



# Recreation and Safety with FRP Pedestrian Bridges and Shared-Use Paths



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# Presentation Outline

- FRP benefits for pedestrian bridges
- Truss bridges
- Decking
  - Features
  - Short Span
  - Long Span; Signature Bridges
- Fully Assembled Spans
- Shared Use Paths
- Cantilever Sidewalk
- Questions

# Market Progression

- Over 25 years
- Recreation
  - Parks, trails, neighborhoods
  - Low traffic usage
- Urban Areas
  - Commuter Safety
  - Boom in Outdoor Recreation
- Shared Use Paths
  - Walkers, Joggers, Bicyclists

# Benefits of FRP Bridges and Decks

## **Corrosion Resistance to chemicals and water**

Sustainable

Expected life of 50 to 75 years

No Maintenance

## **Prefabricated Large Structures**

Simpler installation

Faster installation

Less expensive installation

## **Light Weight for Accelerated Construction**

80% lighter than concrete decking

Simpler installation

Reduced cost of substructure

## **Architectural/Structural Features Molded into Structure**

Engineered connection points

Many surface finish options

Crowns, cross slopes, scuppers, curbs, etc..

## **Design Flexibility**

High strength; high energy absorption

Optimized designs

Size, shapes, structural properties

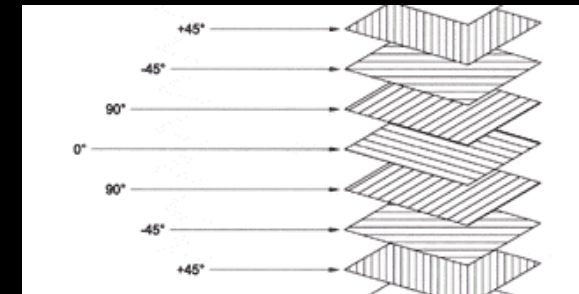
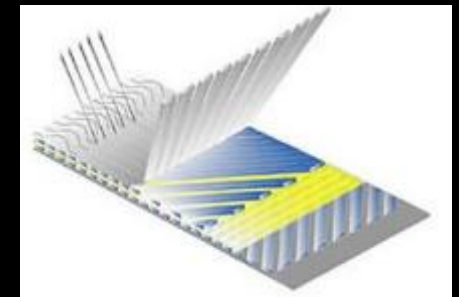
## **100% Domestic Source Material**

# FRP Design

- Strong, stiff fibers surrounded by tough environmentally resistant polymers
- FRP Composites are orthotropic materials
  - Properties are different along each axis.
  - Designer can tailor the properties in each direction.
- Compared to steel
  - Lower stiffness
  - Similar strength
- Deflection generally drives the design
  - L/240, L/360 or L/500
  - Results in high strength safety factors



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# FRP Truss Bridges

- E.T. Techtonics under Eric Johansen set the standard starting in 1990's
- Design History
  - Minimize lower structure for hydraulics and minimal approach work
  - Widths of 4 foot to 14 foot
  - Lengths now up to 152 ft
  - US Forest Service specification
  - AASHTO Guide Specification
- Over 1200 bridges



# FRP Truss Bridge Design

- Uniform live load; wind load
- Seismic load; snow load; fundamental frequency
- Vehicle load. H-5 for widths of 6 to 10 ft; H-10 for  $> 10$  ft
- Allowable Stress Design
  - AASHTO Guide Specifications for Design of FRP Pedestrian Bridges First Edition 2008
  - Strength safety factor  $> 4$
- LRFD Standard now available



# FRP Truss Bridge Installation

- Standard pultruded profiles are bolted to create the truss
- Delivered assembled or as a kit
- Kits are easy to install in remote locations; pieces can be carried to the site; and assembled in 1-2 days

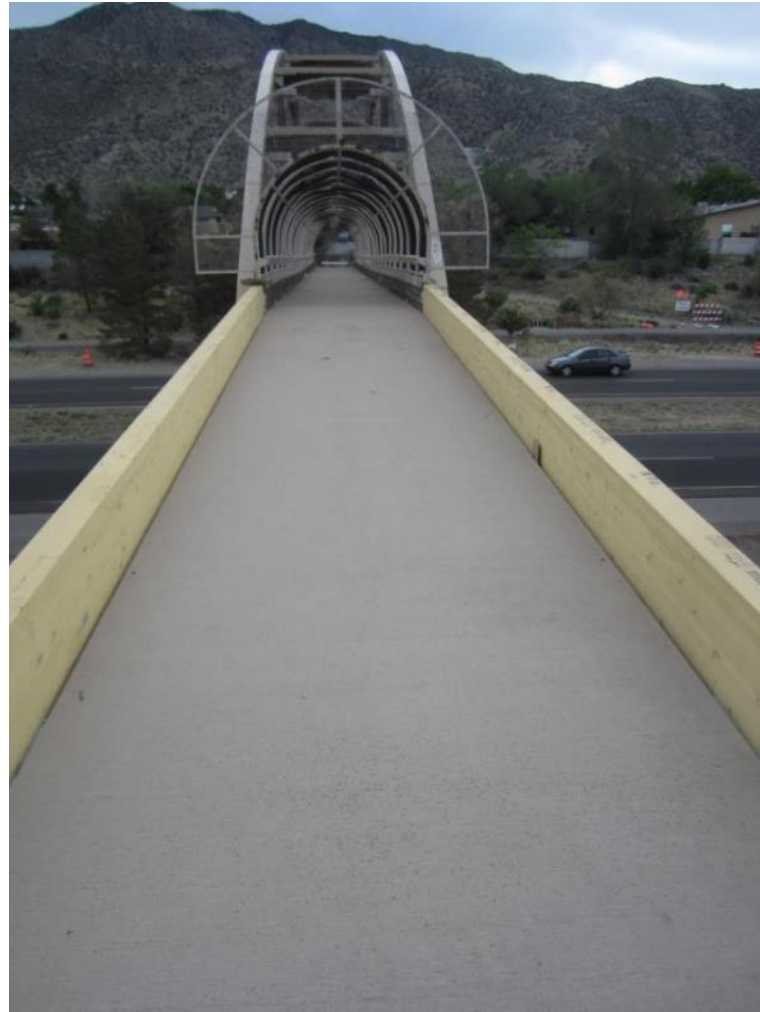


# World's Longest FRP Truss Bridge

- Bermuda Railway Trail
- 152 ft long, 8 ft wide







## FRP Pedestrian Bridge Decks

- Light weight (5 to 10 psf)
- Fast installation
- Eliminate maintenance
- Increase usable life

# Bridge Decking

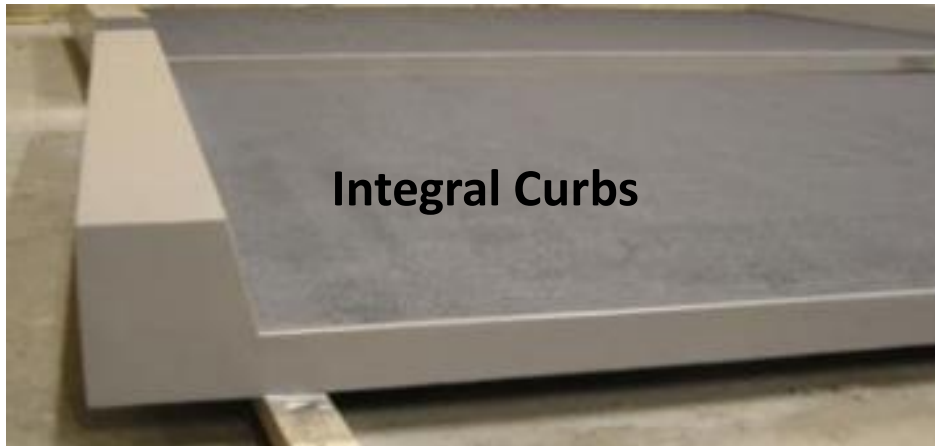
- Shorter span bridges:
  - Pultruded profiles for timber plank replacement



- Long span bridges; Signature bridges
  - Larger molded panels
  - Design features



- Key design parameters
  - Support span
  - Vehicle load
  - Deflection limit
  - Installation plan



**Integral Curbs**



**Integral Crown**

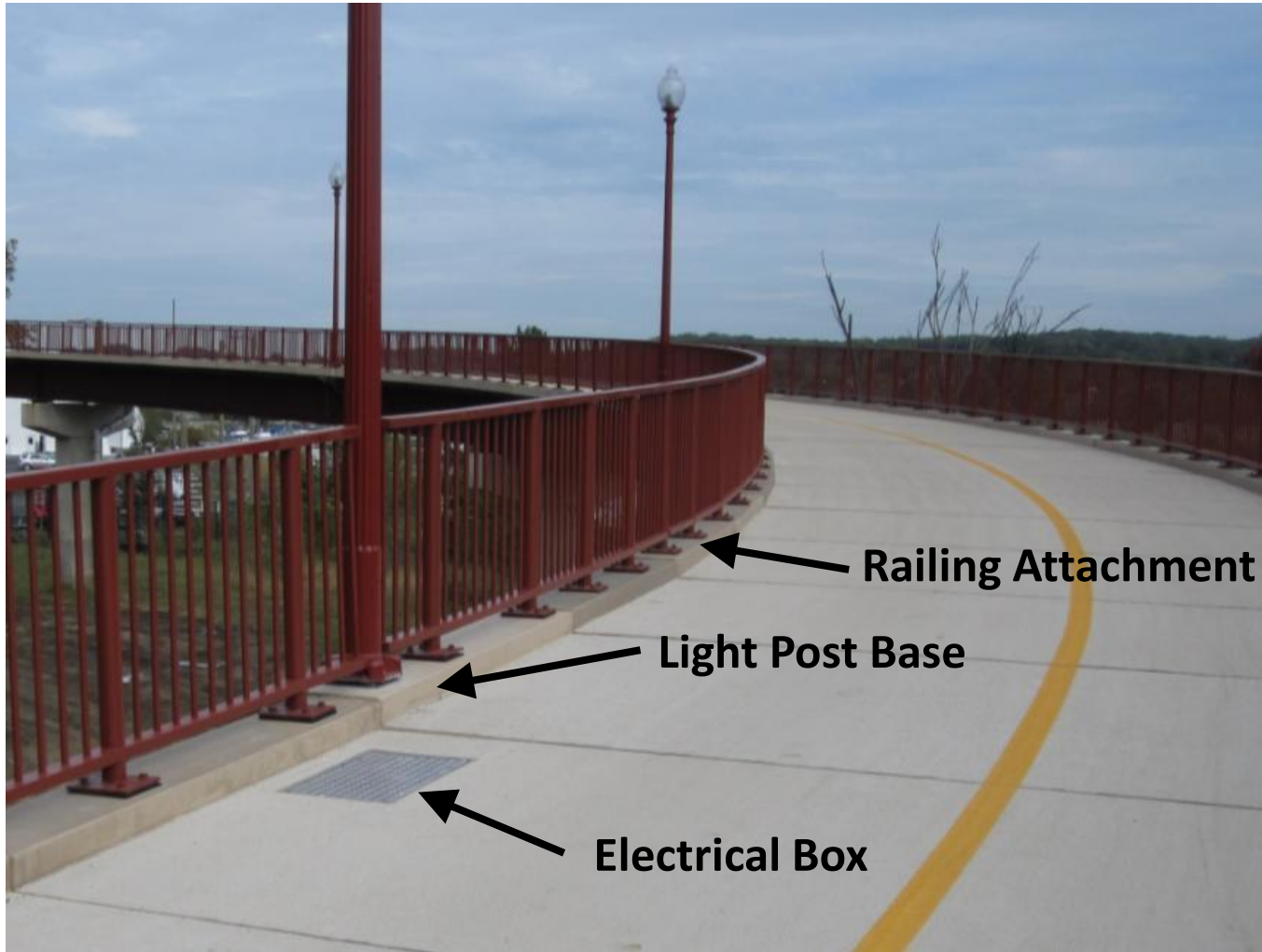


**Integral Scuppers**



**Integral Cross-Slope**

## FRP Deck Features/Details



**Bench bolted to Deck**



**Scupper – Bottom View**

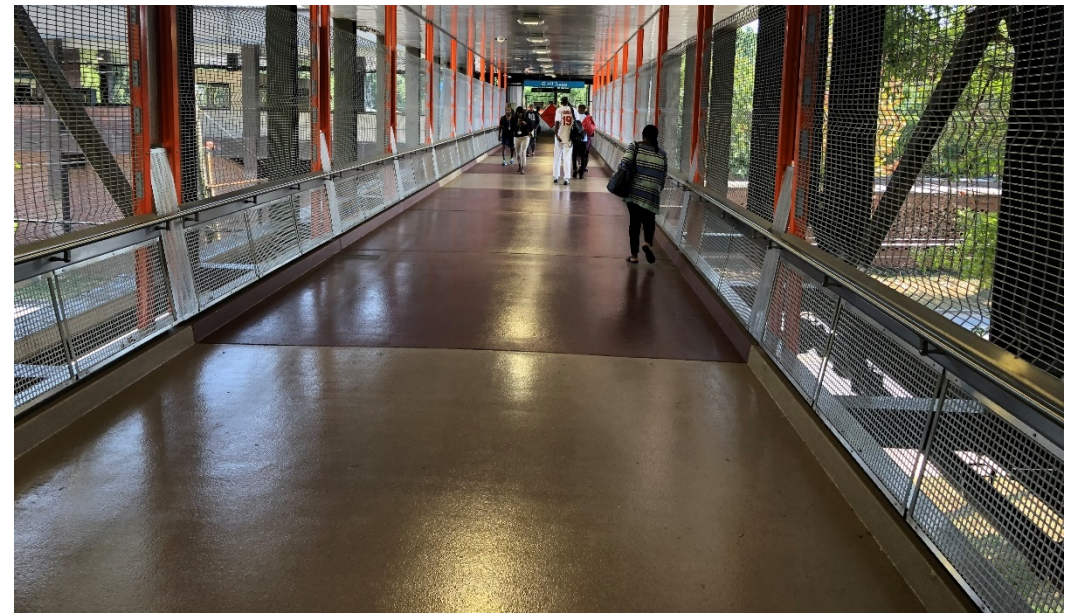
# FRP Deck Features/Details



**Conduit Attachment**

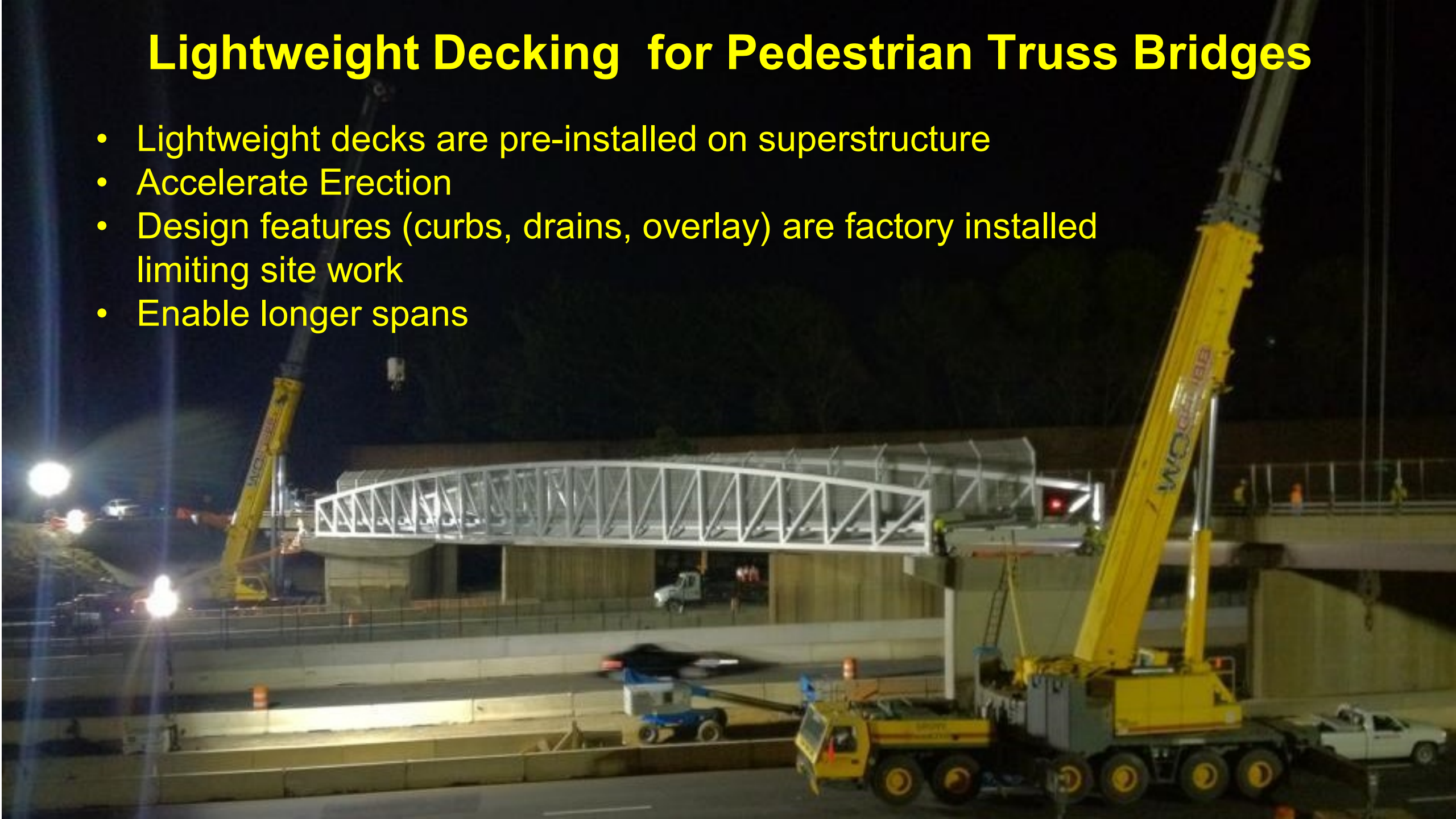
# Non-Slip Overlay

- Non-slip products shop applied for safety and aesthetics
- High Traffic
  - Quartz or aluminum oxide aggregate in polymer
  - High elongation (toughness); great adhesion to FRP
  - Many standard colors; UV stable
  - In use for 20 years without wear or repair



# Lightweight Decking for Pedestrian Truss Bridges

- Lightweight decks are pre-installed on superstructure
- Accelerate Erection
- Design features (curbs, drains, overlay) are factory installed limiting site work
- Enable longer spans



# West Thames Bridge, Lower Manhattan, NYC



- FRP deck installed in truss prior to lift



# Prefabricated Bridges for Lake Tahoe, NV



- Bridge Spans delivered with
  - FRP deck bonded to steel beams and cross beams
  - Pre-drilled and fitted railing; re-attached on site
- FRP deck is shear diaphragm; high shear layup
- Fast installation on micropiles to minimize vehicle traffic interruptions







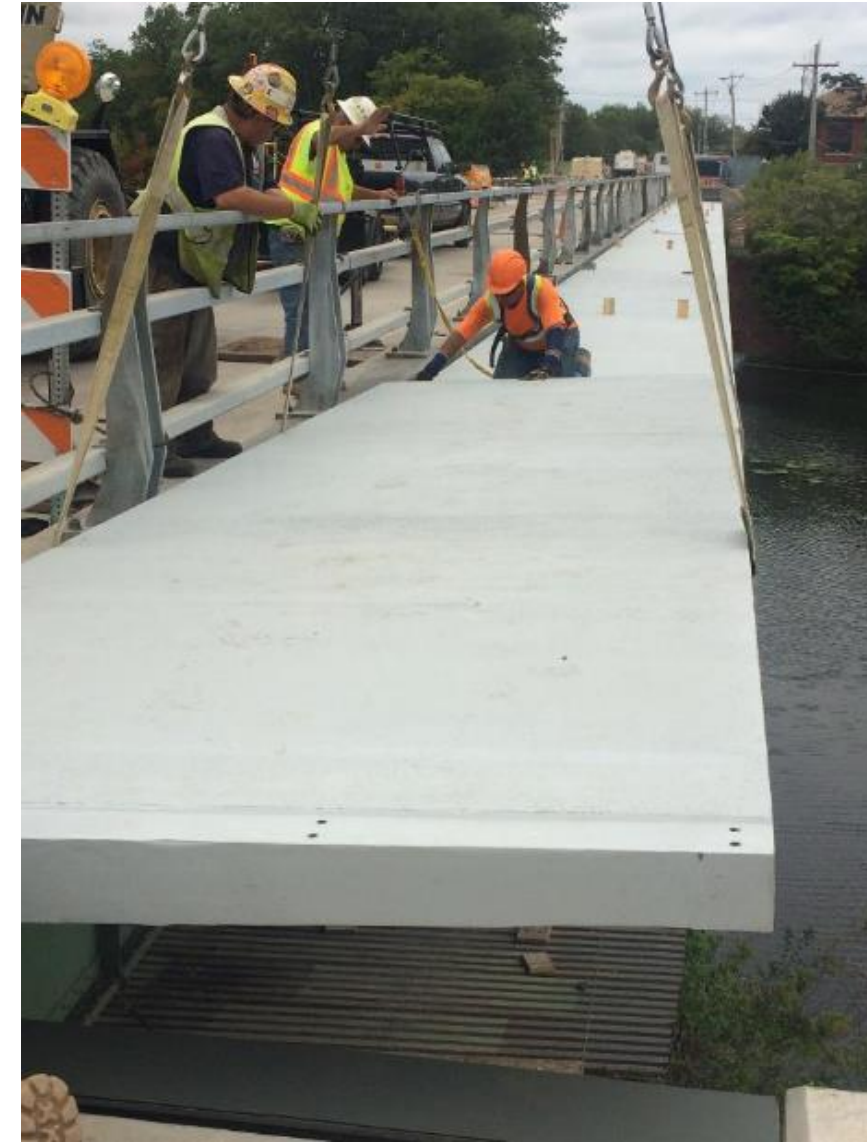
# Cantilever Sidewalks for Shared Use Paths

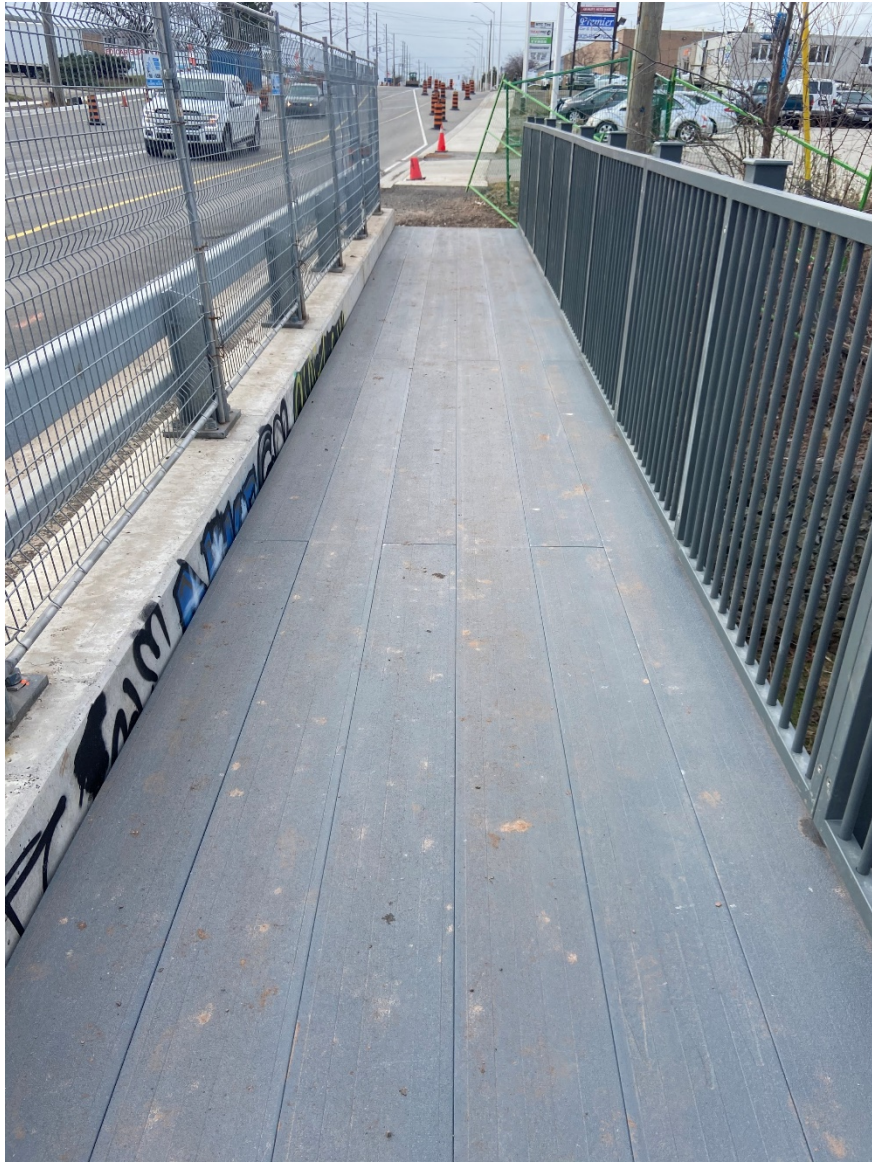
- Safety
  - Move users from vehicle bridges to dedicated sidewalks
  - Expand crumbling curbs to usable widths
  - Separate pedestrians and bicyclists from vehicles
  - Wide paths of 10 to 14 ft so pedestrians and bicyclists can safely share
- Recreation
  - Connecting entertainment districts currently separated
  - Urban residents want more recreation paths
- Cost Considerations
  - Add during vehicle bridge repair/rehabilitation
  - Lower cost than separate bridge





# Sidewalk Installation





# Oakville, Ontario Sidewalk

- Safe separation from vehicles
- Simple installation from top side



# Emergency Sidewalk Replacement Albany, NY



# San Lorenzo River Trail

- Critical connection in coastal trail
- Provide safe access amusement park
- Keep pedestrians from using active rail line





# FRP Pedestrian Bridges and Shared-Use Paths

- FRP bridges and decking enable safe and enjoyable paths for everyone
  - Not just for weekend parks
  - High traffic urban settings
- Important benefits are:
  - Lightweight
  - Design flexibility
  - Fast installation
  - Safety features
- FRP is a great solution when balancing the needs of owners and users

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