Hybrid Spliced Girder Concept to Solve Bridge Constructability Challenges

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Western Bridge Engineers Seminar
Reno, Nevada
September 2015

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Conventional CIP PT Box Girders

- Cost effective
- Seismic performance
- Aesthetics

- Relatively long construction time
- Reduced temporary clearance

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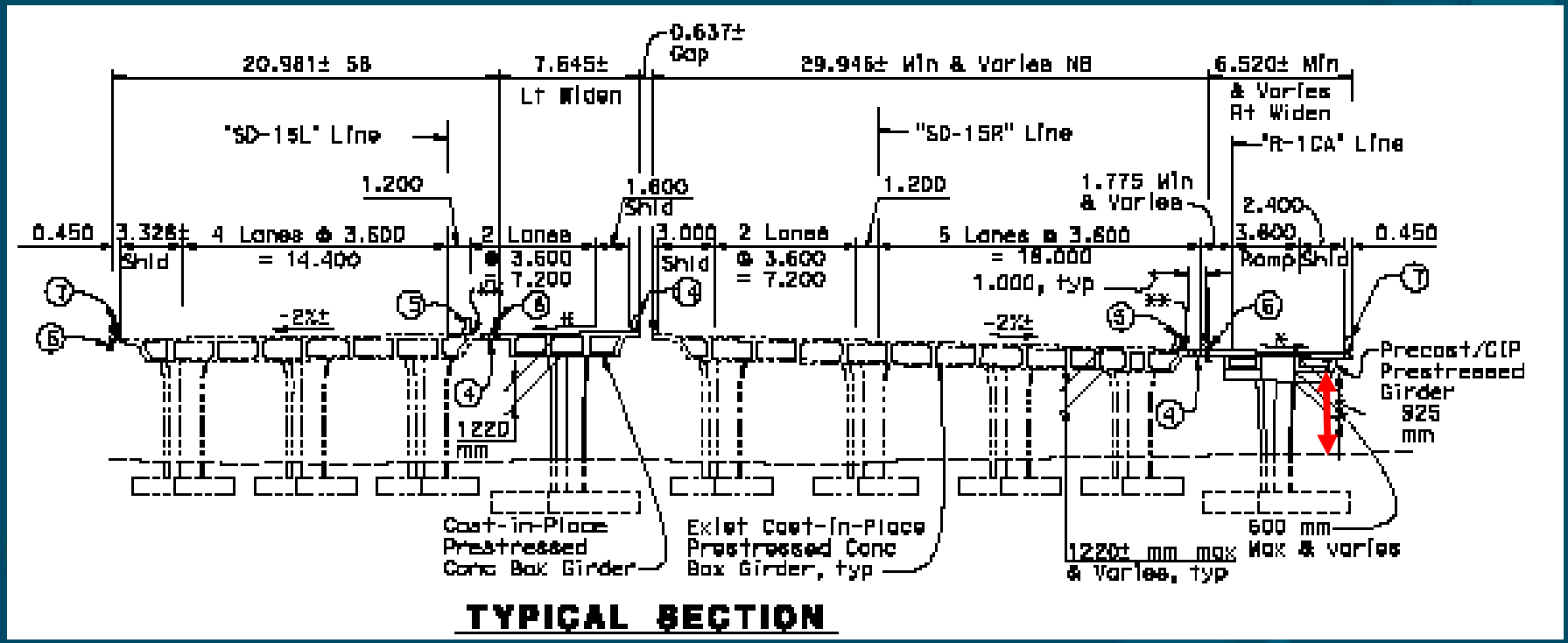
Project Challenges

- Insufficient vertical clearance for formwork
- Insufficient permanent vertical clearance
- Congested traffic
- Accelerated construction schedule
- Other requirements (aesthetics, geometric,…etc.)



Superstructure Alternatives

- Cast-High and Lower
- Precast girders:
  - Precast girders (full span)
  - Spliced Precast girders
  - **Hybrid of Precast girders spliced with CIP girders**

Hybrid Precast/CIP used in two projects:

- SR-22/I-5 Separation Widening (Orange, CA)
- I-15/Felicita Road UC Widening (San Diego, CA)

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SR-22 HOV Widen D/B

- $550 million project
- 12 - mile freeway widening
- 34 bridges widened or replaced
- 800 day schedule
- 1st design/build in Caltrans R/W

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SR-22/I-5 Widening

SR-22/I-5 Widening

Project Constraints:

- Traffic congestion
- Vertical clearance above I-5 NB
- Accelerated construction (D/B)
- Cost constraints (D/B)
- Aesthetics

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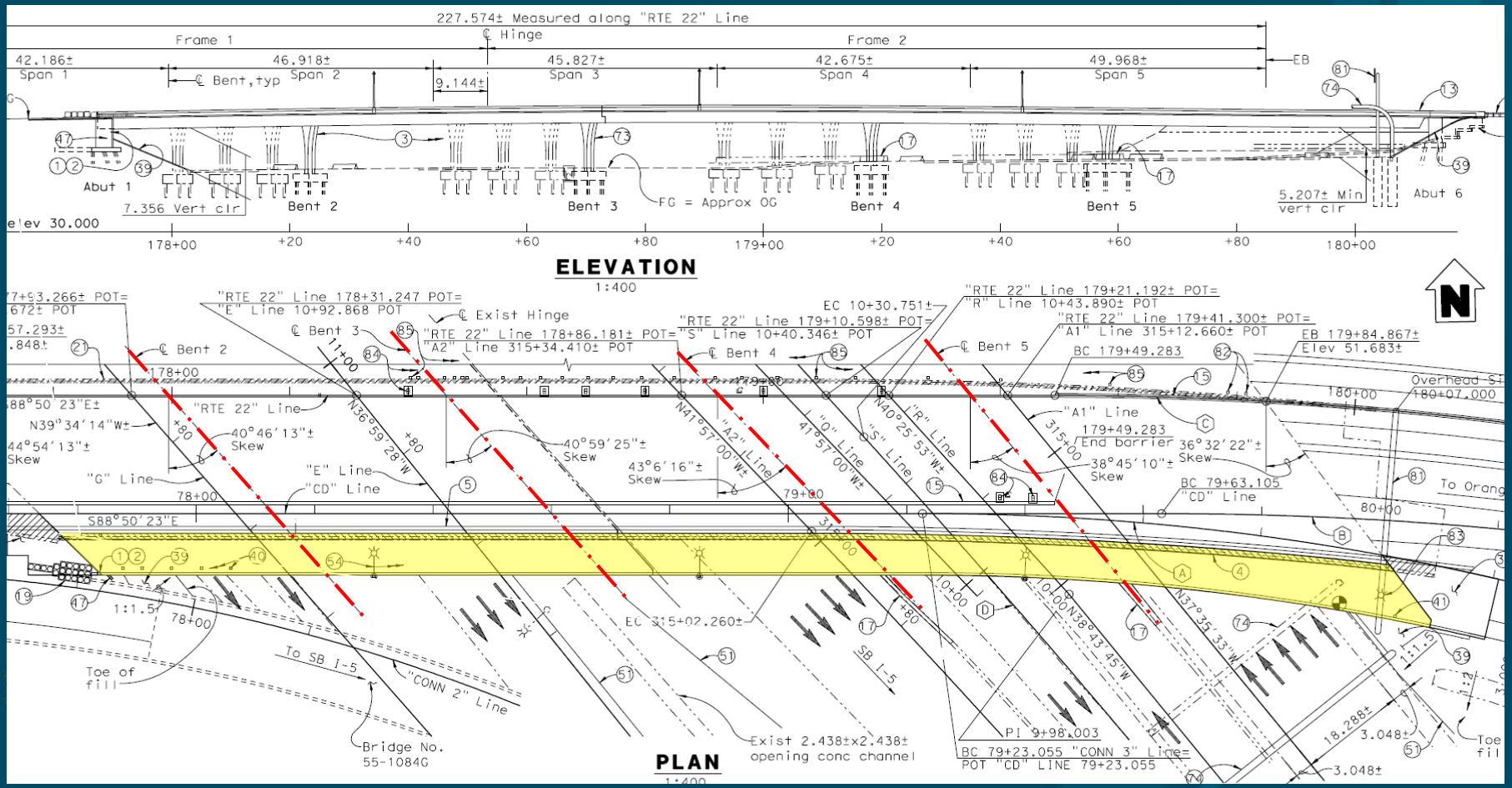
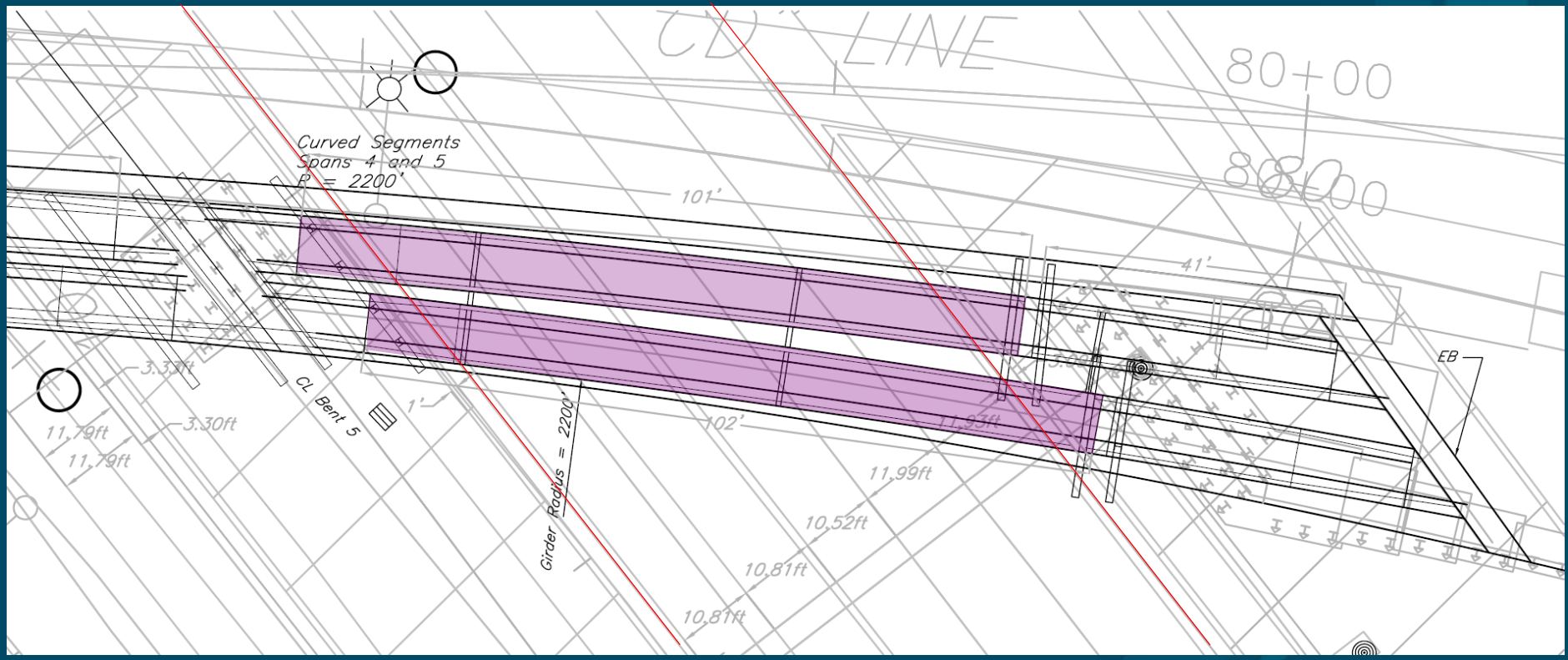
SR-22/I-5 Widening

- Spliced bathtub girders
- Multi-stage post-tensioning



SR-22/I-5 Widening

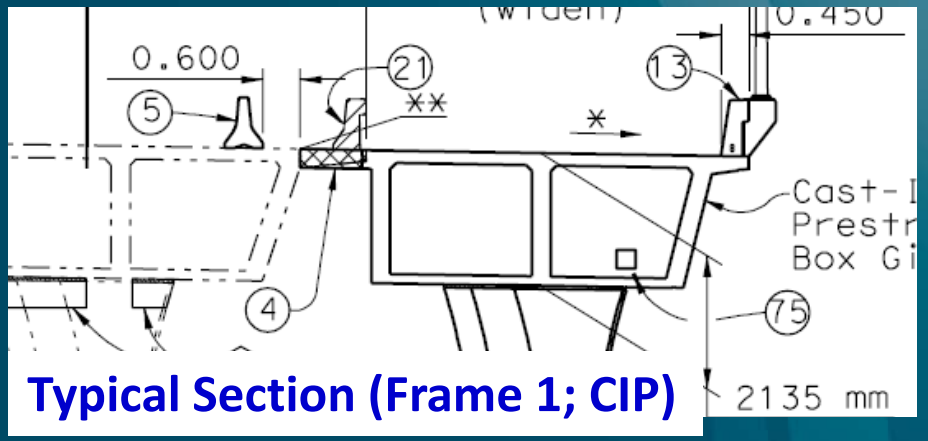
- Re-design using hybrid precast/CIP spliced bathtub girders
- Precast bathtub girders over I-5 NB
- CIP elsewhere
- Multi-stage post-tensioning



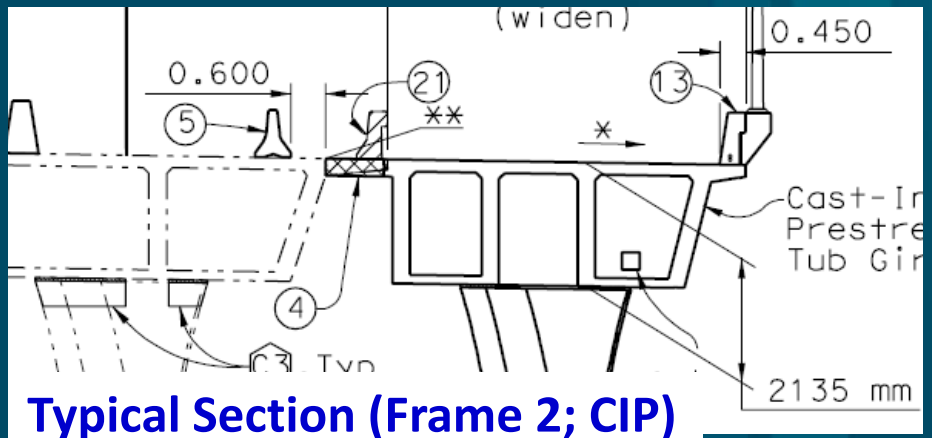
SR-22/I-5 Widening

- Max Girder Length: 103 ft
- Max Girder Weight: 240 kip
- Girder depth: 6.2 ft
- Girder width (soffit): 6.0 ft
- Minimum curvature: 1,640 ft

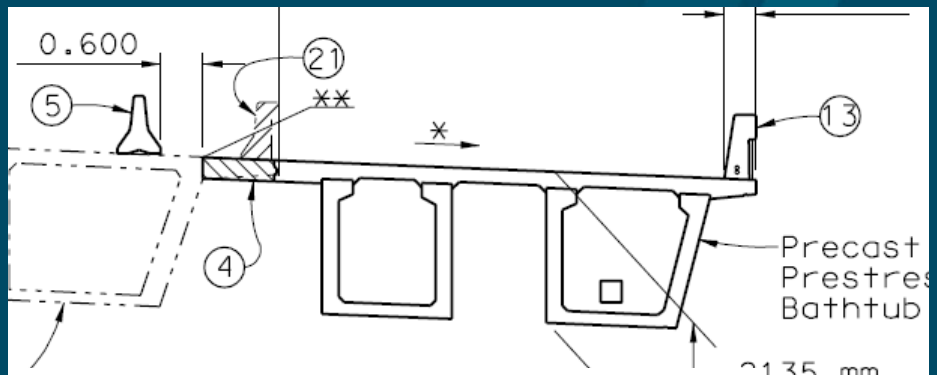
First curved spliced bathtub girder project in California



Typical Section (Frame 1; CIP)



Typical Section (Frame 2; CIP)



Typical Section (Span 5; Precast)

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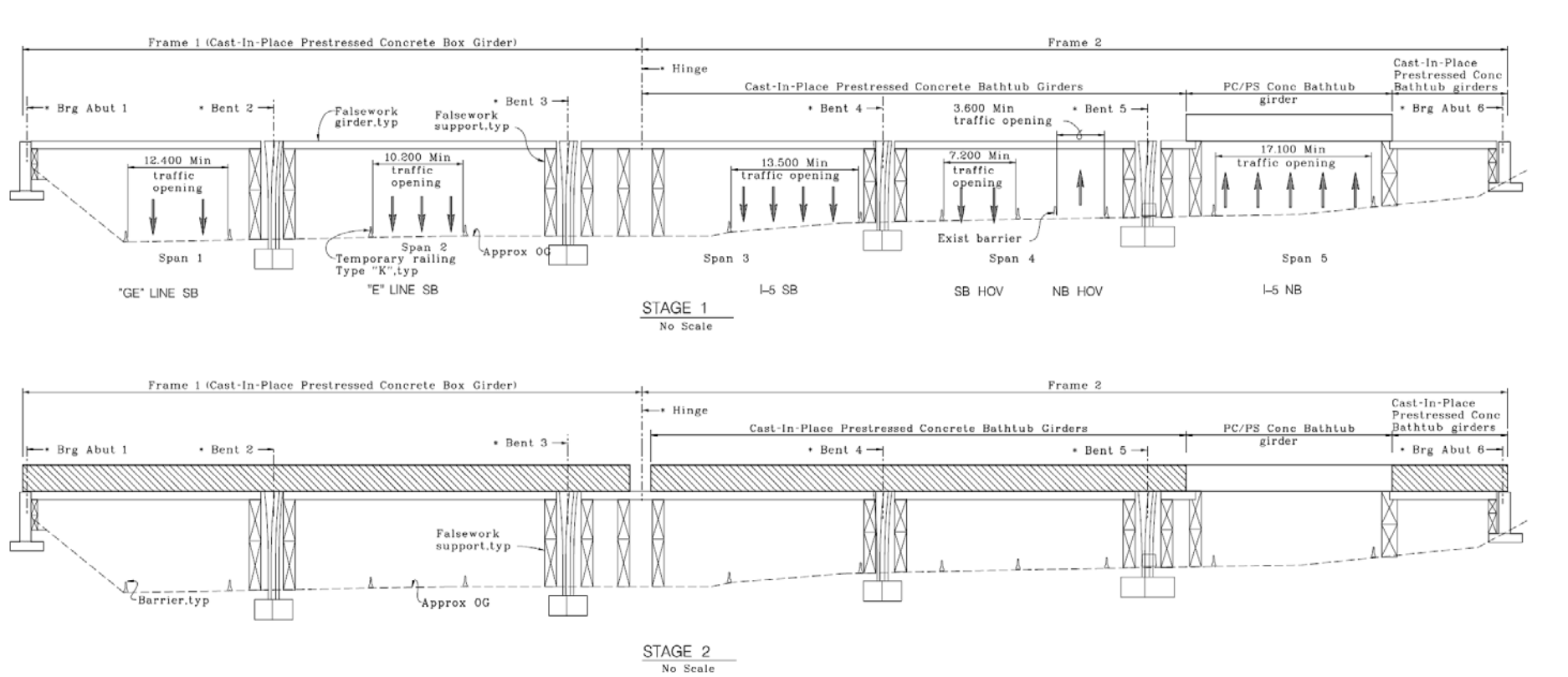
SR-22/I-5 Widening

Construction Stages



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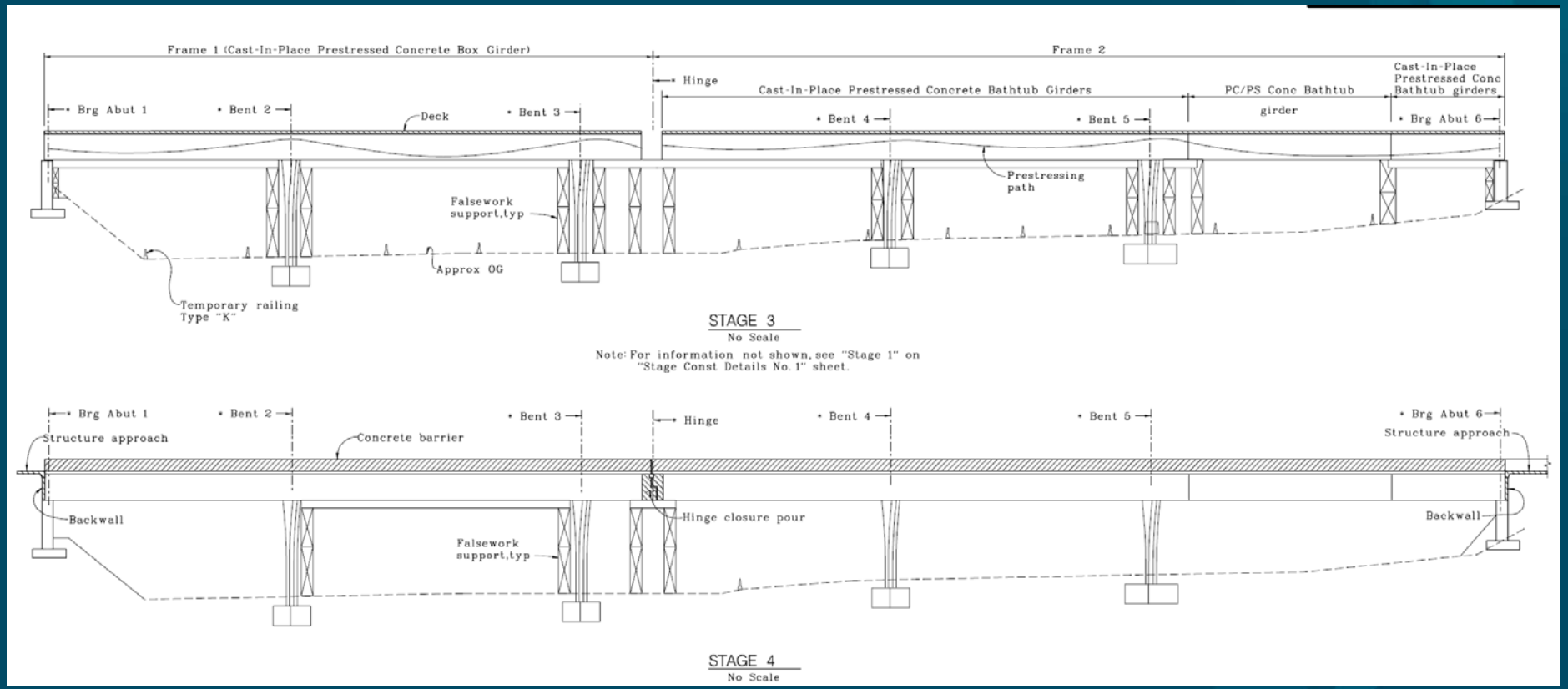
SR-22/I-5 Widening

Construction Stages



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SR-22/I-5 Widening


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SR-22 HOV Widen D/B

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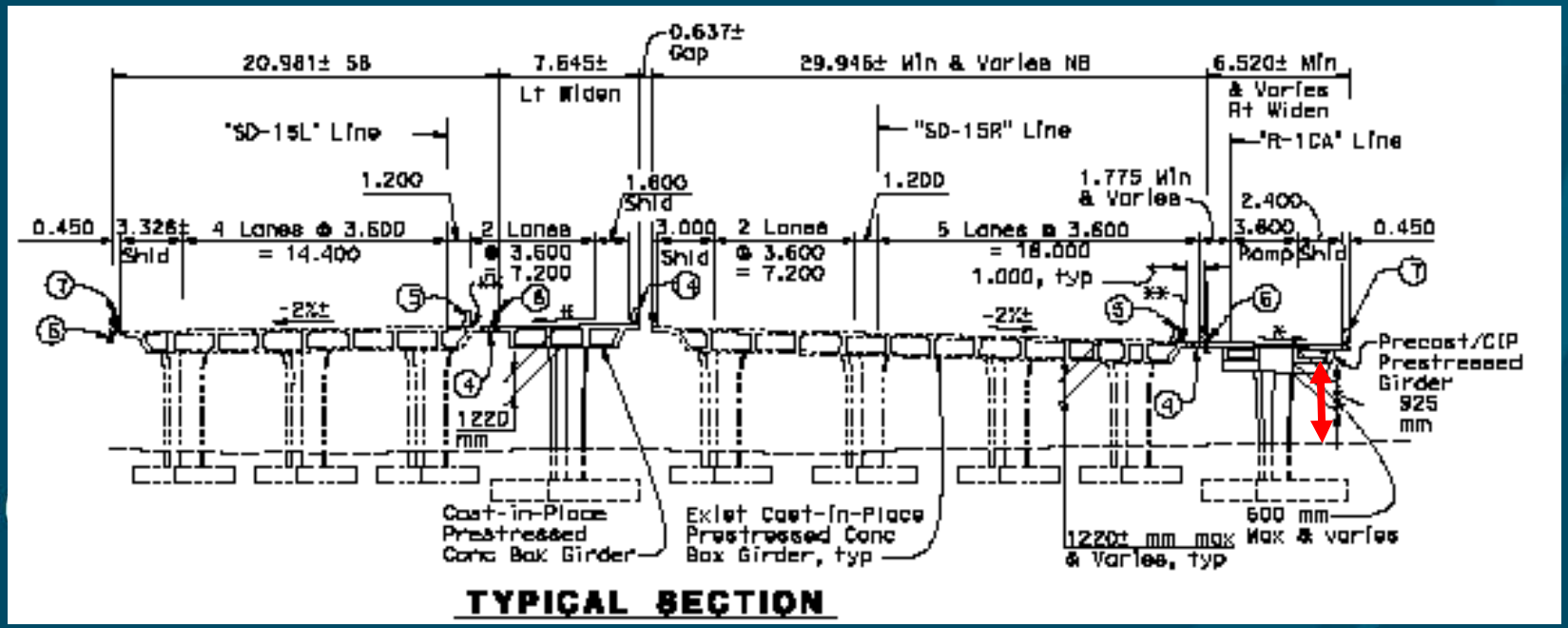
I-15/Felicita Road UC

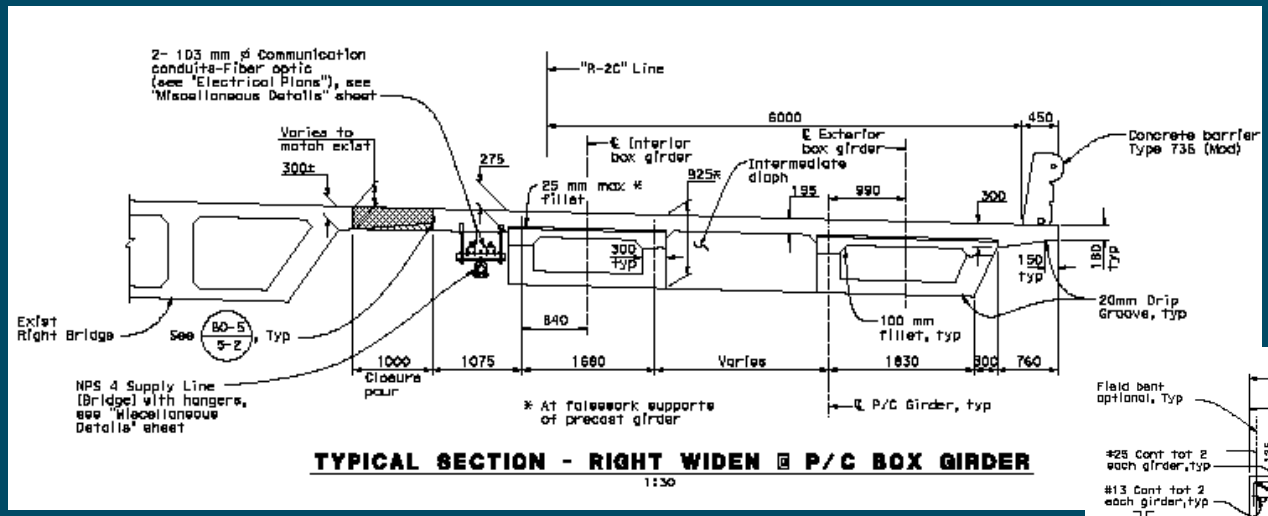
- Insufficient temporary formwork for CIP alternative
- Insufficient permanent vertical clearance
- Minimum traffic closures

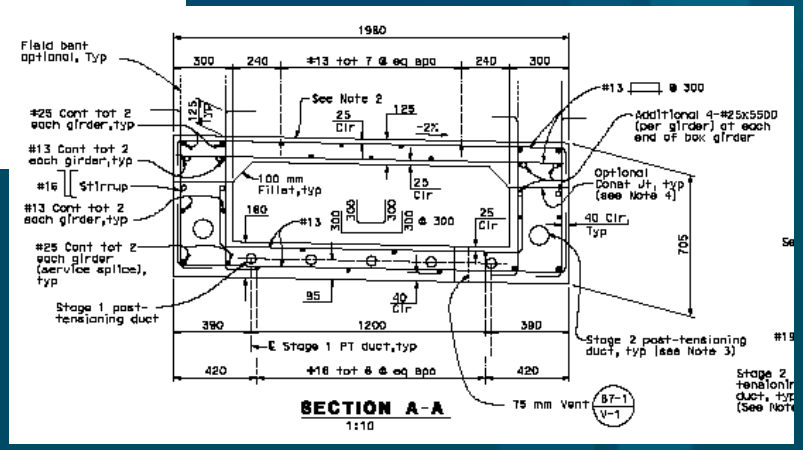
Alternative Solutions:

- CIP PT Box Girder ➡ lower existing roadway
- **Precast/CIP Hybrid with variable depth**

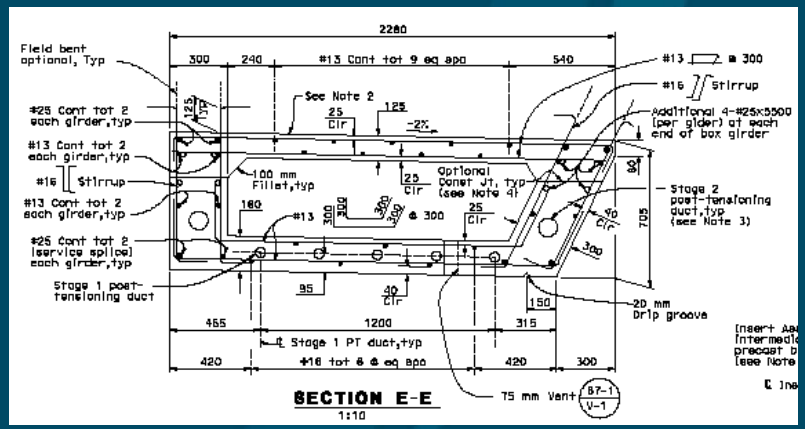


I-15/Felicita Road UC





- Precast girders depth is 2'-3 3/4″
- Superstructure depth is 3'-0 1/2″
- Depth-to-Span Ratio (D/S) = 0.028
- Recommended D/S = 0.040



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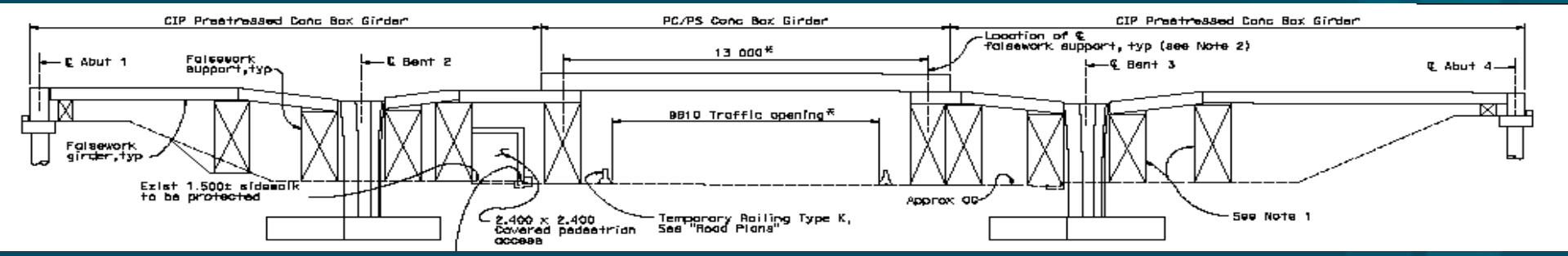
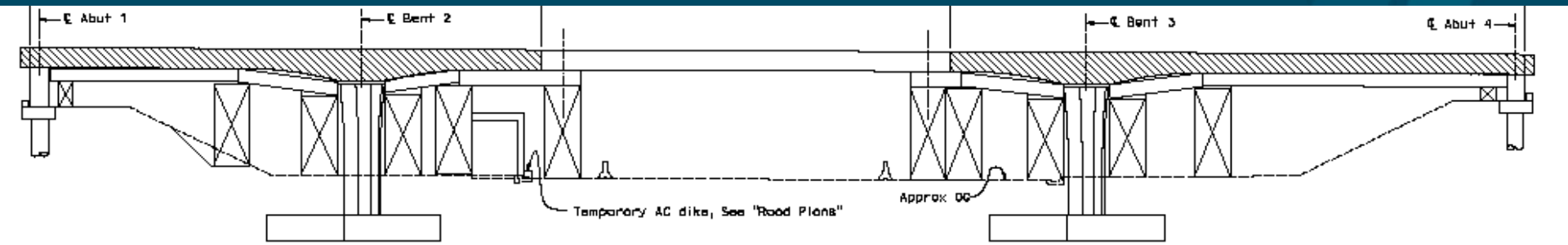
I-15/Felicita Road UC

Construction Stages





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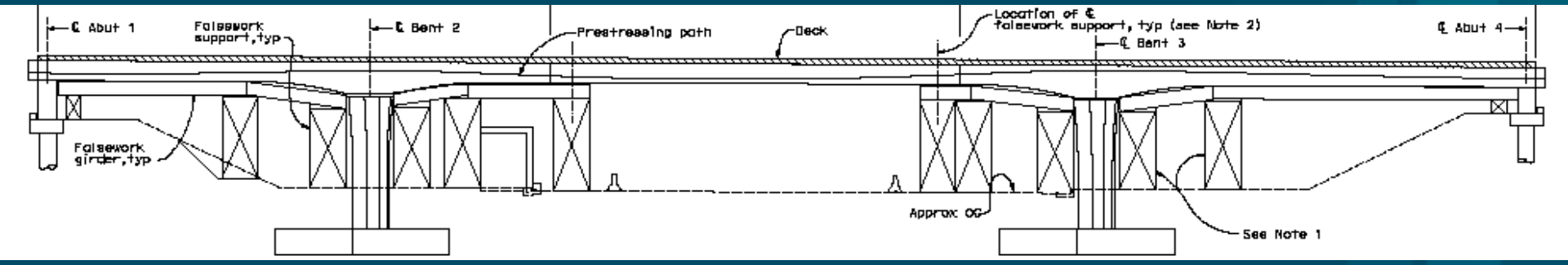
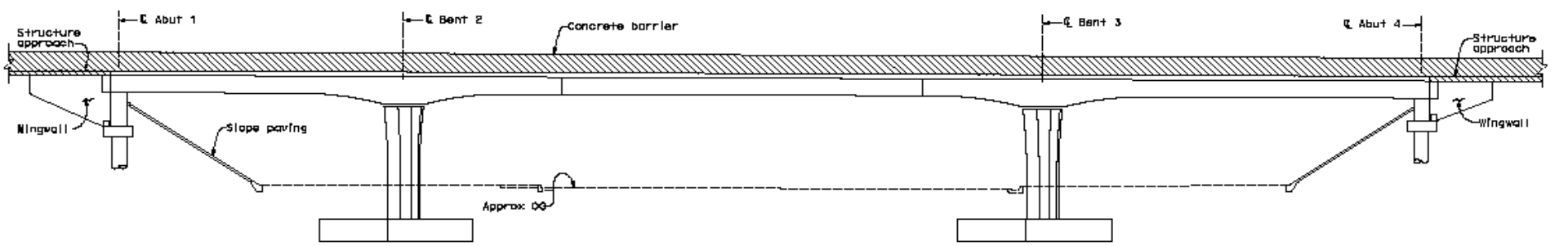
I-15/Felicita Road UC

Construction Stages





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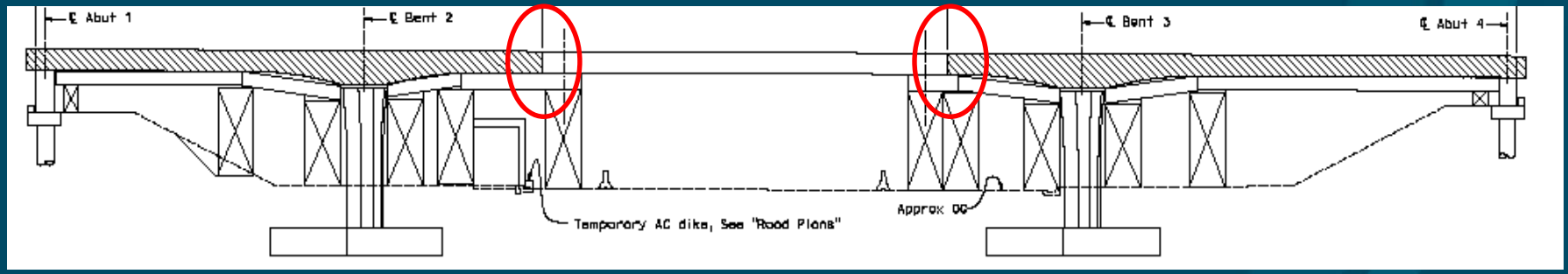
Design Considerations

- Precast girders could be pre-tensioned or post-tensioned
- Multi-stage post-tensioning
- Stage construction analysis
- Tensile stresses at the CIP/Precast interface



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Conclusions

- Hybrid precast/CIP spliced girder concept can be used to solve bridge constructability challenges including:
  - Geometric constraints
  - Traffic congestion
  - Aesthetics
- Lowering grade to meet required vertical clearance can be avoided
- Concept used successfully in Design-Build project with accelerated construction schedule

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Thank you

Questions?