Use of Spliced Girders for Long Spans Crossing Environmentally Sensitive Areas

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Western Bridge Engineers' Seminar

Presentation Outline

- Introduction
- Project challenges
- Geometry and construction sequence
- Analysis model and results
- Construction

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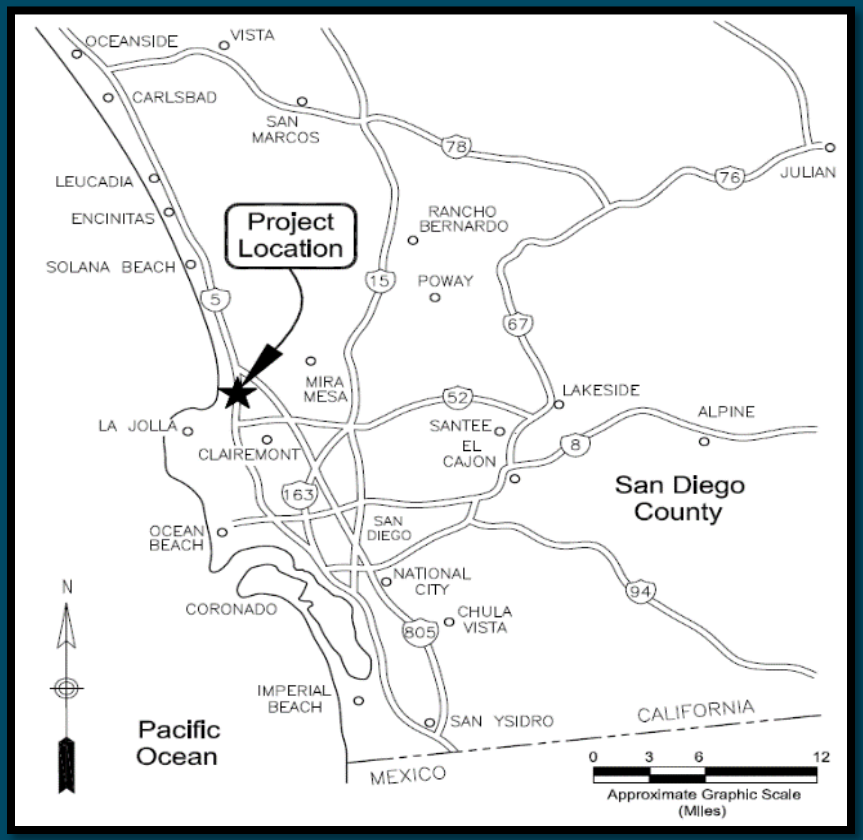
Introduction



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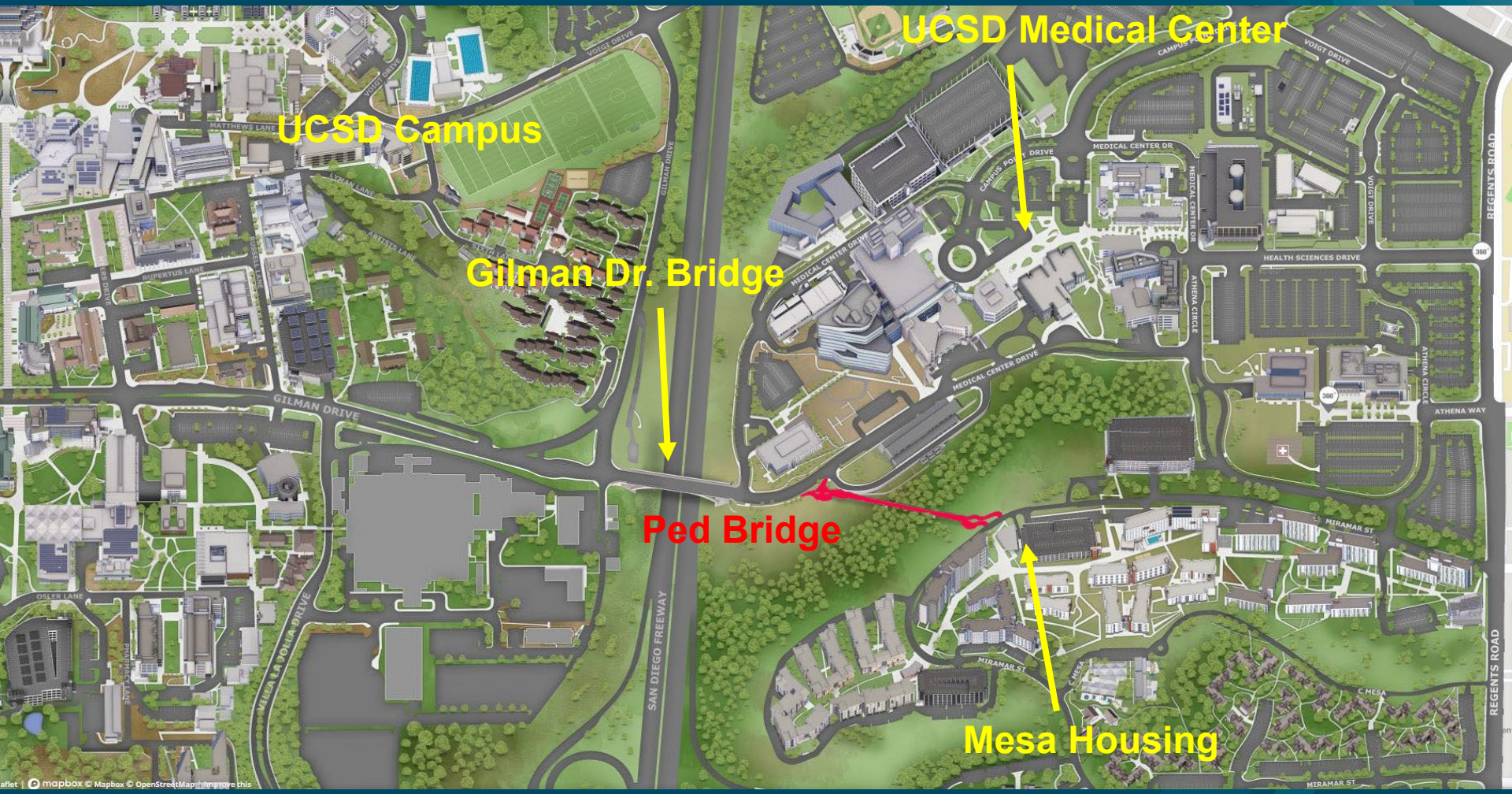
Project Site



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Project Site

Project Challenges

- Environmentally Sensitive Area (ESA)
  - No temporary supports in the ESA
  - Long Spans
- Steep slopes at the site
- Simultaneous construction of the Nuevo West Housing
- Construction equipment
- Architectural features

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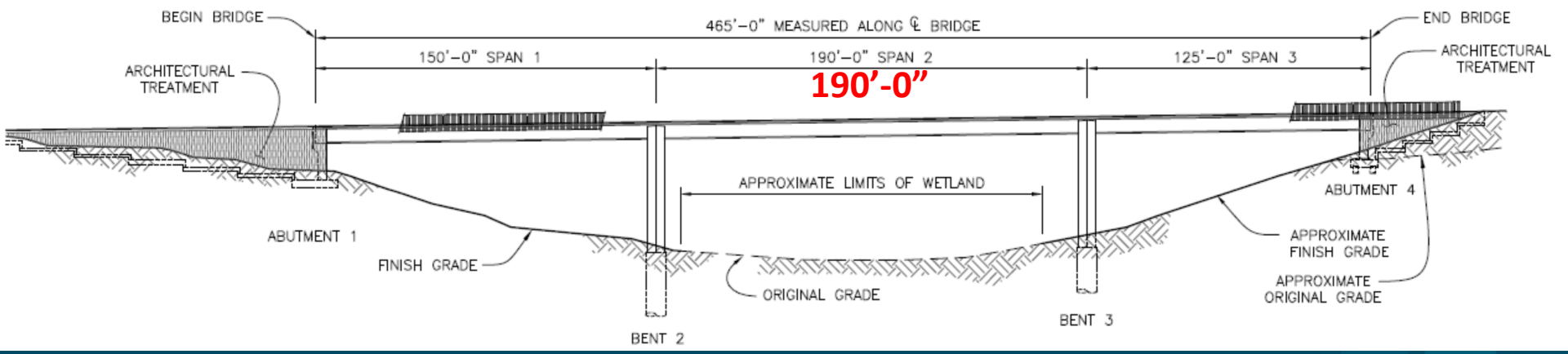
Bridge Geometry



- Center span crosses the ESA. Length of center span = 190 ft
- Limit on girder length (girder transportation routes) = 150 ft
- Girders need to be spliced
- Temporary falsework supports at splice locations are not allowed in the ESA
- Girders need to be spliced in air

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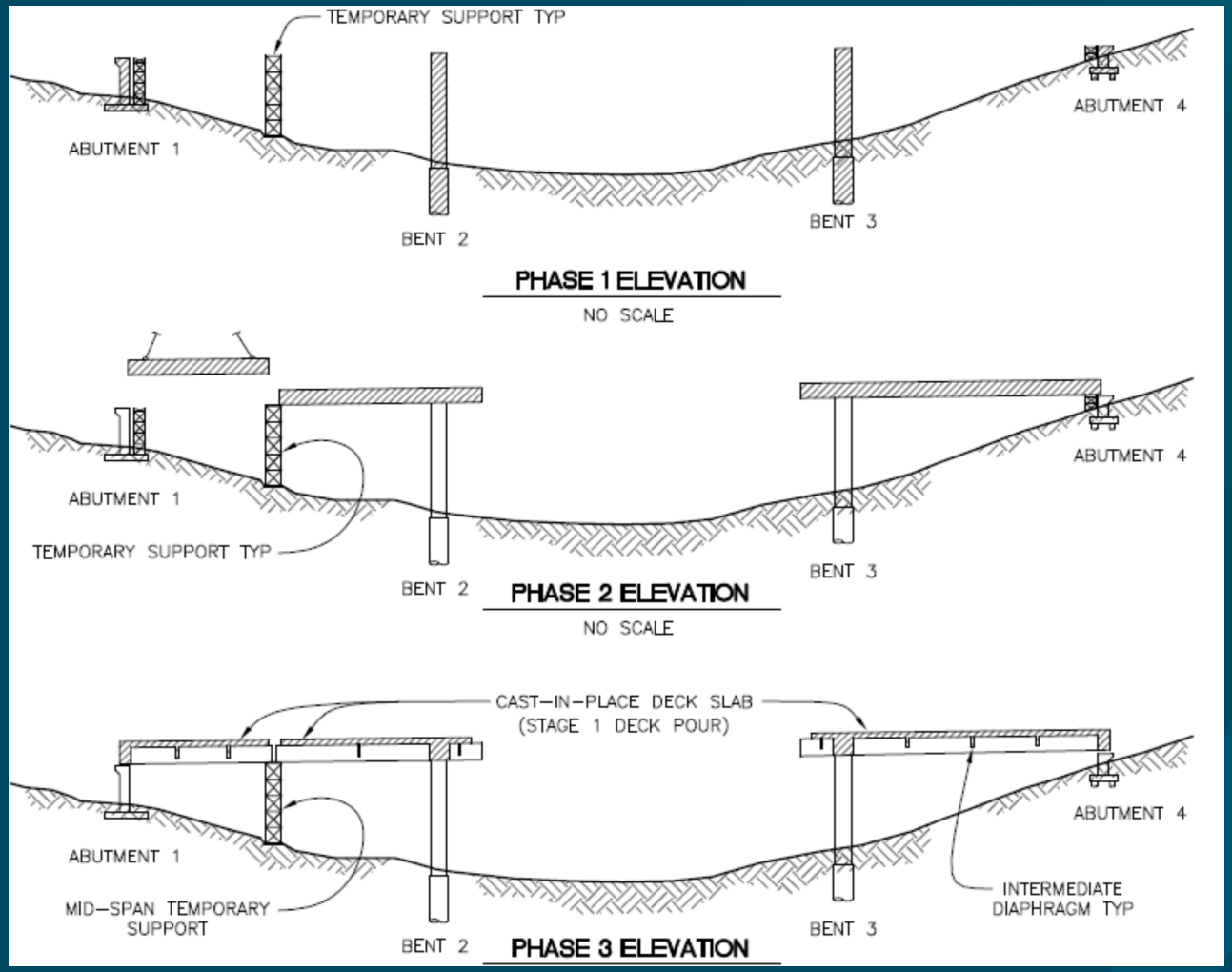
Construction Sequence



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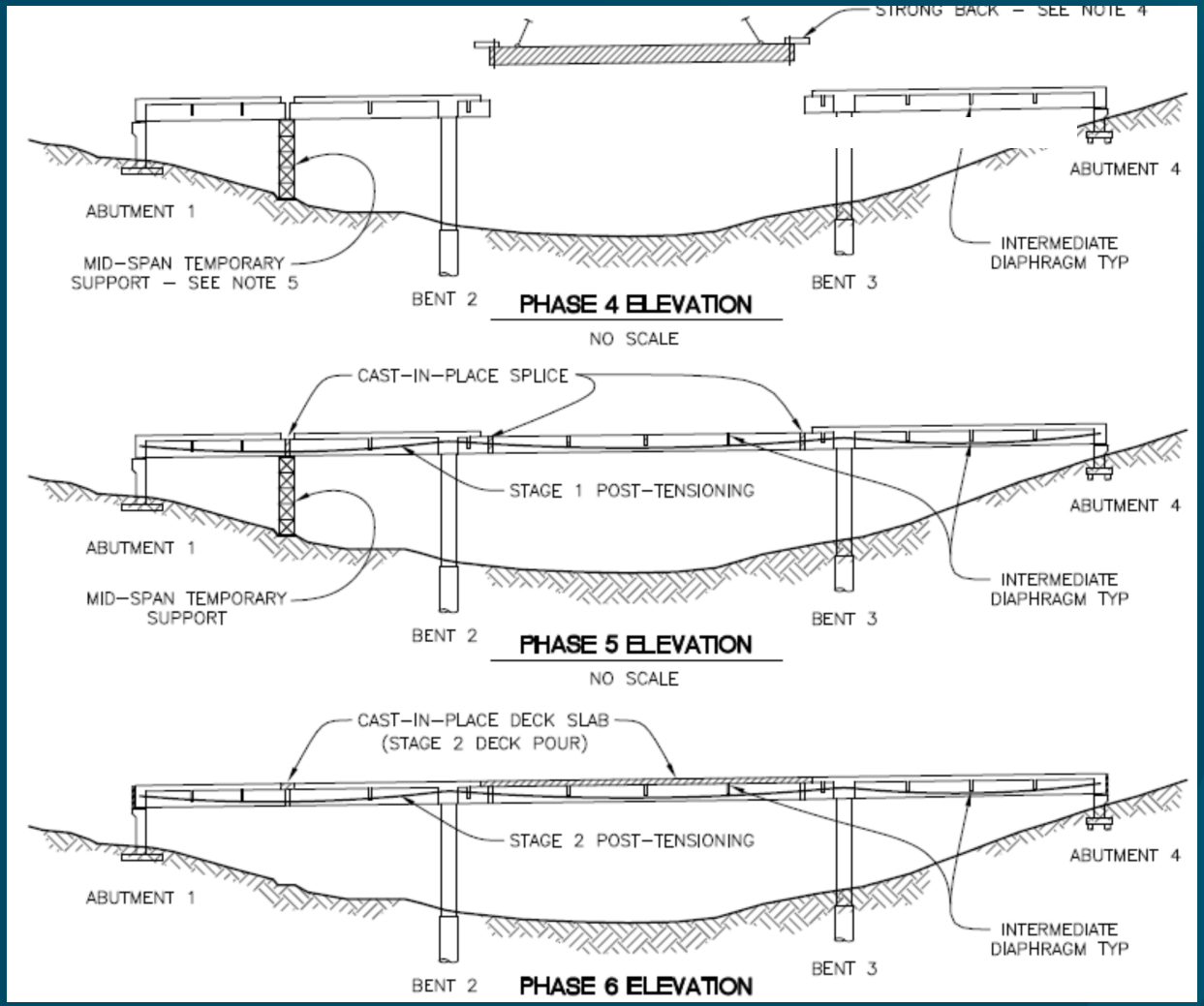
Construction Sequence



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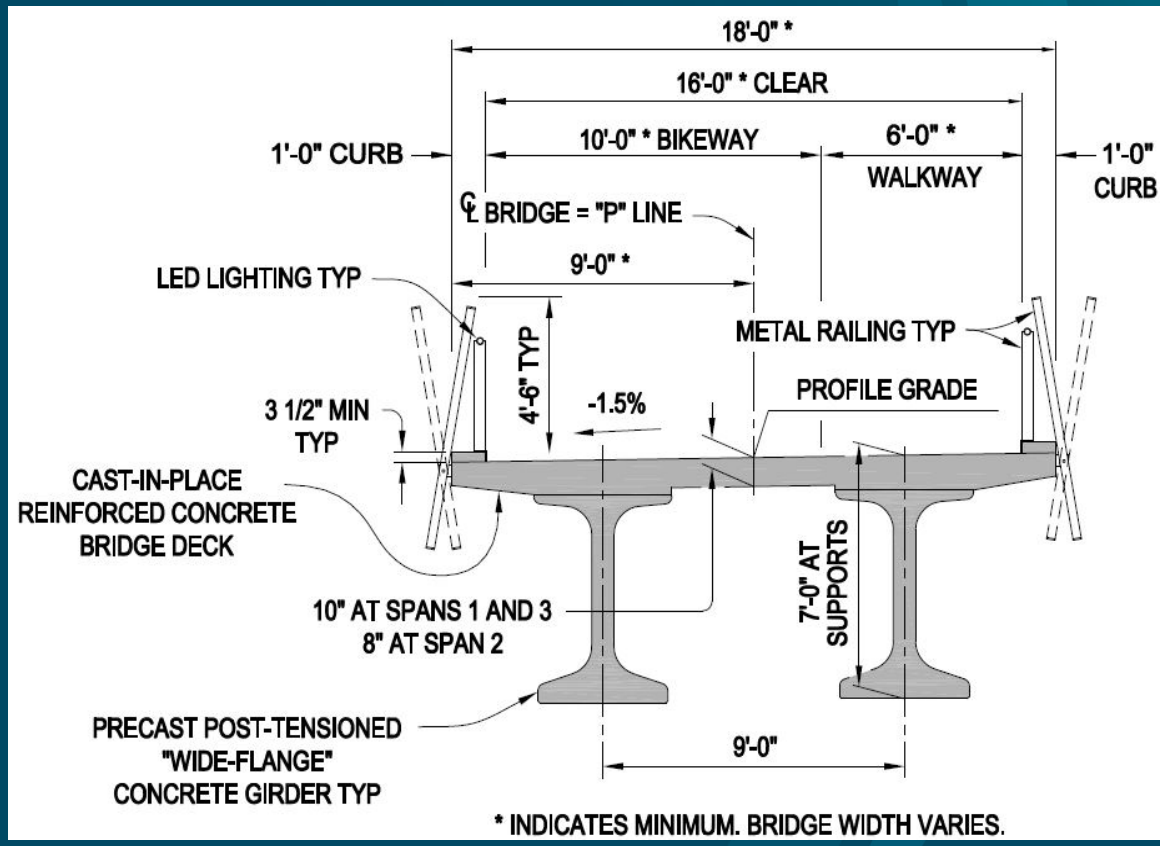
Typical Section

- Depth of girder = 6 ft
- Superstructure depth = 6’-8”
- Depth/Span = 0.035 < 0.04
- Reduced lifting weight of the erection cranes
- Shallower superstructure has better aesthetics
- Live load deflections checked
- Vibrations



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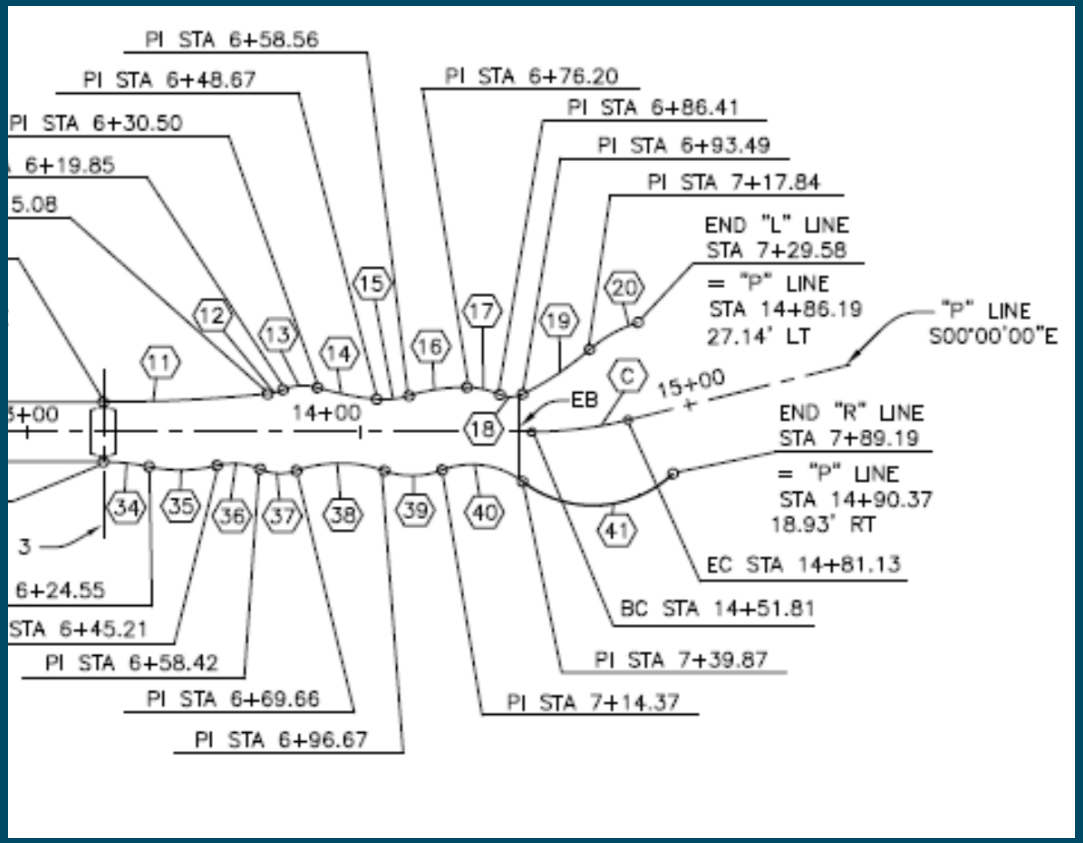
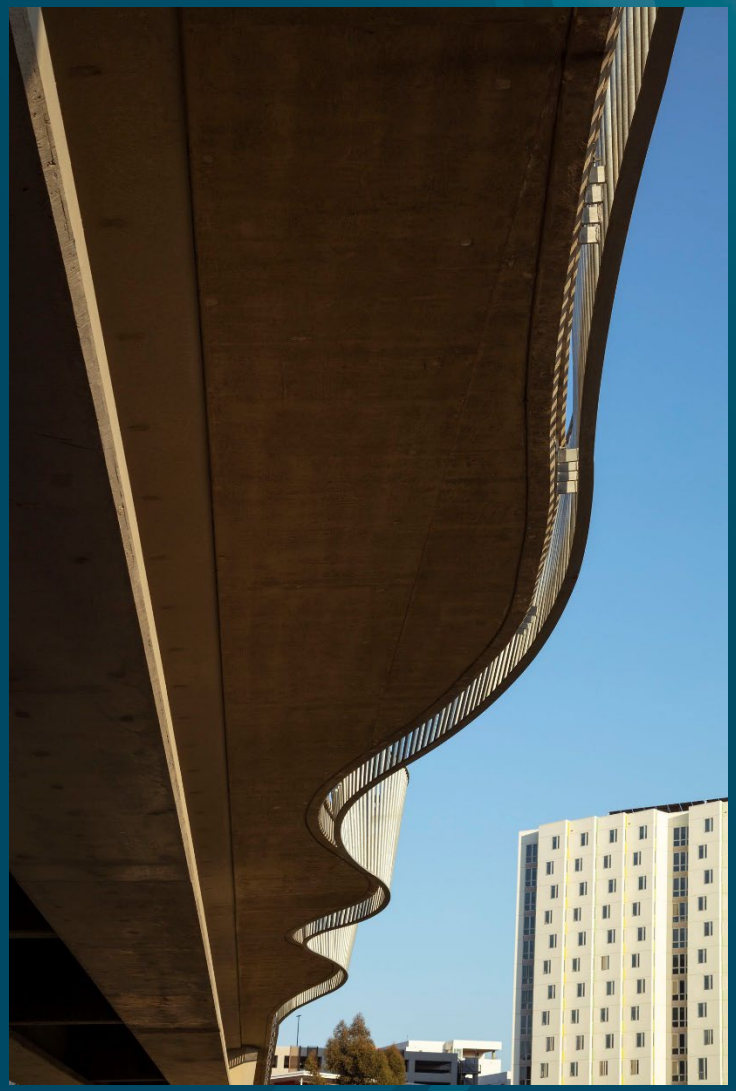
Deck Slab Geometry





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Analysis Model

- Stage construction analysis
- Time-dependent material properties
  - Elastic modulus of concrete
  - Concrete creep
  - Concrete shrinkage
  - Relaxation of prestressing steel
- CEB-FIP MC90 for material properties
- Different construction schedules

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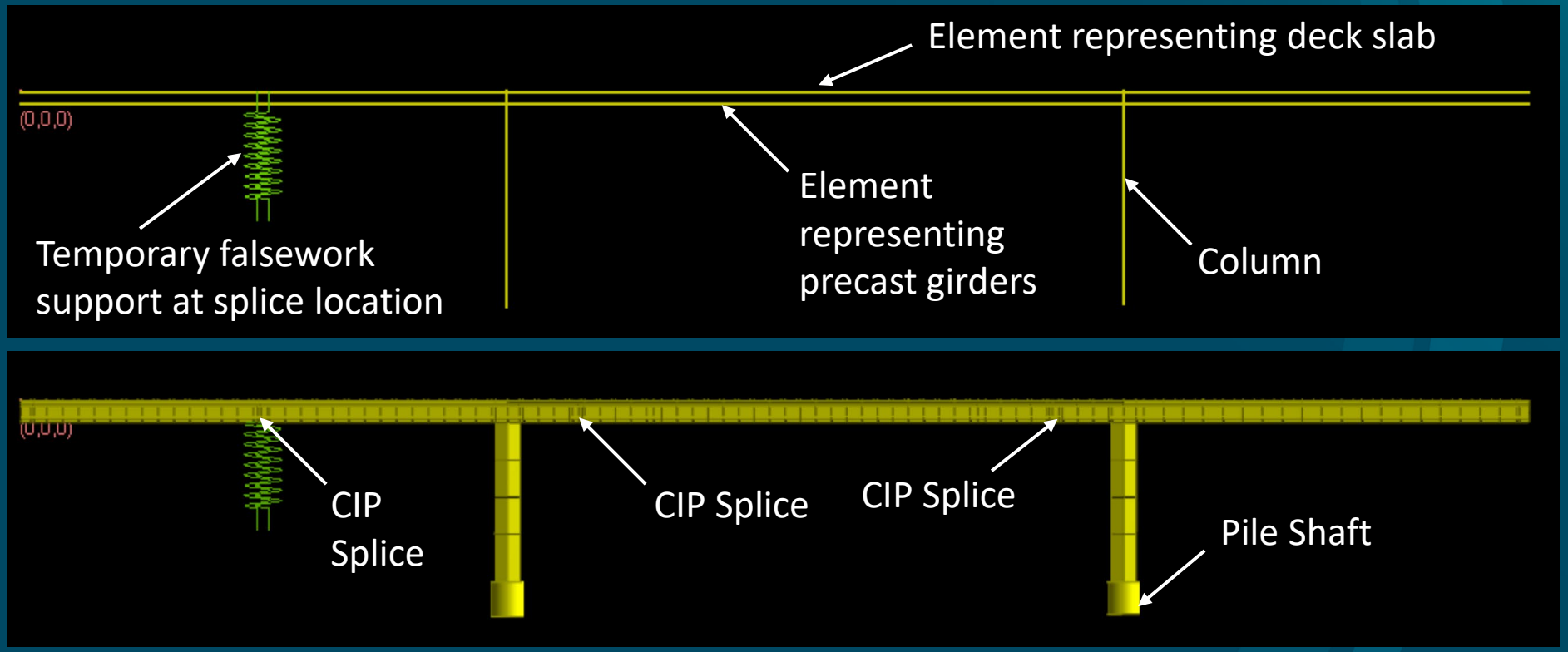
Analysis Model



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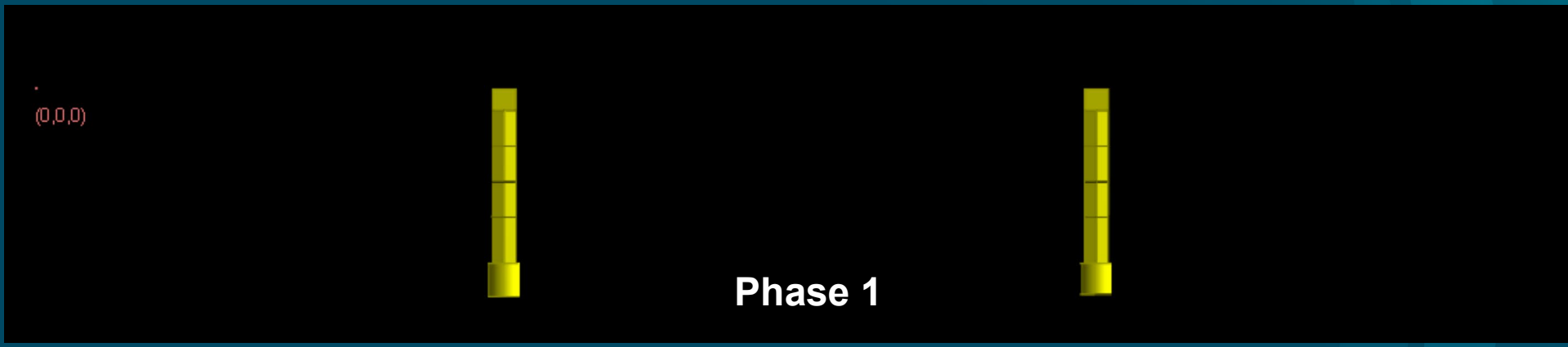
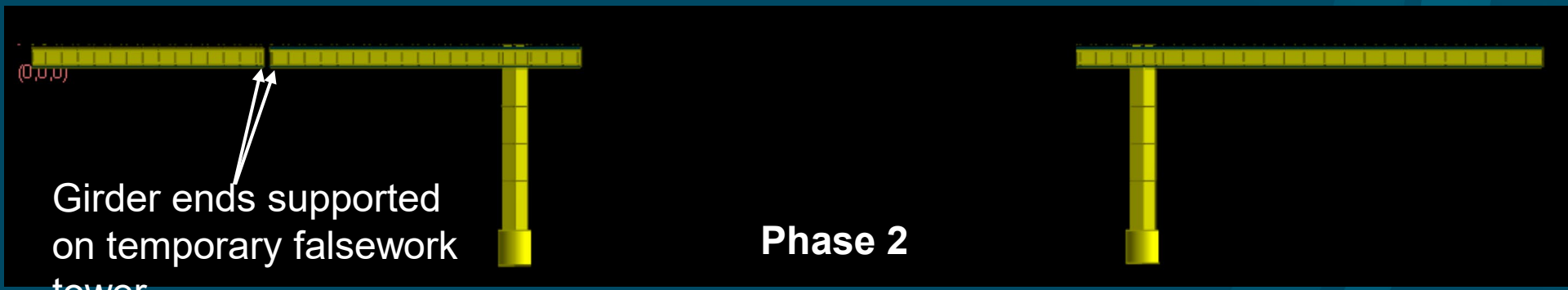
Analysis Model (Construction Sequence)





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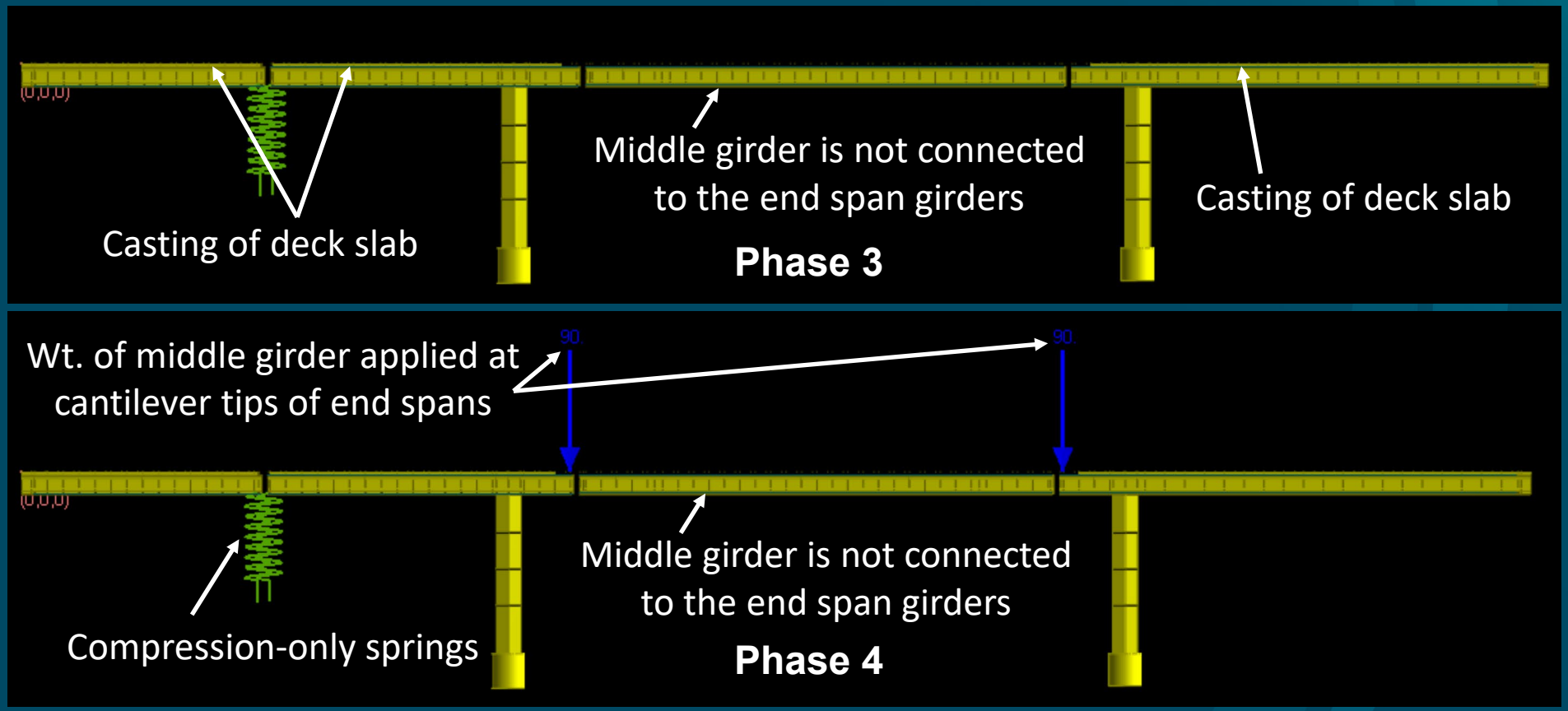

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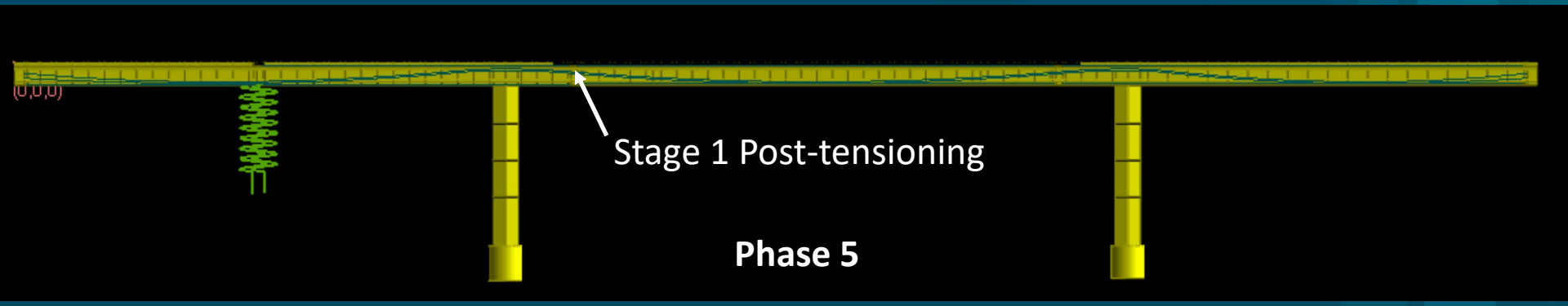

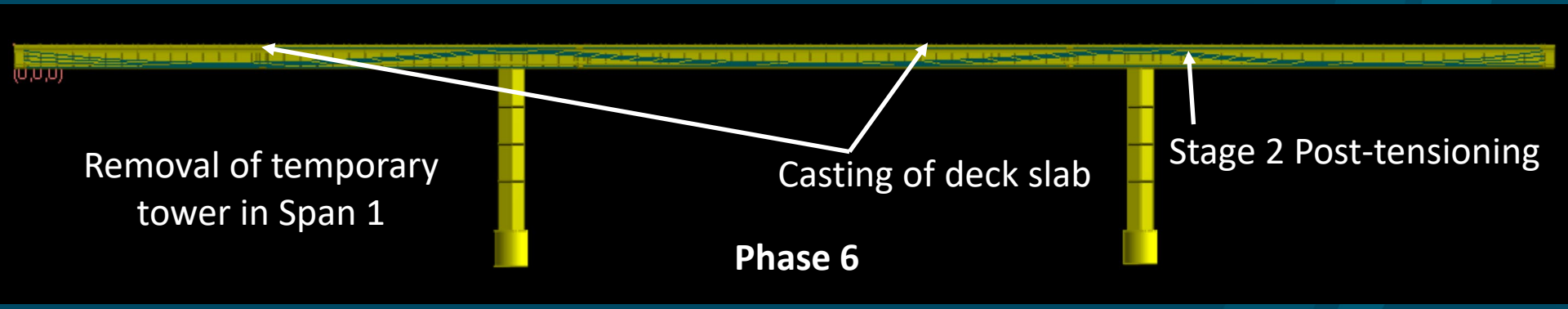

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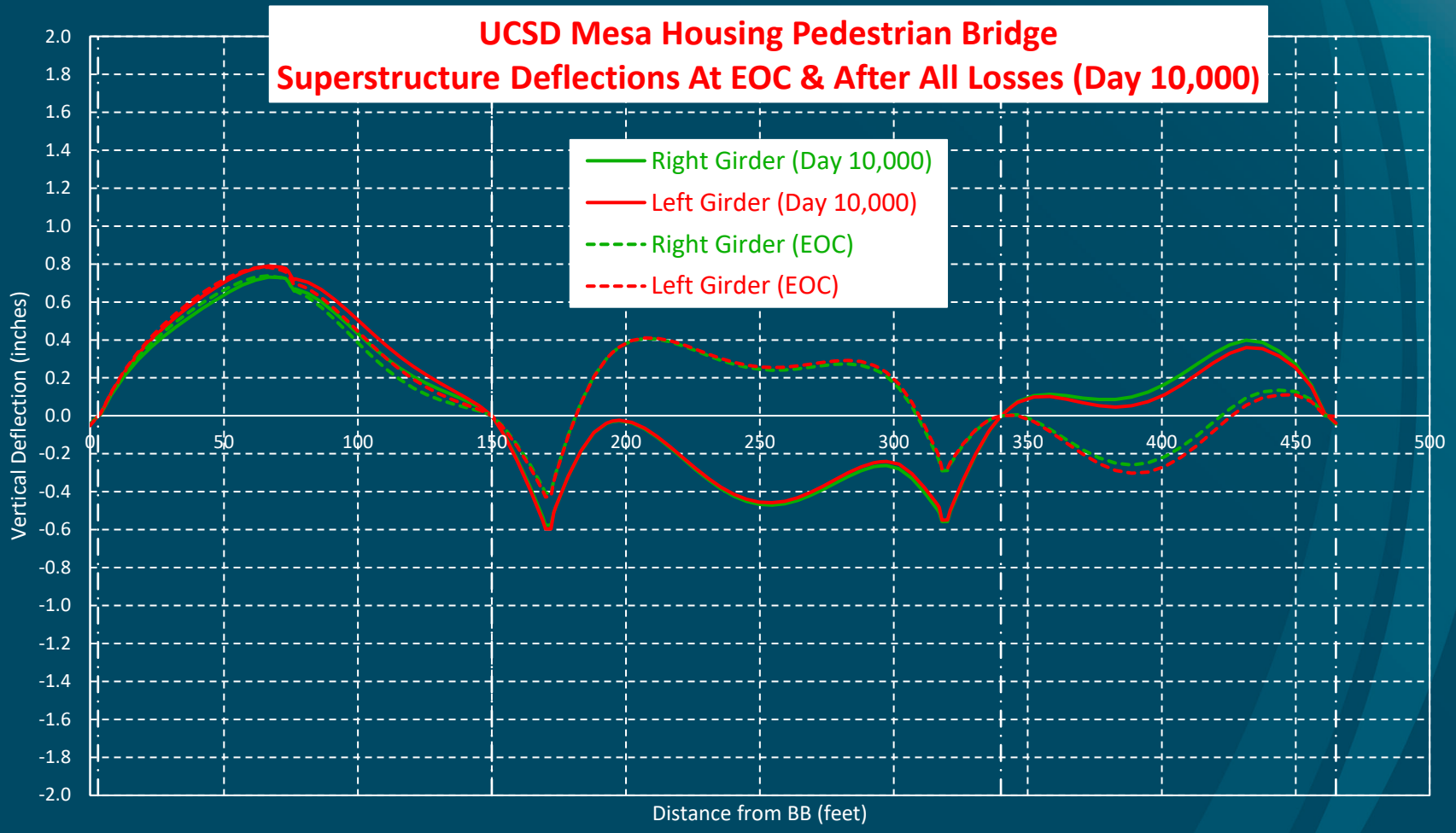
Analysis Results (Deflections)



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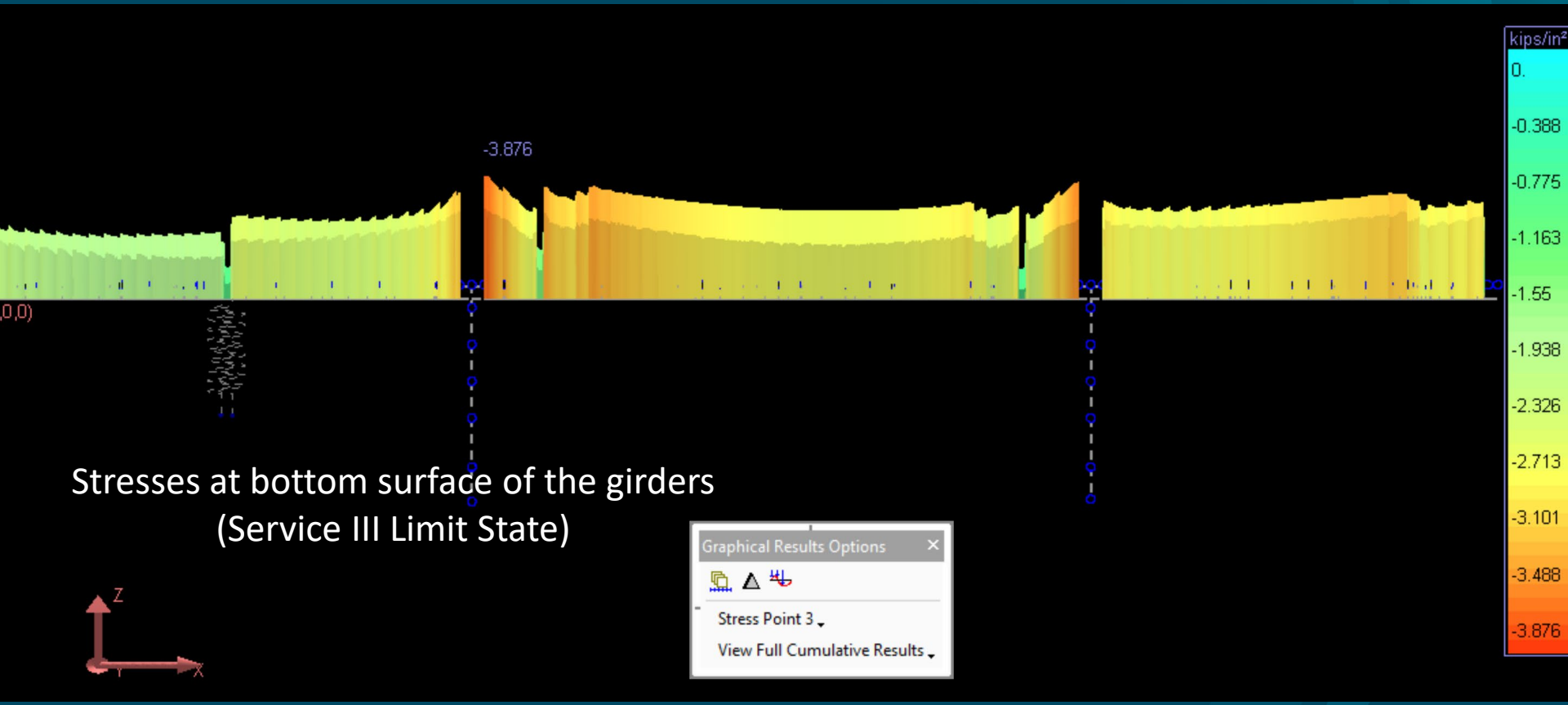
Live Load Deflections:
Allowable deflection due to LL = L/1000 = 2.28”
Max. deflection= 0.42”

Analysis Results (Concrete Stresses)



Stresses at bottom surface of the girders
(Service III Limit State)

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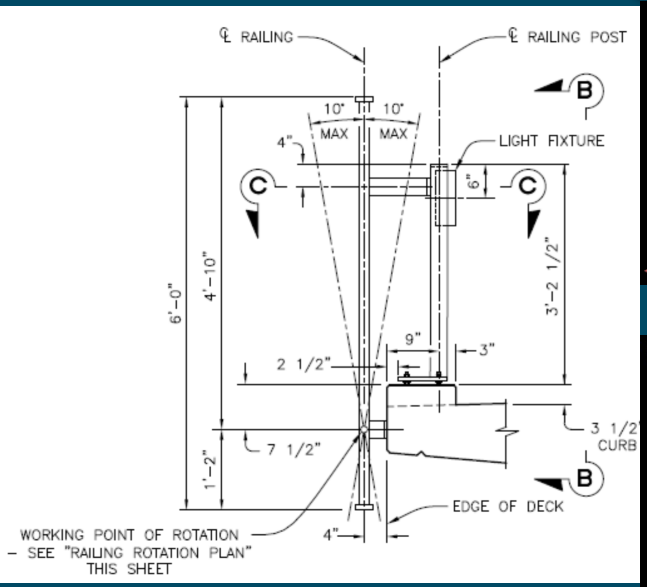
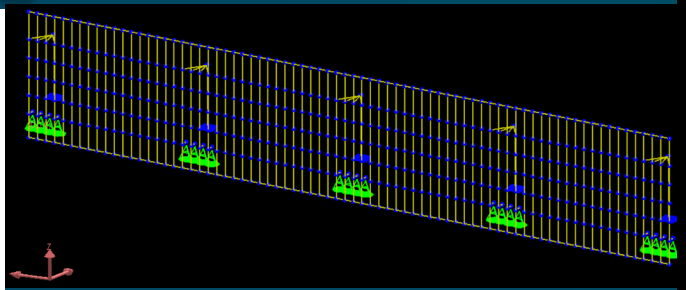
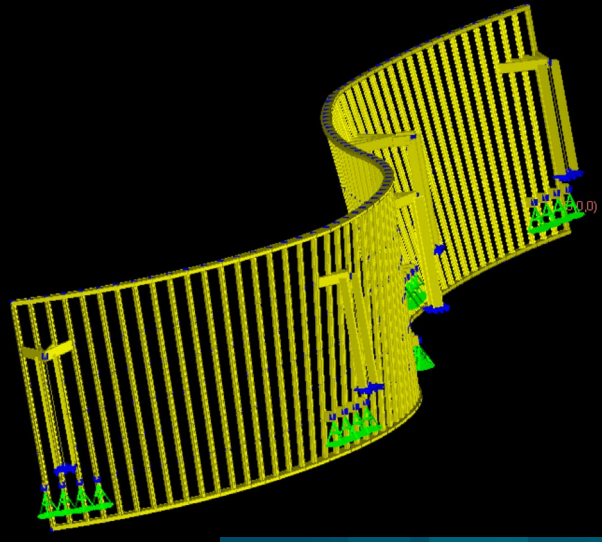
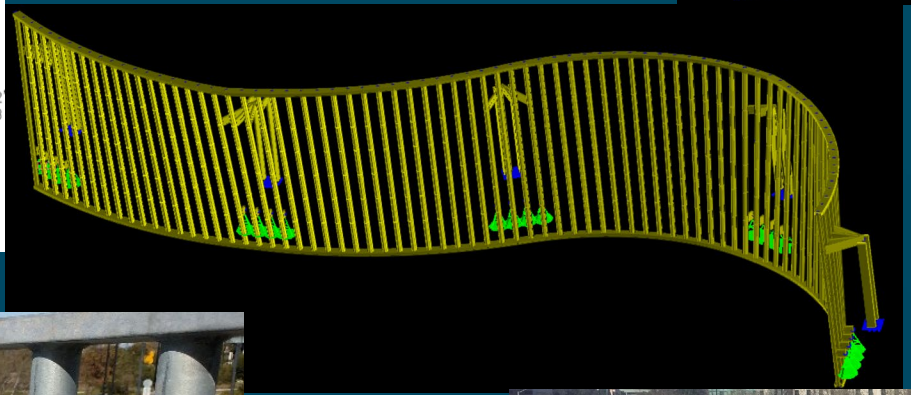
Metal Railing

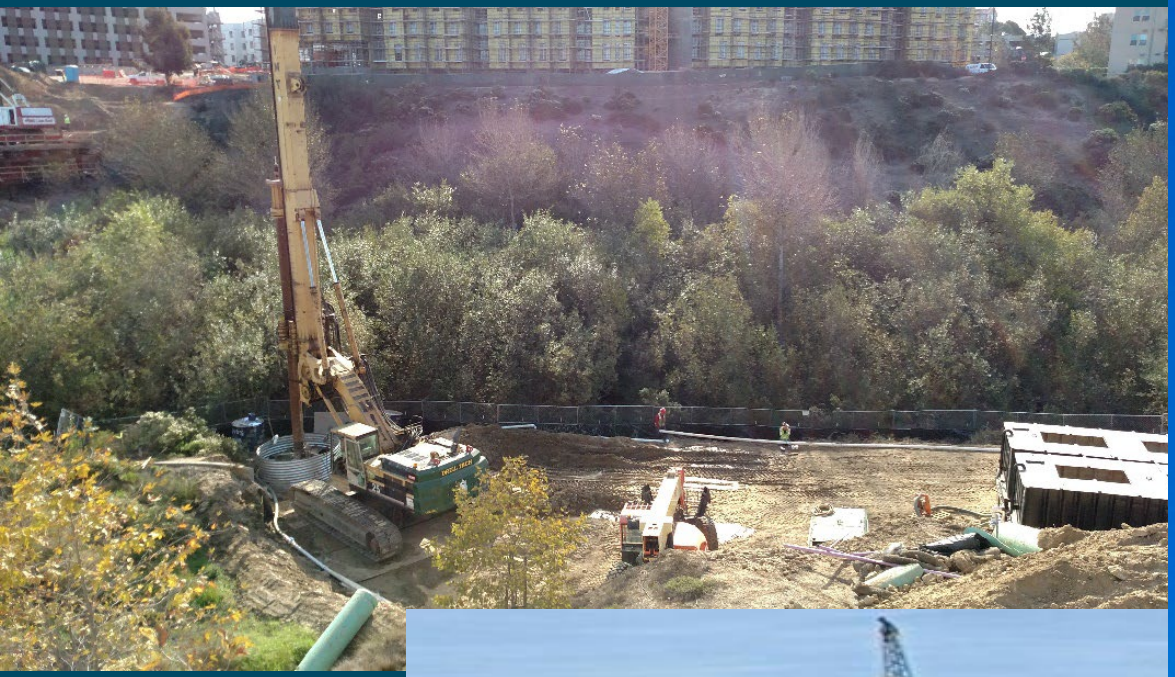








Piles



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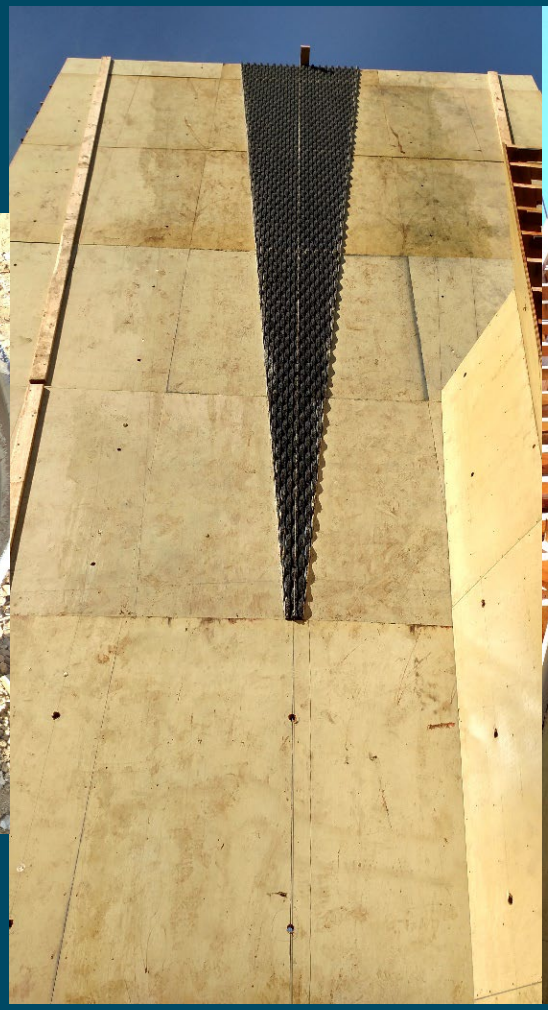
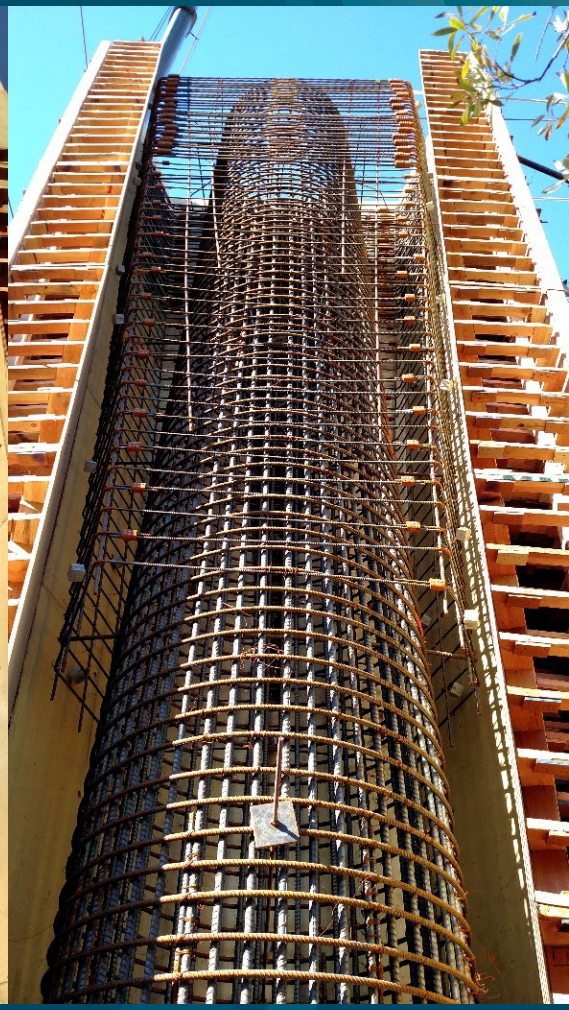
Columns





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Abutments

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Precast Girders

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Erection of Span 3 Girders

Abutment Retrofit

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Erection of Span 1 Girders

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Erection of Span 2 Girders

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Erection of Span 2 Girders

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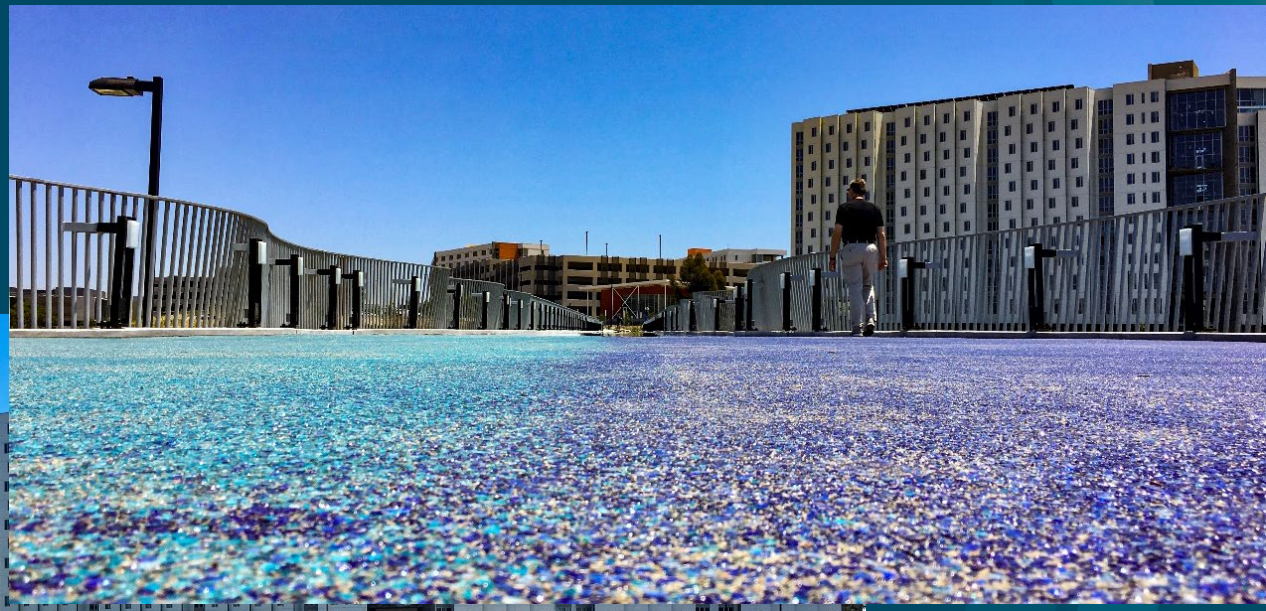
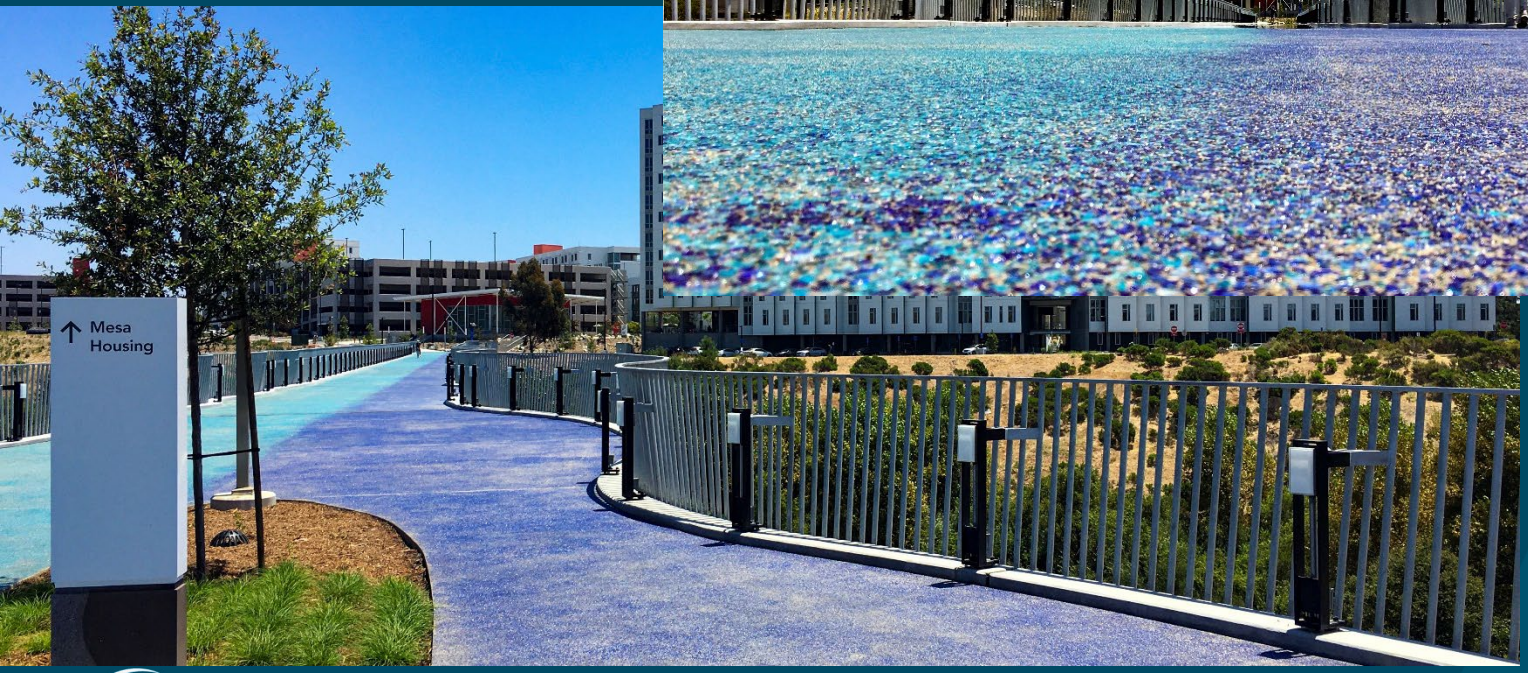
Erection of Span 2 Girders

Metal Railing

Completed Bridge

Lithocrete





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Architectural Treatment

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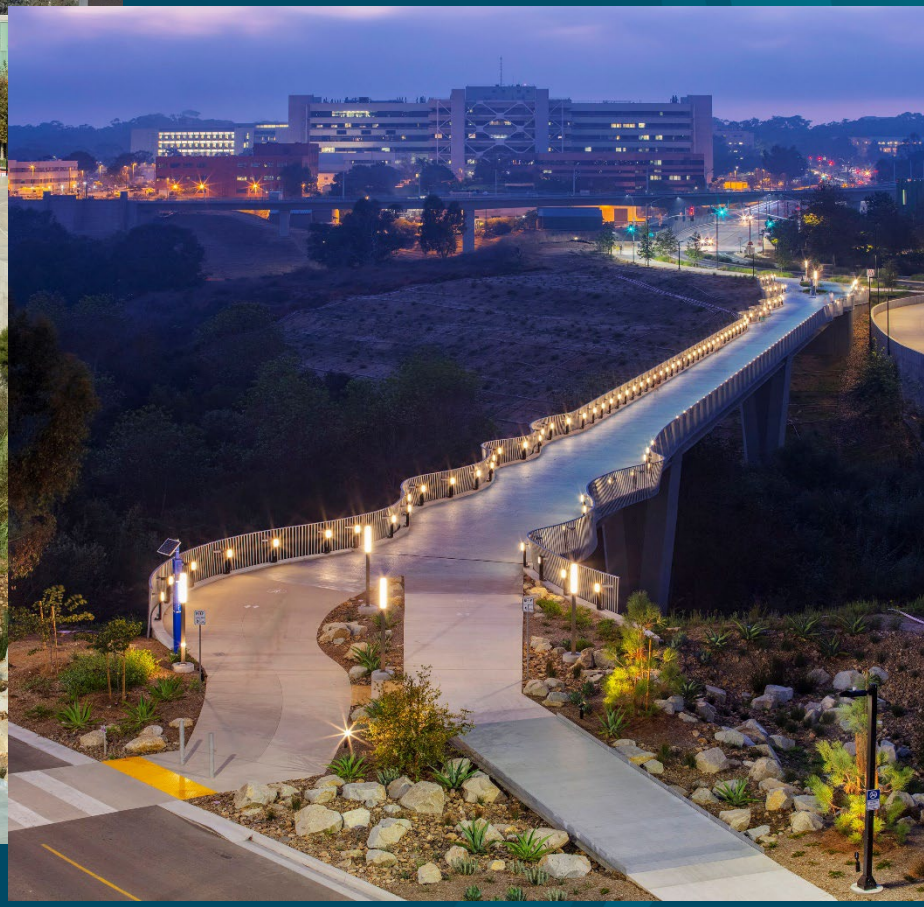

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Awards

- San Diego Architectural Foundation (SDAF): Orchid (2020)
- American Council of Engineering Companies (ACEC): Engineering Excellence Honor Award (2021)
- APWA (San Diego): Project of the Year (2021)
- APWA (San Diego): Outstanding Chapter Project (2021)
- ASCE (San Diego): Project of the Year (2021)
- ASCE (San Diego): Outstanding Bridge Project (2021)
- American Society of Concrete Contractors (ASCC): Decorative Concrete Council Award (2021)
- ACI (San Diego): Transportation Award (2022)
- ACI (San Diego): People's Choice Award (2022)
- PCI: Best Non-Highway Bridge (2022)

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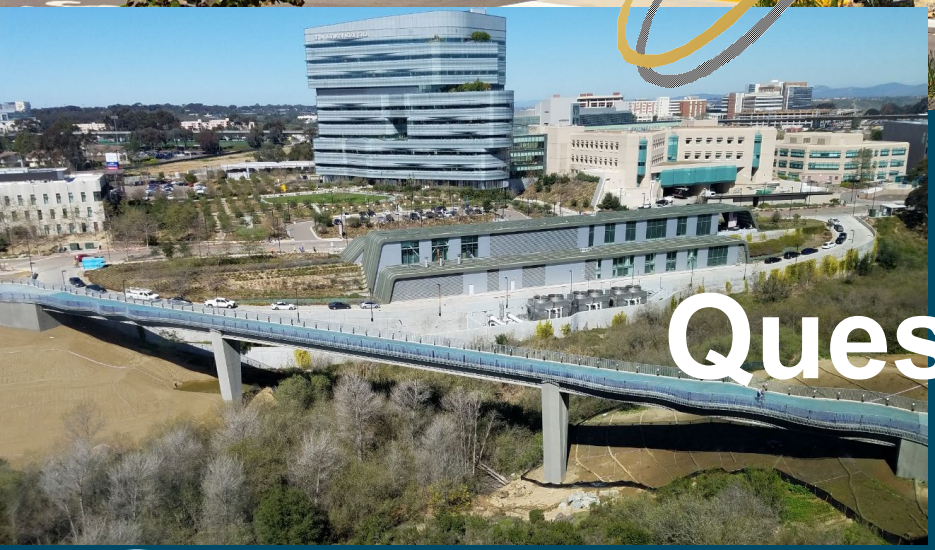
Thank You



Questions?

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