Overview

- Existing dual bridge steel beam with concrete-filled steel grid deck
- Carries I-895 over Patapsco River Flats
- Built in 1957, LMC overlay and widened in 1984
- About 2380’ long in each direction with 42 simply supported spans
Condition of the Existing Bridge

- Existing deck in poor condition
Condition of the Existing Bridge

- Existing superstructure in poor condition
Condition of the Existing Bridge

- Existing superstructure in poor condition
Condition of the Existing Bridge

- Existing substructure in fair condition

Substructure rehabilitation contract (HT-2454) completed, raising the rating to satisfactory condition
Typical Existing Superstructure

- 42 span steel multi-beam
- Concrete filled steel grid deck
Typical Existing Substructure

Hammer Head Pier and Column

Pile Bent
Superstructure Rehabilitation Study

- RK&K performed a MOTAA and Superstructure Rehabilitation Study in November 2012

- Study evaluated
  - Replacement options
  - Sequence of construction
  - MOTAA during the replacement
Replacement Options

- **Deck replacement with superstructure rehabilitation**
  - Rehabilitation-painting, intermediate diaphragms, bearings, cover plates, plating
  - Deck replacement
    - Normal weight concrete
    - Lightweight concrete
    - Steel grid deck partially filled with lightweight concrete

- **Superstructure replacement**
  - Concrete beams
  - Simple and two span continuous steel girders
Five different sequence of construction options were investigated:

1A - Maintain one lane of traffic in each direction at all times, both lanes on one bridge

1B - Maintain one lane of traffic in each direction at all times, one lane on each bridge

2 – Close the bridge and detour all traffic

3 – Maintain two lanes of traffic in each direction

4 – Detour any one direction of traffic
MOTAA During Replacement

- MOTAA
  - Work zone traffic analysis
    - Capacity analysis
  - Construction & user cost analysis
    - Construction cost, road user cost and loss of revenue

- Selected Alternative 1 A- One lane of traffic each direction on one bridge
Superstructure Rehabilitation Study – Constraints/Goals

- Capacity of the existing substructure
- Evaluate continuity for live load
- Reduce number of joints
- Replacement structure shall not exceed capacity of the existing substructure and piles
- Upgrade existing 2’-10” barriers to 42” deep, TL-5 standard barriers
Substructure Evaluation

- Existing hammer head pier was analyzed using RC Pier and STAAD
- Existing cross-girder and pile bents were analyzed using STAAD
- Pile capacities were limited to those indicated on as-built drawings
- HS-20 Live Load was used for superstructure design
Pile Layout

- Expansion Pier
- Fixed Pier
<table>
<thead>
<tr>
<th>Deck Option</th>
<th>Slab Thickness</th>
<th>Load Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Concrete</td>
<td>8”</td>
<td>115 psf</td>
</tr>
<tr>
<td>Light Weight Concrete (118 pcf)</td>
<td>8”</td>
<td>93.7 psf</td>
</tr>
<tr>
<td>Existing Grid Deck Filled with Conventional Concrete</td>
<td>7”</td>
<td>88.5 psf</td>
</tr>
<tr>
<td>Proposed Steel Grid Deck Partially Filled with All-lightweight Concrete (100 pcf)</td>
<td>7 3/16”</td>
<td>50.0 psf</td>
</tr>
</tbody>
</table>
Proposed bridge replacement consisted of:

- Galvanized steel grid deck
- Partially filled with all-lightweight concrete
- Using Sequence of Construction 1A
- 2 span continuous segments
- 42” barriers to meet TL-5 requirements
Design Phase

Typical bridge section
- Galvanized steel grid deck with galvanized reinforcing steel
- Stainless Steel Reinforcing Steel was used in the barriers
- Overall Depth of 7 3/16”
  - 5 3/16” Grid Deck
  - 2 1/2” Concrete Infill
  - 2” Integral Concrete Overfill
- Full Pour Over Girders
- 3/8” Maximum Aggregate Size
- Designed by Contractor
- Steel Plate Girder
- Shop Painted
- 30” to 32” Total Girder Depth
- Optional Field Splice
- Contractor elected not to use splices
- 96’ to 120’ Span Lengths
- 2 Simple Spans on the Northbound Bridge about 55’
- Elastomeric Bearings
Design Phase | All Lightweight Concrete

- All Lightweight Concrete
  - LW Fine Aggregate
  - LW Coarse Aggregate
- Equilibrium Density of 100 pcf
- 28-days Compressive Strength of 4,500 psi
- Greater absorption than regular aggregates
- Prewetting is required
- Single sourcing of aggregates
- Communication
Project Background

- **Low Bidder:** McLean Contracting Company - $48.5 Million (Construction)

- **Schedule:**
  - Advertised: December 2, 2015
  - Bids taken: February 18, 2016 (10 bidders)
  - Construction NTP: July 11, 2016
  - Construction duration: 3+ years – anticipated completion – Summer 2019

- **Bridge Cost:** $220/sq. ft.

- **Delivery Method:** Design-Bid-Build
Construction Phase
Construction Phase

- **Challenges**
  - Access
  - Schedule
  - Materials

- **Our Approach**
  - Sequential timing
  - Crane selection

- **Lightweight Concrete**
  - Supply
  - Placement
Construction Phase
Construction Phase

- Steel plate girders
- Grid deck panels
- Average time to place grid deck was 11 days
- Estimated time for placing conventional bridge deck was calculated to be 18 days
Construction Phase

- Assembled grid deck
Construction Phase

- Concrete placement
Construction Phase

- Existing grid deck has found a new home in the Chesapeake Bay
- Artificial Reef Program
- Provides marine habitat for reef dwelling Oysters, fish and other ocean creatures
ABC Aspects of this Project

- The existing substructure was rehabilitated as part of a previous contract in 2013, which improved the substructure rating and made it feasible to be re-used.

- The re-use of the existing substructure prevented construction activity in environmentally sensitive areas and reduced construction duration.

- The use of grid deck accelerated the construction, typical span placement took 8 - 10 days.

- Use of shop painted steel plate girders.

- Use of Stainless Steel/Galvanized Reinforcing Steel to provide durability.

- Use of non-standard materials to meet the project goals and deliver a bridge structure with 50% less joints.

- Superstructure Replacement with reduced maintenance and increased design life.

- Practical Design approach to MOT, allowing for lane reductions and reasonable traffic impacts.
Conclusion

• Collaboration with the Material Manufacturers during design phase

• Understanding Material Constraints

• The specifications should require the presence of the lightweight aggregate manufacturer, ready mix producer, design engineer and the contractor at the deck pour meeting

• Use of grid deck accelerated construction

• Construction duration for deck placement was reduce by about 38% in comparison to conventional concrete deck
• Mid-Atlantic region is bustling with transportation projects to near saturation levels,

• Maryland Governor Hogan committed to replace or repair every structurally deficient state-owned bridge, committing $2 billion additional funds to get it done,

• Despite the very competitive transportation market, MDTA continues to attract strong bidder pools on our projects thru a legacy of:
  o Strong Project Marketing
  o Innovative projects
  o Strong partnering with Contractors and Consultants

• Committed to an “all of the above” strategy to accelerate project construction
  o Innovative Contracting – Incentives and bonuses
  o Alternative Delivery – Design Build and CMAR
  o Innovative materials and prefabrication
  o Network approach to project timing
Project Time Lapse Video