East Cambridge (Lechmere) Viaduct Preservation

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VHB
Meeting with you today

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Today’s Agenda

- Learning Objectives
- Project Background
- Structure Conditions
- Proposed Repairs
- Advice and Takeaways
Learning Objectives

Discuss how modern materials and current technologies can be applied in a conscientious way to benefit a historic structure rehabilitation

Case study: MBTA Owned and Operated East Cambridge (Lechmere) Viaduct, Eligible for National Register of Historic Places
Project Introduction

Existing Conditions
- Reduced operating speeds and a single 2-car set
- Significant operational bottleneck
- Contributing resource within Charles River Basin Historic District and individually eligible for listing in the National Register

Project Goals
- Rehabilitate/Strengthen bridge to eliminate operational restrictions for current and future train types for 75-year service life
- Construction within an abbreviated window to match GLX construction timeframe
Historic Background

- Construction: 1907–1912
- Designed by prominent architect Robert Peabody for the Boston Elevated Rail Company
- At the time of its design, it was to be the visual terminus of the Charles River Basin, but since the construction of Museum of Science, no longer serves that function
Existing Structures Condition

- Conditions based on 2018 Bridge Inspection
- Concrete members exhibit cracking with and without efflorescence and isolated spalling
- Stringers and floorbeams meet statutory ratings for the #7, #8, #9, and Future #10 Green Line Revenue Vehicles, as well as the Type V Work Car
- Arch does not meet statutory ratings for the #7, #8, #9, and Future #10 Green Line Revenue Vehicles, nor the Type V Work Car at design speeds (acceptable for current operations at lower speeds)
- Bascule girders do not rate for fatigue. Superstructure is in fair condition based on 2018 Bridge Inspection Report. Peeling paint and light rust throughout.
Key Character-Defining Features

- 13 piers, 12 spans
- Paired reinforced concrete arch ribs
- Hollow, non-load bearing spandrel walls
- Open track deck system
- Neo-Classical architectural treatment
- Decorative battered design and “pier and panel” schemes for piers and parapets
- Contrasting smooth and bush-hammered surface treatments
Summary of Proposed Repairs

- Full replacement of stringer and deck system
- Retain open track deck system
- Patch and repair floorbeams, spandrel walls, arches, railing, and pier walls
- Use materials to match existing concrete color and texture to extent feasible
- Replace railing with precast
- Use materials to match existing concrete color and texture to extent feasible
- Strengthen bascule girders with top and bottom cover plates
- Retain overall look of bascule span
- **Improve water management!**
Summary of Proposed Repairs

- Clean and paint bascule span
- Strengthen arches and floorbeams with carbon fiber reinforced polymer (CFRP) wrap
- Replace safety walk and deck panels with fiber reinforced polymer (FRP) panels
- Replace safety railing with precast concrete
CFRP Wrap: Arches and Floorbeams

- Strengthen tension flange of arch
- Added shear strength for floorbeam
- Meet historic color/texture requirements
CFRP Wrap
FRP Panels

- Lightweight, reducing overall structure weight
- Modular, easy to replace discrete sections for future maintenance and repair
- Easy to adjust during installation to meet structure’s “quirks”
- Ability to select color and texture to satisfy historic requirements
Safety Railing

- Precast concrete to provide consistent product
- Redundant detailing ideal for precast fabrication
- Mock ups to match existing color/texture
Other Considerations

- Concrete mix design
  - Which mix are you using and where?
  - Do you need rapid set qualities?

- Considerations of materials
  - Today's methods vs. yesterday's look
  - Color matching
  - Texture matching—bush hammered concrete
  - Forms—finishing methods

- Newer materials that were not options in 1910
  - Sealants
  - Expansion joint materials
  - CFRP
  - Epoxy
Advice and Takeaways

- Historic preservation involves many stakeholders with differing opinions and interests. This affects the amount of coordination and patience needed to get the job done.

- Historic structures are not straight, plumb, or consistent. Be prepared for surprises in construction!

- Think carefully about scope of work—what is worth preserving or replacing based on budget and timeline.
Thank You!

Photo Courtesy of the Cambridge Historic Commission
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