

# ABC-UTC September 2019 Monthly Webinar – 09/19/19

## Agenda:

- Project Challenges – Precast Segmental Solutions
- Simplicity Drives Process
- Lesson Learned – Best Practices
- Questions and Answers

# PROJECT COST COMPETITION PRECAST SEGMENTAL VERSUS STEEL BOX GIRDER



Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Project Challenges - Precast Solutions|2

# PUBLIC DEMAND FOR AESTHETICS LOW COST, NO COST SOLUTIONS



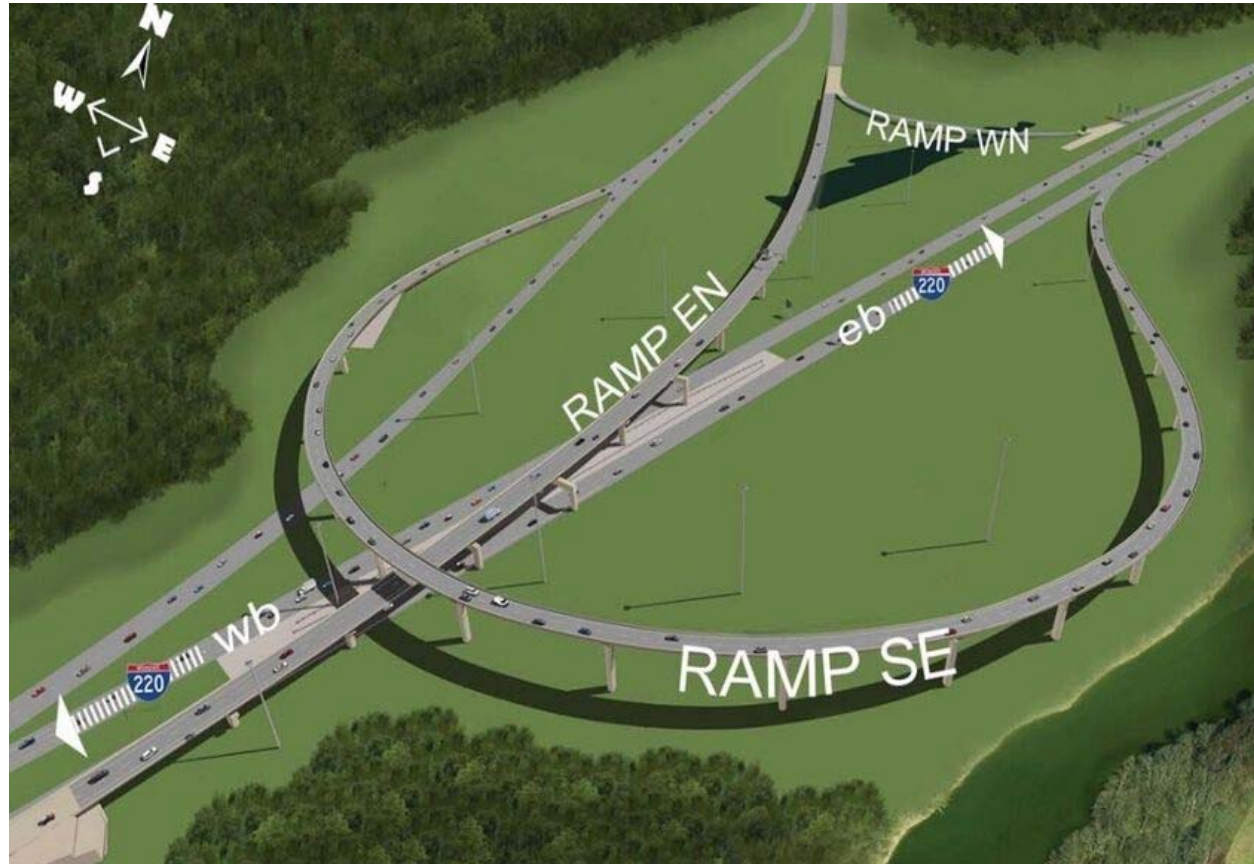
Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Project Challenges - Precast Solutions|3

# URBAN INTERCHANGE

## SPAN LAYOUT AND CROSS SECTIONS



- Spans varies from 140 ft to 260 ft
- Segments depths varies from 9 ft to 13 ft
- Pier heights range from 14 ft to 90 ft
- Cross section widths varies from 31.5 ft to 50.83 ft
- Horizontal curve radius varies from 550 ft to 3,500 ft

# SEGMENT CASTING DETAILS



- Minimize number of machines and form changes
- Small number of segments with a lot of variation
- Consistency of bulkheads, post-tensioning, and rebar layouts
- Segment depth, width, and weights

# TRANSPORTATION AND ERECTION METHODS



- Cast segments on site versus existing facilities away from site
- Site offices and labor – one versus multiple locations
- Variance in pier heights and span lengths
- Erection methods



Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Project Challenges - Precast Solutions | 6

# SITE ACCESS FOR CASTING YARDS, SUBSTRUCTURE, & SUPERSTRUCTURE CONSTRUCTION



- Casting yard and storage close to site
- Casting yard on available right of way
- Casting machines capable of segment dimension changes
- Efficient yard layout
- Matchcast from pier segment to center of span

# SITE ACCESS FOR CASTING YARDS, SUBSTRUCTURE, & SUPERSTRUCTURE CONSTRUCTION



- Minimize forming requirements – constant column and cap
- Variable pier heights handled with constant column details
- Aesthetics enhancements where form follows function
- Simple reinforced concrete footings, pier columns, and caps
- Integration of bridge aesthetics with construction and future maintenance

# SITE ACCESS FOR CASTING YARDS, SUBSTRUCTURE, & SUPERSTRUCTURE CONSTRUCTION



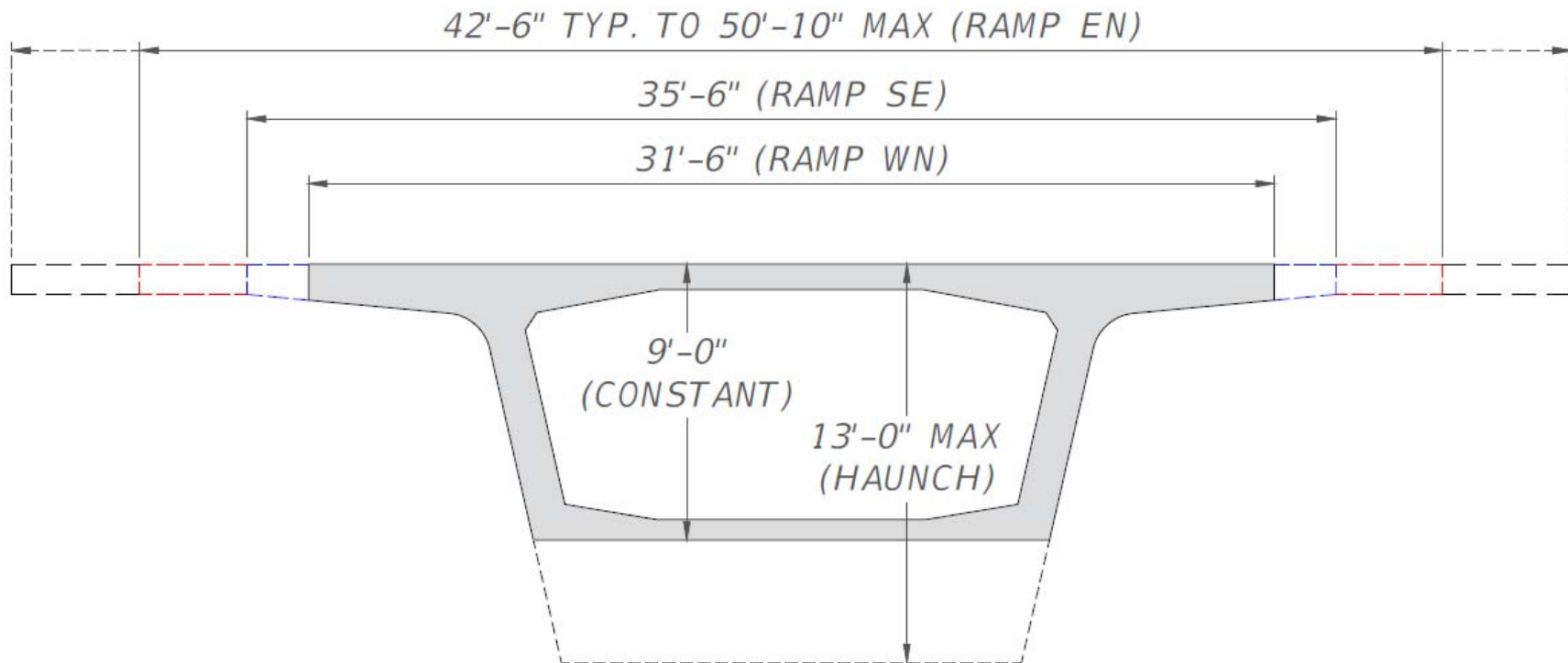
- Drill Shaft Capacity - 970 tons to 1,600 tons required nominal resistance
- Length Range from 39 ft to 90 ft
- Drill Shaft spacing typically 16.5 ft
- Footing size from 24.5 ft x 41 ft x 8.5 ft up to 41.5 ft x 57.5 ft x 9.5 ft
- Temporary towers sit on footing

# SITE ACCESS FOR CASTING YARDS, SUBSTRUCTURE, & SUPERSTRUCTURE CONSTRUCTION



- Modular towers used for cantilever stability during construction
- Accessibility of erection cranes
- Non-linear construction sequence
- Segments pre-positioned for crane erection
- Faster, Simpler & Competitive

# CROSS SECTIONS ADAPTATION TO VARYING ROADWAY WIDTHS AND SEGMENT DEPTHS



- Constant exterior shape
- Varying wing widths
- Accommodated by one casting machine
- Special segments (pier, abutment, and deviator) with modified form panels

# CROSS SECTIONS ADAPTATION TO VARYING ROADWAY WIDTHS AND SEGMENT DEPTHS



Precast Segmental Bridges for the LaDOTD I-49/I-220 Interchange



# CROSS SECTIONS ADAPTATION TO VARYING ROADWAY WIDTHS AND SEGMENT DEPTHS

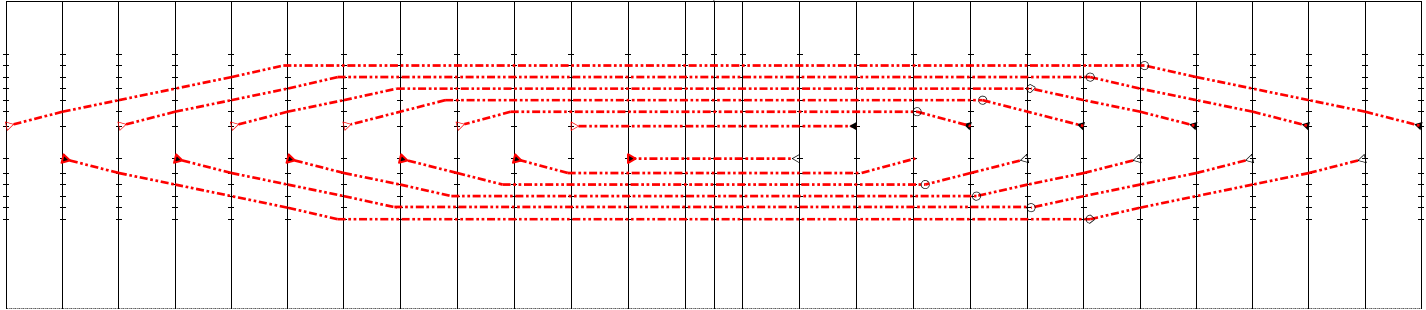


Precast Segmental Bridges for the LaDOTD I-49/I-220 Interchange



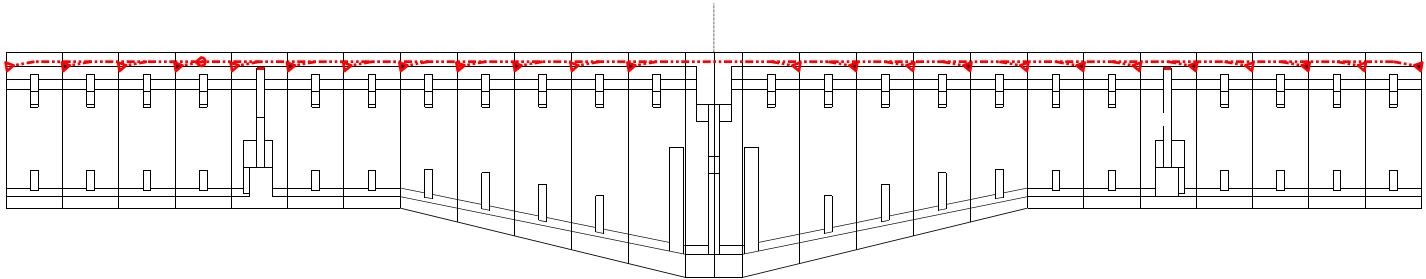
# POST-TENSIONING LAYOUTS

## CANTILEVER INTERNAL TENDONS



PLAN

SCALE: N.T.S



ELEVATION

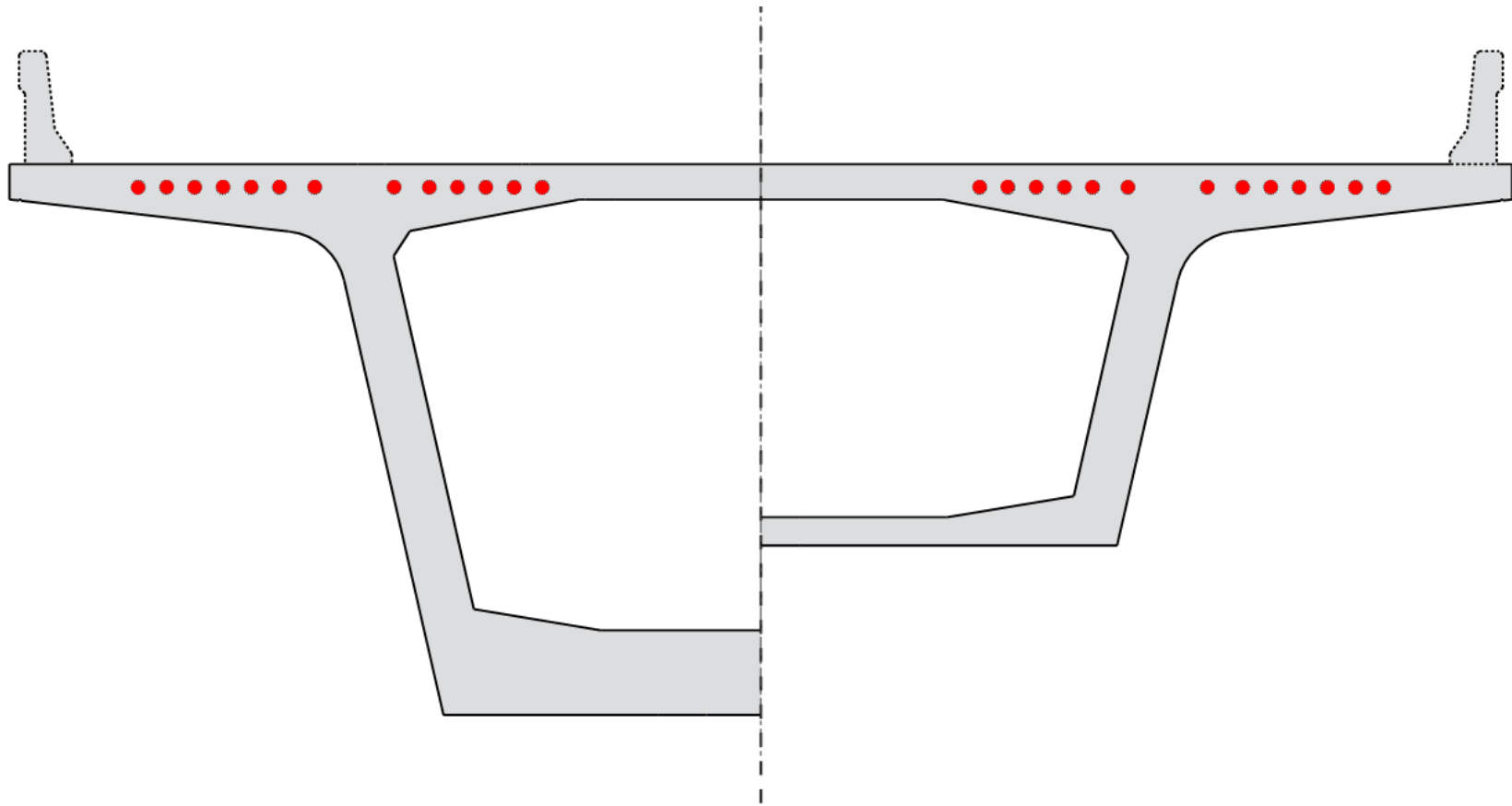
SCALE: N.T.S

Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



# POST-TENSIONING LAYOUTS

## BULKHEAD FOR INTERNAL POST-TENSIONING



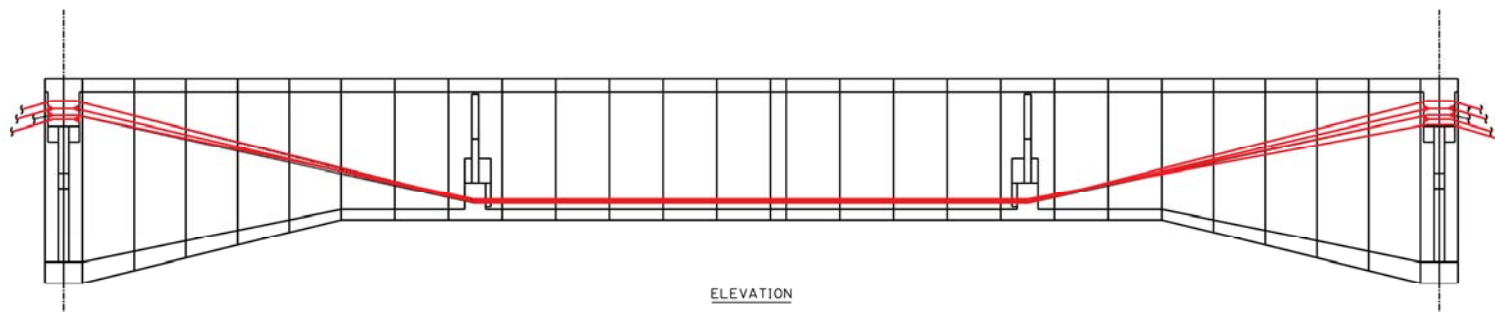
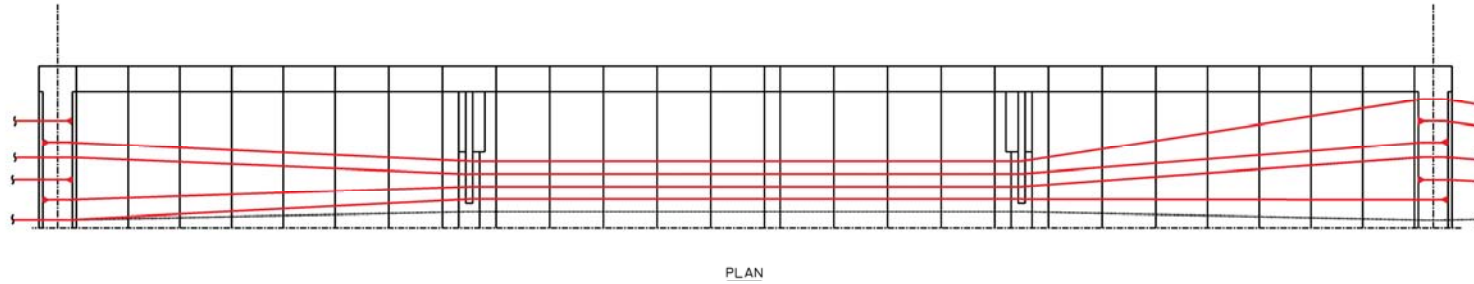
Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Simplicity Drives Process | 15

# POST-TENSIONING LAYOUTS

## EXTERNAL CONTINUITY TENDONS

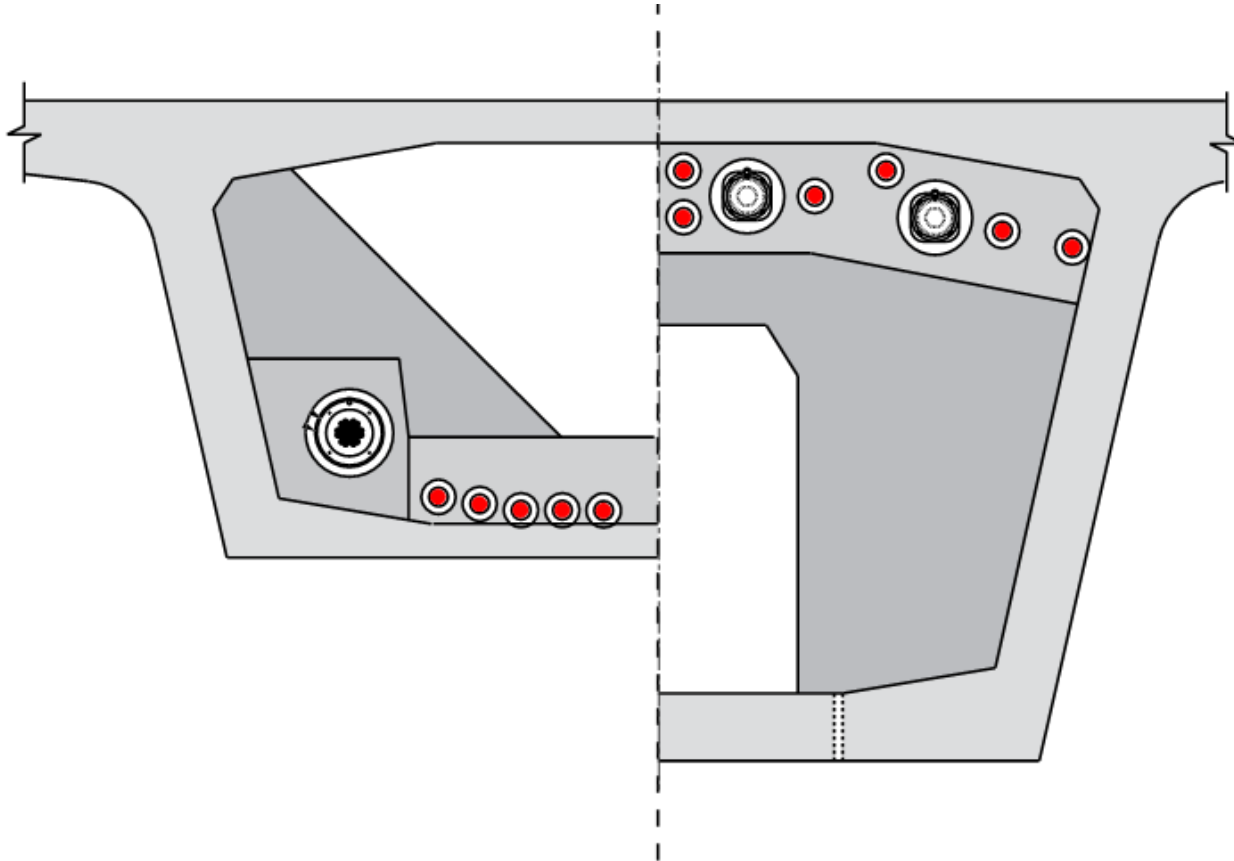


Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Simplicity Drives Process | 16

# POST-TENSIONING LAYOUTS ELEVATIONS EXTERNAL TENDONS



Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Simplicity Drives Process|17

# USE OF DIABOLOS AND EXTERNAL POST-TENSIONING



- Diabolos allow standard inserts for varying tendon geometry
- Eliminates schedule 40 pipe
- Continuous HDPE ducts
- Reduces cross section thickness and weight
- Easier to install, inspect, and maintain

# USE OF DIABOLOS AND EXTERNAL POST-TENSIONING

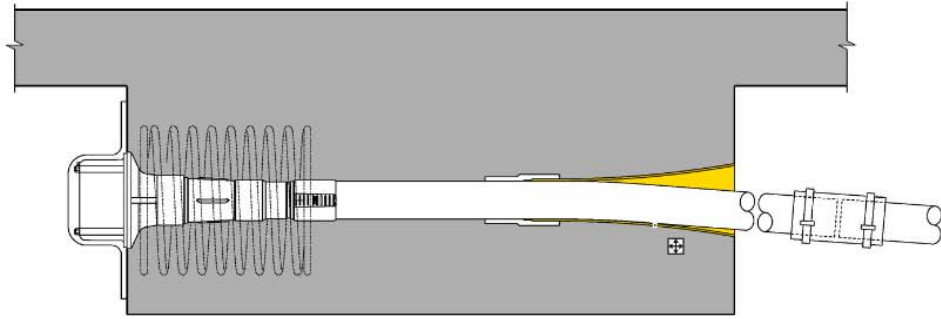


Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange

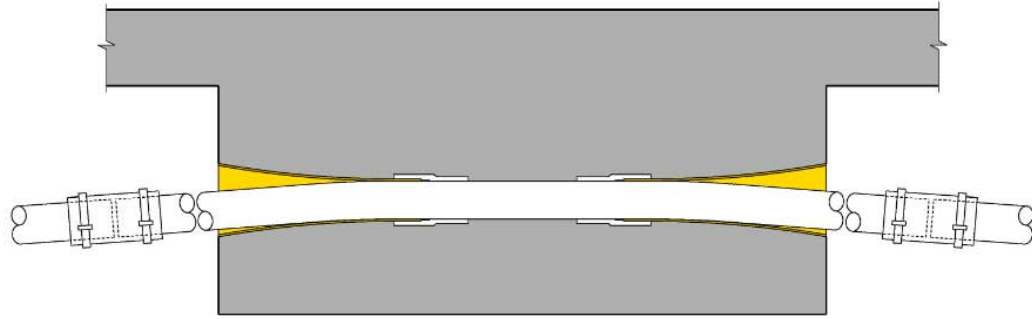


Simplicity Drives Process|19

# USE OF DIABOLOS AND EXTERNAL POST-TENSIONING



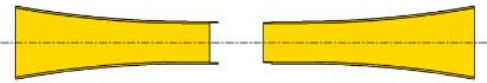
Pier Segment – Anchored Tendon



Pier Segment – Draped Tendon

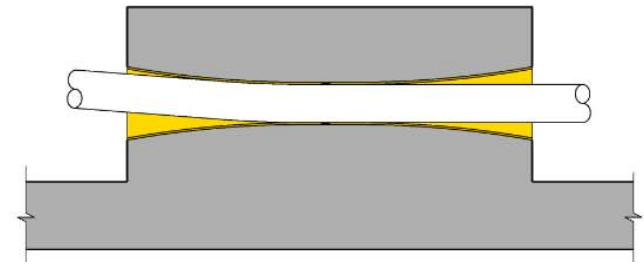


Diabolo Assembly



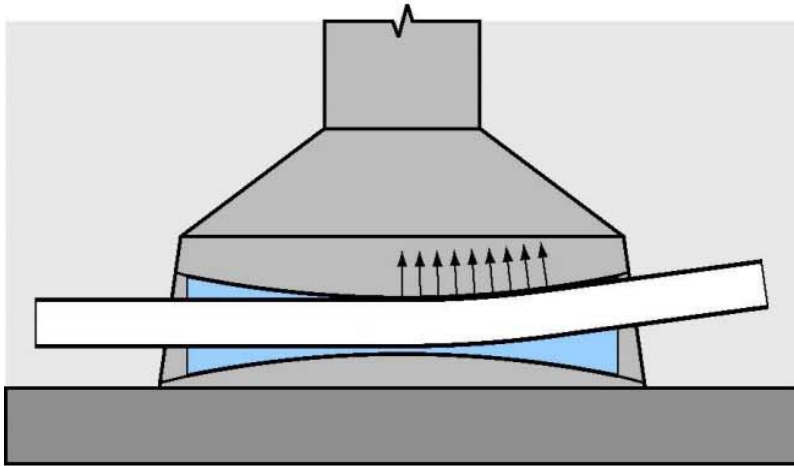
Female Diabolo

Male Diabolo

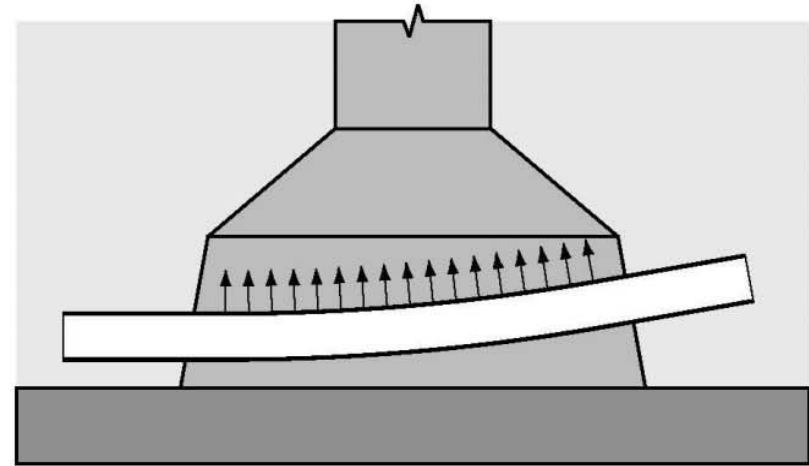


Deviator Segment – Draped Tendon

# DIABOLO VERSUS STEEL PIPE FOR EXTERNAL TENDONS

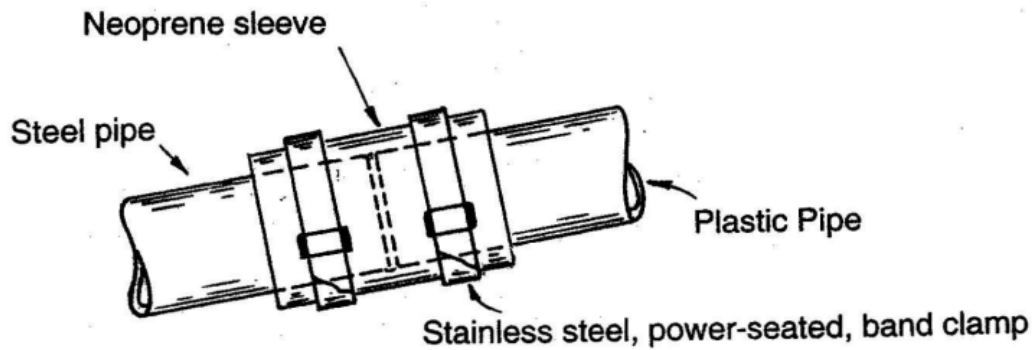
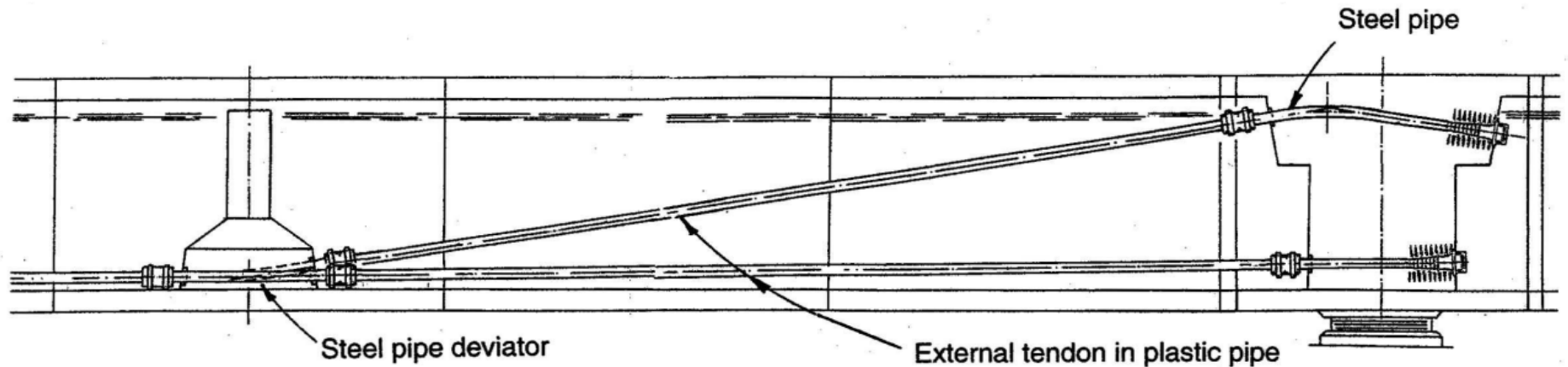


Diabolo Deviator



Deviator with Curved Pipe  
Pre-bent to Radius

# DIABOLO VERSUS STEEL PIPE FOR EXTERNAL TENDONS



Enhanced Neoprene  
Sleeve Connector

# LIMITED NUMBER OF SEGMENT TYPES

Segment Type	Ramp EN	Ramp SE	Ramp WN	Subtotal
Pier	22	24	6	52
Typical	256	288	58	602
Deviator	28	28	8	64
Abutment	6	4	2	12
Total	312	344	74	<b>730</b>

- Maximize use of common casting machines and details!

# BALANCED CANTILEVER SUPERSTRUCTURE CONSTRUCTION



- Same temporary support system at each pier location
- One crane size for all segmental erection
- Consistent erection procedures for all segmental cantilevers and ramps

# BALANCED CANTILEVER SUPERSTRUCTURE CONSTRUCTION



- Non-linear construction sequence
- Work at multiple locations at the same time
- Precasting and erection accelerate bridge construction

Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Simplicity Drives Process|25

# MISCELLANEOUS DETAILS

- Bearings
  - Multi-rotational, guided, and fixed disk bearings
  - Up to 3,100 kips service level design axial load in bearings
  - Up to 8 inches of total movement in bearings
- Expansion Joints
  - Finger joint expansion device
  - 4 inches to 10 inches of total movement in expansion device
  - Distance between expansion joints range from 700 ft to 1,900 ft
- Drainage
  - Drain Scuppers within cantilever wings of concrete box section
  - Drain pipe leads to catch basin at pier locations

# PALMETTO EXPRESSWAY SECTION 5 FDOT MIAMI, FL



- Similar interchange flyover ramps
- Variable spans and cross sections
- First use of diabolos in Florida
- Common segment details
- Consistent casting and erection requirements
- Similar aesthetics required

Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



Lesson Learned – Best Practices|27

# LESSONS LEARNED



- Experienced contractor with existing resources
- Variable segment depth, diabolos, and external post-tensioning
- Minimize exceptions and maximize commonality
- Consistency of methods and special equipment
- Balanced cantilever advantageous for critical path scheduling
- Construction simplicity drives cost efficiency

Precast Segmental Bridges for the  
LaDOTD I-49/I-220 Interchange



# Questions and Answers

- LaDOT Panelists
  - Paul Vaught III, P.E. – Asst. Bridge Design Administrator
  - Bernard Sincavage, P.E. – District 04 Eastern Area Engineer
- FINLEY Panelist
  - Craig Finley, P.E. – Managing Principal
  - Ivan Liu, P.E. – Bridge Engineer

# Contact Information

- Louisiana DOTD:
  - Paul Vaught, P.E. – Asst. Bridge Design Administrator
    - (225) 379-1816
    - Paul.vaughtiii@la.gov
  - Bernard Sincavage, P.E. – District 04 Eastern Area Engineer
    - (318) 371-3039
    - Bernard.sincavage@la.gov
- FINLEY Engineering Group, Inc.:
  - Craig Finley, P.E. – Managing Principal
    - (850) 894-1600
    - Craig.finley@finleyengineeringgroup.com
  - Ivan Liu, P.E. – Bridge Engineer
    - (850) 894-1600
    - Ivan.liu@finleyengineeringgroup.com