

A Tale of Three Bridges

By: Charles W. Nelson, P.E.

When travelling east out of New Orleans to get to Mississippi, a driver has three options: U.S. Hwy 11 across the 'Five Mile Bridge', Interstate 10 across the 'Twin Span', or U. S. Hwy 90 across the Chef Menteur bridge. This article discusses a bit of the history of those three bridges - not just the chronological history, but also the SURVIVAL history.

The 'Five Mile Bridge' on Hwy 11 was the brainchild of Louisiana businessmen who recognized the opportunity to put to work the old adage that 'time is money'. For someone wanting to travel by car to Mississippi from Louisiana in the 1920's, it meant an indirect route around Lake Pontchartrain, along its shoreline to Hammond, then east through St. Tammany Parish to Mississippi. This invited a business venture to shorten the route, charge a fee for the savings in time realized, and allow motorists of the day to choose between time and money. The realization of that economic model resulted in a private bridge longer than any in the world at its time. It was called the Watson-Williams Bridge by its owners.

The bridge was built by the Raymond Concrete Pile Company as a 4.78 mile long, 33 foot wide structure and opened on Feb. 18, 1928 at a cost of \$6,000,000. The construction system included 2' x 2' and 2' x 2'6" reinforced concrete piles having an average length of 73.7 ft and average penetration of 60.5 ft below Mean Gulf Level (MGL). Pile bents had four piles each, and were spaced at 35' centers, supporting reinforced concrete pile caps. (Figure 1)

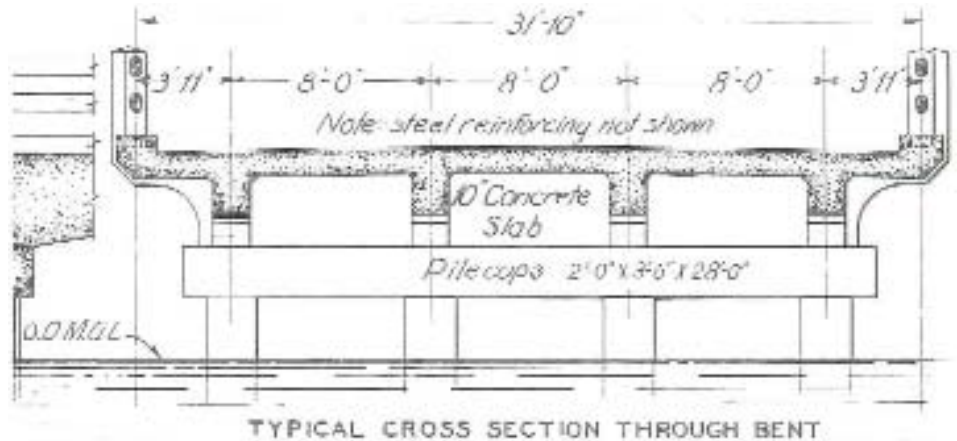


Fig 1. Watson-Williams, or Hwy 11 Bridge

Reinforced concrete longitudinal girders span from pile cap to pile cap, and support a 10" reinforced concrete slab overlain by a 1 1/2" rock asphalt surface. Ford, Bacon and Davis were the design engineers, and Elliot and Harmon Engineering Company were consultants. Figure 1 seems to indicate that the 35' x 33' roadway sections were pre-cast, but this is not known definitively.

Two double leaf bascule bridges were installed, one spanning 106' about 2500' from the South shore, and one spanning 150' located about 6000' from the North shore. Toll booths were located on the western end of the bridge, and the toll was \$1.25 per vehicle plus \$.10 per passenger. This bridge was designed by engineers using slide rules and log tables, likely gen-

erating drawings with pen and India ink on linen cloth. Construction equipment at the time would have included wooden barges and steam powered cranes and pile drivers.

Chronologically speaking, the next bridge to discuss is the U. S. Hwy 90 bridge at Chef Menteur Pass. It, and its companion bridge at the Rigolets, at the eastern end of the eight mile Chef Menteur Island, were built between 1921 and 1928 under a campaign promise completed by then Gov. Huey Long to have 'free bridges' in the state of Louisiana. This promise stuck hard, as research shows that of the 15,150 bridges in the watery state of Louisiana, only three have tolls - the Crescent City Connection across the Mississippi at New Orleans, the Sunshine Bridge across the Mississippi in St.



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German Autobahn built by Hitler, which Eisenhower may have realized was a key to not only military movement, but also commerce. The I-10 Twin Span was built using lessons learned from the earlier Lake Pontchartrain Causeway, which is worthy of its own discussion. Spans were 65 ft. long, and pre-cast roadway panels were placed between these, as is the practice for many elevated roadways across Louisiana. Designers of the time no doubt had early computer programs to assist with the structural designs, and a bevy of 'board drafters' to depict their designs for delivery to the constructors selected to build the bridges. One design element apparently not considered by its designers must have been a question thought to be unlikely: what happens if it gets hit by a hurricane which puts it underwater?

The survival history of these three bridges is the topic of the remainder of this article. Their test came during Hurricane Katrina, which attacked Louisiana in late August of 2005 from the east, traveling across the Gulf of Mexico for 5 days before making landfall. The eye of the storm hit Bay St. Louis, Mississippi, about 60 miles east of New Orleans. The storm pushed Gulf of Mexico waters into the passes at the Rigolets and Chef Menteur until Lake Pontchartrain was filled to about 6 feet above sea level. Then, in its

pass east of the Lake, the storm's counter-clockwise rotating winds pushed this six foot surcharge of water to the south for at least 24 hours, reaching 11 feet at New Orleans. Above this storm surge rode wind-driven waves which by physical principal can grow to about 38% of the water depth on which they ride before breaking.

When this onslaught hit the Hwy 11 bridge (the northern-most and oldest of the three), little happened. The lower elevation and solid construction of the two-lane bridge served it well during this test. Minor damage to guardrails on the bridge were likely caused by floating debris, boats most likely, which would have been blown into, on and over the bridge. This damage was quickly cleared, and the Hwy 11 bridge became a primary access route from eastern New Orleans to Slidell for months after the storm.

The Interstate 10 bridges did not fare so well. At 10 ft above normal lake level, they were submerged when Katrina whipped the Lake to its frenzy. Waves running hard south from the day's long thrust of the hurricane winds would have piled 10 foot plus waves on top of the storm still water level. Some theorize that these waves caused uplift on the precast spans stretching between pile bents. A combination of buoyant uplift and dynamic 'slamming' of wave forces are hypothesized as contributing to the damage of the Twin Span. A recent look at aerial photos of the post-Katrina damage encourages another theory: wind-driven waves from the north breaking on the northern span would have travelled south, exerting enormous lateral load on the southern spans - acting on both the north and the south guard rails, which were solid concrete walls three feet high. This may explain the reason that on the South (eastbound) span, roadway panels were displaced to the south by several feet, due to the force of the water. (Fig. 3) The South span suffered greater overall damage as numerous roadway panels were knocked completely loose from their supporting bents.

Despite the damage to the twin span bridges, emergency repairs by Boh Brothers Construction Company restored traffic on the southern span in an amazing 28 days. 172 span

Charles Parish, and the Lake Pontchartrain Causeway.

The 'Chef' bridge at Hwy 90 has two approaches of reinforced concrete on concrete piles, and two fixed riveted steel Baltimore truss spans and one swing span. The trusses sit on cylindrical concrete caissons which were cast in place inside steel forms. (Fig. 2) They are 28' in diameter, with 7' walls and a 14' center void. A 'cutting shoe' 12' long at the lower end of the caisson allowed it to penetrate the bottom of the pass under its own weight, to depths from 80' to 140' below MGL. The bridge is 979'7" long and carries a 20' roadway. It was designed by the Bridge Engineering Department of the Louisiana Highway Commission and built by Frederick Snare Corporation. Interestingly, when opened, the free Chef Bridge put the Watson-Williams toll bridge out of business and it was sold to the State of Louisiana for \$940,000.

The last of the Tale of Three Bridges is arguably a tale of TWO more bridges. About a mile south of the Five Mile Bridge is the U.S. Interstate 10 bridge, recently rebuilt after Hurricane Katrina. The original 'Twin Span' bridge was built during the nation's Interstate Highway and Defense Program initiated by President Eisenhower upon his election to lead the nation following World War II. The program was to emulate the efficiency of the

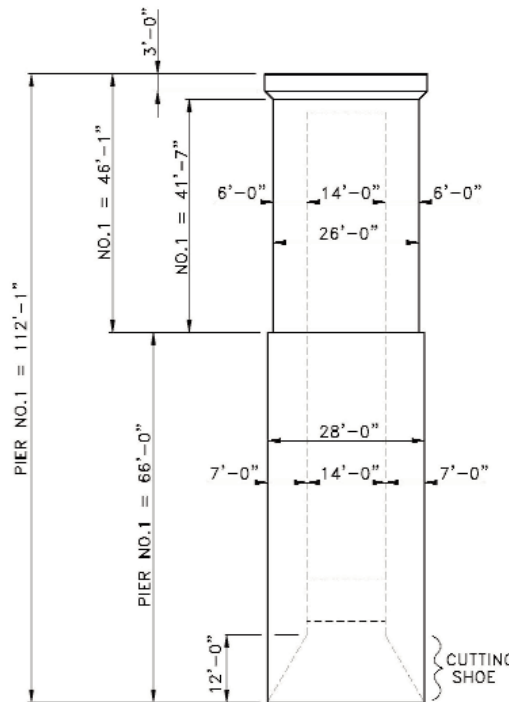


Fig. 2 Chef Menteur Bridge Pier No. 1 Details



Fig. 3 - I-10 Twin Spans
Looking East

realignments were needed to adjust spans which were offset between 2" and 20'. Thirty-eight spans were removed and replaced, mostly using less damaged spans from the northern bridge. The easy realignments (less than 5') were done by jacking the span up, inserting Teflon slide plates under the girders, and sliding the span back into position using hydraulic jacks (Figure 4). The more difficult realignments used 'Goldhofer' hydraulic trailers mounted on a barge to lift the spans, allowing repositioning. For damaged spans needing removal, an excavator with a hydraulic breaker punched holes in the 285 ton unit. Cables 3.5" in diameter



Fig. 4: Jacking Spans Back In Place
(Photo Courtesy of Boh Bros.)

were strung through the holes by divers; the span was lifted out of the water by crane, and placed on a transport barge for transport to shore for demolition. The 'Goldhofer' trailers were also used to re-set spans pirated from the northernmost bridge of the twin span.

The Hwy 90 bridge at Chef Menteur had its own unique history of Katrina-related damage. This bridge has a deck elevation of +/-15 ft, and would not have been totally submerged during Hurricane Katrina. Due to the restrictions of Chef Menteur pass, it would not have been subjected to the same severity of wave action as the Interstate 10 bridge, although it is in much deeper water. The physical effect governing this is limited 'fetch', or travel distance for wind to build a wave in water of a given depth. The 1930's era Chef Menteur bridge survived well during Katrina. Structural damage was minimal, but mechanical and electrical systems repairs were months in coming, due to other priorities in the rebuilding effort and the fact that 90 percent of the buildings on Chef Menteur Island, which the bridge services, were destroyed.

For those interested in the history and survival of these three bridges, there are several lessons to be learned. First, the oldest of the three bridges survived best. Second, the newest suffered the greatest damage. Its inaccessibility caused millions of dollars of losses, both in the rebuilding and the disruption to commerce for several years. And thirdly, the value of aged infrastructure was brought into focus for our community post-Katrina. The Hwy 11 bridge carried all New

Orleans/Mississippi traffic after Katrina, and today carries 23,000 while the Interstate carries 43,000 vehicles per day. Such situations must exist throughout the United States, where older facilities often become the stepchildren of our infrastructure. Planners and engineers alike are well served by determining which of our past infrastructure investments can be extended at reasonable cost for continued service.

In Memoriam



Donald J. Guidry, P.E.
August 19, 1944 - May 20, 2010

It is with deep regret that we share the news of the passing of Don Guidry, a long time and valued member of our firm, following his valiant battle with cancer. A devoted husband, father and grandfather, he leaves behind his wife, Kathy; two daughters, Leslie and Amy; and his son, Rob, a member of our Mechanical Department; as well as two brothers and sisters. Don will be sadly missed by all of us at the company, and we extend our heartfelt condolences to all the Guidry family.

NELSON Design Helps Combat BP Leak

Watching BP webcasts of several attempts at controlling the flow of oil from their MC 252 discovery shows that a key tool at attacking the problem has been the Q 4000 multi-service vessel. NELSON was retained in August of 1999 to provide professional engineering and project management services for the mechanical and hull systems designed for this unique vessel. Its excellent station-keeping ability, large deck space and high deck load capacity have been well suited for water depths up to 10,000 feet. General details of the vessel appear in our Consultant issue for November/December of 1999, available at www.wsnelson.com.



A check was presented to Children's Hospital New Orleans during the volleyball tournament and telethon held in June at Coconut Beach



Representatives from Children's Hospital joined employees at the Bar-B-Q in recognition of the Company's long time support of Children's Hospital.



Employees raised money for Children's Hospital New Orleans by having lunchtime Bar-B-Q's and Bake Sales during the month of May.



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