

Gravity played role in New Orleans' bridge failures



Sir Isaac Newton did a number on the Interstate 10 bridges in New Orleans, according to a team of researchers at the University of Missouri-Rolla that helped document some of the damage caused by Hurricane Katrina.

The team believes Newton's theory of gravity can explain why the 65-foot concrete slabs dropped off their supports into Lake Pontchartrain.

"The bridge's design created structures in the shape of an upside-down rice bowl in each span, with the opening faced downward to the water," explains Dr. Genda Chen, associate professor civil, architectural and environmental engineering at UMR. "Our preliminary analysis shows that the main culprit for the collapse or displacement of spans is the significant reduction of effective gravity loads. Air was trapped underneath the bridge decks in these 'rice bowls,' allowing the bridge decks to partially float and tilt."

The reduced gravity load weakened the ability of the bridge spans to resist the water current.

"The main span over the navigation channel is a much taller structure than the approach spans; it experienced no damage during Hurricane Katrina," Chen says. "All the approach spans experiencing excessive horizontal displacements were moved toward the ocean, which indicates that the displacement was caused by the storm surge and wave-structure interaction rather than the wind gusts associated with the hurricane."

After the water level was lowered or air escaped from underneath the bridge decks, the bridge structures landed again on piers -- but at wrong positions -- or dropped off their supports altogether.

The rice bowl theory helps explain why Highway 11 and railroad bridges -- located near the twin bridges -- suffered minor or virtually no damage, Chen says.

"The Highway 11 bridge consists of shorter spans and shallower girders, reducing the volume of air that could be trapped underneath," Chen explains. "The railroad bridge is a solid deck structure, which means no air can be trapped underneath the bridge."

The U.S. Geological Survey (USGS) in Rolla sponsored the team's trip to New Orleans and provided researchers with satellite imagery, and various forms of mapping information and scientific assessments of the damaged areas.

The team is preparing its final report and intends to share its findings on the Internet by early next spring, using a tool developed by the USGS and the Department of Defense.

Source: University of Missouri-Rolla

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