PARSONS WBES – September 26, 2011

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Innovative Design for a Constrained Site

The Dallas Area Rapid Transit Trinity River Bridge

Outline

PARSONS

- Project Overview
- Site Description
- Structure Type Selection
- Stretching the TxDOT Standard Girder
- Serviceability Considerations
- Post-Tensioning Considerations
- Constructibility

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Project Overview

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- Project: Orange Line Extension
- Client: Dallas Area Rapid Transit (DART)
- Joint Venture Team – KSWRP
  - Kiewit
  - Stacy Witbeck
  - Reyes
  - Parsons
- Start Date: January 2009
- Planned Design Completion Date: January 2010
- Planned Construction Completion Date: October 2012

Project Overview

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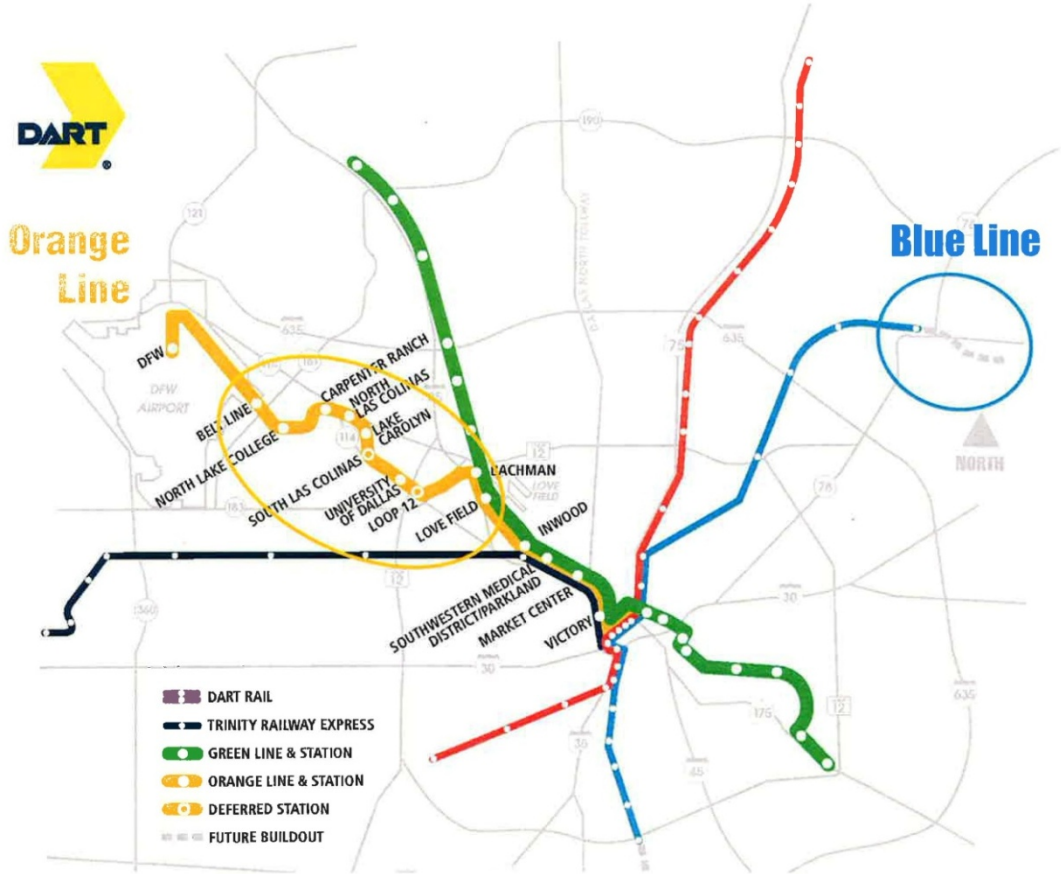

KSWP

Project Overview

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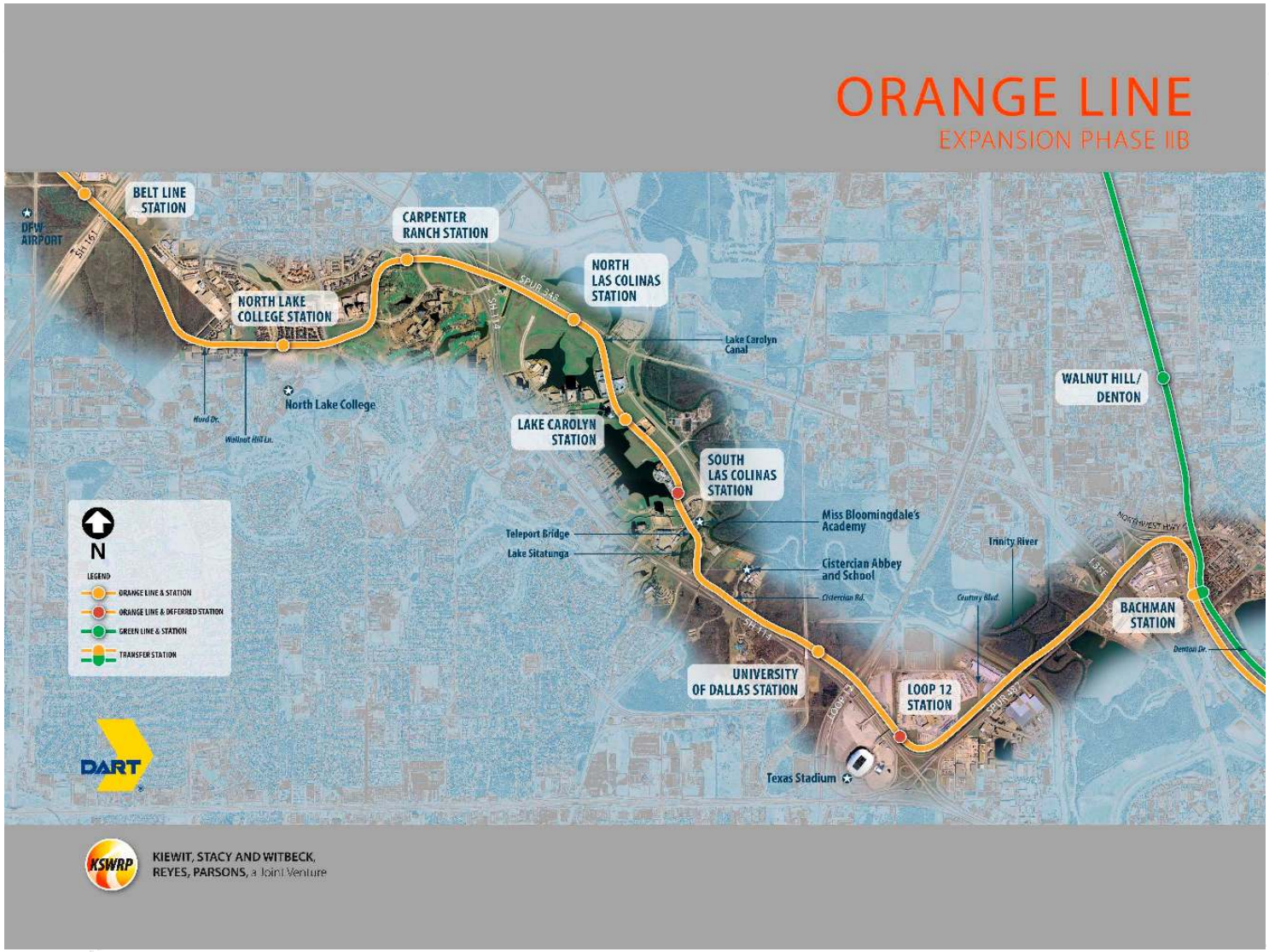

Project Overview

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- Creation of Orange Line route extension
- Branches off existing Green Line at Harry Hines Boulevard and goes to DFW property
- Total length approximately 9 miles of light rail
- Total structure length nearly 3 miles
- Project Estimated Total Cost - $430M
- Design started in January, 2009
- First Drilled shaft to be constructed by June 1, 2009
  - Actually started drilling on May 29th, 2009

Project Overview

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- **8 total bridges**
  - Harry Hines/I-35/Trinity River - 7555’ long
  - SH114/Spur 348 Bridge - 3995’ long
  - SH 161 Bridge - 947’ long
  - Cistercian Boulevard Bridge - 780’ long
  - Teleport Boulevard Bridge - 270’ long
  - McArthur Boulevard Bridge - 270’ long
  - Lake Carolyn Canal Bridge - 90’ long
  - Meadow Creek Bridge - 90’ long

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Site Description – It's a Little Cramped

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- Power lines above

Levee below

Site Description – It's a Little Cramped

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- Power lines above.

Site Description – It's a Little Cramped

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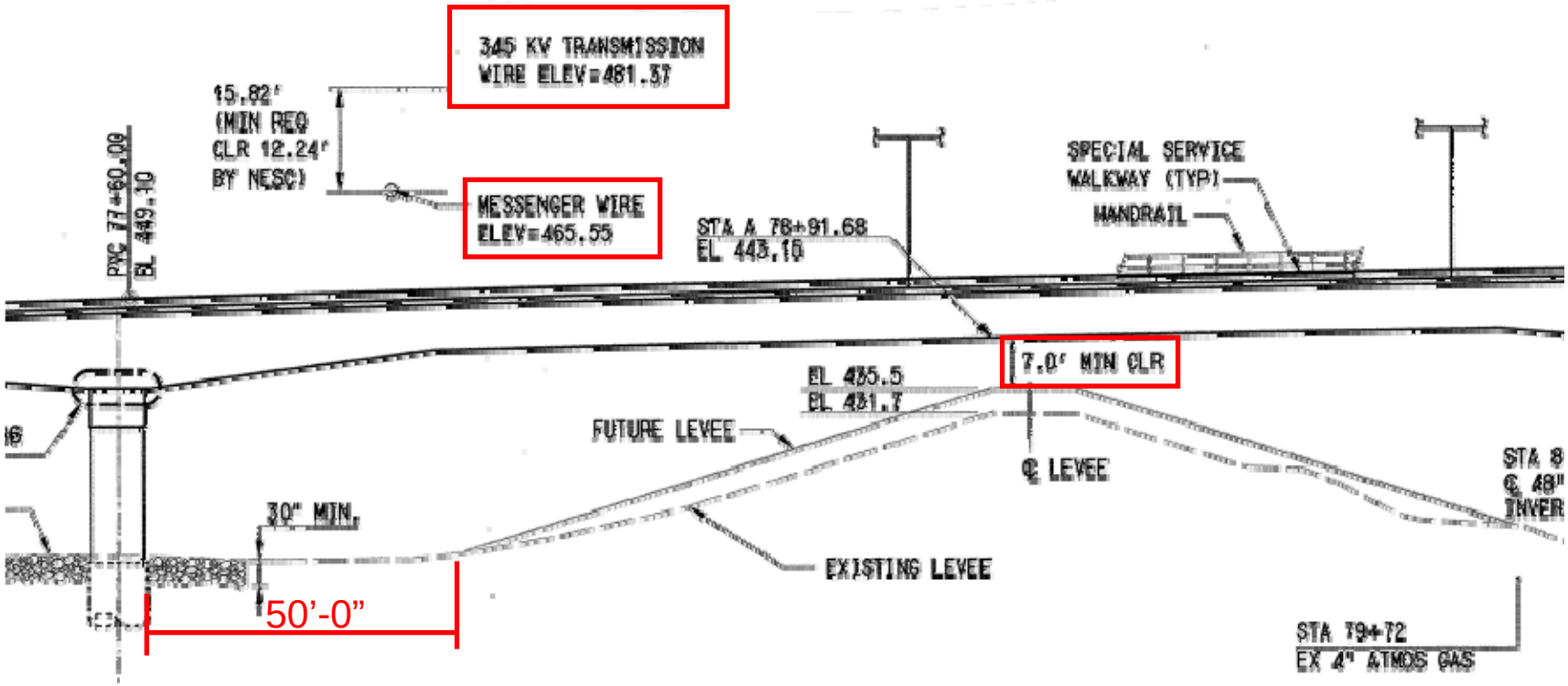

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Structure Type Selection

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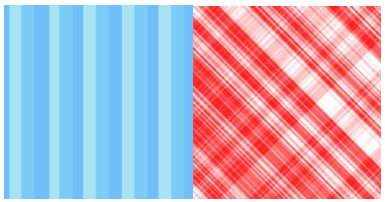
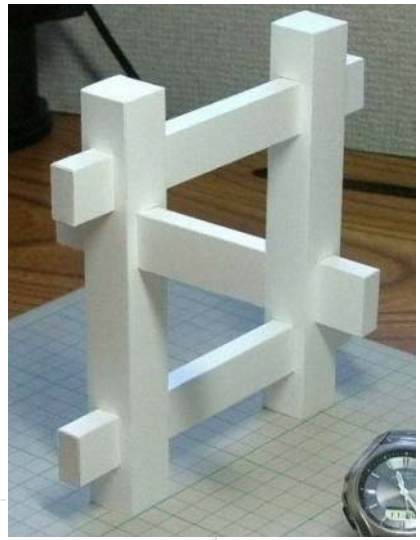
- Considerations
  - 260’ span

  - Thin profile

  - Economical



  - Tie-in with adjacent spans
  - Constructible



Structure Type Selection

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- Possible Options
  - Steel

  - Costly
  - Equipment needs

  - Depth Concerns
  - DART Frequency Requirements

Structure Type Selection

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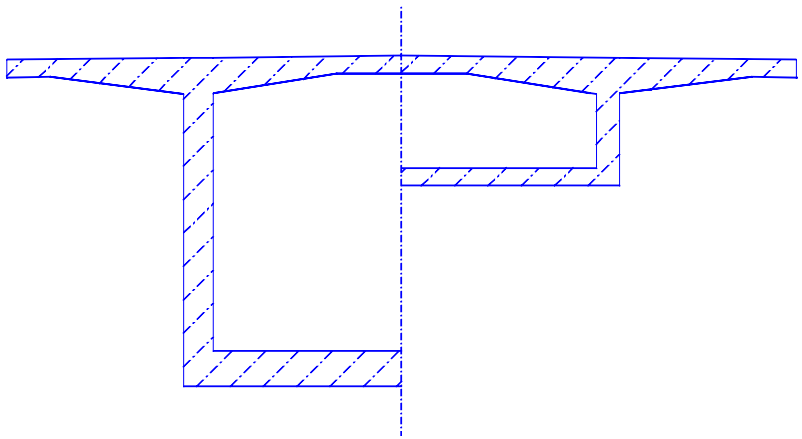
- Possible Options
  - CIP Balanced Segmental
    - Cost
    - Inexperienced workforce
    - Duration
      - » Need to lay rail early



Structure Type Selection

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- Spliced Girder Bridge
  - Hundreds of precast girders elsewhere.
    - Standard details
    - Easy aesthetic transition
  - Use the same crews and similar equipment.
    - Limited learning curve
    - Limited deployment cost
  - Adds up to an economical solution

Structure Type Selection

Structure Type Selection

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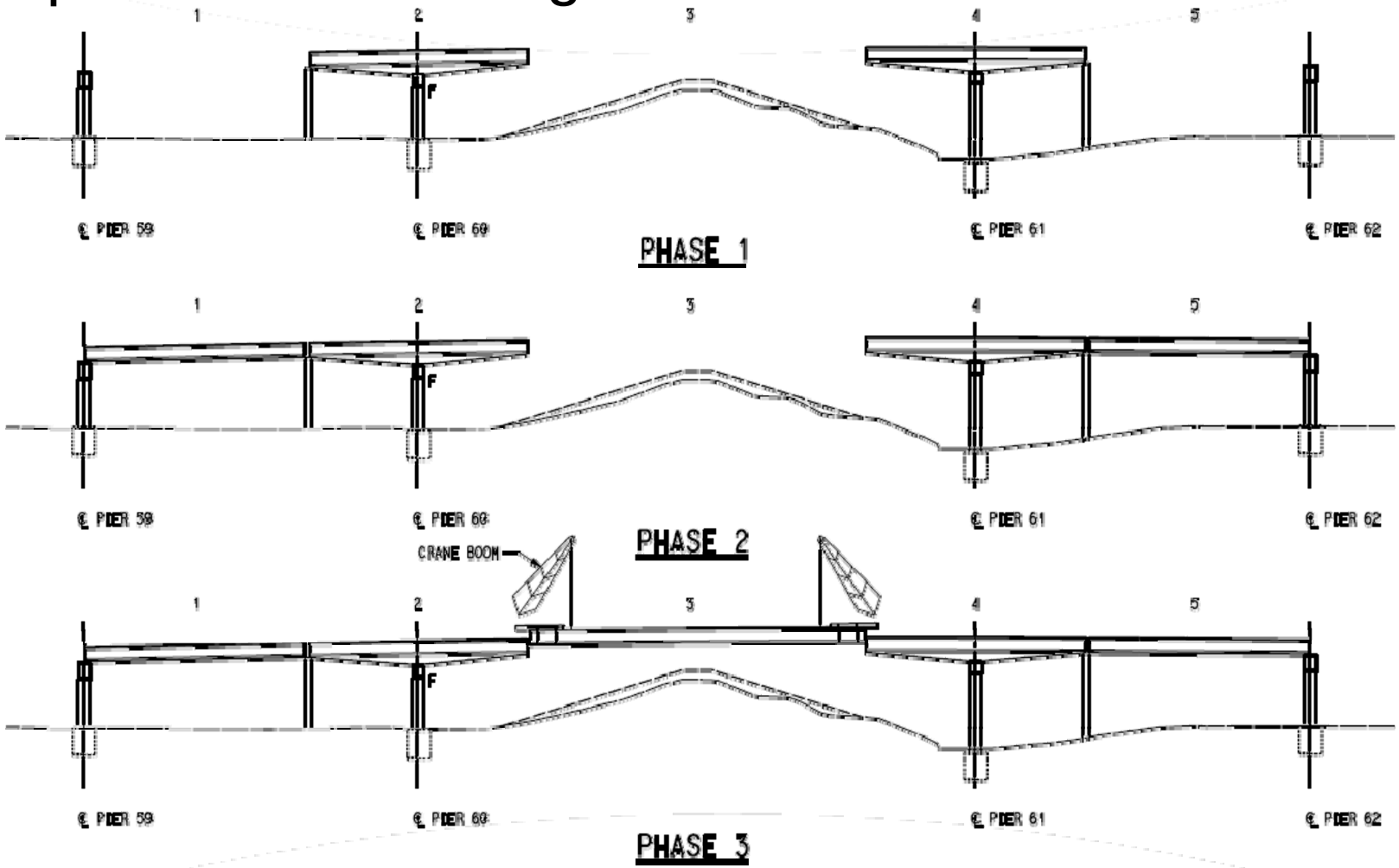
Spliced Girder Bridge



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Stretching the TxDOT Standard Girder

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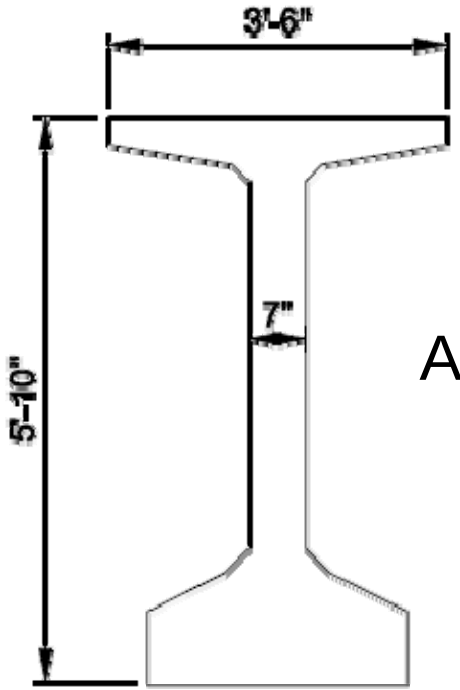
- Begin with TxDOT Standard Tx70 shape.



AAANNDD...

Stretching the TxDOT Standard Girder

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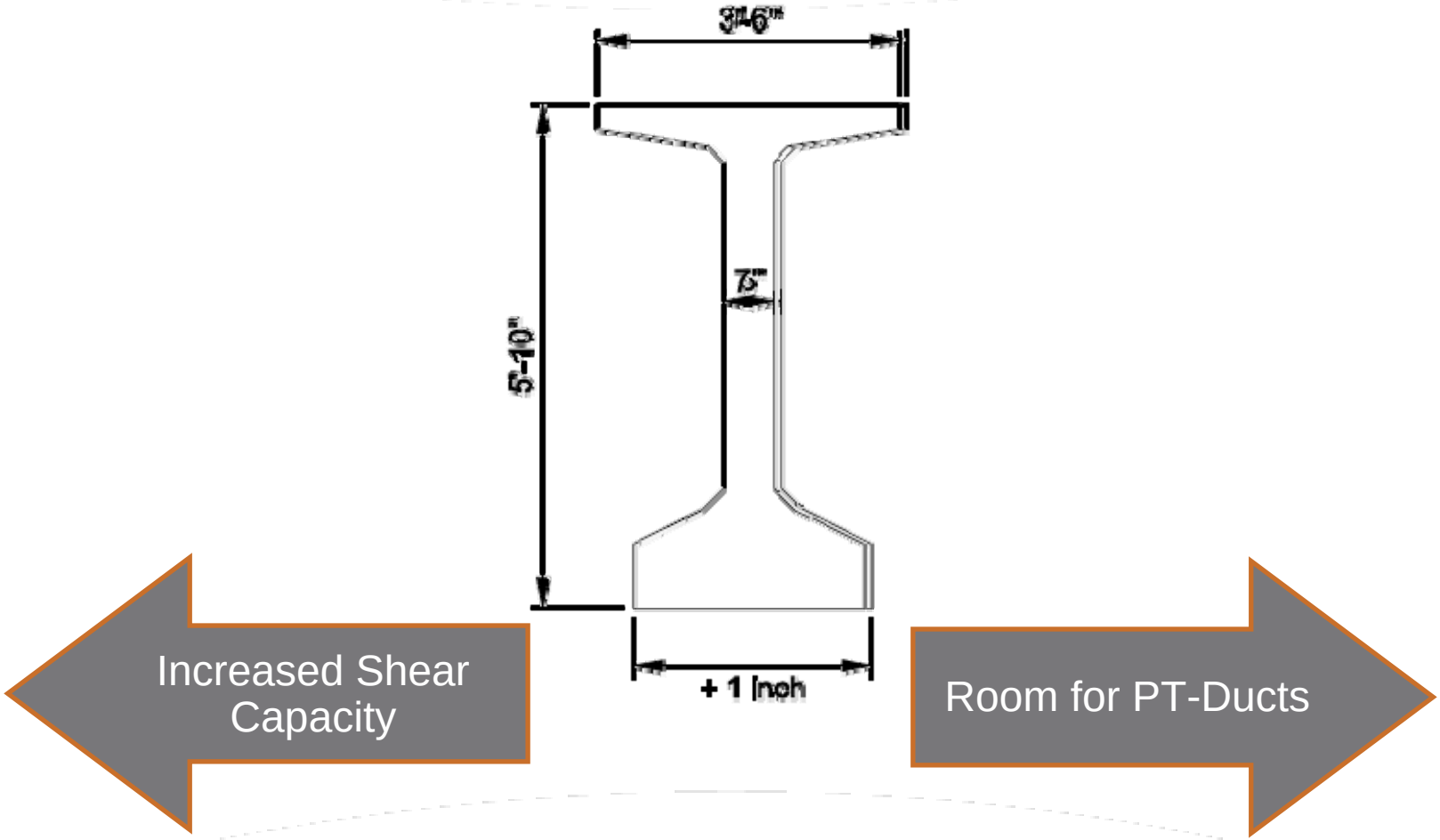
- Increase the overall width by 1”



Stretching the TxDOT Standard Girder

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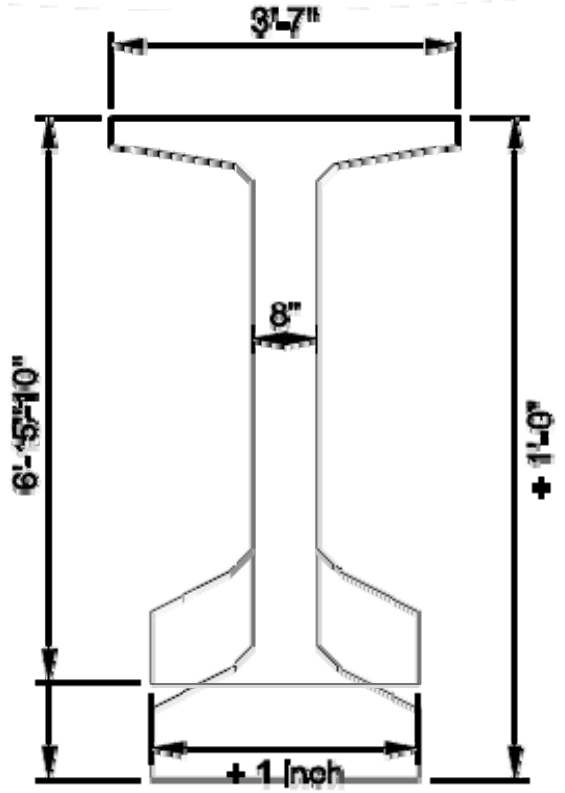
- Increase the typical height by 12”



Stretching the TxDOT Standard Girder

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- Final result…

Longest Precast Girder Erected in TX.

Stretching the TxDOT Standard Girder

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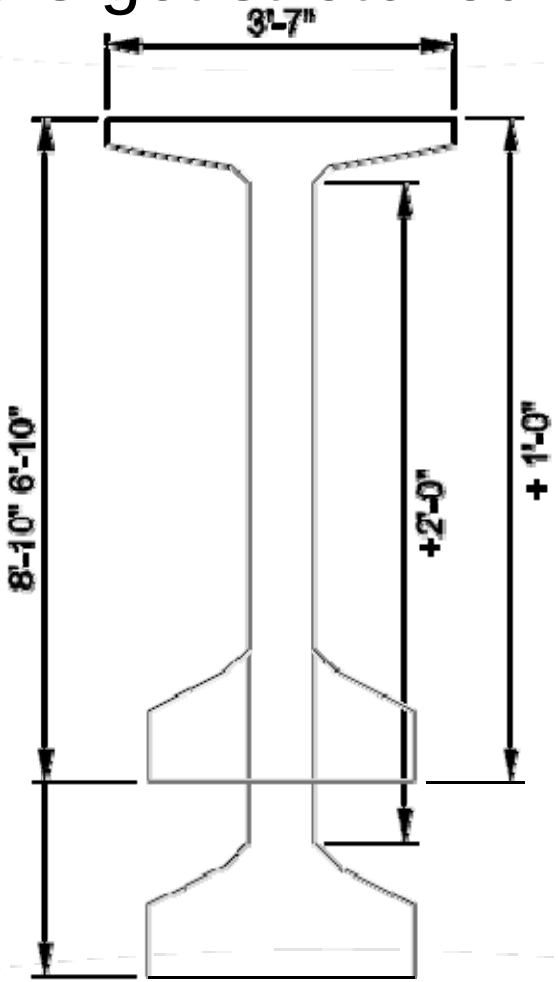
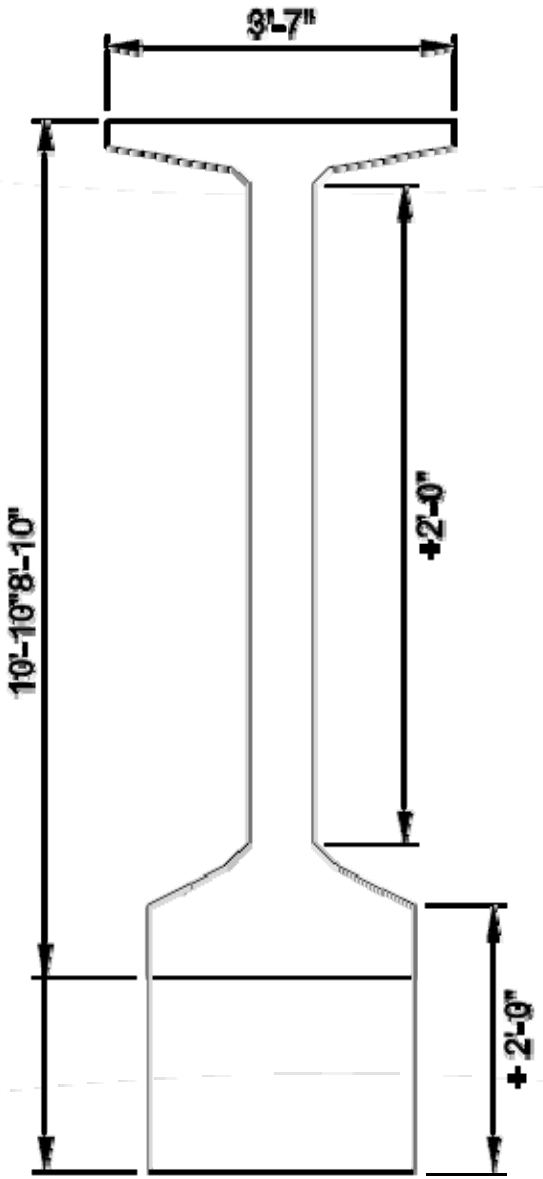
- Haunch girders get stretched some more…



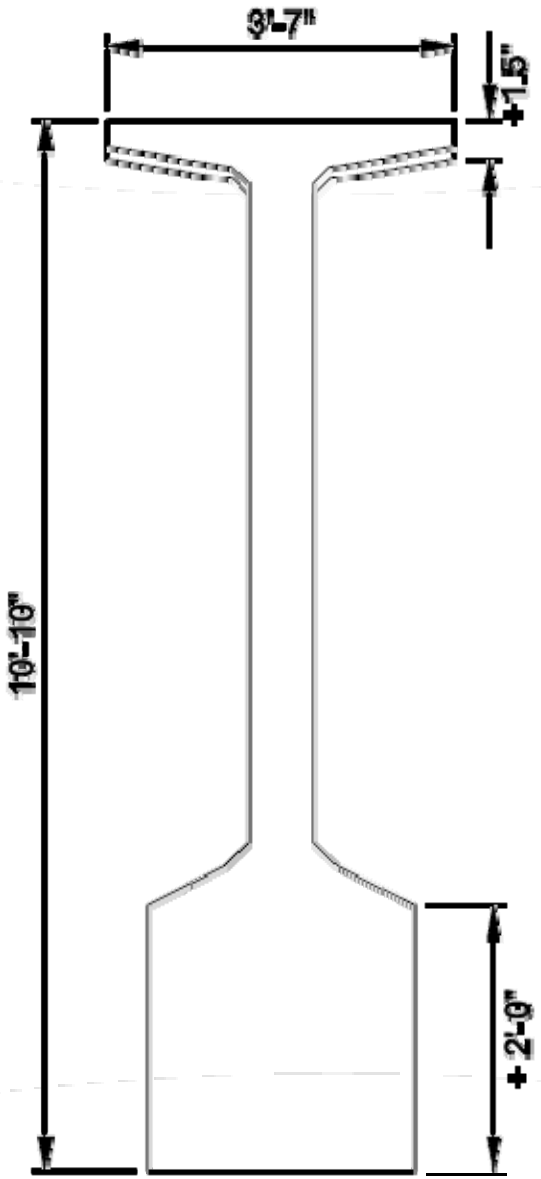
Stretching the TxDOT Standard Girder

- Bottom Bulb Increased



Stretching the TxDOT Standard Girder

- Additional Top Flange Thickness



Stretching the TxDOT Standard Girder

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- Final result…

Segment B and D. Pier pieces.

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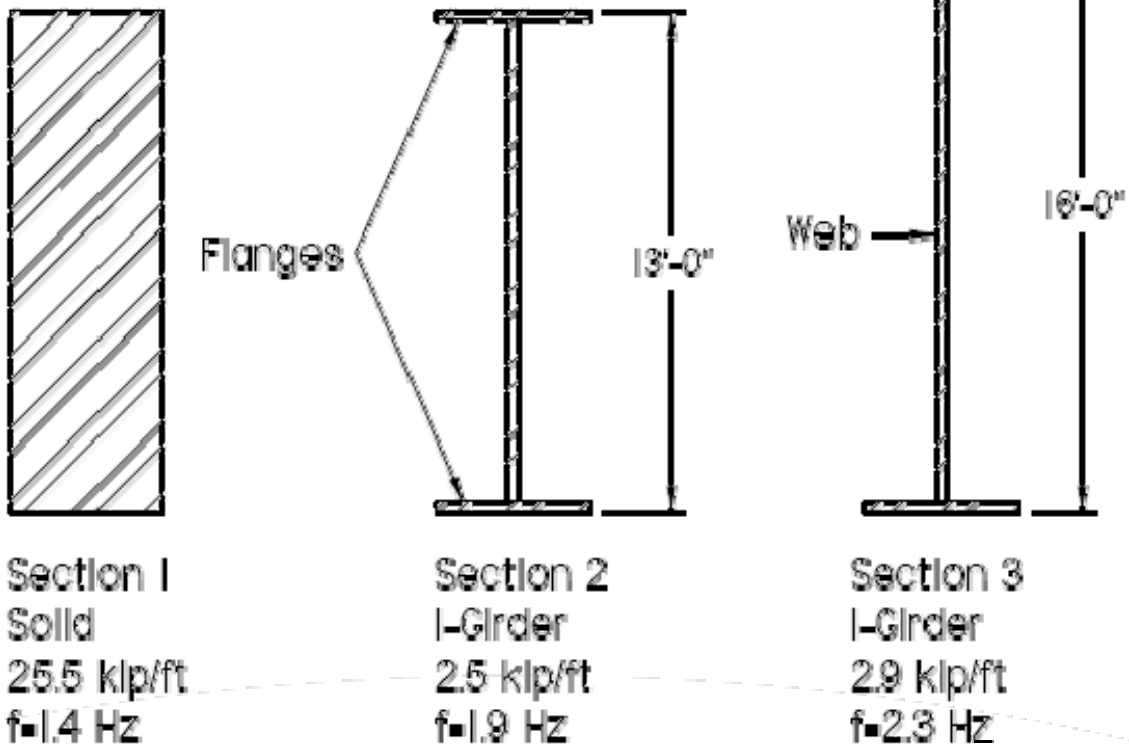
Serviceability Considerations

- Rider Comfort
  - DART ensures this by:
    - 2.5 Hz min. natural frequency
    - L/1000 deflection



Serviceability Considerations

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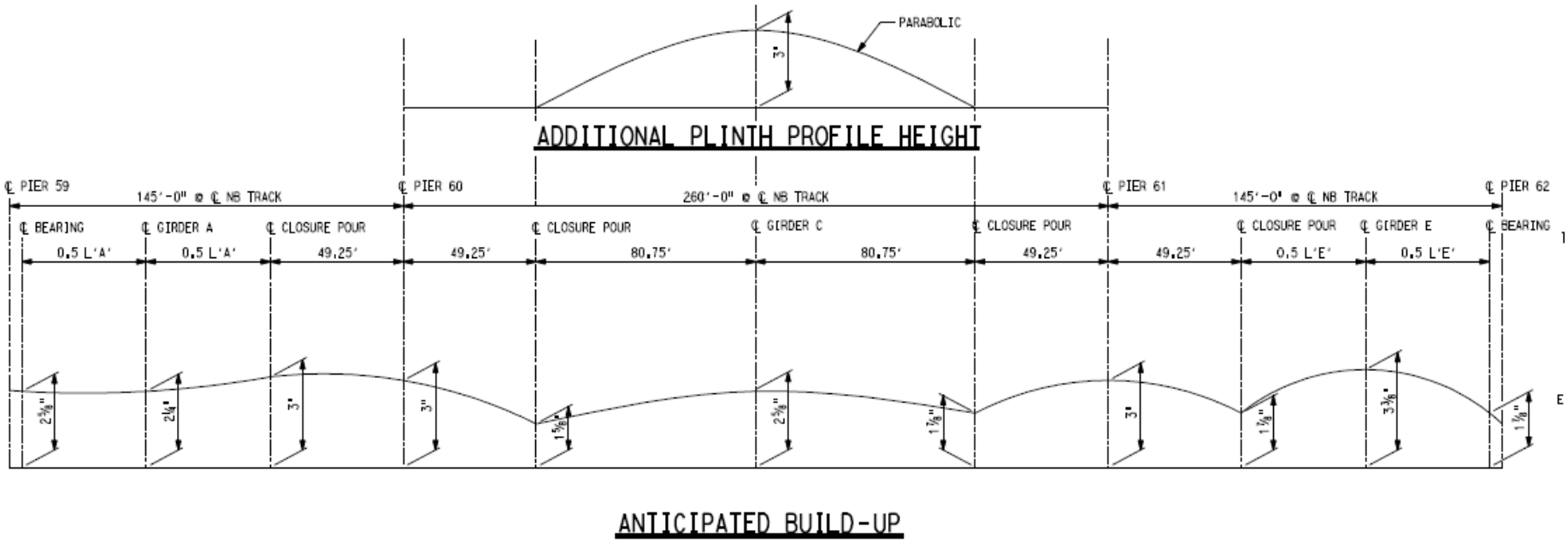
- Train-structure interaction study
  - Provide DART a primer explaining train-structure interaction.
  - Perform a full dynamic rolling stock analysis.
    - Series of ramp function loadings with time history.
    - Deck level accelerations
    - Dynamic magnification factors

Serviceability Considerations

- Clearance envelopes over time
- Considering geometry during construction process



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Pre-Tension Considerations

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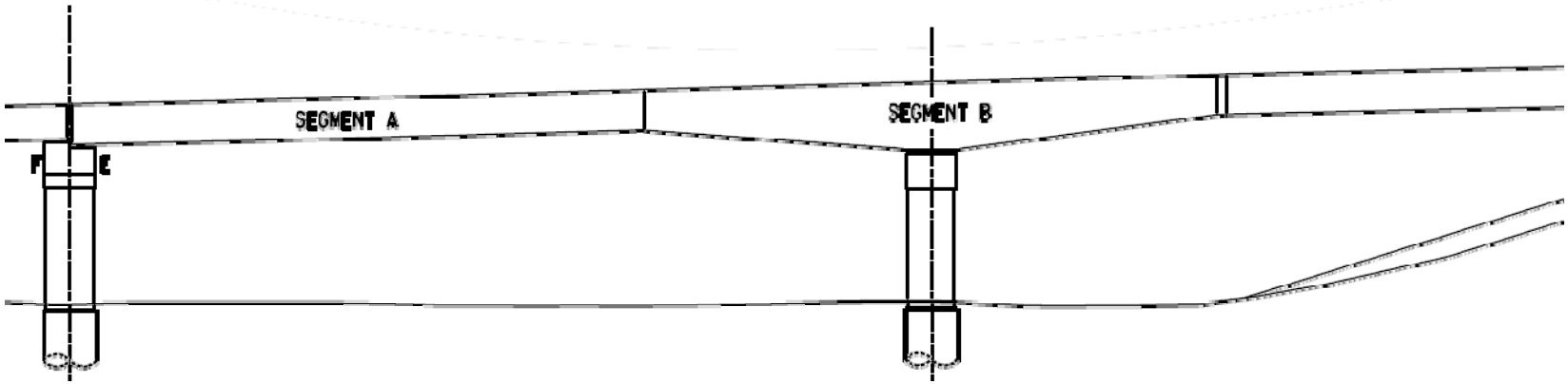
Haunch girders designed for this condition.



Pre-Tension Considerations

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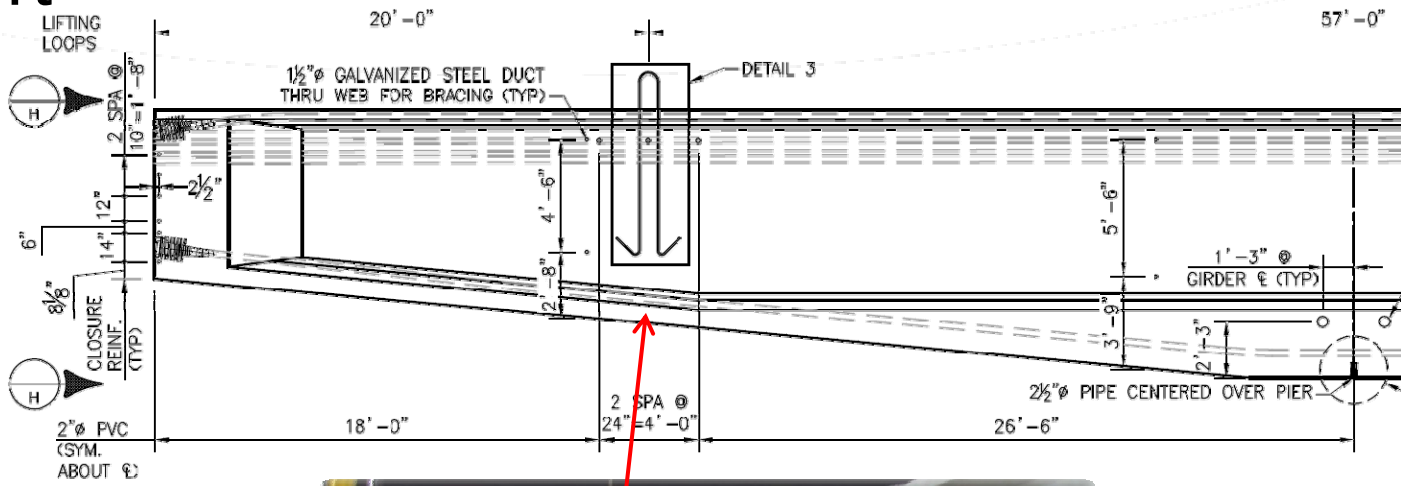
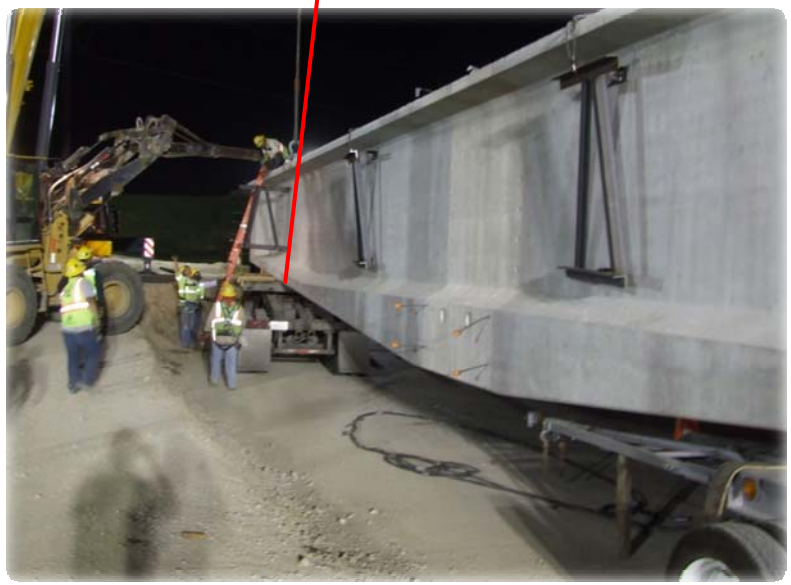
Transport





Pre-Tension Considerations

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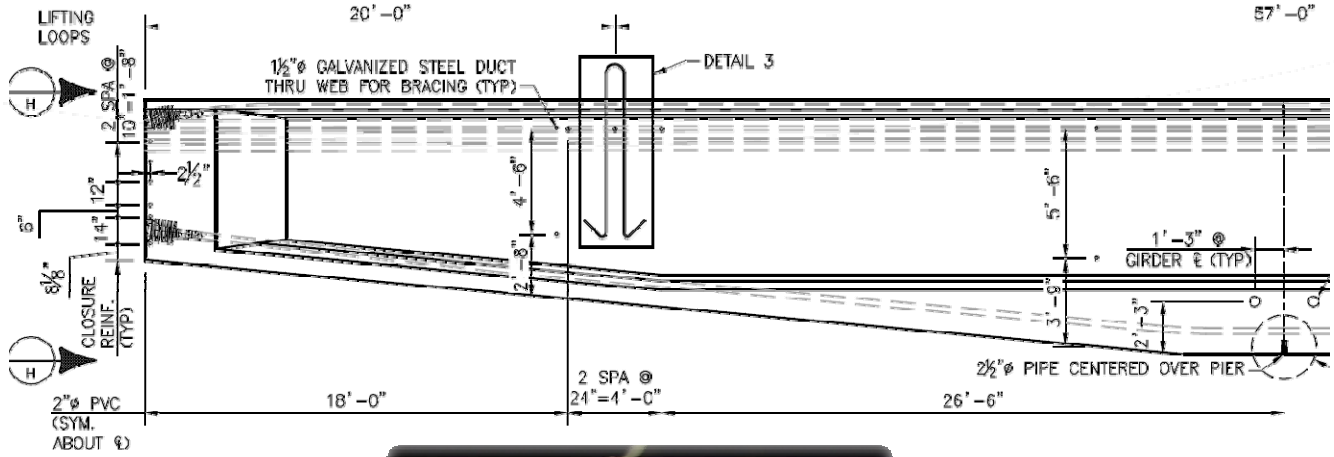
Lifting



Post-Tension Considerations

Perm. Tendons – Construction sequence and final strength

Temp tendon for lifting & transport

B2

Post-Tension Considerations

B1

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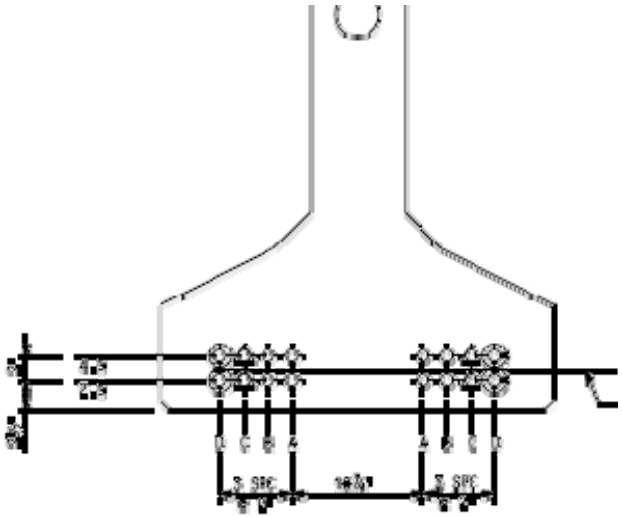
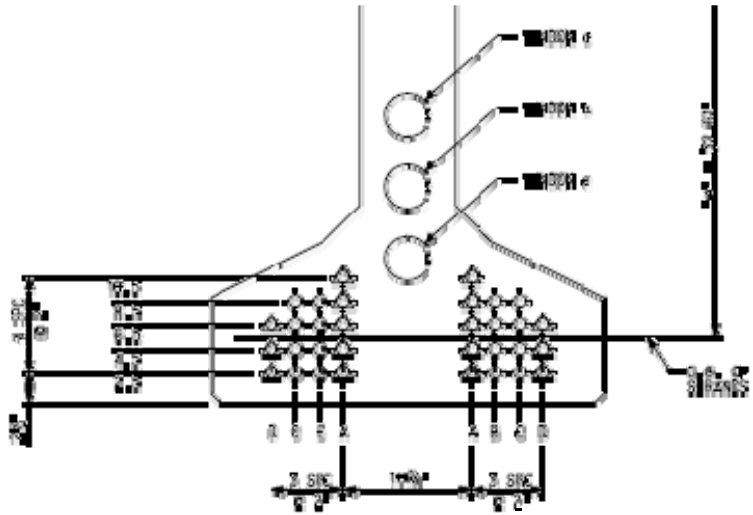


Spans A and E

~100’ girders



Span C

160’ girders

B1 Ben, 08/23/2011

B2 Add a "typical" girder PT amount for reference. Only enough Pretensioning to get it up.
Ben, 08/23/2011

Post-Tension Considerations

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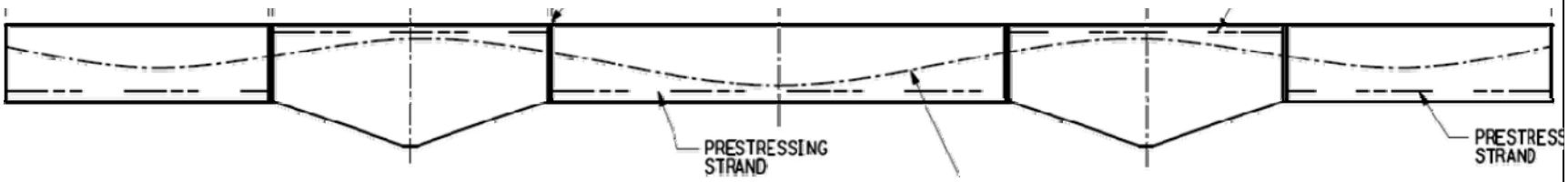
Post-tensioning

- Avoid multiple stressing operations
- Stressed in non-composite state.
- Continuity between girder segments



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Constructibility

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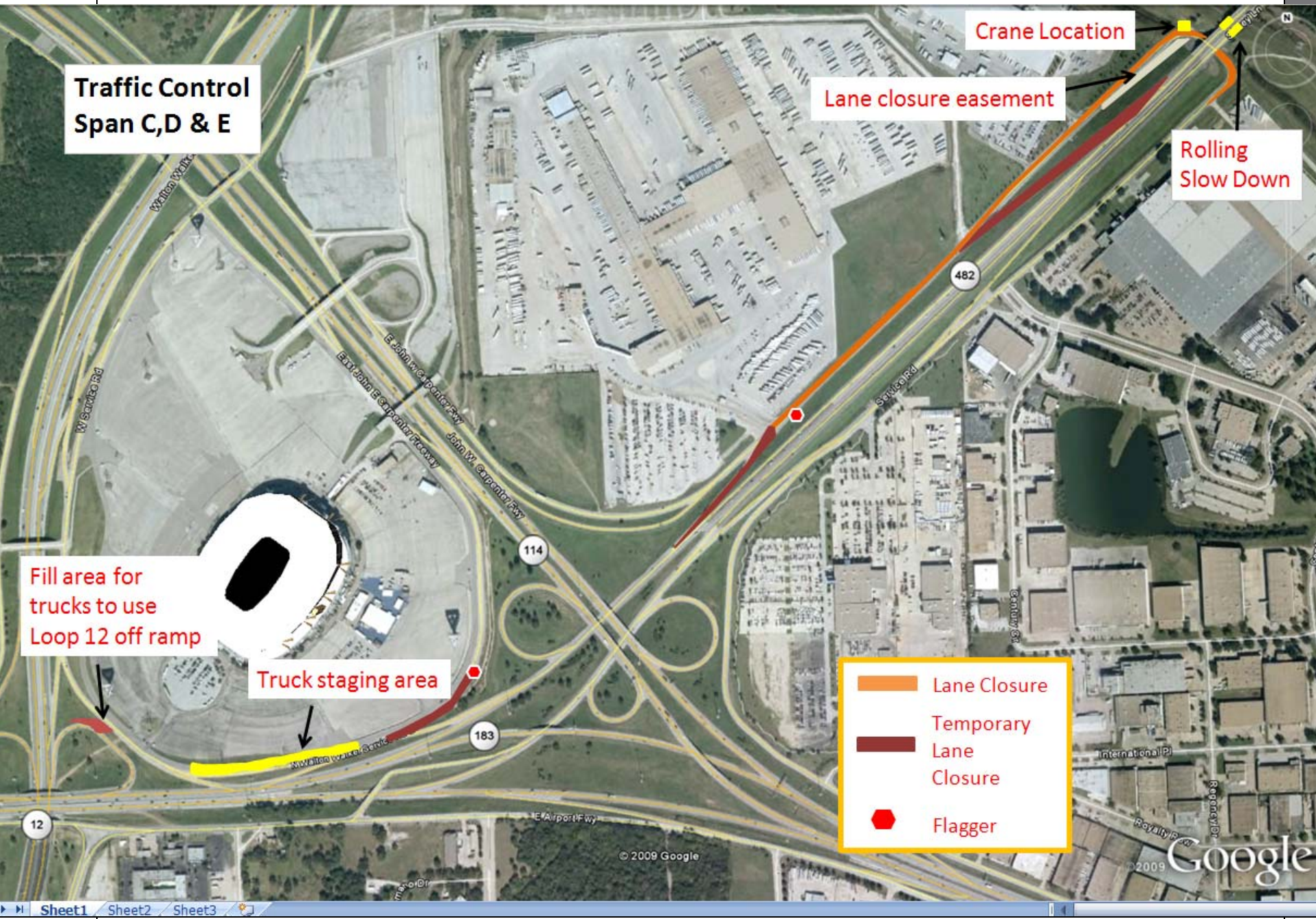
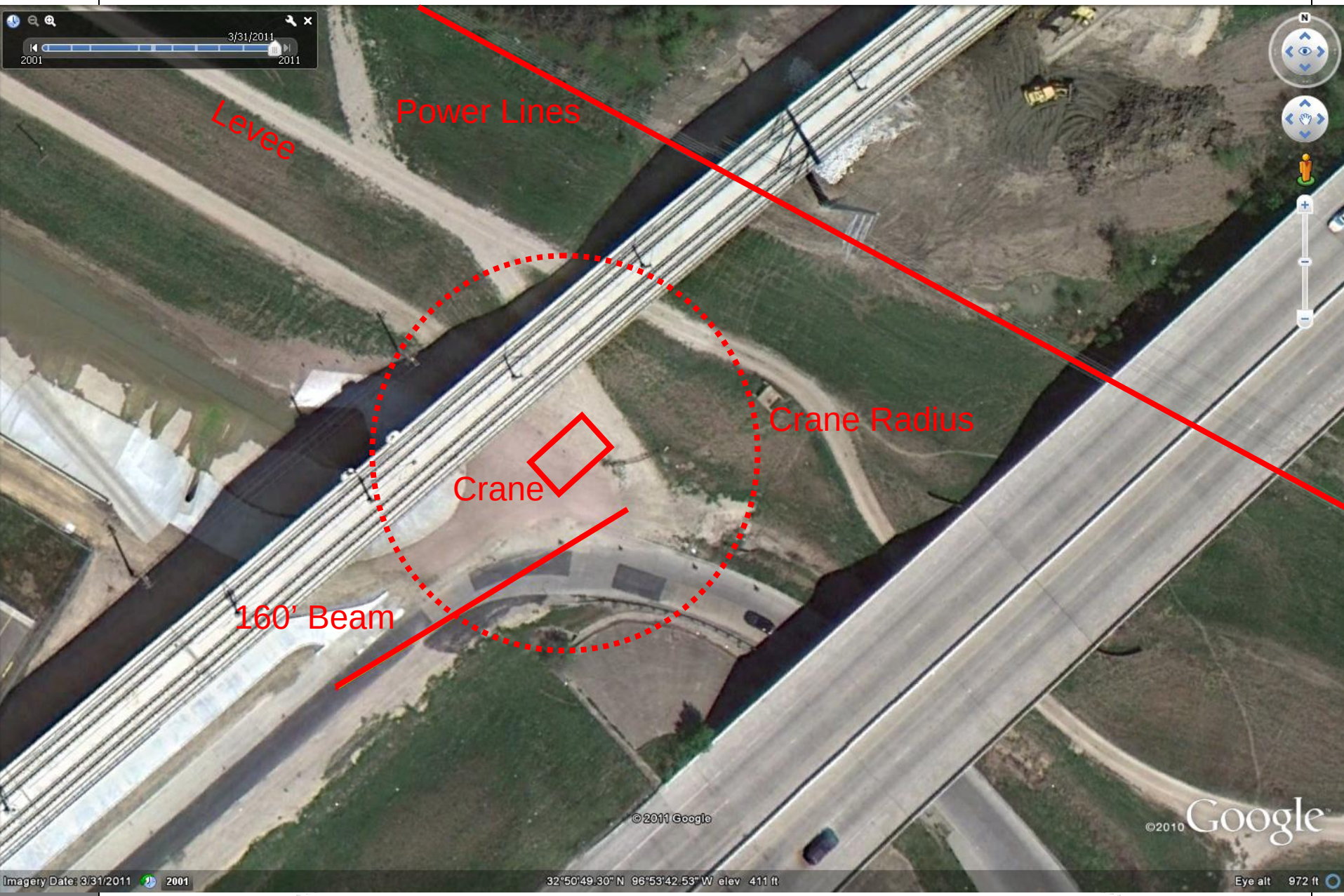
- Site access


Traffic Control
Span C,D & E
Crane Location
Lane closure easement
Rolling
Slow Down
Fill area for
trucks to use
Loop 12 off ramp
Truck staging area
Lane Closure
Temporary
Lane
Closure
Flagger
482
114
183
12
© 2009 Google
Google
Sheet1
Sheet2
Sheet3


Levee
Power Lines
Crane Radius
Crane
160’ Beam
3/31/2011
2001
2011
© 2011 Google
©2010 Google
Imagery Date: 3/31/2011
2001
32°50'49.30" N 96°53'42.53" W elev 411 ft
Eye alt 972 ft

Constructibility

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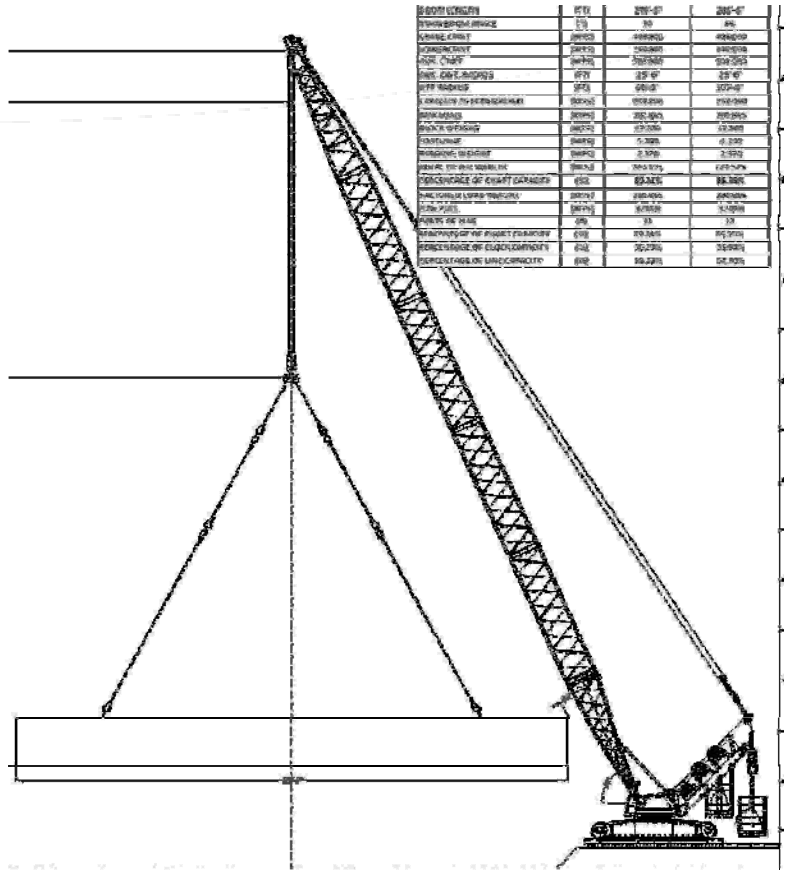
- Site access
- Nightwork required
  - Not just because it's hot

- Massive crane resting on utilities
  - Deep South CC 9600 Versa Crane (750 TN)
  - 240' of Boom Length
  - 1000 kips of counterweight
  - 48" Waterline Services Entire City of Irving

Constructibility



Temporary Works

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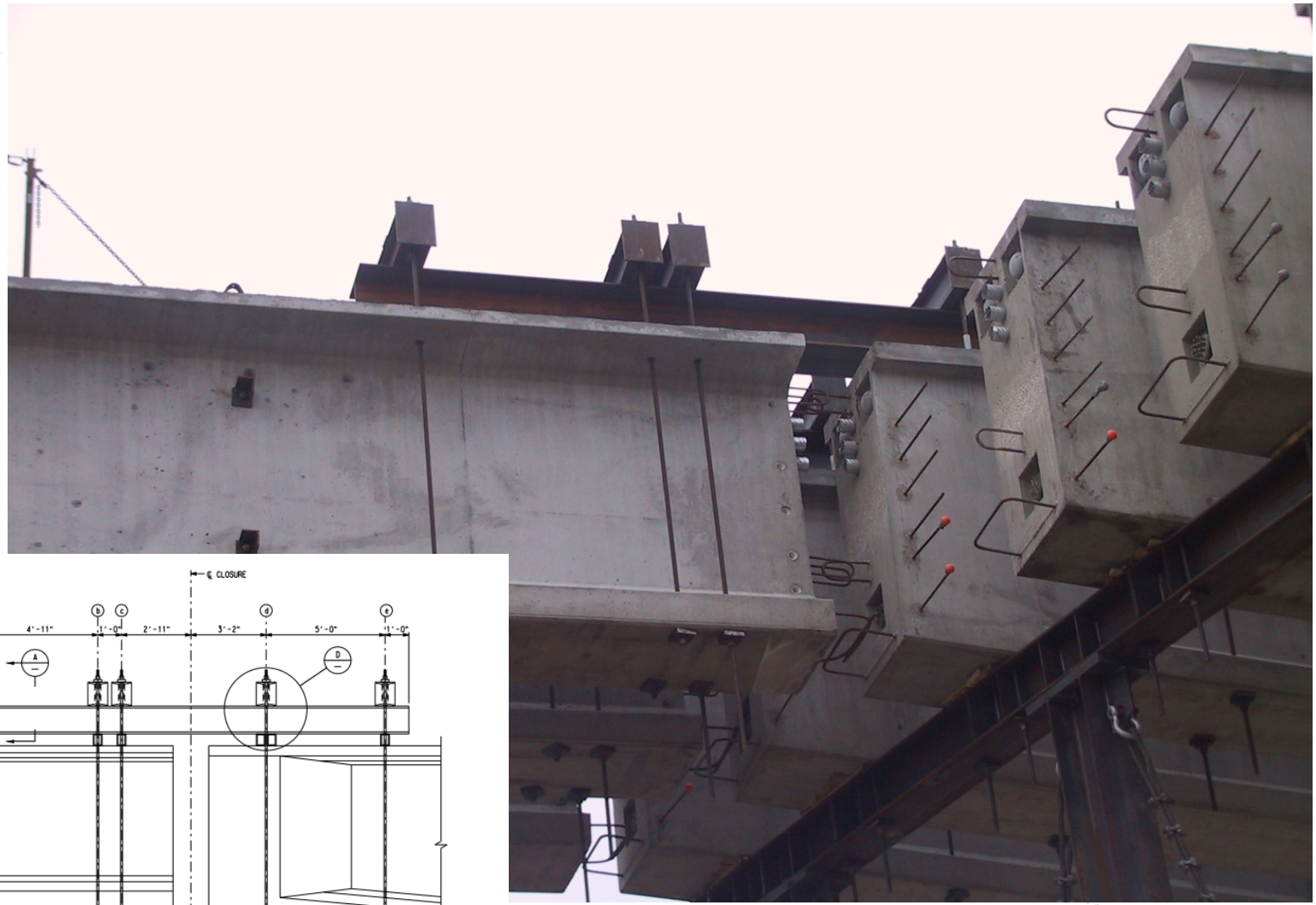
- Variety of temporary works
  - Girder tie-down
  - Dead man and temporary tower
  - Slip critical bolts in the temporary braces
  - Strongbacks

Girder Tie-down and Temp. Tower

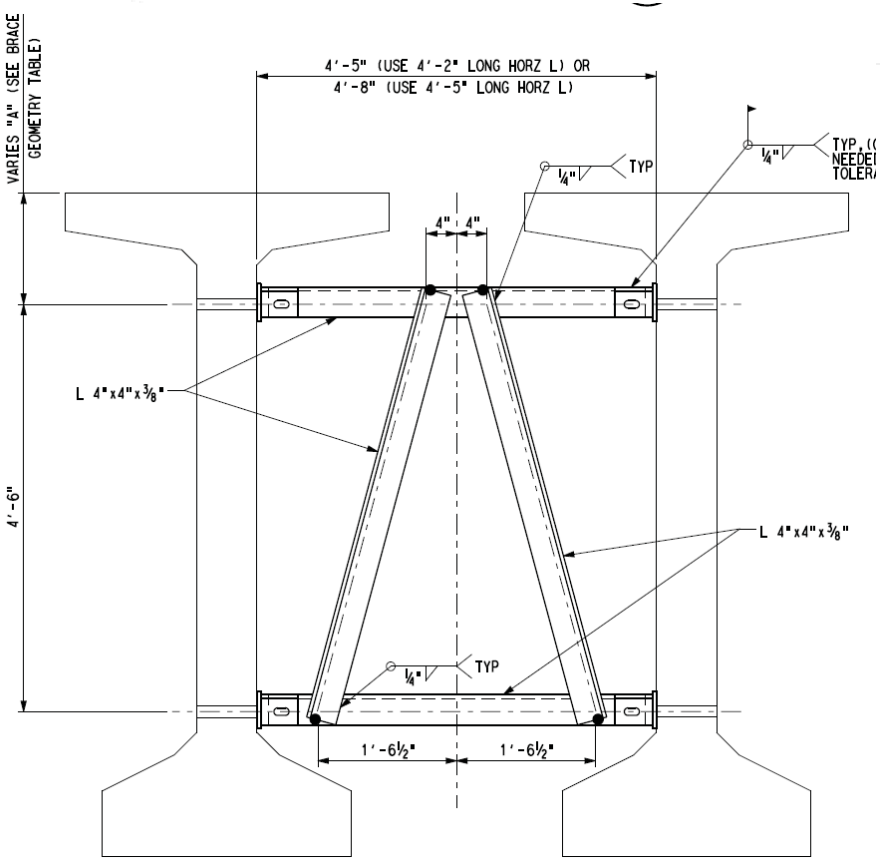
Strongback



℄ CLOSURE
a
b
c
d
e
1'-0"
4'-11"
1'-0"
2'-11"
3'-2"
5'-0"
1'-0"
1"Ø PT BAR
C12 x 20.7
HP14 x 102
HSS7 x 4
A
D
C
SEGMENTS A, C, OR E
SEGMENTS B OR D

Strongback

Temporary Bracing



Shoring Tower with Concrete Dead-man

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Thank You!

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