# RIDOT - Glenbridge Avenue Bridge Replacement

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## **RIDOT RhodeWorks Program**

# RhodeWorks is the plan by which we live:

- Completely reorganized RIDOT
- Asset management
- 10-year plan
- · Rebuild roads and bridges
- Modernize Infrastructure
- · Strict accountability
- Support economic development
- · Build workforce skills





# **RIDOT Rhode Works Program**

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### **Bridge Projects**

- To date, 244 bridges have been repaired or replaced
- 136 bridges under construction now
- 23% of the state's bridges deficient at the start of RhodeWorks in 2016
- Today, less than 15% of bridges in Rhode Island are deficient
- RIDOT is on target to meet its goal of less than 10% by 2026



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GOOD, FAIR AND POOR BRIDGES BY BRIDGE COUNT





## **RIDOT Rhode Works Program**

### ABC in Rhode Island

- RIDOT has embraced ABC as part of the RhodeWorks program
- Virtually all forms of ABC have been used
  - Prefabricated Elements
  - Modular Deck Beams
    - Also known as Prefabricated Beam Units (PBUs)
  - Bridge Systems
    - SPMTs
    - Lateral Slides
  - GRS-IBS
  - FRP Arches and Girders





Lafayette Road Bridge North Kingstown, RI



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### **Glenbridge Avenue Project**

Rhode Island





# **Glenbridge Avenue Project**





### **Glenbridge Avenue Project**

#### Project Facts

**Providence** 

- Located in Providence, RI
- Carries Glenbridge Avenue over US Route 6
- Two-span bridge
- Full replacement with the exception of the abutment foundation
- Traffic Volumes (AADT)
  - Glenbridge Avenue: 14,200
  - Route 6: 67,800



Note: This and following maps rotated 90 degrees clockwise



# Glenbridge Avenue Project

- Project Site
  - Nearby Industrial Sites
  - Residential areas



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# Glenbridge Avenue Project

#### Location Information

#### Route 6

- · Busy commuter road
- · 6-lane expressway
- Glenbridge Avenue
  - Two lane bridge
  - Two sidewalks
- Multi-use Trails
  - Woonasquatucket River Greenway
  - Merino Park Trail
- Buttonhole Drive





# Glenbridge Avenue Project

- Initial Project Construction Approach
  - Conventional construction
  - 2 construction phases
    - · Maintain one lane and one sidewalk at all times
  - Temporary signals used at each end of the bridge
    - One lane alternating traffic throughout construction



# **Glenbridge Avenue Project**

#### Phase 1A

- Cut deck
- Remove half of the bridge
- Maintain one lane of traffic and one sidewalk on existing half





# Glenbridge Avenue Project

- Phase 1B
  - Construct half of the new bridge
  - Maintain one lane of traffic and one sidewalk on the existing half





# Glenbridge Avenue Project

#### Phase 2A

- Demolish the second half of the bridge
- Maintain one lane of traffic and one sidewalk on the new half



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# **Glenbridge Avenue Project**

- Phase 2B
  - Construct the second half of the new bridge
  - Re-open to full traffic





# **Glenbridge Avenue Project**

- Issues with phased construction
  - Required detour of Grimwood Street
  - Required detour of -Buttonhole Drive
  - During early construction, the Buttonhole detour became an issue





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### **Buttonhole Drive Issue**

- Project Site
  - Nearby Industrial Sites
  - Closure of Buttonhole Drive required detour through a residential neighborhood
  - 2.3 mile detour
  - Result:
    - Significant increase in truck traffic through the residential neighborhoods
- Resolution
  - Use ABC to minimize the impact on the local residential street



### **Project Change**

- Started as a Design-bid-build contract
- The Department desired a change to address these impacts
- They approached the contractor to change to ABC
- This was similar to "Value Engineering" via a change order
  - VE is not always just about \$\$
  - Also, about impacts and time

# **ABC** Options

- Option 1:
  - SPMT?
  - No reasonable staging area nearby
    - Slopes along Route 6
    - Wetlands
    - Multi-use paths
    - Local roads



# **ABC** Options

### Option 2

- Modular Deck Beams?
  - Beams, piers, and abutments were already designed
  - This would require a complete redesign of the project





# **ABC** Options

#### • Option 3

- Lateral Slide
  - Construction over Route 6 was reasonable.
  - Ample room to build temporary pier and temporary abutments
  - Maintain 2 lanes and one sidewalk at all times
  - Buttonhole Drive remains open
  - Grimwood Street is closed with a very short detour
  - Most of the original design could be salvaged
  - Short-term closures Of Glenbridge Avenue and Route 6



Selected Option



### **Change Approach**

- CHA was brought in by the Contractor (Manafort Brothers, Inc.) for the re-design and to assist with the design approach for the slide
- Mammoet was brought in for the heavy lift/move
- · The project essentially changed to design-build
  - The contractor, the owner, the designer, and the heavy lift engineer worked together on the design change



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# Design Changes to Facilitate the Lateral Slide

- Abutment Stem
  - Convert from CIP to Precast



# Design Changes to Facilitate the Lateral Slide

#### Abutment Backwall

#### - Convert conventional to semi-integral



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# Design Changes to Facilitate the Lateral Slide

- Pier
  - Convert column bent to wall pier
    - · Accommodates moving loads better (if slide track is placed on the pier)



# Design Changes to Facilitate the Lateral Slide

- Approach Slabs
  - Convert CIP to Precast



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# Design Changes to Facilitate the Lateral Slide

• Return Walls





# Slide System

#### · Preliminary plan

- 3 slide tracks
- 2 abutment tracks and one pier track



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# Slide System

- · Revised Plan Mammoet
  - 2 abutment tracks
  - Change Pier track to SPMT
    - Eliminated a significant structure for the pier track
    - Eliminated jacking systems at abutments



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# Slide System

#### • Revised Plan - Mammoet







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Jacking Method



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Slide Method

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# **ABC Construction Schedule**

#### Closure of Glenbridge Avenue

- 7 Days
  - Demolition
  - · Construction of precast abutments and precast pier cap pedestals
  - · Pedestrian access was maintained on the NEW bridge

#### Closure of Route 6

- Short-term closures during off-peak hours for demolition
- 8 Hours for slide



## Construction

#### Pier Construction

- There was room for temporary support towers
- Contractor elected to build the new pier under the existing bridge
  - Remove work from the critical closure period
- There was ample room to build the temporary pier as well





## Construction

#### The call you never want to get

- "The new bridge was hit by an overheight truck"
- New bridge was 6" higher than the existing
- The new bridge was approximately 90% complete
- The fascia girder was heavily damaged
- The temporary supports were undamaged



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# Construction

#### Repair Options Considered

- 1. Removal of a portion of the beam and heat straightening of the remainder
  - RIDOT concerned with damage to metalizing and paint system
- 2. Removal of the entire fascia beam and repair to minor damage on other beams
  - · Provided a "like new" result
  - This option was chosen



### Construction

#### · How to mitigate this

- Raise the bridge higher
  - Slows construction due to need for significant lowering during the move
- Add a sacrificial beam
  - Increases costs
- Design temporary supports for an impact load



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# Construction

· Precast abutment stem installation





























# Construction

#### · Final setting issue

- The pier touched down
- The abutments had a 2" gap
- Elevation calculations were triple checked
- Survey shots before the move were checked
- Everything was correct
- Result: The SPMT moved lower relative to the abutments
- Solution: Set the bridge down on the abutments
- No issues with this



Greatly exaggerated profile



### Construction

#### · How to mitigate this

- Include deflection monitoring during the move
- Normally not required for a slide
- The adjustability of the SPMTs is cause for the need for monitoring
- If this happens, the SPMTs can easily be adjusted during the move





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### Acknowledgements

- Owner:
- Designer:
- Contractor:
- ABC Design:
- Heavy Lift:
- Temporary works design: Commonwealth Engineers

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- Manafort Brothers, Inc.
  - CHA Consulting, Inc.,
    - Mike Sullivan PM
  - Mammoet



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# **Conclusions & Lessons Learned**



- It was relatively easy to reverse-engineer the design from phased construction to ABC
- The project was a success
- Precast element detailing was kept simple
- It is possible to complete a lateral slide with SPMTs
- It is possible to mix SPMTs and slide tracks
- Take advantage of the contractor's "means and methods" options Be flexible
- Make sure temporary supports for bridges over traffic are robust
- Lesson Learned: Use flex/twist monitoring during the move

