Lake Pontchartrain Causeway Bridge & Safety Bay Construction, Past & Present

Safety and Efficiency Through Construction Manager at Risk (CMAR) Contracting and Accelerated Bridge Construction (ABC)

ABC-UTC
August 2020
Webinar
Our Mission

To make the transits of all our commuters across the Lake Pontchartrain Causeway Bridge safe and timely.
Construction of the original bridge (today’s Southbound) costs $46 million which also included, three north shore approach roads, Causeway Blvd. to Jefferson Hwy., and Veterans Hwy. from Causeway to the Orleans Parish line.
For safety and to handle increased traffic, a second span (today’s Northbound) was completed in 1969 at a cost of $30 million.
Continuous maintenance and inspections have made the Causeway one of the most structurally sound bridges in the world.

However, with no shoulders, it is a 20th century bridge operating with 21st century traffic and vehicles.
Traffic Increases

• 1956, annual traffic was 50,000 vehicles.

• 1969, 2nd Span completed, annual traffic was 2 million vehicles.

• Today, annual traffic is 12 million vehicles.
Why Safety Bays/Segmented Shoulders Are Needed
## Statistics

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakdowns</td>
<td>3,200</td>
<td>3,478</td>
<td>3,700</td>
<td>3,633</td>
</tr>
<tr>
<td>Accidents</td>
<td>183</td>
<td>184</td>
<td>170</td>
<td>133</td>
</tr>
<tr>
<td>Response Time</td>
<td>&lt; 4 Minutes</td>
<td>&lt; 4 Minutes</td>
<td>&lt; 4 Minutes</td>
<td>&lt; 4 Minutes</td>
</tr>
</tbody>
</table>
| Rear Ends into Disabled Vehicles | 59 of 183 | 62 of 184 | 57 of 170 | 38 of 133 | (*within 2 Minutes of Breakdown)
Goals

- Provide most emergency stopping area
- At the least cost
- With least impact to Commuters
CMAR

Construction Management at Risk

• CM @ Risk / CM At-Risk
• Early Contractor Involvement (ECI)
• Construction Manager / General Contractor (CM/GC)
Construction Progress of Second Span

David Volkert & Associates of Louisiana
Prestressed Concrete Products Casting Yard

David Volkert & Associates of Louisiana
Casting Second Span Slab Sections and Bents

David Volkert & Associates of Louisiana
Barging Slab Sections and Placing Bents on Second Span

David Volkert & Associates of Louisiana
Setting Spun Cast Piles and Bents

David Volkert & Associates of Louisiana
Traffic Data through the Decades

Annual Traffic in 1956: 200,000
Annual Traffic in 2019: 12 Million
Recommendations for Improving Traffic Safety

- Ideally Provide Outside Shoulders Entire Length
- Install Flashing Lights for Warning
- Intensify Public Involvement
- Provide Intermittent Pull-Off Locations
CMAR Advantages

• Owner, Designer, and Contractor Share Mutual Project Goals
• Owner Controls Risk Identification
• Risk of Construction and Design Disputes are Minimized
• Costs are Controlled through Collaboration
• Design and Construction are Executed Concurrently
54-in. dia. Cylinder Pile

1-in. Open Deck Joint

Dowelled Cap Closure Joint

Type III AASHTO Girder

SOUTHBOUND EXISTING & PROPOSED
CROSS-SECTION
(LOOKING NORTHBOUND)
SCALE: 1/4" = 1'-0"
Accelerated Construction: Issues

• Construction stress limits were considered for the various elements such as girders and deck.

• These stresses considered change of boundary conditions such as support conditions, dynamic loads (NCHRP Project 12-98), vibration due to site conditions (waves, traffic, etc.).

• One area that should be considered for future projects is the bridge barrier railing as cracks tend to develop under the dynamic loads and change in support conditions.
Supports moved from design location to SPMT condition. This creates tension in the top of the girder and deck which must be considered.
Accelerated Construction: Issues

• Consideration should be given to pouring the bridge barrier rail in place to reduce or eliminate cracking.

• To lift spans using SPMT, supports were moved in which creates tension at the top of the beam over the support.

• AASHTO compressive stress limits for the prestressed elements are as follows:

<table>
<thead>
<tr>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due to the sum of effective prestress and permanent loads</td>
</tr>
<tr>
<td>Due to the sum of effective prestress, permanent loads, and transient loads as well as during shipping and handling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stress Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.45 f'_c$ (ksi)</td>
</tr>
<tr>
<td>$0.60 \Omega_e f'_c$ (ksi)</td>
</tr>
</tbody>
</table>
Accelerated Construction: Issues

- AASHTO tensile stress limits for the prestressed girder using composite section properties are as follows (moderate corrosion condition used because it is a temporary condition):

<table>
<thead>
<tr>
<th>Bridge Type</th>
<th>Location</th>
<th>Stress Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Than Segmentally Constructed Bridges</td>
<td>Tension in the Precompressed Tensile Zone, Assuming Uncracked Sections</td>
<td>0.19$k \sqrt{f_c} \leq 0.6$ (ksi)</td>
</tr>
<tr>
<td></td>
<td>• For components with bonded prestressing tendons or reinforcement that are subjected to not more than moderate corrosion conditions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• For components with bonded prestressing tendons or reinforcement that are subjected to severe corrosive conditions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• For components with unbonded prestressing tendons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No tension</td>
<td></td>
</tr>
<tr>
<td>Segmentally Constructed Bridges</td>
<td>Longitudinal Stresses through Joints in the Precompressed Tensile Zone</td>
<td>0.09$k \sqrt{f_c} \leq 0.3$ (ksi)</td>
</tr>
<tr>
<td></td>
<td>• Joints with minimum bonded auxiliary reinforcement through the joints sufficient to carry the calculated longitudinal tensile force at a stress of 0.3 $f_c$; internal tendons or external tendons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Joints without the minimum bonded auxiliary reinforcement through joints</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No tension</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transverse Stresses</td>
<td>0.09$k \sqrt{f_c} \leq 0.3$ (ksi)</td>
</tr>
<tr>
<td></td>
<td>• Tension in the transverse direction in precompressed tensile zone</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stresses in Other Areas</td>
<td>No tension</td>
</tr>
<tr>
<td></td>
<td>• For areas without bonded reinforcement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• In areas with bonded reinforcement sufficient to resist the tensile force in the concrete computed assuming an uncracked section, where reinforcement is proportioned using a stress of 0.5 $f_y$, not to exceed 30.0 ksi</td>
<td>0.19$k \sqrt{f_c}$ (ksi)</td>
</tr>
</tbody>
</table>

**Table 5.9.2.3.2b-1—Tensile Stress Limits in Prestressed Concrete at Service Limit State after Losses**
Accelerated Construction: Issues

- AASHTO tension stress limits for the precast deck (and barrier) were (should be) limited to the modulus of rupture using the composite section properties:

5.4.2.6—Modulus of Rupture

Unless determined by physical tests, the modulus of rupture, $f_r$, for lightweight concrete with specified compressive strengths up to 10.0 ksi and normal weight concrete with specified compressive strengths up to 15.0 ksi may be taken as $0.24 \lambda \sqrt{f'_c}$, where $\lambda$ is the concrete density modification factor as specified in Article 5.4.2.8.

Where physical tests are used to determine modulus of rupture, the tests shall be performed in accordance with AASHTO T 97 and shall be performed on concrete using the same proportions and materials as specified for the structure.
CMAR Advantages – Contractor’s Perspective

- True team mentality
- Guide project design and construction methods to meet Owner’s goals
- Risk Mitigation – Identify, assign ownership, mitigate
- Opportunity for innovation
- Advanced Work Packages
CMAR Challenges – Contractor’s Perspective

- Intensive collaboration – takes effort
- Owner involvement – timely decisions
- Independent Cost Estimator - familiar with scope of work
- Complete transparency
Project Cost Data

Total Cost of Project $57,500,000
Cost of Precast Elements $34,800,000
Project Schedule

• **Project Construction**
  • Start: December 17, 2018 (NTP)
  • Completion: August 19, 2020

• **Precast Production**
  • Start: August 7, 2018 (Pile)
  • Completion: February 18, 2020 (Cast Final Deck Unit)

• **Precast Erection**
  • Start: February 14, 2019 (Pile Installation)
  • Completion: April 24, 2020 (Final Deck Unit)
Lessons Learned
Thank You
Questions?