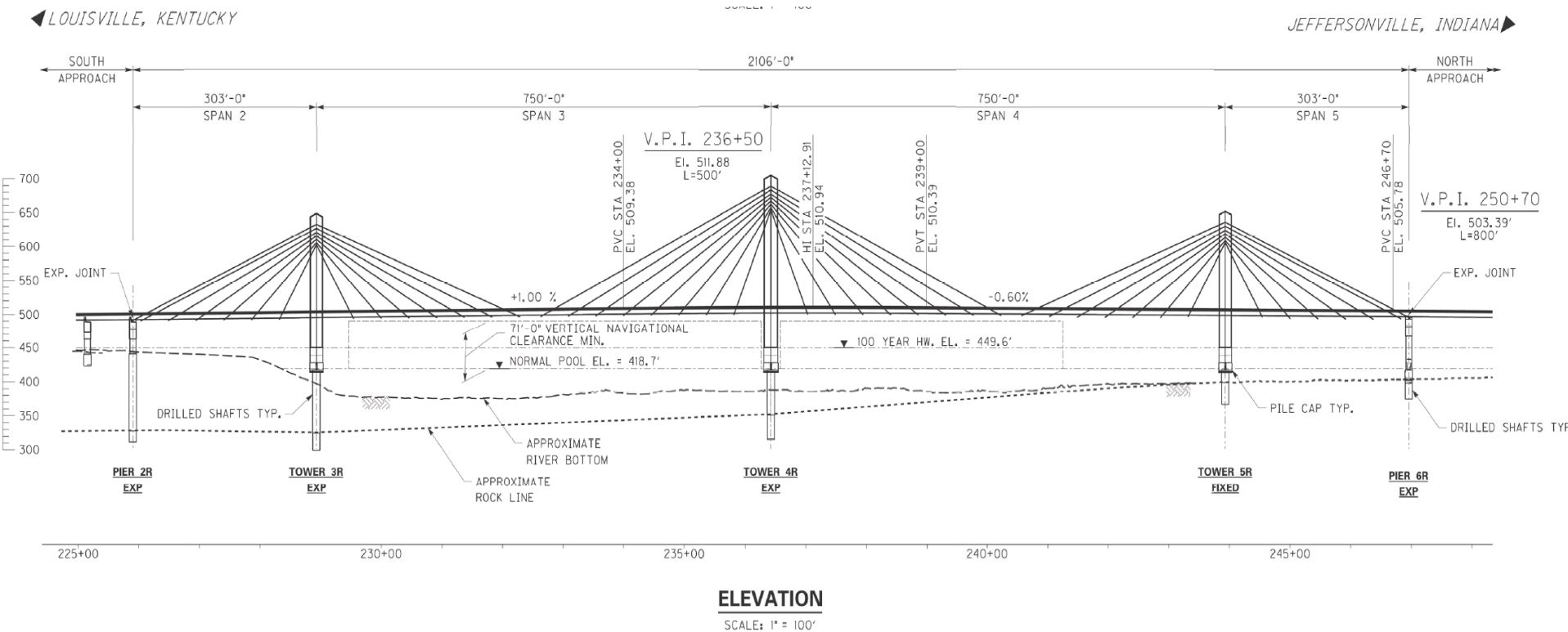


Existing JFK Bridge 2,497'

SB Approach 659'



Downtown Crossing – Section 2 Technical Highlights

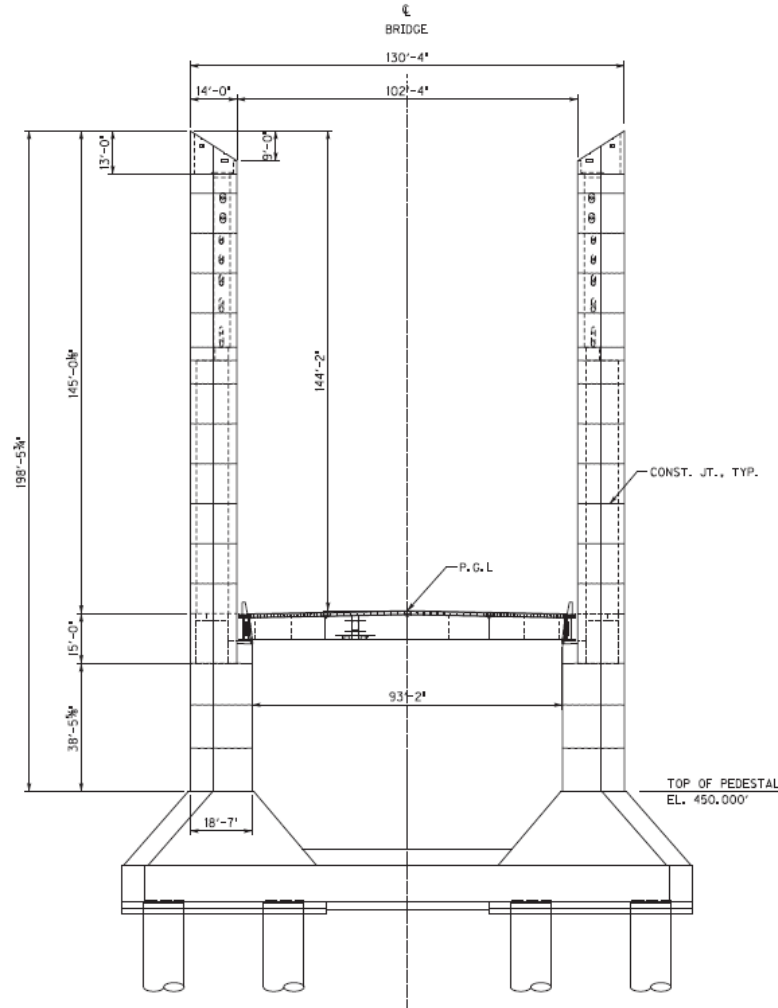


NB I-65 Cable Stay Bridge Design

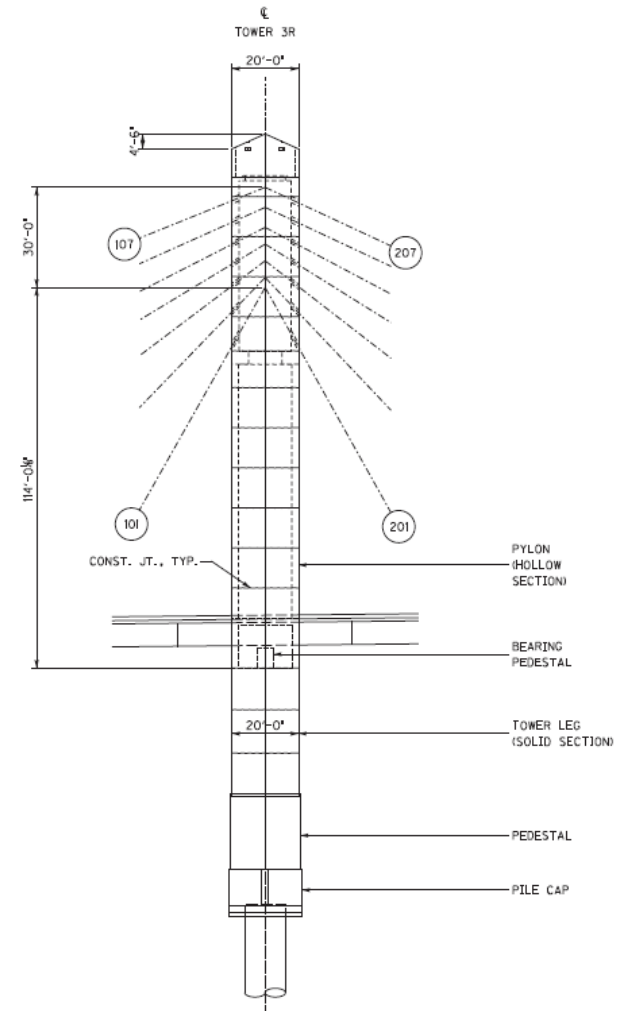
3 Towers (Center Tower 254' Tall, North and South Towers 198' Tall)

4 Spans (Center Spans 750' Long, Outer Spans 303')

Downtown Crossing – Section 2 Technical Highlights



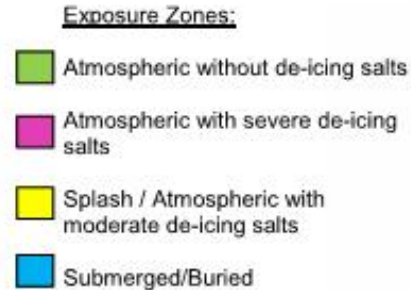
TRANSVERSE ELEVATION
SCALE: 1"=20'



LONGITUDINAL ELEVATION
SCALE: 1"=20'

Cable Stay Bridge Design

Downtown Crossing – Section 2 Challenges/Solutions

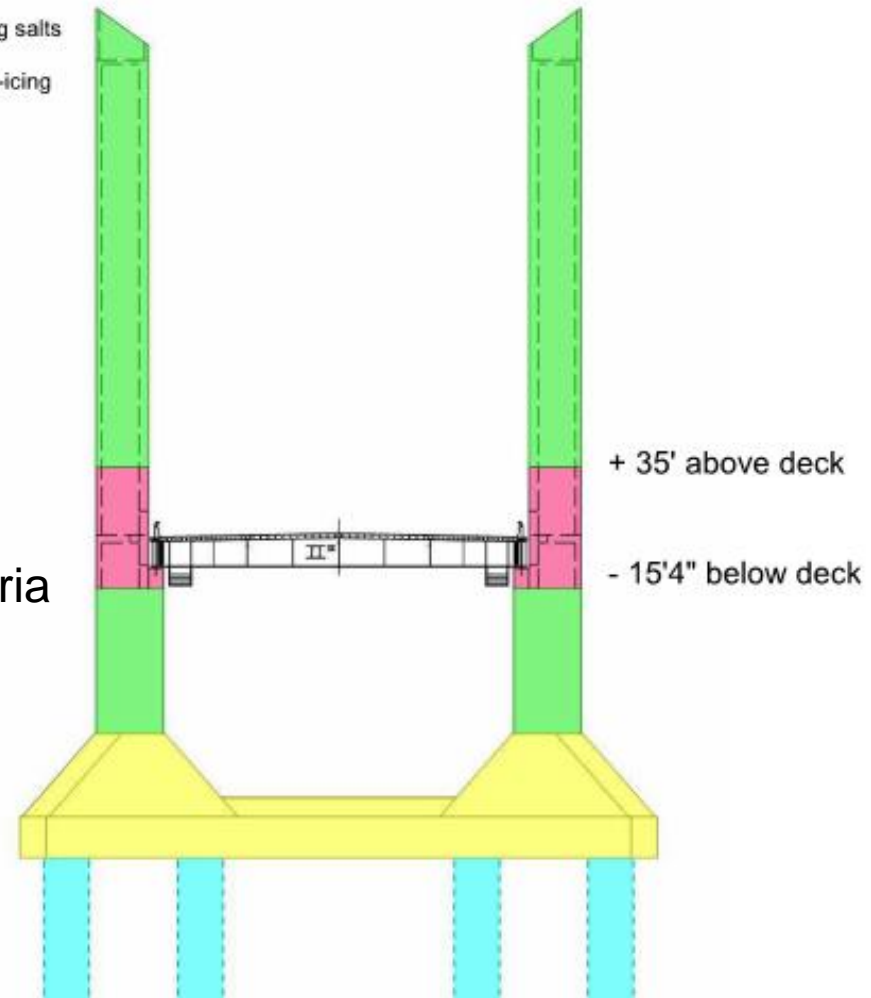


- **Challenge**

- Design Structure for durability
- Different Exposure Zones

- **Solution**

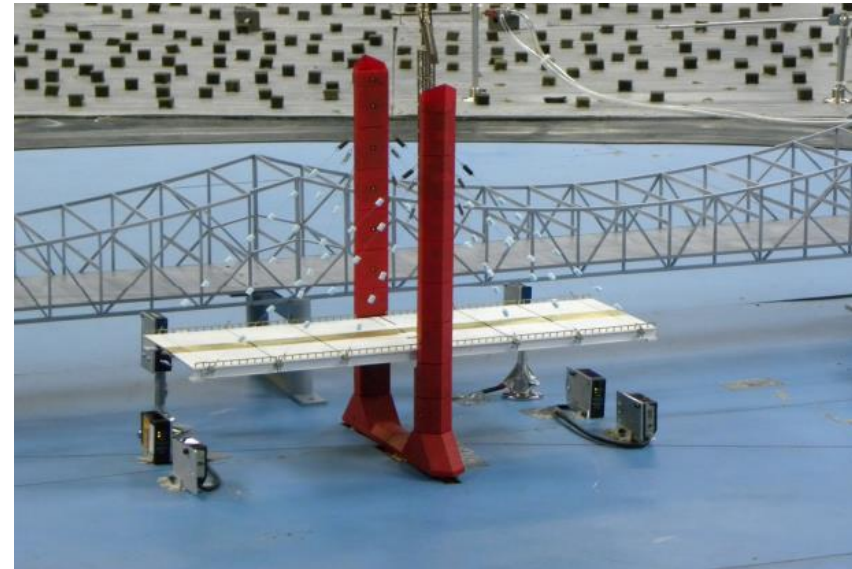
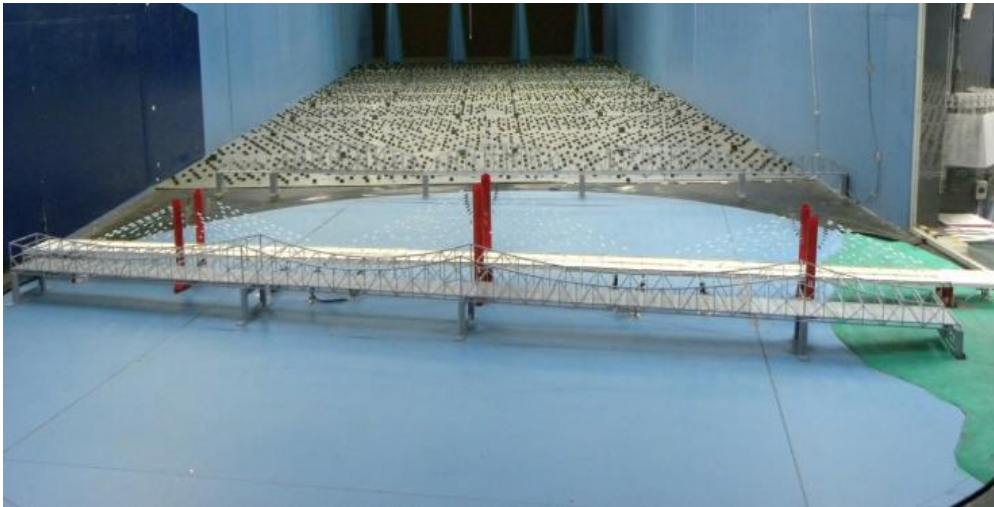
- Delineate Exposure Zones
- Develop Zone Specific Durability Criteria
- Design Modifications –
 - Concrete Mix – Flyash and Slag
 - Rebar Coating requested from KYTC
 - Corrosion Inhibitor at Road Level



Durability Design of Structure

Downtown Crossing – Section 2 Challenges/Solutions

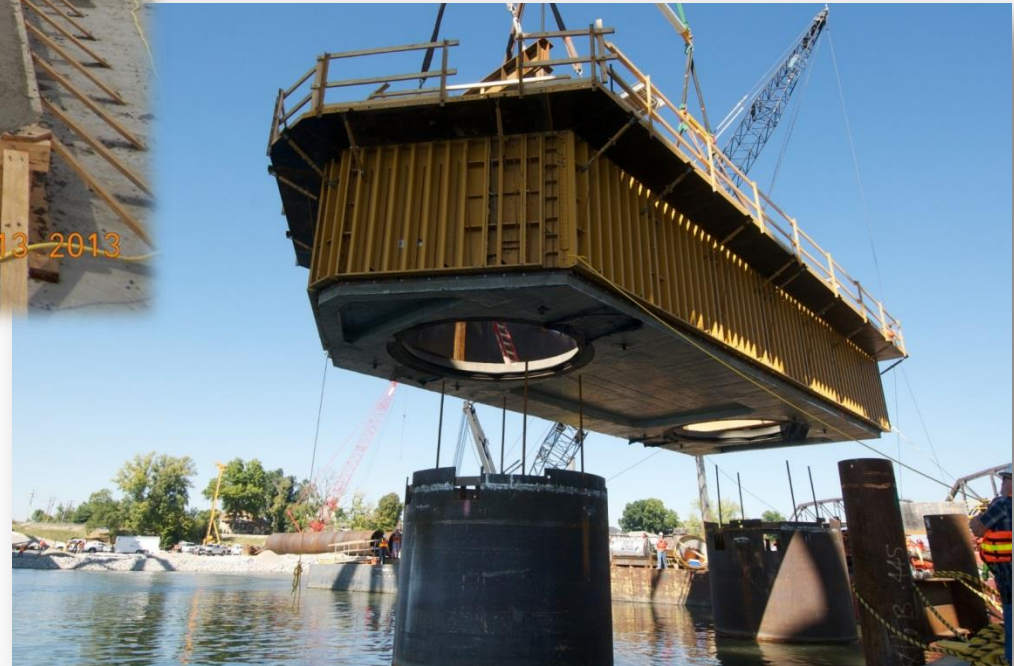
- **Challenge**
 - Determine the effects of Wind on Structure during construction and when completed.
- **Solution**
 - Scale Model of Existing JFK and new Bridge Built in Wind Tunnel
 - Modeled Completed Cable Stay Bridge
 - Modeled Various Critical points During Construction for Stability



Downtown Crossing – Section 2 Photos



Downtown Crossing – Section 2 Photos



Downtown Crossing – Section 2 Photos



Downtown Crossing – Section 2 Photos

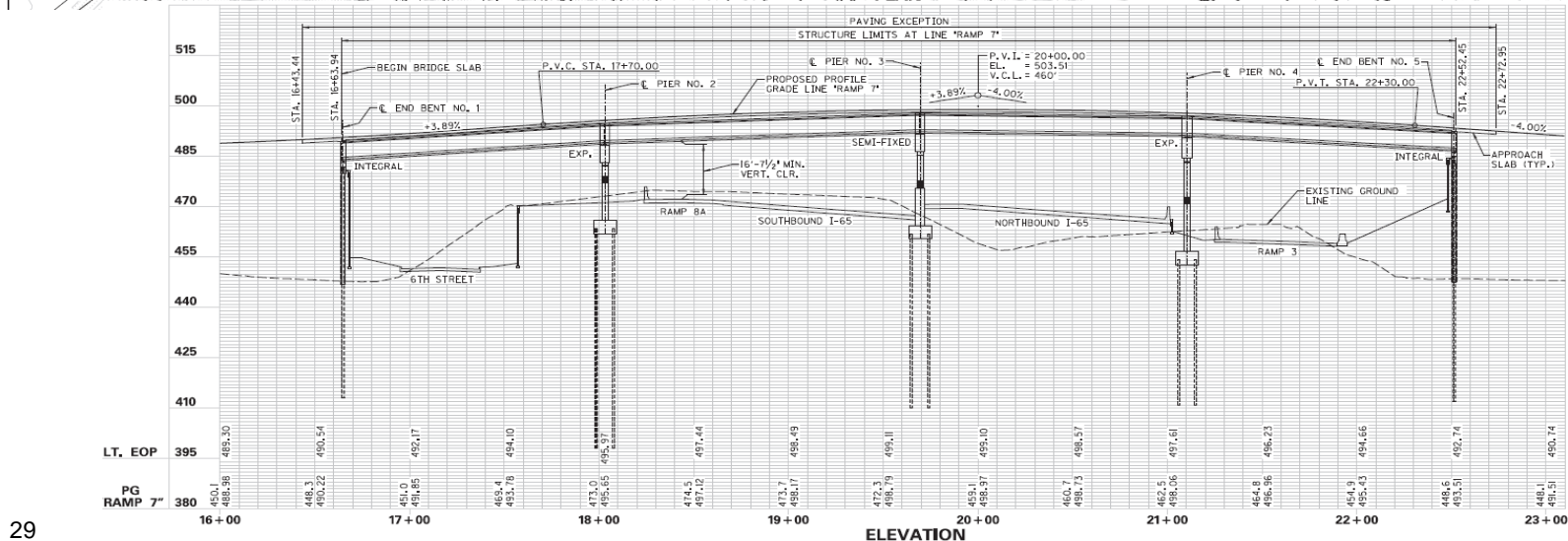
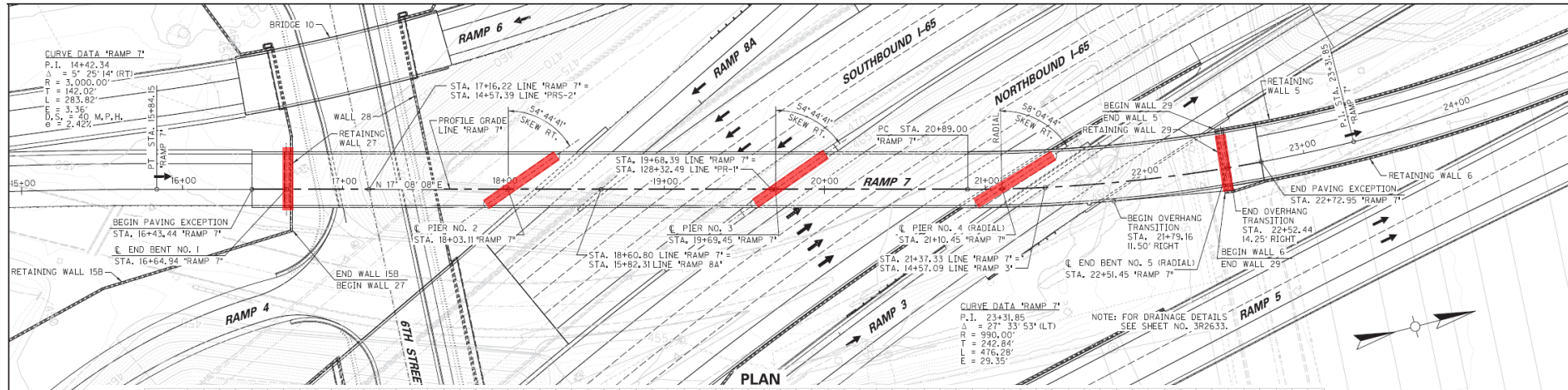


Downtown Crossing – Section 2 Photos



Downtown Crossing – Section 3 Technical Highlights

- Bridge B11 Fly over Bridge



Downtown Crossing – Section 3 Challenges/Solutions

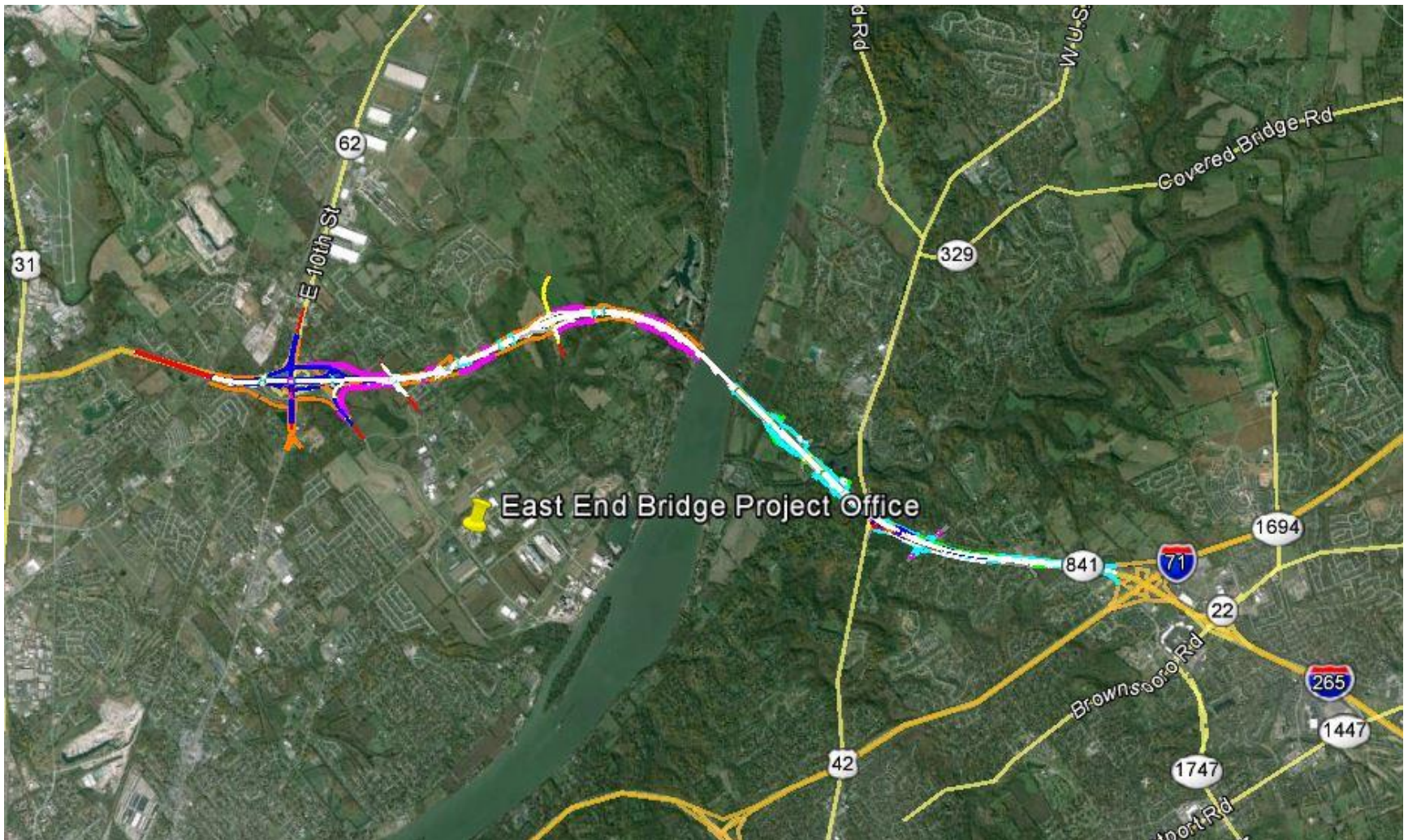
- **Challenge**
 - Reconstruct the structural elements to the approach of the Clark Memorial bridge while maintaining historic block features.
- **Solution**
 - Bridge was surveyed with Lidar and each block was individually numbered for reassembly.
 - A specific plan package was put together for block removal and reassembly.



East End Crossing – P3

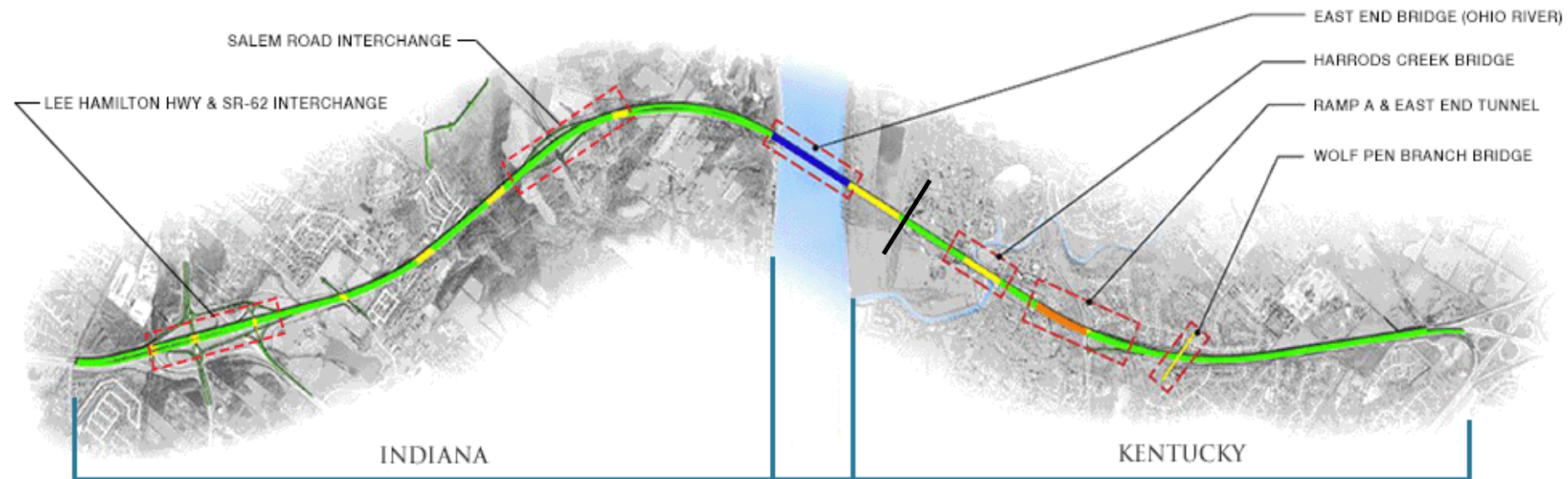


East End Crossing Project Location – Prospect, KY



East End Crossing Project Facts/Overview

- Completes I-265 loop
- New Cable Stay Bridge over the Ohio River
- New Tunnel under the historic Drumanard Estate
- Greenfield Roadway Section in Indiana
- Project Cost = \$1.08B



East End Crossing Project Team

Owner / Developer / Builder



Design Team



- **American Structurepoint Inc.** – Section 6 Design
- **Stantec** – Geotechnical for Section 4 and 5
- **Earth Exploration Inc.** – Geotechnical for Section 6
- **Buckland and Taylor** – Section 5 Independent Design
- **International Bridge Technology** – Section 5 Superstructure Design
- **Wiss Janney Elstner** – East End Bridge Corrosion Protection Plan
- **Carman** – Landscaping
- **Macdonald Architects** – East End Bridge Aesthetics
- **Global Solutions** – Civil Engineering and General Support
- **Rowan Williams Davies and Irwin** – Wind Study
- **PCS Engineers** – Section 4 Noise and Safety Walls
- **Applied Research Associates** – East End Bridge and Tunnel ATVA

East End Crossing Design Offices

- **Project Office**

- **Section 4**

- Dallas (Non-Tunnel)
- New York (Tunnel)

- **Section 5**

- Morristown
- San Diego

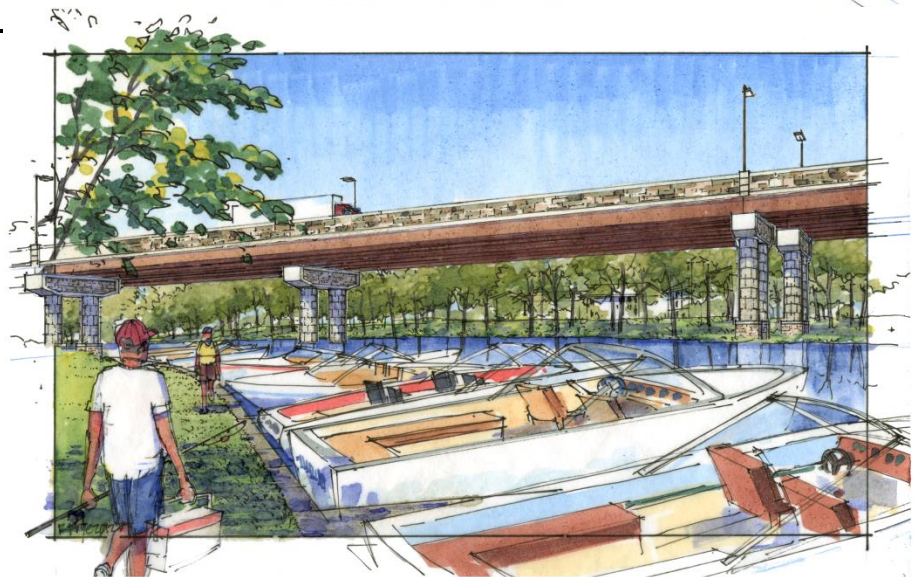
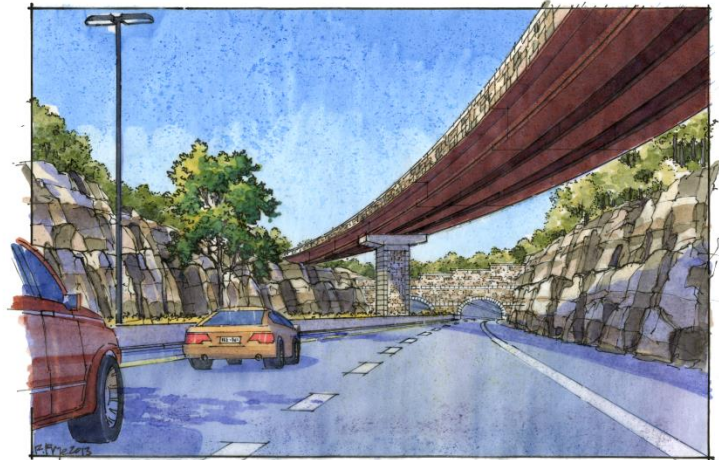
- **Section 6**

- Indianapolis



East End Crossing – Section 4 Overview

- Begins at KY 841 / I-71 Interchange
- Passes thru a depressed section
- A Tunnel extending 1700 feet under US 42 and the historic Drumanard Estate
- Crosses over a creek -
5-span twin Steel structures –
Max span 350'
- High fill area – fill > 60'
- Connects to East End Bridge



East End Crossing – Section 4 Technical Highlights

- Tunnel Fire protection – Reduced Design Fire
- Harrods Creek Bridge – up to 350' Span
- Approach Structure to Main Span Bridge



East End Crossing – Section 4 Challenges/Solutions

- **Challenge**

- Impact of pile driving on LWC's water filtration tunnel
- Impact of pile driving on LWC's Sludge Pond
- Challenging rock conditions during construction of rock and soil anchored walls
- Harrods Creek Bridge Foundation – differing rock elevation

- **Solutions**

- Engaged original tunnel designers to evaluate
- Sheet piling as cut off wall
- Existing soil characterization study
- Provide different option for different conditions
- Geo-tech Engineer on site
- Changed foundation type to Drilled shaft



East End Crossing – Section 4 Photos



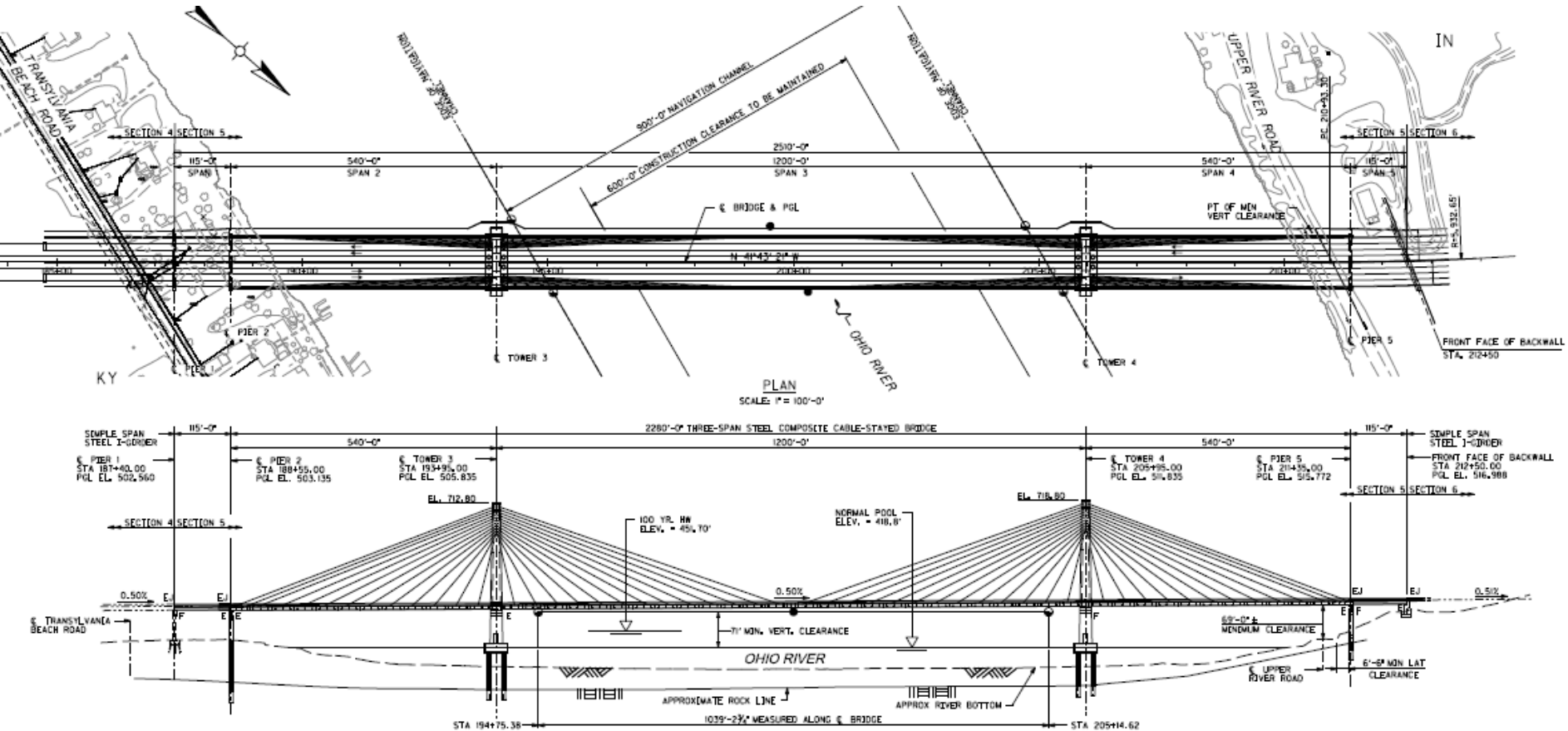
East End Crossing – Section 4 Photos



East End Crossing – Section 5 Overview

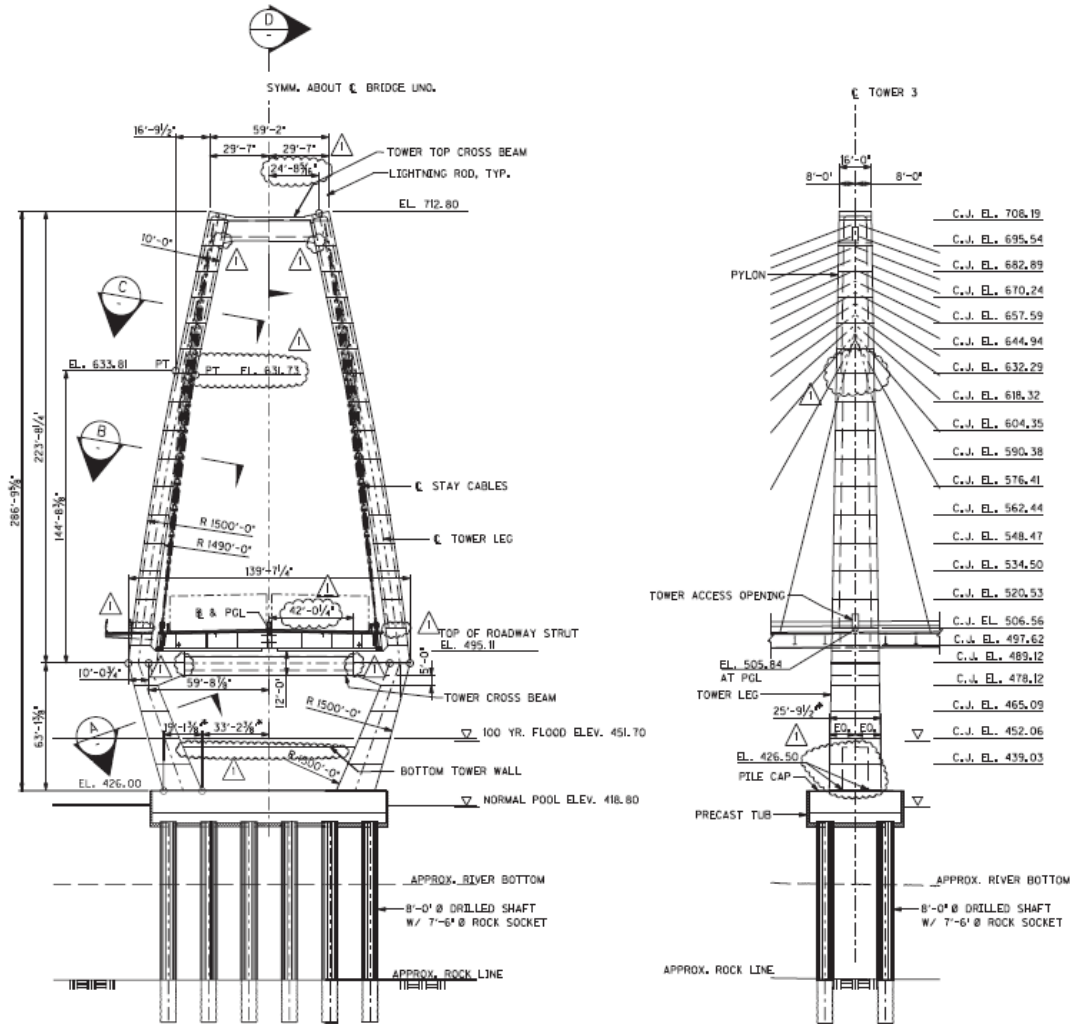


East End Crossing – Section 5 Overview



3 span, Two tower, cable stay structure over the Ohio River; 2500 feet long; Towers are ~300 ft tall; 71 feet minimum vertical clearance from river normal pool; Four lane section, scalable to six lane; 13 foot pedestrian and emergency access path

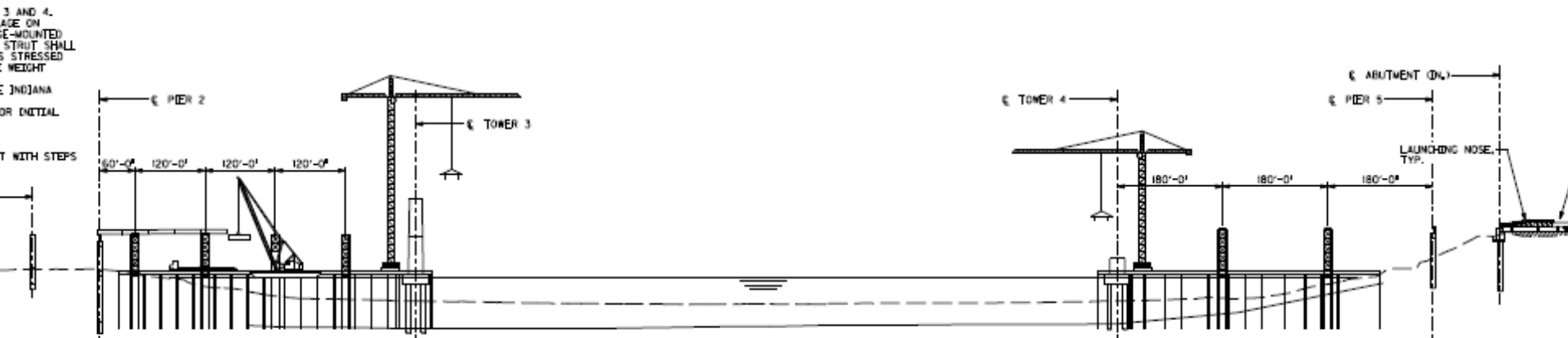
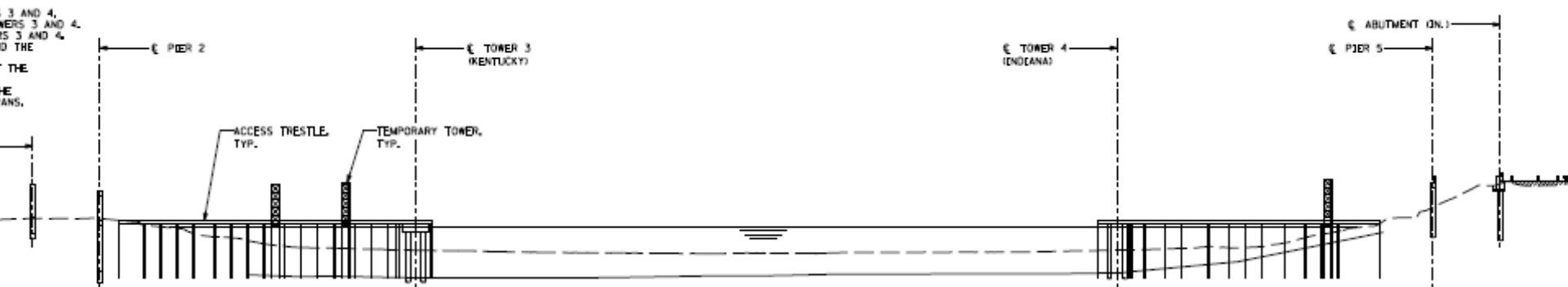
East End Crossing – Section 5 Overview



East End Crossing – Section 5 Technical Highlights

- Stringent Corrosion Protection Requirements
- Avoidance of Fracture Critical Steel members
- Independently checked design
- Bridge construction method

East End Crossing – Section 5 Technical Highlights



East End Crossing – Section 5 Technical Highlights

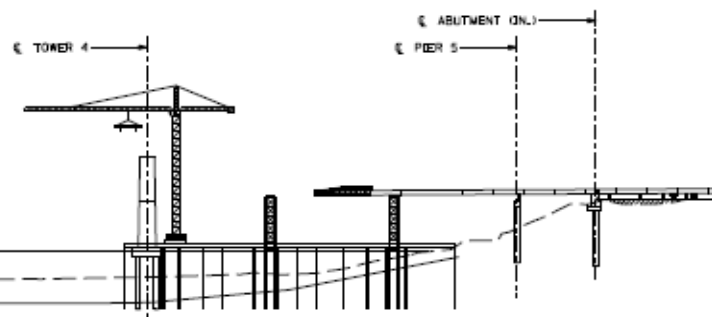
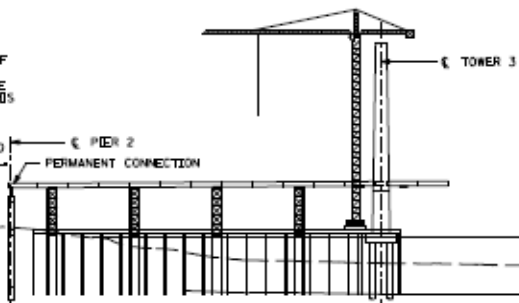
STUCKY SIDE SPAN
PRIMARY TOWERS,
TURNS AND
PIER 2, SEE NOTE
CAL AND
TOWER 3, ENGAGE
BEARINGS AT

GRILLAGE ON
LAUNCHING NOTES
F TOWER 3.

CONNECTION CAPABLE OF
PATED LOADS AND
Y BE PROVIDED ON THE
AT CONNECTION. IN THIS
NECTION SHALL BE
ALLONG THE BALLAST

ON SHALL BE DESIGNED
ECK ERECTION MANUAL.

PIER 1



HEEL GRILLAGE ON
OR 4 CROSS BEAM
IE THE LAUNCHING
SEE LAUNCHING

TURNS AND
PIER 5,
CAL AND
TOWER 4, ENGAGE
BEARINGS AT

F TOWER 4,
ON THE FIRST SIDE

FIRST STAY IN THE
THE FIRST SIDE

ON THE FIRST MAIN

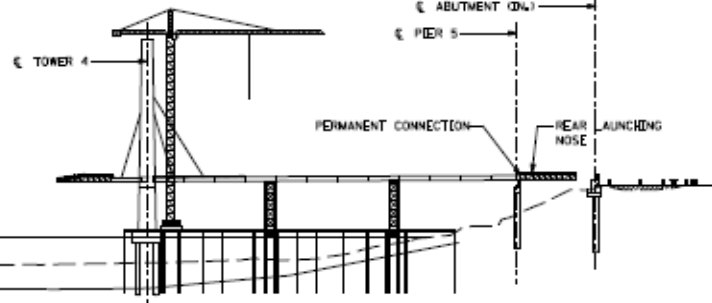
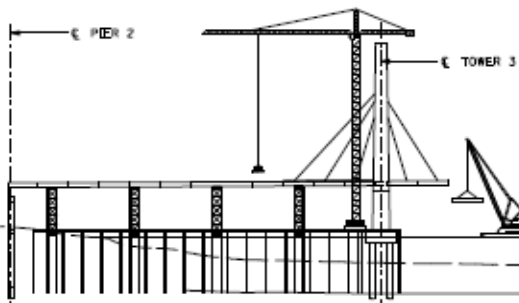
IN THE MAIN SPAN,
FORCE

IN THE MAIN SPAN TO

EVER
T EACH 45'
E PROCEDURES

BE CONCURRENT AT
ROUGH 5.

R 1



LAUNCHING NOTES:

1. LAUNCHING SHALL BE PERFORMED ON THE STEEL SUPERSTRUCTURE EDGE GIRDERS AND FLOOR BEAMS ONLY. ANCHILLARY STEEL FRAMING, SUCH AS STAY ANCHORAGES AND PEDESTAL CANTILEVER BEAMS MAY BE ATTACHED DURING LAUNCHING. NO CONCRETE PANELS MAY BE PRESENT DURING THE LAUNCH PHASES. DECK PANEL SUPPORT BEAMS AND ANY OTHER BRACING DETERMINED TO BE REQUIRED BY THE LAUNCHING ERECTION MANUAL SHALL BE INSTALLED PRIOR TO LAUNCHING.
2. THE LAUNCHING NOSE IS ASSUMED TO BE 80' LONG AND TO WEIGH 55 TONS.
3. AT THE COMPLETION OF EACH LAUNCHING PHASE THE STRUCTURE SHALL BE SUPPORTED NEAR LEADING EDGE OF THE CORNER. THE LENGTH OF THE CORNER ASSEMBLY IN THE ASSEMBLY PLATFORM SHALL BE SUFFICIENT TO MAINTAIN STABILITY THROUGHOUT THE LAUNCH.
4. ON THE INDIANA SIDE, A SUPPLEMENTAL REAR LAUNCHING NOSE SHALL BE USED TO CONTROL CORNER STRESSES AS THE CORNER IS LAUNCHED ACROSS THE TRANSITION SPAN.

East End Crossing – Section 5 Technical Highlights

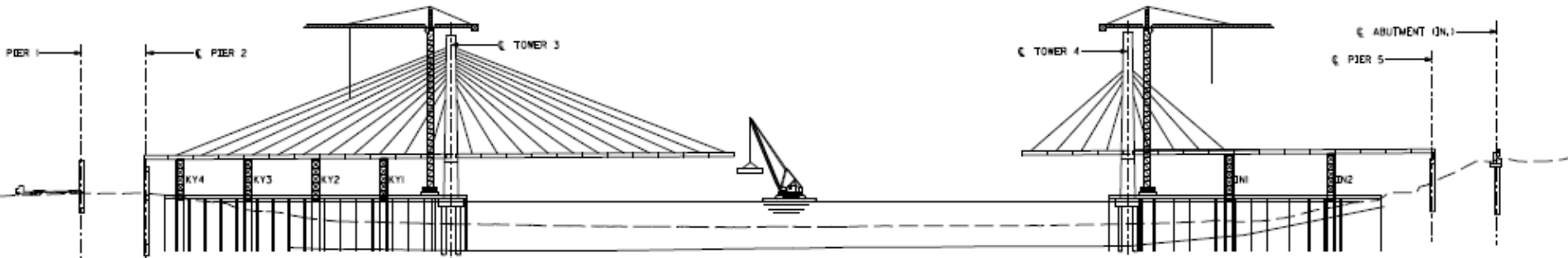
CANTILEVER
AS 3 AND 4 ACCORDING
SHOWN ON DWG NO.
SELF WEIGHT IMBALANCE
OF THE PANELS FOR
IMBALANCE IN DEAD
SIDE SPANS.
MARKED WITH AN
DETAILED TO PROVIDE
LIFT, THE UPLIFT
ENGAGED ONLY FOR
DUE TO THE
SHALL NOT BE ENGAGED
CON ACTIVITIES.



TABLE 1

TEMPORARY TOWER	REMOVE AFTER CYCLE
KY1	TOWER 3, CYCLE 4
KY2	TOWER 3, CYCLE 7
KY3	TOWER 3, CYCLE 10
KY4	TOWER 3, CYCLE 10
DN1	TOWER 4, CYCLE 6
DN2	TOWER 4, CYCLE 10

CANTILEVER
PROCEDURES SHOWN
ROUGH THE
II. TEMPORARY
ENGAGED UNTIL NO
AFTER COMPLETION OF
CYCLE LISTED IN TABLE 1.
CONSISTS OF
OF PANELS, STAY
TO COMPLETE STITCHES.



East End Crossing – Section 5 Technical Highlights

SHALL BE CAST IN
D IN THE FINAL

SPAN DECK PANELS
TO THE TARGET

CK PANELS IN TIE-

MAIN SPAN,
LONG No. CESMS,
SPAN
TARGET VALUE,
MAIN SPAN PER
No. CESMS,
POST-TENSIONING
STRENGTHS PRIOR TO
E DECK ERECTION MANUAL

PIER 2

ER 1

ER 1

GRILLAGE

TRIAL CLOSURE

NDING IN MAIN SPAN,
DEAD LOADS,
ACHIEVE TARGET

ANS 1 AND 5,
E CONSTRUCTED AT
ECTION OF THE
BACK SPAN GRILLAGE.

ER 1

ER 1

ER 1

ER 1

ER 1

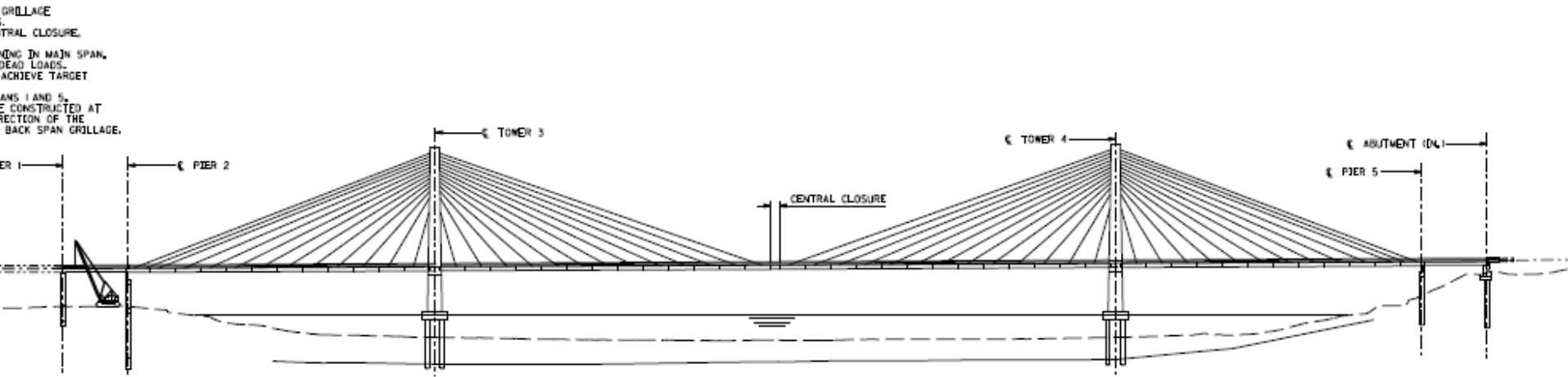
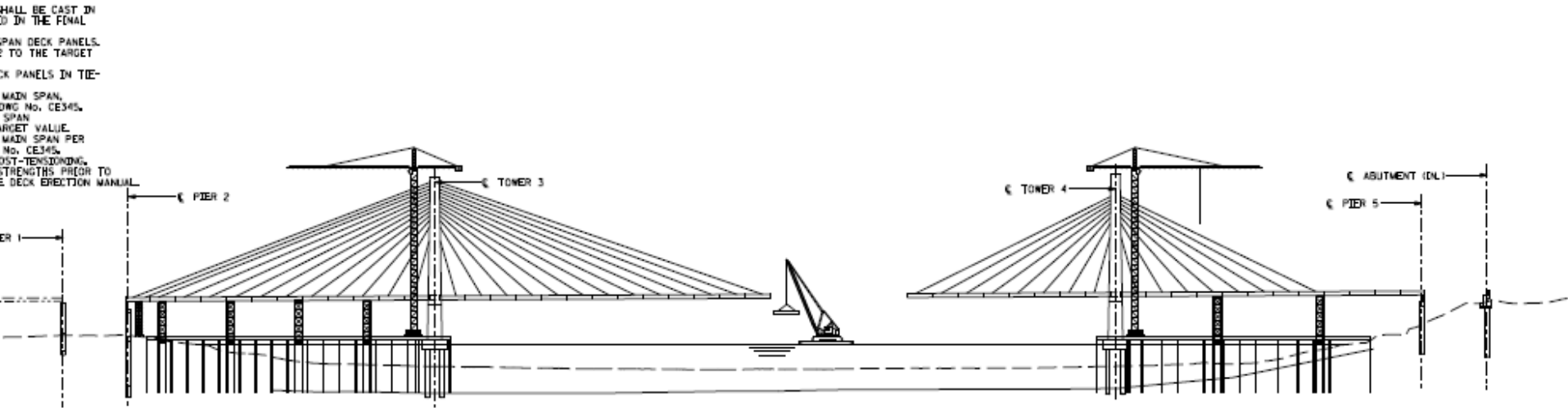
ER 1

ER 1

ER 1

ER 1

ER 1



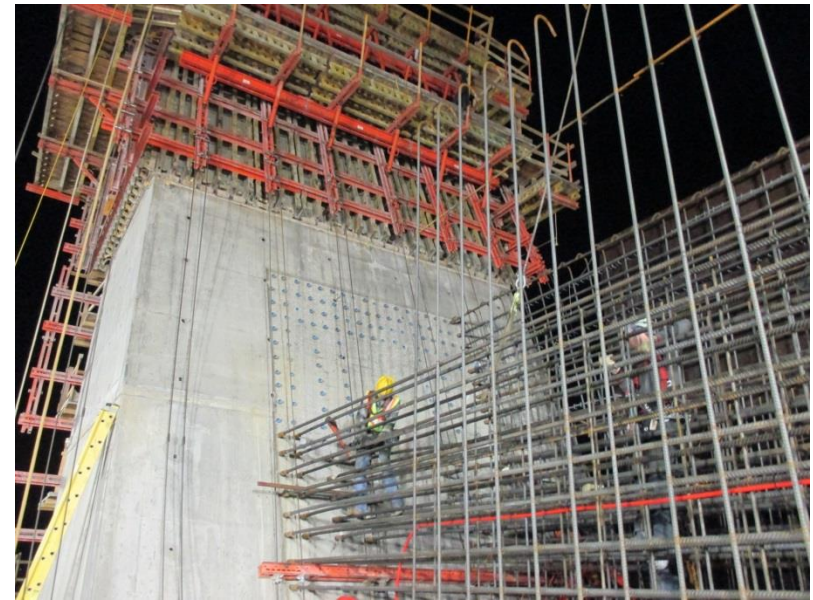
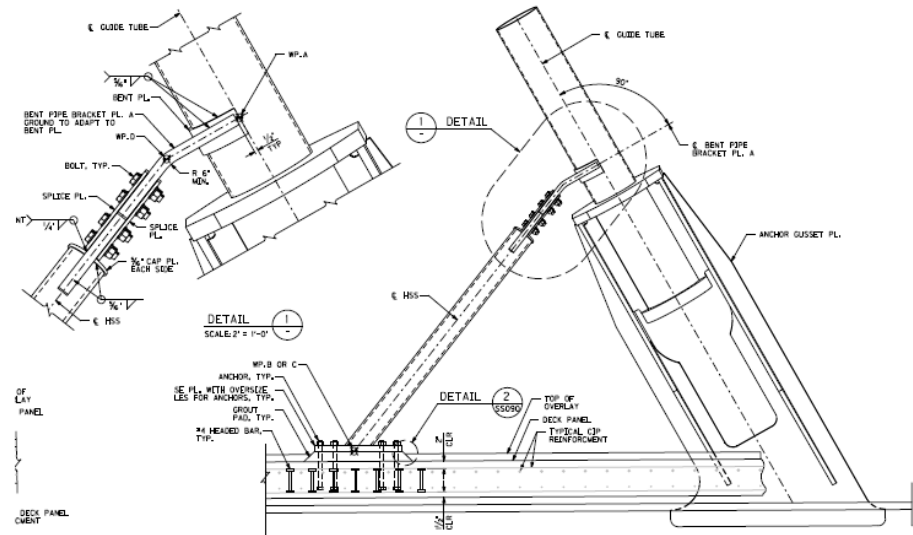
East End Crossing – Section 5 Challenges/Solutions

Challenges

- Access to construct Indiana side pier and abutment
- Rebar and Miscellaneous items conflict
- Expansion Joint System – Longitudinal and Vertical Movements
- Additional Vibration from Wind Analysis

Solutions

- Grading plan
- Integrated Drawings
- Used Modular Joints by Mageba
- Added cable stay braces, open barrier



East End Crossing – Section 5 Photos



East End Crossing – Section 6 Overview

- Mostly Green Field Construction
- Reconstruction of I-265 and SR 62 Interchange
- Addition of new full interchange at Old Salem Road



East End Crossing – Section 6 Technical Highlights

AMERICAN
STRUCTUREPOINT

DEFINING THE BUILT ENVIRONMENT

RID Design



East End Crossing – Section 6 Technical Highlights

AMERICAN
STRUCTUREPOINT

DEFINING THE BUILT ENVIRONMENT

Roundabout Interchange



East End Crossing – Section 6 Technical Highlights





Questions?





Downtown Crossing – Section 3 Challenges/Solutions

Tolling

- **Challenges**
 - 1- Tolling Requirements for Design / Toll Integrator Selection
 - 2- Due to RFP requirements, both the East End and Downtown must be turned on as soon as either bridge is open to traffic.
- **Solutions**
 - 1- Design barriers, medians, and foundation locations to meet the most likely number of scenarios for tolling infrastructure.
 - 2- A temporary tolling system was designed and installed to capture tolls in the interim condition, and was designed not to conflict with the permanent condition.



Downtown Crossing – Section 2 Photos



Downtown Crossing – Section 2 Photos



East End Crossing – Section 6 Challenges/Solutions

• Challenges

- Deck Replacement of Existing Bridges
- MOT of a busy interchange (with heavy railroad passing thru it)



• Solutions

- Challenge in protecting beams – Fixes to damages
- Collaboration with Builder during construction and traffic phasing

