

Levee breaks linked to design flaws

Preliminary reports say New Orleans flooding was likely preventable

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NEW ORLEANS – Within a space of 15 hours on Aug. 29, three massive, concrete floodwalls in separate parts of the city fractured and burst under the weight of surging waters from Hurricane Katrina. The breaches unleashed a wall of water that swept buildings from their foundations and transformed what might have been a routine hurricane into the costliest storm in U.S. history.

Eight weeks after the storm, the three breaches are looking less like acts of God and more like failures of engineering that could have been anticipated and prevented.

Investigators in recent days have assembled evidence implicating design flaws in the failures of two floodwalls near Lake Pontchartrain that collapsed when weakened soils beneath them became saturated and began to slide.

They also have confirmed a little-used navigation canal helped amplify and intensify Katrina's initial surge, contributing to a third floodwall collapse on the east side of town. The walls and navigation canal were built by the U.S. Army Corps of Engineers, the agency responsible for defending the city against hurricane-related flooding.

The preliminary findings, based on physical evidence, corps documents and hydrodynamic models run through a Louisiana State University supercomputer, are the work of three teams of engineers and forensic experts conducting separate probes.

The investigations are shedding light on the cause of the failures and the scale of the rebuilding effort: The discovery of major flaws in the design of the city's levees and floodwalls could add billions of dollars to the cost of New Orleans' recovery.

Investigators have rejected the initial explanation offered by corps officials in the hurricane's aftermath that massive storm surges had overtopped and overwhelmed floodwalls on the 17th Street and London Avenue canals on the north side of town.

Investigators' findings point to a human role in the major floodwall failures that left about 100,000 homes underwater and caused most of Louisiana's approximately 1,000 hurricane deaths.

Experts believe Katrina was no stronger than a Category 3 hurricane when it roared into

New Orleans, and Congress had directed the corps to protect the city from just such a storm. "This was not the Big One, not even close," said Hassan Mashriqui, a storm surge expert at LSU's Hurricane Center. He said Katrina would have caused some modest flooding and wind damage regardless, but human errors turned "a problem into a catastrophe."

The National Science Foundation, the American Society of Civil Engineers and the state of Louisiana are conducting investigations of the floodwall breaches, and Defense Secretary Donald Rumsfeld announced last week the National Academies of Sciences will lead a separate probe. The corps has offered data and other assistance to the independent inquiries, but the agency has declined to speculate on the causes of the disaster.

John Paul Woodley, the assistant Army secretary overseeing the corps, said it's too early to cast blame for the drowning of New Orleans. However, he said the corps intends to learn from the Katrina investigations, and use the lessons to build stronger protections for the city.

"I'm not afraid of finding out the truth," Woodley said.

The independent investigations have pointed to two failures in the infrastructure maintained by the corps that were critical factors in the destruction in New Orleans.

In 1965, the corps completed the 76-mile-long, 36-foot-deep Mississippi River Gulf Outlet, a larger dirt-moving project than the Panama Canal. The outlet, known locally as MRGO, or "Mr. Go", created a navigation shortcut to the Port of New Orleans, but also what amounted to a funnel that would accelerate and enlarge storm surges headed for the city's levees.

Three months before Katrina, Mashriqui told a room full of emergency managers the outlet was a "critical and fundamental flaw" in the corps' hurricane defenses, a "Trojan horse" that could amplify storm surges 20 percent to 40 percent.

With the help of a supercomputer, Mashriqui has concluded the effect was worse than he predicted.

Katrina's aftermath

Three teams are conducting separate investigations of the floodwall breaches in New Orleans. Among the preliminary findings:

- Hurricane Katrina turned a navigation canal built by the U.S. Army Corps of Engineers into a "funnel" that intensified the initial surge, contributing to the collapse of a floodwall.
- Two other floodwalls built by the corps collapsed when soft soils beneath them became saturated and shifted.
- Investigators reject the idea that storm surges overtopped and overwhelmed the floodwalls. Instead, they say engineering flaws turned "a problem into a catastrophe."

The analysis shows the outlet's "funnel" intensified the initial surge by 20 percent, raising the wall of water about three feet. It also increased the velocity of the surge, which Mashriqui believes contributed to the scouring that undermined the levees and floodwalls along the outlet and Industrial Canal. He found Katrina's surge moved through nearby Lake Borgne at less than 3 feet per second. But the rate was about 6 feet per second at the mouth of the funnel, and as much as 8 feet per second in the funnel.

Mashriqui also found that in the areas where the outlet had wiped out marshes and other wetlands, levees and floodwalls were much more likely to fail. In areas where the natural buffers remained, the man-made defenses held, even when overtopped.

"Without MRGO, the flooding would have been much less," he said. "The levees might have overtopped, but they wouldn't have been washed away."

Corps officials declined to comment on the results of the modeling. Corps spokesman Jason Fanselau said the agency's data point to a massive surge that exceeded the height of the Industrial Canal floodwall by more than a few feet.

"Katrina flat-out overwhelmed the system," he said. "There was a huge wall of surge that obliterated entire sections of the floodwall."

In the case of the 17th Street and London Avenue canals, the independent investigators believe the floodwalls were the problem. The reason was the naturally soft soil was made of river silts and swampy peat that has been the bane of builders here for two centuries.

Investigators believe the walls collapsed when soft soils beneath them became saturated and began to shift under the weight of relatively modest surges from the lake. Newly released documents show the corps was aware years ago a particularly unstable layer of soil lay beneath both floodwalls.

"These levees did not overtop, yet they failed anyway," said Peter Nicholson, an engineering professor at the University of Hawaii at Manoa and leader of the ASCE investigating team. "It's important that we find out now exactly what went wrong, because the corps is already starting to rebuild."

A proposal for rebuilding the floodwalls has set far tougher standards than existed 15 years ago.

"Nothing beats a full-scale field test, and this was a full-scale field test," said Gordon Boutwell, president of Soil Testing Engineers and a member of the ASCE investigative team. "Some structures did the job they were supposed to, but some were total failures, and those you can't just leave alone. And you can't expect to just stack them higher and walk away."