Hurricane Katrina

Bridging the Gaps

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In the wake of being the costliest natural disaster in American history, Hurricane Katrina extensively damaged and destroyed a number of major bridges throughout the Mississippi and Louisiana region. As a result, this area will receive an unprecedented economic stimulus of nearly $3 billion to restore its transportation needs. A majority of these funds will be used to restore the new 5.4 mile I-10 Twin Spans Bridge over Lake Pontchartrain from Slidell to New Orleans, LA and the U.S. 90 bridges at Bay St. Louis and Biloxi, Mississippi. These structures will account for nearly half of the $3 billion emergency funds.

The full effect and outreach of Katrina were widespread. Several major railroad structures adjacent to the structures noted above were also significantly damaged, including the 5.4 mile Norfolk-Southern Railroad Bridge over Lake Ponchartrain in Louisiana and the CSX Railroad Bridge over Bay St. Louis in Mississippi. The effects of Katrina were even more widespread in Louisiana. The Louisiana Department of Transportation and Development (LA DOTD) reported that nearly 90 movable structures and three tunnels were damaged by the hurricane. Of these 90 movable structures, 20 were severely damaged and qualified for Emergency funding from FEMA.

While the damage to these structures severely affected the local communities and recovery efforts, the emergency repairs to the 5.4 mile I-10 "Twins Spans" Structure over Lake Ponchartrain was paramount to the recovery effort in New Orleans. This portion of I-10 serves as the primary transportation corridor in the continued rebuilding effort. The Twins Spans carried a majority of the commerce traffic and residents into New Orleans, a city that historically has served as a vital role in the shaping of our nation. The urgency for these repairs was best illustrated by ability of the LA DOTD to prepare, advertise, and award the contract for the emergency repairs in just nine days after the full effects of Hurricane Katrina. Boh Bros. Construction LLC of New Orleans won the $35 million emergency repair contact, with HNTB Corporation of Baton Rouge serving as a subconsultant in providing engineering and construction services.

Figure 1: Damaged I-10 "Twin Spans" looking north

To fully comprehend the damage incurred and the repairs required, one needed to understand the dynamics and sequence of events of how Katrina impacted the Twin Spans bridge. As Katrina moved to the north and east of the site, the storm surge entered Lake Ponchartrain from the east while the wave action came from the north and northwest. At this location, Twin Spans runs predominately north-south. With the low members of the bridge at approximately 8.5 feet above mean high water, the storm waters rose to depths that totally encapsulated the 260-ton precast units. As a result, air pockets formed beneath the bridge and buoyed the spans. This phenomenon combined with the wind and wave action to cause a general shift of all spans to the east. The structure experienced repeated damage to the girders, with the failure of nearly all anchor bolts. This left the only lateral restraint to be provided by the elevated bearing seats.

Thirty-eight spans on the eastbound structure fell into the water, while 20 spans on the westbound structure fell. On the eastbound structure, 171 spans were misaligned, while 303 spans were misaligned on the westbound structure. Because of the extensive misalignment, girder damage, and more than three miles of damaged barrier railing on the westbound structure, it was decided that the eastbound structure would be repaired first. To meet the contractual demands of opening the eastbound structure in a 45-day schedule, the entire team employed a tireless work schedule using two 12-hour shifts.

Design was in accordance with the 17th Edition of AASHTO's *Standard Specification for Highway Bridges*. The repairs were temporary in nature, since the bridge is currently being replaced by a new six-lane structure that will be completed in approximately five years. All design submittals consisted of only design sketches and back-up calculations (signed and sealed). Preparation of final as-built plans took place after the completion of all repairs and the opening of the bridges to traffic. All designs and reviews occurred on-site with a maximum review period of four hours (24 hours a day, 7 days a week).

The ability to work was greatly controlled by the lake conditions. Due to the large expanse of Lake Pontchartrain and its shallow waters (generally 10 to 15 feet), weather conditions easily generated 3 to 4 foot swells, which added to the challenge of realigning the spans and concrete debris removal. Despite these many challenges, the eastbound structure was repaired in just 28 working days, 17 days ahead of the 45 day schedule. In a similar manner, the westbound structure was also opened eight days ahead of the concurrent 120-day schedule on January 6, 2006.

The repair process was to cannibalize the good spans from the westbound bridge and move them to the eastbound bridge to yield a complete structure. The remaining spans on the westbound bridge were then arranged to yield two continuous gaps of missing spans — one each on the north and south end of the bridge. In

Figure 2: Failed Anchor Bolts and Shifted Spans

Figure 3: Temporary Acrow Span for the WB Bridge

these locations, temporary steel Acrow trusses (700 series) were installed on the existing bents to bridge the gaps.

The project required a high degree of innovation, collaboration, and trust. The entire process was unconventional in that there was very little time for ordering materials.Resources were scarce due to the damage to nearly all local suppliers. The repairs were varied in nature and included helper bents (needle beams supported on 4-24 inch pipe piles), four new pile bents, re-alignment of 473 of the project's 872 spans, and the use of 506 25-ton screw jacks to support the moderately damaged girders. In addition to these repairs, the project also utilized 320 neoprene bearings, 638 custom-cut bearing plates made of Teflon-like materials to replace the missing bronze bearing plates, 96 saddles to support the more heavily damaged girders, modified 68 bents to accept the Acrow bridge, and epoxy injection of approximately 2,000 feet of cracks.

Figure 4: Destroyed US 90 Bridge over St. Louis Bay

Having recently completed the emergency repairs, the final phase of the three year inspection program of the temporary Acrow structure has begun, with attention to the expeditious completion of the permanent structure. For all structures in this region, considerable research has been conducted into the height of the storm surges experienced across the Louisiana and Mississippi region. From all the available data, it has been shown that the storm surges in the region varied from 20 to 30 feet in height. As a result, the low member of the new Twin Span structure will be approximately 30 feet off the water. This new structure will be constructed on an alignment 300 feet to the east of the present structure. This new structure is expected to take 1,800 days to complete, with an intermediate completion date of 1,150 days to open one of the two three lane structures. Boh Bros. recently won the first construction contract valued at $379 million. Volkert Engineering and HNTB Corporation were selected to provide CEI services to the LA DOTD.

In a similar manner, the U.S. 90 structures in Bay St. Louis and Biloxi, Mississippi experienced extensive damage. The storm surge and resulting wave/wind forces were such that these structures were damaged beyond repair. The replacement structures, as with the Twin Spans Bridge in Louisiana, will be built on new alignments with an increased vertical profile.

In case of the Bay St. Louis Bridge, the height of the low member will be 38 feet above mean high water. This structure was recently awarded to the design/build team of Granite/Archer Western with a bid of $275 million. HNTB Corporation and RS&H are serving as the design engineers. Completion is expected in November 2007. As everyone prepares for a new hurricane season, the continued recovery effort is truly expeditiously bridging the gaps.▪

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