Fiber Reinforced Polymer Decks and Challenging Micropile Installation for Pedestrian Bridges in Difficult Terrain

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Introduction

- Project Overview
- Bridge Type Selection & Design
- Construction Photos

Project Partners

Project Location

Shared Use Path

- Three plus miles of shared use path from the south end of Incline Village to Sand Harbor
- An undercrossing of SR 28 near Tunnel Creek
- Vista Points (Pullouts)
- Bridges and retaining wall structures

Design Considerations

- Steep terrain between lake and SR-28
- Highly variable subsurface conditions (depth to bedrock and thickness of alluvium)
- Large diameter boulders
- High seismicity (PGA = 1.25g)
- Maintenance of traffic along SR-28
- Environmental constraints

Bridge Type Selection

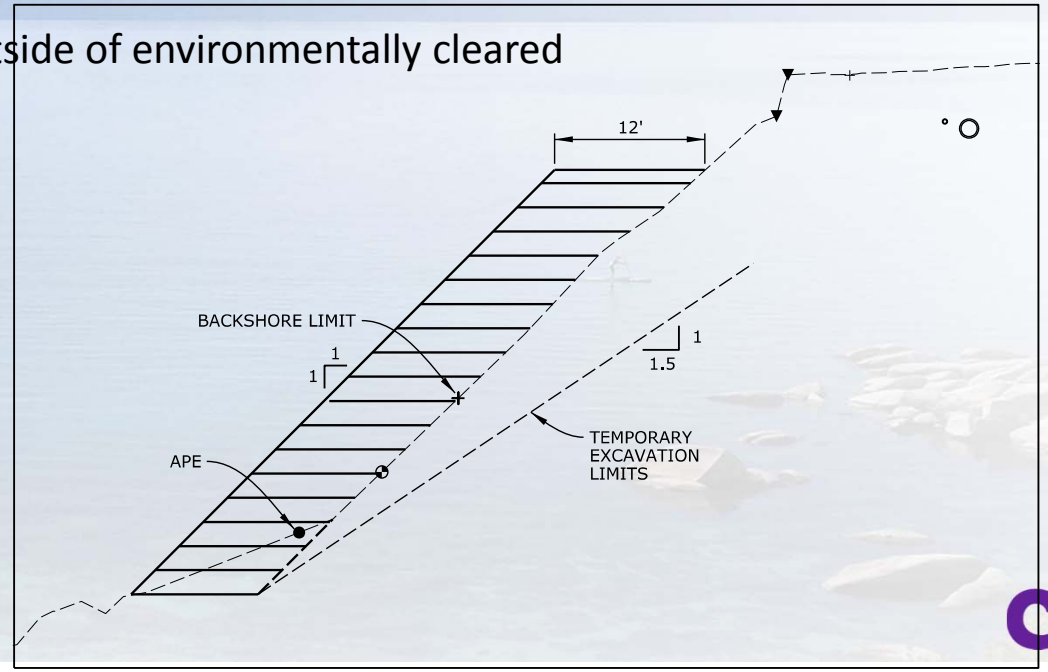
- Structure Type (Engineered Fill vs. Walls vs. Bridge)
- Superstructure Type
- Abutment Type
- Pier Type

Structure Type (Engineered Fill vs. Walls vs. Bridges)

- Geosynthetic Reinforced Slopes
- Soldier Pile Retaining Walls
- Bridges

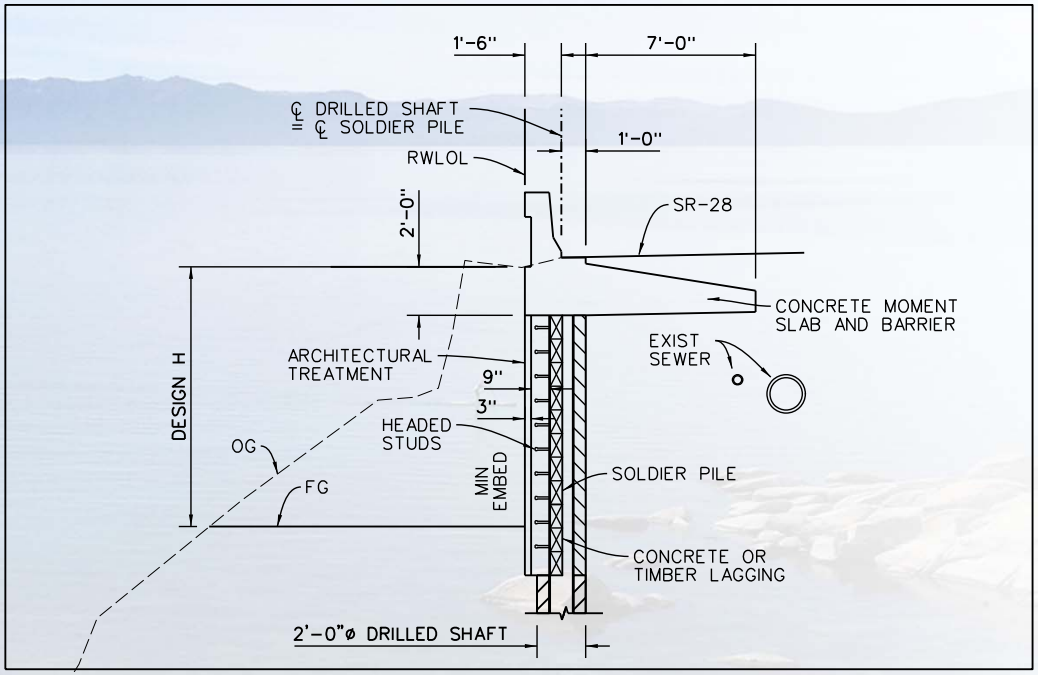
Geosynthetic Reinforced Slope

- Pros:
  - Lower cost compared to bridges
- Cons:
  - Improvements extended outside of environmentally cleared zones, and into lake



Soldier Pile Retaining Wall

- Pros:
  - Top Down Construction
  - Trail separated from highway
- Cons:
  - Traffic Control
  - Construction Duration
  - Higher Construction Cost

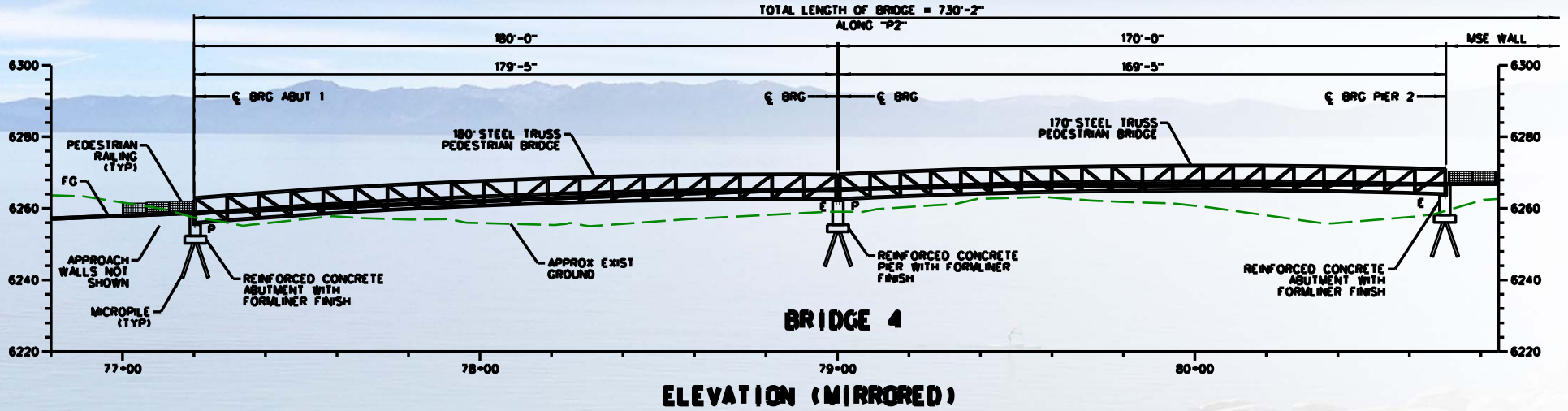


Superstructure Type

- Prefabricated Steel Truss – Long Span Alternative
- Precast Concrete Slabs
- Concrete Deck on Steel Girders
- Fiber reinforced polymer (FRP) deck on steel girders

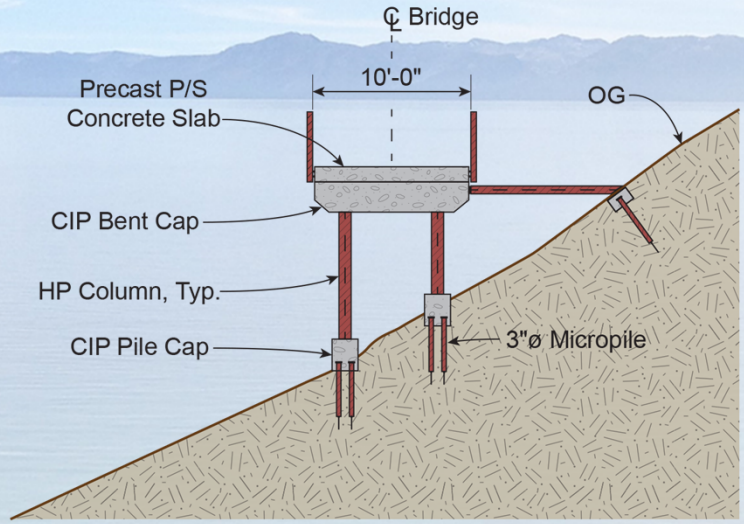
Prefabricated Steel Truss

- Not selected due to larger foundations required

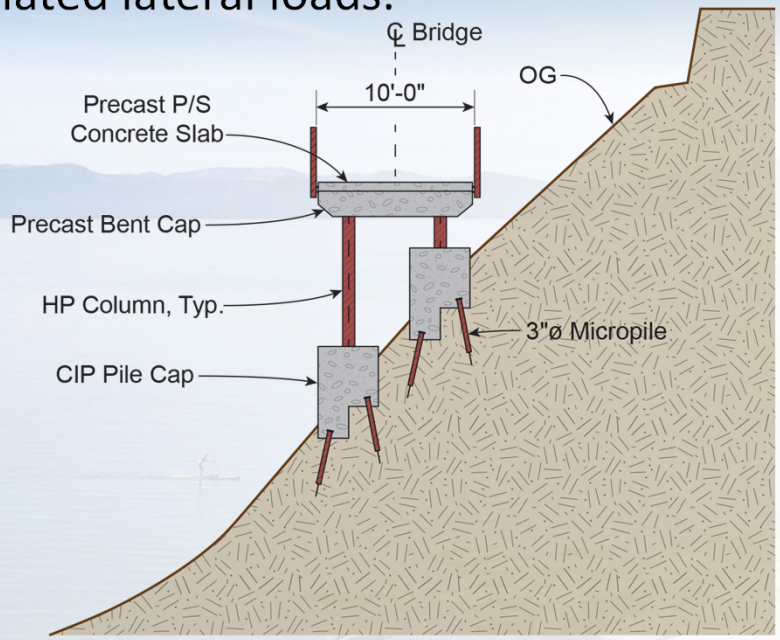


Precast PS Concrete Slab Alternatives

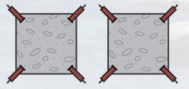
- Not selected due to weight of spans and associated lateral loads.



ELEVATION

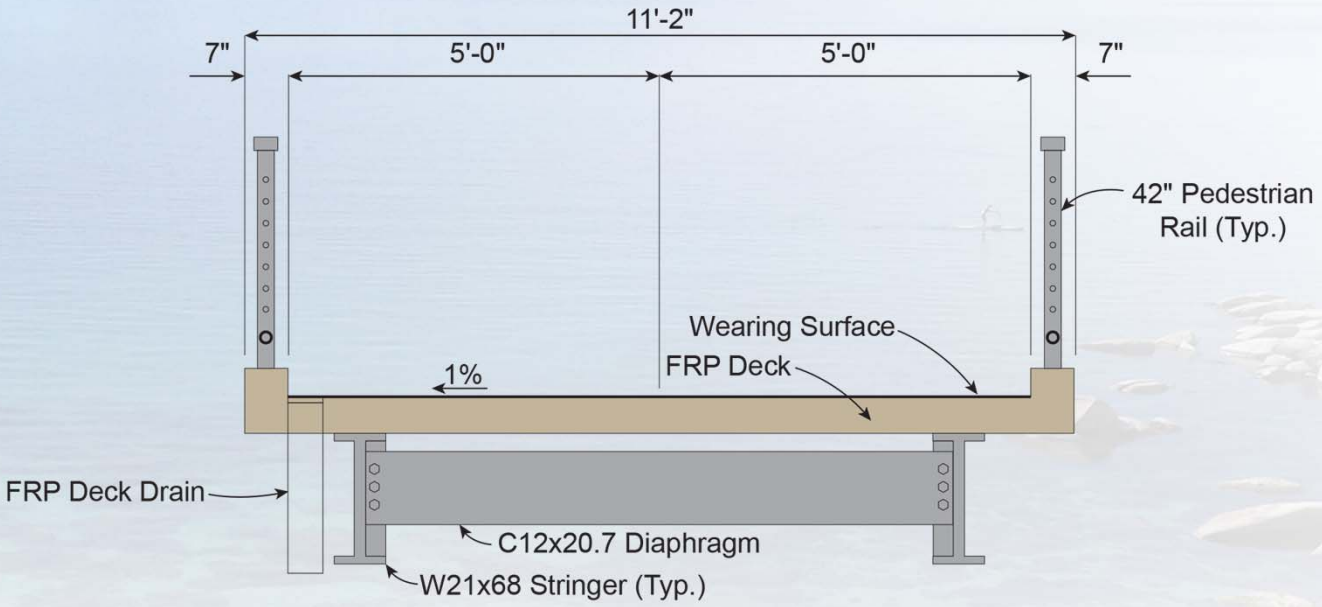


ELEVATION


FOOTING PLAN

FRP Deck on Steel Girders

- Deck Unit Weight = 12 psf
- Stringers are Weathering Steel with Painted Ends
- Piers are Galvanized and Coated with Natina
- Full length FRP deck panels (50-foot span with deck & stringers = 17 kips)
- Deck Panels will be Bonded to Stringers in the FRP Shop and Shipped to the Site in Complete Span Units



Full Length FRP Deck Panel on Steel Stringers

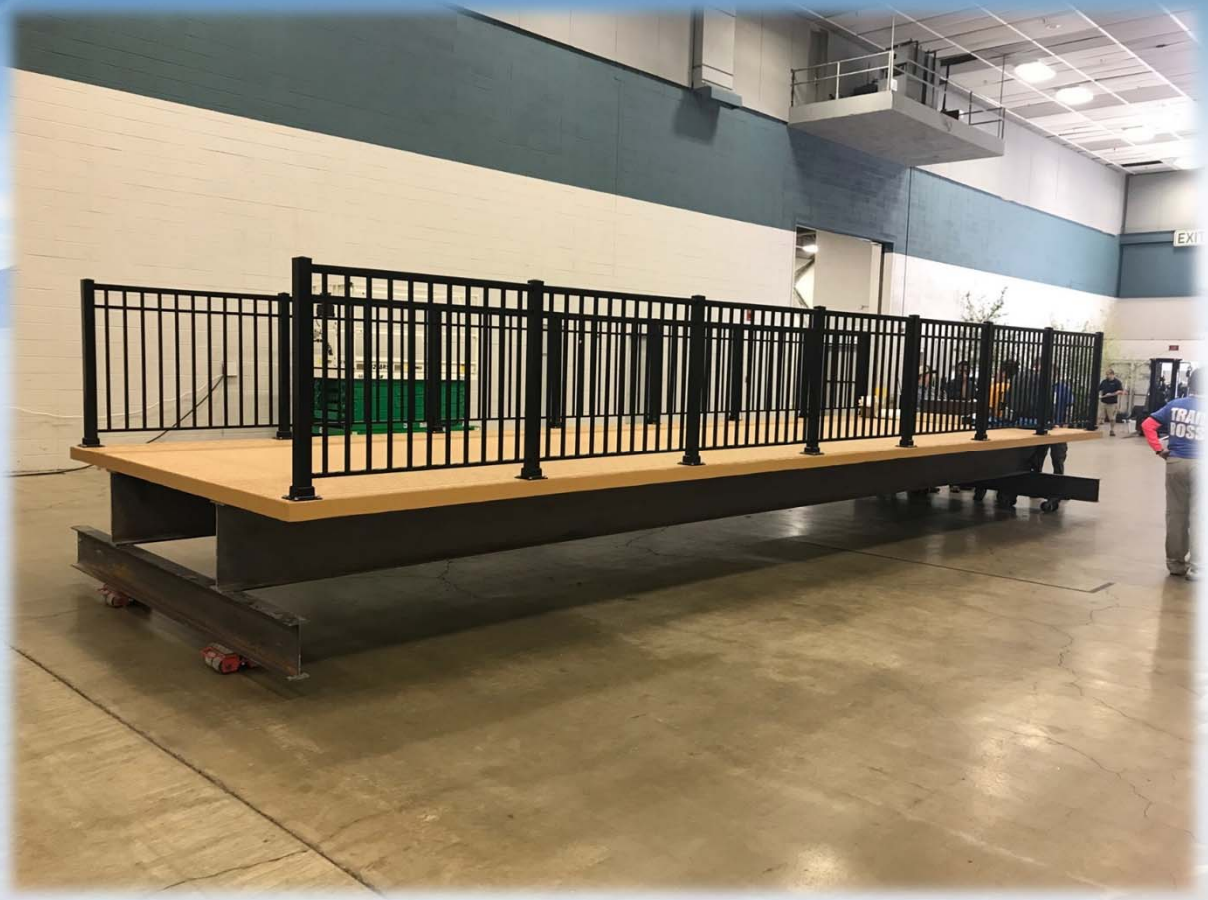


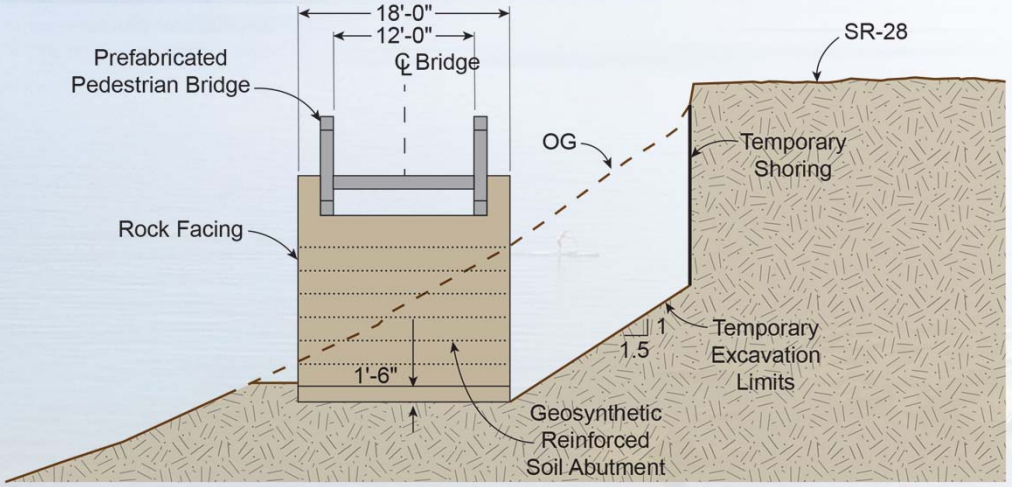
Photo: Composite Advantage

Abutment Type

- GRS Abutment
- Short Seat on Micropiles

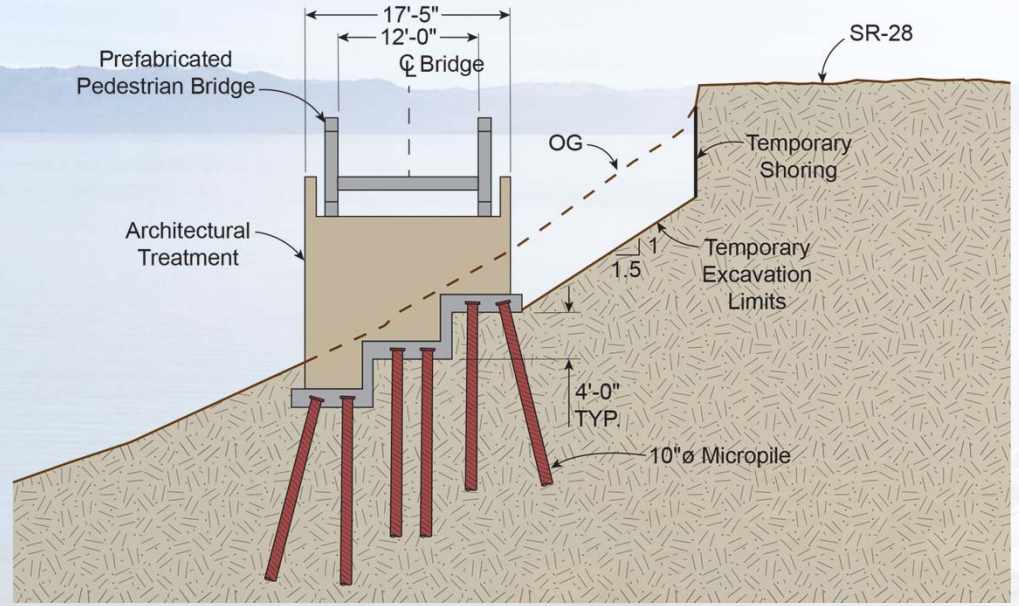
Geosynthetic Reinforced Soil Abutment

- Pros:
  - Low Construction Cost
  - Ease of Construction
- Cons:
  - Temporary Excavation Limits
  - Slope Stability



Short Seat on Micropile Supported Abutment

- Pros:
  - Traditional Foundation
  - Slope Stability
- Cons:
  - Temporary Excavation Limits
  - Higher Construction Cost



Pier Type

Pier Details – Alternative 1

- Reinforced Concrete Pier Cap
- Supported on 3-foot Diameter Drilled Shaft

Pier Details – Alternative 2

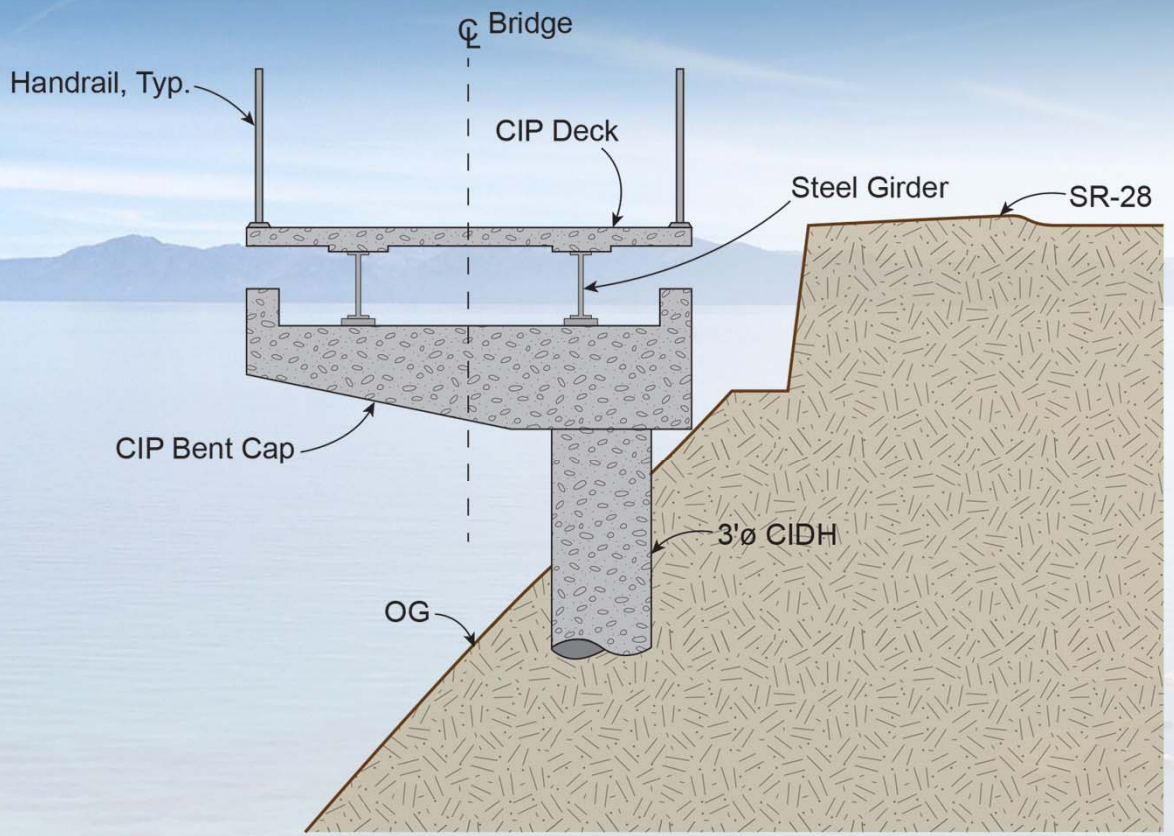
- Reinforced Concrete Pier Footings
- Supported on 3-inch Diameter Micropiles

Pier Details – Alternative 3

- Bolted Splice on Downhill Support
- 2-foot Diameter Steel Pipe on Uphill Support

Pier Details – Alternative 1

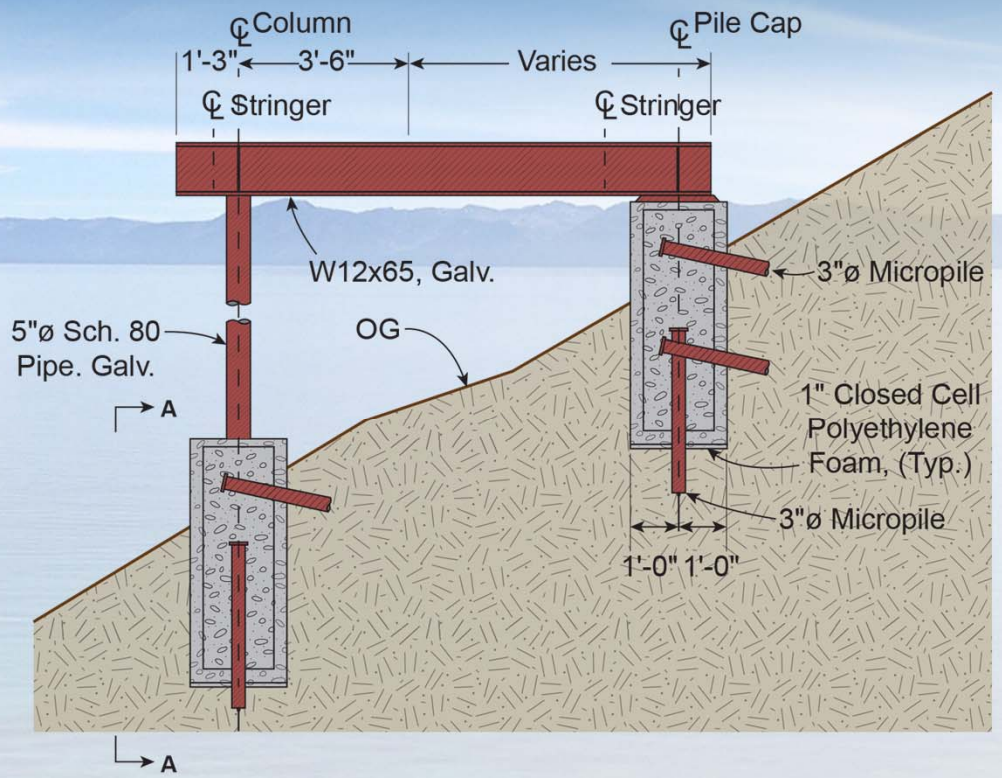
Concrete Cap on 3-foot Diameter CIDH



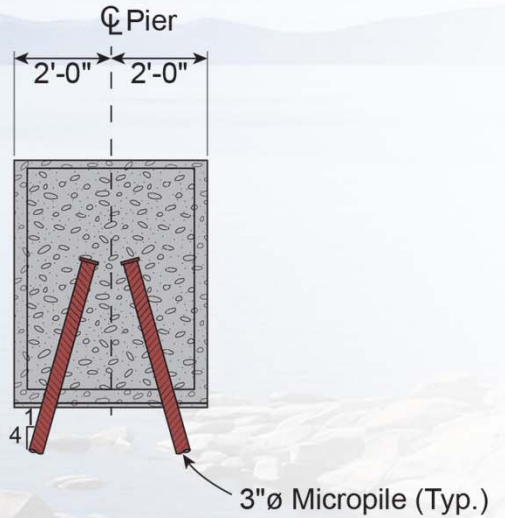
TYPICAL PIER ELEVATION

Pier Details – Alternative 2

Reinforced Concrete Pier Footings Supported on 3-inch Diameter Micropiles



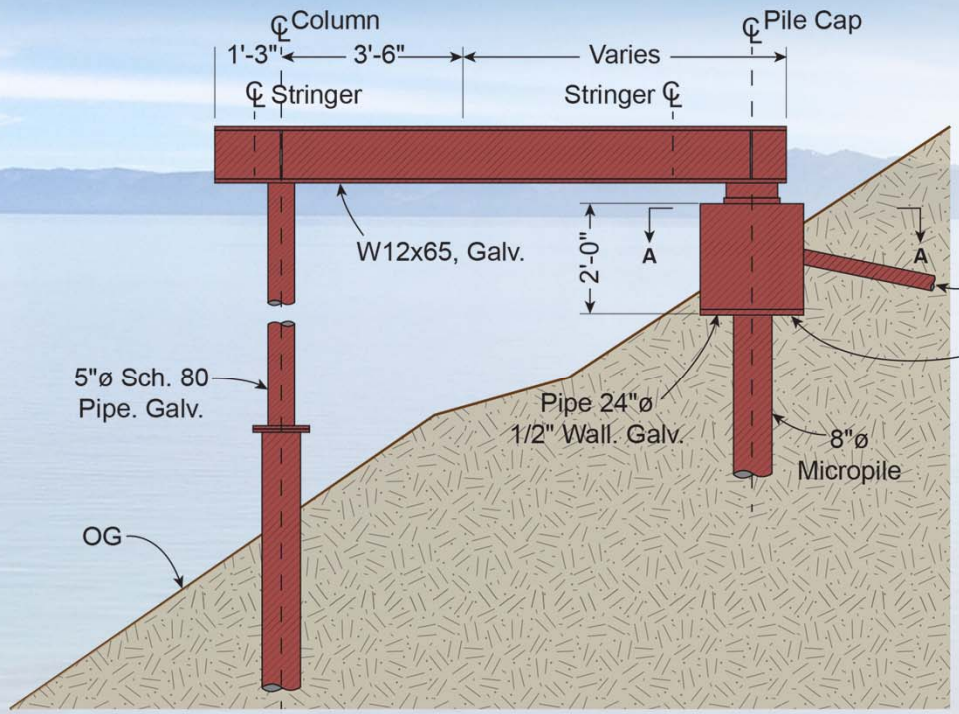
TYPICAL PIER ELEVATION



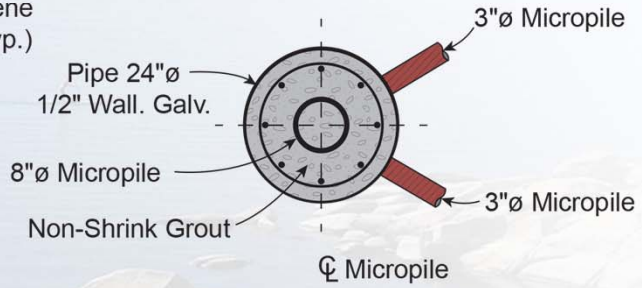
SECTION A-A

Pier Details – Alternative 3

Bolted Splice on Downhill Support 2-foot Diameter Steel Pipe on Uphill Support



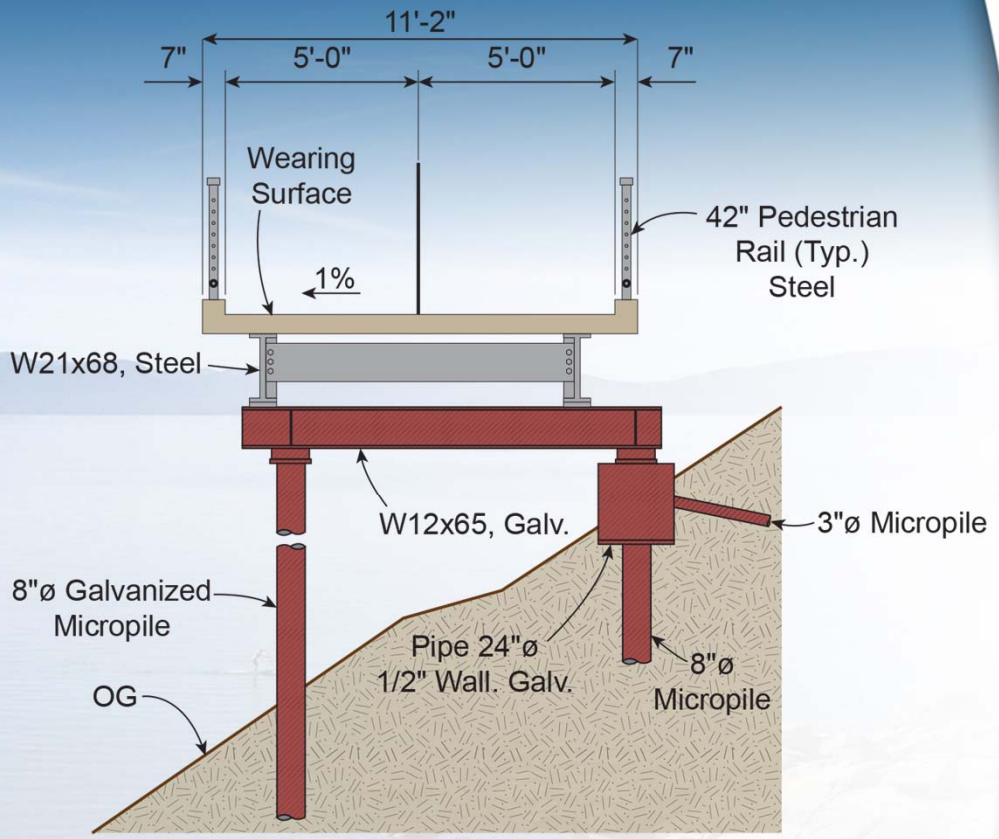
TYPICAL PIER ELEVATION



SECTION A-A

Selected Alternative

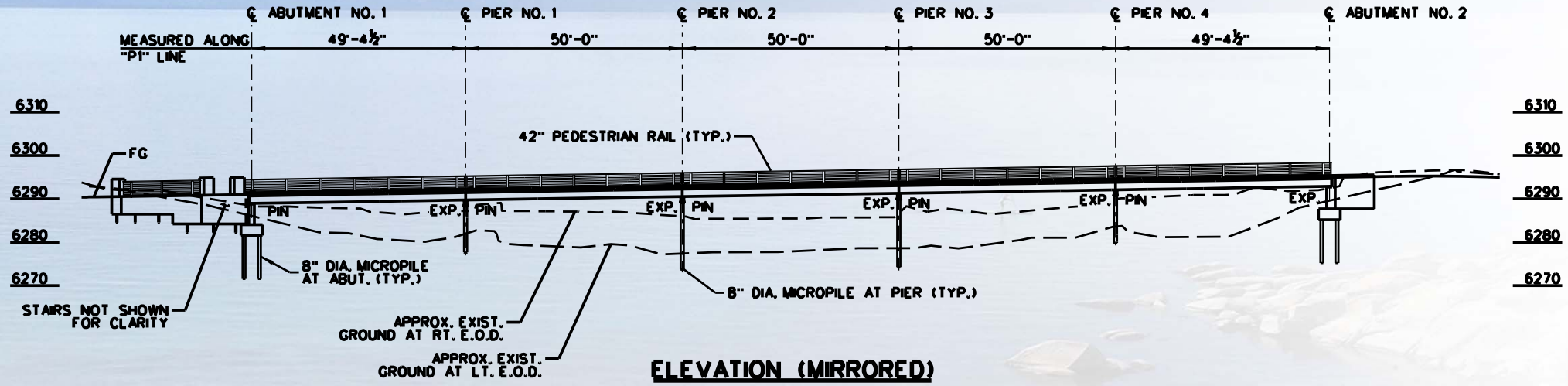
- FRP deck on steel girders
- Conventional seat abutments founded on 8” – 10” diameter micropiles
- Design allows for field adjustments of pier locations without significant design changes



SECTION A-A

Bridge Typical Elevation

- Span Lengths up to 50 feet long for pier design
- Span Length Controlled by Live Load Deflection Criteria (L/160)
- Snow Loading ≈ Pedestrian Live Loads
- H-5 & Pedestrian Loading used for Design



Construction Photos

Abutment Construction – Steep Terrain & Variable Subsurface Conditions

Abutment Construction – Rock Excavation

Abutment Micropile Construction – Track Mounted Rig

Abutment Micropiles Supporting Short Seat Abutment

Abutment with Formliner Finish

Pier Horizontal Micropile Installation – Spider Rig

Pier Vertical Micropile Installation – Spider Rig

Pier Micropile Installation – Excavator Mounted Rig

Pier Micropiles Installed

Questions & Answers