THE CAUSEWAY BRIDGE CONSTRUCTION, PAST & PRESENT

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The Lake Pontchartrain Causeway is a toll bridge which spans over Lake Pontchartrain from Causeway Boulevard in Metairie, Louisiana to Highway 190 at Mandeville, Louisiana. This toll facility is managed by the Greater New Orleans Expressway Commission (GNOEC) and has been listed since 1969 by the Guinness Book of Worlds Records as the World's longest bridge over water at 23.83 miles long. The Causeway Bridge consists of two parallel bridges designed and constructed in different periods of time. The original bridge is on the West, it opened in 1956 and carries traffic from North to South. The second bridge on the East, opened in 1969 and carries traffic in the opposite direction.

Palmer and Baker, Inc., designed the first bridge to exclusively consist of identical panels, caps and pilings. The 56' long and 33' wide spans were cast monolithically to allow for all pieces of the bridge to be fabricated offsite, minimizing cost and time required to construct such a large structure.

Despite the fact many engineers consider "Accelerated Bridge Construction" (ABC) as a new and innovative bridge engineering phenomenon, the design and construction technologies which was incorporated for this bridge in the 1950's is a testament to the fact ABC was being implemented in Louisiana long before it received its formal recognition and title.

The Louisiana Bridge Company (LBC), a joint venture between Brown and Root, Inc. of Houston, Texas and T.L. James Company of Ruston, Louisiana, implemented Palmer & Baker's design. LBC worked with Raymond Concrete Pile Company to construct a yard near the planned site. All pieces of the bridge were produced at this location. The Raymond Concrete Pile Company utilized their unique manufacturing technology to produce prestressed concrete cylinder piles which were capable of resisting corrosive conditions of the Lake's brackish water. A canal was dredged from the lake to the facility to accommodate loading materials on and off barges. pilings and Spans were constructed on the off-construction site plant. e.g. Historic American Engineering record (1)

The second bridge was designed by David Volkert & Associates in the Mid 1960's and it's construction began in 1967. This structure's typical span is made of 84' long and 33' wide with Precast Prestressed members. The GNOEC chose another joint venture consisting of Brown and Root, T.L. James and Raymond International (formerly the Raymond Concrete Pile Company) called Prestressed Concrete Products, Inc. to build the second bridge utilizing the same prefabrication techniques that had proven successful before. Prestressed Concrete Products, Inc. manufactured nearly all components of the second bridge at the plant and transported by barge to the construction site in the lake.

The Prestressed, Precast concrete bridge system built in the 1950's and subsequently in the 1960's display technology that symbolizes modern bridge construction techniques even though such construction techniques were not labeled as ABC.

Today, although both bridges are in reasonably sound structural condition, nearly 60 years of age and have endured harsh site conditions such as brackish water and high humidity, their roadway widths are insufficient for the current increased traffic volumes. Lack of shoulders which have contributed to the high rate of accidents prompted GNOEC to look for the most financially feasible solution to this problem. Several solutions were taken into consideration. Ideally, the best solution would have been to provide an outside shoulder the entire length of the causeway on both bridges. This solution was found to be financially infeasible due to their length. Other solutions were considered but eventually found to be ineffective. The end solution which was a subset of the first solution was to provide intermittent pull-off locations. The end goal became to build 12, 1008' foot long Safety Bays, six along the length of each bridge.

The Urgency to move forward with the design and construction of the safety bays within the available budget and with minimal interruption to the traffic demanded creativity in all phases of this project. The GNOEC was convinced that one of the vehicles to accelerate design and construction and yet to be able to minimize risk and control schedule and budget and ensure quality was to consider project delivery method through implementation of "Construction Manager at Risk" (CMAR) or otherwise known as "Construction Manager/General Contractor" (CM-GC).

Why CMAR? Because CMAR is most effective when collaboration and cost control is desired, concurrent execution of design and construction is preferred for complex projects with tight time frames and when owner, designer and contractor have mutual project goals. Other attributes of this method of project delivery are, identification of risk by owner, minimization of risks of construction and design disputes.

Commonly in States, CMAR statutes require that the owner hire a design engineer and contractor through independent contracts which in turn work together to maximize the efficiency of the design. To that end, request for qualifications for design was submitted by GNOEC and Volkert Inc. was selected. GNOEC also selected Boh Bros. as it's pre-construction contractor. Huval & Associated of Lafayette, Louisiana was selected as project manager for the owner and CEC Inc. of Lafayette, the Independent Cost Estimator.

Boh collaborated with Volkert and the GNOEC on constructability, schedule and budget to help guide the design. In CMAR, intensive owner participation is crucial. Weekly meetings were held with the stakeholders and with the owner present and participating in majority of important decisions.

Boh states that "transparency is paramount when addressing and resolving risk. One concern on any project is pile length variability and whether the piles can be driven to grade." "In low bid world, the contractor assumes the risk of Pile Cutoff and includes its estimated cost in his bid however, if the same cost is presented to the owner as a Risk Item in the case of CMAR, the owner will pay for the actual number of piles that will require cutting off. e.g., Boh Picture (2)

In this project, CMAR process has allowed for a more expedited design and planning and facilitated a construction schedule that minimally impacted traffic through collaboration with the designer.

Advanced Work Packages are among the benefits that is gained by utilizing CMAR. In this project, an advanced test pile program was developed to facilitate establishing pile depths and estimated quantities. This process enabled purchasing majority the required piles prior to an executed Guaranteed Maximum Price (GMP). In CMAR, the advance work packages can be structured so that the owner can have full ownership of the purchased materials regardless of the contractor's ability to negotiate an agreeable GMP Contract.

The contractor's choice for the Safety Bays construction method had many similarities with the methods used for the original construction of both bridges. The decision was made to fabricate the bridge sections off-site and in modular fashion. They barge them to the construction site from the contractor's off-site location. Piles and Caps have been pre-cast and Accelerated Bridge Construction (ABC) has enabled pile driving and pile cap connection to be accomplished exclusively form the barge which has circumvented lane closures. Minimizing lane closures and to allow free flow of traffic was among the owners most significant requirements and ABC has been able to deliver this requirement to the maximum extent possible.

The production in the off-site casting yard is an elaborate process and critical on multiple levels. For example, safe guarding the precast, prestressed members against exceeding their designed stress limits particularly subsequent to the casting of the deck and barrier on the girders is essential. Same also applies to the lifting of the span units by the SPMT during their transportation on the barge and finally to the construction site. Lifting of the units by the SPMT takes place at bearing points under the completed spans at different points along their length than their final bearing locations for which the girders have been designed. Careful analysis is required to ensure compliance with the design specifications during lifting and barge transportation. Once several units are placed on the barge, they are transported to the construction site where they are lifted in place by the SPMT and placed on their permanent locations.

The Safety Bay project team is convinced that the combination of ABC methods of bridge construction with the application of CMAR process has expedited the delivery of this project, saved construction time, minimized interruption of traffic, meeting the budget and has minimized risk for both the owner and the contractor.

SOURCES:

(1) Lake Pontchartrain Causeway & Southern Toll Plaza Bridge, Canopy. Historic American Engineering Record, National Park Services, U.S. Department of the Interior, 1849 C Street NW, Washington, D.C. 20240-0001

(2) Boh Picture, Vol. 47, Number 1/Spring-Summer 2019 A Publication of Boh Bros. Construction Co., LLC "Driving for Safety" CMAR Process Speeds Improvements to the Causeway Bridge.