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MAIN
FEATURE

PRECAST CONCRETE BUILDINGS SURVIVE DIRECT HITS FROM HURRICANES

HURRICANES LAURA AND DELTA WERE NO MATCH FOR THESE
STRUCTURES, WHICH COMBINE PRECAST CONCRETE AND
STEEL FOR A NEARLY IMPREGNABLE FAÇADE

BY SUSAN BADY

A pair of precast concrete projects in Louisiana withstood the wrath of two powerful hurricanes as structures around them were demolished. Bob Pool, executive vice president of Alfred Miller Companies (AMC), a design-build contractor that also manufactures precast concrete components, documented the aftereffects of Hurricanes Laura and Delta on the control room, maintenance shop, and warehouse (CMW) building of Cameron LNG, a liquefied natural gas facility in Hackberry, La., and on the Cameron Parish School District (CPSD) Warehouses in Creole, La.

"This year our area had direct hits from two major hurricanes, six weeks apart," says Pool. "Cameron LNG's CMW building in Hackberry was hit by 150-mile-per-hour sustained winds and 200-mile-per-hour gusts during Hurricane Laura. The only damage [to the CMW building], a laboratory and hazardous-waste storage facility, was to the fabric parking canopy, which was designed to tear away in a hurricane." Pool says several pre-engineered metal buildings (PEMBs) in the same area sustained significant damage.

The school district warehouses are located a mile from the coast, exactly where Hurricane Delta made landfall, he says. Both structures are pre-engineered metal buildings with precast concrete walls and standing-seam metal roofs. "They are literally the only buildings still standing within a 10-mile radius of Creole," Pool says.

AMC shop-applied more than 2 million ft² of lightweight cementitious fireproofing and completed field block-outs, plus equipment supports (shotcrete) totaling more than 2.4 million ft². The project is the largest fireproofing job in U.S. construction history, says Pool. The company also provided four miles of precast concrete trenches for LNG and stormwater containment, and two miles of precast concrete underground electrical duct banks and manholes.



Used to store perishable food and dry goods for school cafeterias in Cameron Parish, this warehouse was elevated to minimize the risk of flooding from storm surge. All photos: Jessica Wene Photography.

Surviving Spills and Storm Surge

For the CPSD Warehouses, the biggest risk was being in the direct path of both the hurricane eyewall and storm surge, says Philip Miller, president of AMC. "The building is literally within sight of the Gulf of Mexico," Miller says. "This is exactly what happened during Hurricane Laura and Hurricane Delta, which had a 17-foot storm surge."

The new structures replace a previous warehouse that was destroyed by Hurricane Rita. Because they're located directly on the beach highway, they are elevated to minimize future risk, Miller says. Their purpose is to store frozen and refrigerated food and dry goods for school cafeterias throughout Cameron Parish. This design-build, public-bid project was designed by Brossett Architect in Lake Charles, La.

The Cameron LNG building is built literally in the shadow of the giant tanks containing liquefied natural gas. "These tanks are 300 feet in diameter and 200 feet high and hold more than a ship load of LNG apiece," Miller says. "The greatest risk is blast exposure from a hydrocarbon vapor cloud that could result from an unintentional LNG spill."

The building is a total-precast concrete project "because it provides the greatest value," he says. "We make total-precast competitive with PEMBs or steel-frame buildings by integrating large amounts of MEP [mechanical, electrical, and plumbing] and sprinkler-system [components] into the precast before shipping it to the construction site. We even apply the roof insulation and roof membrane before shipping the roof panels."

PROJECT SPOTLIGHT

CAMERON PARISH SCHOOL DISTRICT WAREHOUSES

Location: Creole, La.

Size: 8000 ft²

Cost: \$2.1 million

Owner, Contractor, Engineer, and PCI-Certified Precast Concrete Producer: Alfred Miller Companies., Lake Charles, La.

Architect: Brossett Architect, Lake Charles, La.

Precast Concrete Components: 38 precast concrete walls pieces in Building A; 31 in Building B



PROJECT SPOTLIGHT

CAMERON LNG CONTROL ROOM, MAINTENANCE SHOP, AND WAREHOUSE (CMW) BUILDING

Location: Hackberry, La.

Size: 100,000 ft²

Cost: \$42 million

Owner, Contractor, Engineer, and PCI-Certified Precast Concrete Producer: Alfred Miller Companies, Lake Charles, La.

Precast Concrete Components: 713 pieces covering 91,000 ft² of floor area

Shown is the interior of Cameron LNG's control room, maintenance shop, and warehouse building, which is directly adjacent to several large liquefied natural gas tanks. The building is designed for blast resistance in the event of a gas spill.

Design and Construction Challenges

The biggest design challenge in the CPSD project was to build a ramp up to the desired 12-ft elevation for deliveries by tractor-trailer trucks. "Another significant challenge was the relatively remote location," says Miller. "The nearest concrete batch plant was over an hour away."

The Cameron LNG building presented even bigger challenges. "The footprint was part of the impoundment basin for the LNG tanks," he says. "The basin exists to contain millions of gallons of LNG in the event of a catastrophic failure of the piping or the tanks themselves." LNG, he adds, is a liquid that is -270°F and boils off upon exposure to the atmosphere to a vapor cloud of pure natural gas.

In addition, the building was part of a much larger, \$10 billion project to convert an existing LNG Import Facility into an Export Facility. Because the original facility was "live"—full of hydrocarbons and in operation—the area was considered a brownfield, says Miller.

Construction took place during an extremely wet year, when Hurricane Harvey dumped 60 in. of rain on some areas in two days, he says. The building site needed to be raised by 6 ft, but the earthwork was significantly delayed by constant rain. At the start of construction, the schedule was already six months behind.

To overcome these issues, AMC devised a method of precasting the entire foundation of the building. "We drove the precast

piles so that they stuck out of the ground by six feet and installed all of the pile caps for the building columns and perimeter grade beams for the walls at that elevation."

Once the piles, caps, and grade beams were installed, the company installed 20,000 yd³ of flowable fill, specifically lean concrete, to bring the entire site up to grade. "This innovation recovered four months [that had been lost from] our schedule," he says. Lean concrete is a mixture in which the amount of cement is lower than the amount of liquid in the strata, which provides a uniform and level surface underneath foundations.

The major logistical challenge for the Cameron LNG building was that no staging area was available. "Every component from the foundation to the roof had to be delivered to the site just in time and directly to the crane hook," says Miller. "This all had to be executed in a live operating hydrocarbon facility." ●



See the Insight column on page 4 to read how a storm chaser survived Hurricane Delta by seeking shelter inside the Cameron Parish School District Warehouses.



PRECAST CONCRETE STANDS UP TO HIGH WINDS

Philip Miller can attest to the resilience of precast concrete because he himself lives in a total-precast concrete home. The president of Alfred Miller Companies in Lake Charles, La., stayed at home with his family throughout a hair-raising onslaught by Hurricane Laura that delivered sustained winds of 155 mph.

"The house was hit by peak intensity of the strongest part of the eye-wall," Miller says. "I watched 10-foot-tall panes of glass deflect 12 inches out of plane and pulse at a rate of about five cycles per second. Obviously, the glass blew out and we all sat and watched 155-mile-per-hour winds blow through the living room."

Other than the broken glass, the home sustained no significant damage. More conventional structures, on the other hand, fared much worse. "An auto-parts [store] built with joist, deck, and CMU [concrete masonry unit] walls had the entire roof torn off. It landed in the parking lot before all the walls collapsed. That store was a half mile from my house."

Precast concrete is resilient because the components are heavy and the connections are very few, but very strong, Miller says. The deadweight helps resist the pulsating winds and avoid sympathetic resonance, which is the susceptibility of a structure to respond to increased amplitude. In other words, if a structure begins to vibrate in a violent manner, it's liable to fail mechanically.

"In a hurricane, weight is your friend," he says.

Lake Charles architect David Brossett designed two food-storage warehouses (see the profile on page 14) in Creole, La., for the Cameron Parish School District. The pre-engineered metal buildings have standing-seam metal roofs and precast concrete walls. "I truly believe in the system and have full faith that it is the best method for building in any hurricane-prone region," says Brossett.