

Gone With The Wind

By Paula Ouder





John Holmes shows the wooden forms he used to study windborne debris near the large fan that drives the wind tunnel in his experiments. Photo by Paula Ouder.

Q. What do a high-tech airplane and a two-by-four have in common?

A. Under the right circumstances, both will fly.

Both also have captured the attention of John Holmes, operator of JDH Consulting in Australia, who conducted research at LSU's Hurricane Center and held the John P. Laborde Endowed Chair for Sea Grant Research and Technology Transfer.

In an average hurricane season, the United States sustains more than \$5 billion in property damage. Frequently, lives are lost as well.

In less-developed countries that lack strict building codes and effective evacuation plans, the toll in human lives and misery is many times greater. Though the 2004 hurricane season was extraordinarily active and destructive, Hurricane Andrew remains the single costliest natural disaster in U.S. history. In 1992, the Category 5 storm hit Florida, weakened to a Category 3, and made landfall again in Louisiana. According to the National Oceanic and Atmospheric Administration, the storm killed 61 people, damaged or destroyed more than 125,000 homes and caused about \$27 billion in insured and uninsured losses in the United States alone.

Holmes is studying the dynamics of windborne debris in order to reduce the potential for devastating statistics like these in the future.

Holmes' engineering career began in Melbourne, Australia, where he located after graduating from the University of Southampton in his native United Kingdom. As a scientific officer,

ILLUSTRATION BY ROBERT RAY

he worked in aircraft design for an aeronautical research laboratory, and after two years, went to work in Melbourne's government aircraft factories.

When Holmes decided to pursue a graduate degree, his attention was turned from the glitzy, futuristic world of aircraft design to a more down-to-earth aspect of wind engineering – wind effects on buildings. Later, he became interested in the effects of windborne debris.

"To be honest, I was a bit reluctant to go into the field," Holmes said. "I was more or less forced by the Monash University (Australia) department chair. I was more interested in high-tech aircraft. However, it's quite often these areas that appear to be less high-tech that turn out to be the most interesting."

Holmes said the field of wind engineering is still relatively young, and there is much left to discover. However humble working with windborne debris may appear, Holmes' work is technically sophisticated and may prove useful in preventing damage to structures and saving lives around the world.

"People want to deal with bigger things like bridges and towers rather than a piece of debris," he continued. "Debris does as much or more damage during hurricanes than wind. People have been aware of that, but haven't seen the need to research it. I decided to pursue windborne debris because it seemed something needed to be done."

It's a long way from Melbourne to Baton Rouge, but that hasn't stopped Holmes from bridging the gap and lending his expertise to LSU. His most recent appointment isn't his first experience in the Bayou State – he first taught a wind loading and response course for civil and environmental engineering students at LSU in 2001.

That experience brought Holmes' capabilities to the attention of Marc Levitan, director of the LSU Hurricane Center. Levitan encouraged Holmes to apply for the John P. Laborde Endowed Chair for Sea Grant Research and Technology Transfer.

The Laborde Endowed Chair was established in 1994 by Tidewater Inc.

of New Orleans with a gift of \$600,000 to the LSU Foundation in honor of the company's retiring chairman, CEO and president. Matching funds of \$400,000 from the Louisiana Board of Regents brought the total endowment to \$1 million. Income from the endowment supports chair appointments in the Office of Sea Grant Development that bring experts with exceptional abilities to LSU for temporary assignments to advance the sustainable use of Louisiana's coastal and marine resources and environments. Holmes is the first engineer to be awarded the chair.

"John is internationally renowned in his field," Levitan said. "He has worked in so many areas related to wind engineering – research, academia and consulting. He is a former Fulbright scholar who has traveled the world and collaborated with many institutions around the globe.

"He worked on the roofs of the 2000 Olympics' stadiums in Australia and other major buildings and skyscrapers, as well as long-span bridges. He is a leader in international codification on wind loads on structures. John is working to develop an international building code, and his book on wind engineering is one of the best selling and most enduring. He's well known and respected in the field, with a tremendous publication record."

At the Hurricane Center, Holmes used wind tunnels and computer modeling to understand how debris will behave under hurricane-force winds. He tested three representative geometric figures – compact forms (cubes and spheres), flat forms (plates and sheets), and rods. To conduct these tests, three-dimensional wooden models of each shape were mounted on a stationary bar inside the wind tunnel and attached to six load cells. These cells measured forces on each object when it was exposed to wind and sent readings to a computer. From these readings, Holmes created computer models to predict how each shape will travel in a hurricane. In a real storm, compact forms translate into debris like roof gravel; flat forms represent shingles and roof cladding; and rods represent two-by-four wood studs or rafters.

Holmes says he has learned quite a bit about how things move from his wind tunnel work.

"I'm looking at the aerodynamics and mechanics of the debris. Cubes and spheres plop. Plates roll and tumble," he explained. "It's important to know how a piece of debris is likely to behave in order to construct buildings that can withstand impacts from the things that might strike it in a storm.

"A hurricane is not likely to sweep debris from the ground into the air. Most of the flying debris in a hurricane would come from an elevation like a roof. In tornadoes it can be picked up from the ground. People think things can be picked up off the ground in hurricanes, but I don't think that happens. They roll on the ground instead."

In August, Holmes got a close-up view of the damage a hurricane can inflict when he and Levitan traveled to Florida after Hurricane Charley. The purpose of their trip was to survey designated disaster shelters to see how well they stood up against the



storm's Category 4 winds and the debris they hurled. The researchers did "lots of driving around" in Punta Gorda, Port Charlotte and Arcadia, as well as Hardee County. While numerous structures were damaged, Holmes said most of the storm shelters he saw performed well.

"It shows that you can design buildings to withstand hurricane-force winds," Holmes said of the disaster shelters and the surviving homes he examined.

In addition to nearly 100 photographs of everything from damaged gas stations to

destroyed houses, Holmes brought back a few pieces of debris to see if he can use his computer models with field data on the trajectory and weight of the debris to back-calculate Charley's wind speed in certain areas.

"However, we don't learn as much from observing damage as we do from computer models and the wind tunnel," he said.

At the time, Holmes could not have predicted that he would make yet another trip to Florida that same hurricane season to examine the effects of a second powerful storm. Only a month later, he traveled with Elizabeth English, associate professor at the LSU Hurricane Center, to study the effects of Hurricane Ivan.

English has worked with Holmes on his current project studying plates. She has conducted damage assessments, and sees great value and potential in Holmes' research.



A gas station lost its roof during Hurricane Charley.

"John has a real skill for numerical modeling," she said. "This is a good project for him. He has enormous experience in wind tunnel testing and impressive abilities at numerical modeling. For those of us living in Louisiana, it's a particularly relevant topic and a significant local issue.

It's rewarding to be engaged in activities that benefit the community.

"John is a very important player in the wind engineering community. It's an honor to be able to work with him on a project like this. He is a feather in LSU's cap."



Manufactured housing cannot withstand Category 4 winds like those of Hurricane Charley. Photos courtesy of John Holmes.



John Holmes examines debris that impacted a building in Florida during Hurricane Charley. Photos courtesy John Holmes.



Due to the demands of running his own business, Holmes' 12-month appointment to the Laborde chair was spread over two years. After spending the summer at home in Melbourne, Holmes returned to LSU in fall 2004 to conduct more research on a different shape of debris – two-by-fours.

The information he gathered will be used to test wall materials for buildings, storm shelters and safe rooms.

In addition to his research and teaching responsibilities at LSU, Holmes found time to enjoy Louisiana food, music and culture. He said he enjoyed the academic culture and his students as well. Holmes said he is grateful for the opportunity to do research, and his experiences here were overwhelmingly positive.

“Louisiana Sea Grant has a lot of nice people, and they have been very supportive of me,” he said. “I was funded to do research, which I enjoy. When I’m in Australia, I’m working for clients and I’m consulting. I’ve got to give them what they want. I would never have a chance to do this sort of research in Australia because the funding opportunities just aren’t there now.”

ON THE WEB

Federal Emergency Management Agency
<http://www.fema.gov>

FEMA for Kids: Hurricanes
<http://www.fema.gov/kids/hurr.htm>

Hurricanes: How They Impact Louisiana's Environment
<http://www.leeric.lsu.edu/le/cover/lead075.htm>

JDH Consulting
www.users.bigpond.net.au/jdholmes

LSU Hurricane Center
<http://hurricane.lsu.edu/>

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