New lab to simulate 200 mph hurricanes in quest to make storm-resistant homes

To prepare for extreme weather, Florida International University plans to simulate some of the world's most catastrophic storms.

Two model homes inside Florida International University's "Wall of Wind" facility—one with an upgraded roof and one without—will face hurricane force winds. After Hurricane Andrew struck Florida in 1992, local building codes were updated to fortify homes again hurricanes.

PHOTOGRAPH COURTESY NSF-NHERI WALL OF WIND, FIU

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When Florida International University turns on the “Wall of Wind” inside its airplane hangar turned engineering lab, the 12 enormous fans recreate the strength of a major hurricane. Within seconds, the walls and roof of their target, a shed-sized model of a home, can be torn away and flung into a net-covered field.

Winds blowing at 140 mph tear the walls and roof of a model home from its makeshift foundation, flinging debris into a field.

NSF-NHERI WALL OF WIND, FLORIDA INTERNATIONAL UNIVERSITY, MIAMI, FLORIDA.

That test, and others, tell the engineers at the university's Extreme Events Institute how to design and build structures that will withstand the 157 mile-per-hour winds that come with a top-rated Category 5 storm. But now, as climate change threatens to make storms worse, scientists are planning to build a new hurricane lab to test what some unofficially call a Cat 6.

"I want to be seeing research and testing in the 170-, 190-mph range. A lot of the research is at lower wind speeds, but I need to be changing to extreme wind speeds because that's where nature is going," says Richard Olson, the institute's director. "Who wants to be explaining in 20 years, 'Ya—I knew this was coming but we didn't do anything about it.'"

Two recent storms make his point: Hurricane Patricia struck Mexico in 2015 after reaching 215 mph winds, and Hurricane Dorian crashed into the Bahamas in 2019 with 185 mph winds.

Using a $12.8-million grant from the National Science Foundation (NSF), the university plans to design a lab where powerful 200-mph winds can be tested, and add equipment that can inundate life-size model homes with 20-foot storm surges.

"We'll have a facility that can simulate that range. It's going to give the U.S. and the world a new capability," says Arindam Gan Chowdhury, a civil engineer at FIU and the lead researcher on the project.

A single fan at the testing facility is 15,000 pounds. It takes 12 to generate Category 5 hurricane wind speeds.
PHOTOGRAPH COURTESY NSF-NHERI WALL OF WIND, FIU

Better testing could save more homes

This year, forecasters are predicting an above-average hurricane season for the third year in a row. Just a day after the official June 1 start of the season, south Florida was inundated by over a foot of rain from what would eventually strengthen into Tropical Storm Alex. Last year's hurricane season was the third most active on record, following 2020, the most active.

The science behind how climate change will affect hurricanes is increasingly clear. A report released in August by the Intergovernmental

Panel on Climate Change (IPCC) found that warming temperatures will make hurricanes slower, rainier, and more likely to rapidly intensify, when a storm increases wind speeds by 35 mph in just 24 hours.

On the Saffir-Simpson scale, Category 5, the highest, does not have an upper limit. Scientists disagree about creating a Category 6; some think another classification could overly focus attention on wind, when 90 percent of the hurricane deaths in the United States result from storm surges and flooding, which threaten some 24 million people.

FIU's Wall of Wind lab, built in 2012, was in response to Hurricane Andrew, the catastrophic Category 5 that slammed into south Florida in 1992 and caused $25 billion of damage. Recovery was long and painful; Florida's hurricane building codes, upgraded after Andrew, remain the nation's strictest today, according to the Insurance Institute for Business and Home Safety.

Since then, FIU's engineers have continued to advance the science of protecting structures. They've learned how small retrofits can help harden homes against ferocious winds. Indented ring shank nails, for example, hold stronger than smooth nails; four-sided roofs are most likely to stay on; and metal hurricane straps help keep roofs attached to walls.

The facility is the largest of its kind in the U.S. that can test top Category 5 winds. To generate such speeds, it requires fans six feet across and 15,000 pounds each, the weight of two trucks.

Even blowing at just 60 mph, the roar of the fans is so loud, conversations have to be shouted. During a May test funded by the Florida Division of Emergency Management, engineers set up a two-foot plastic model of a mobile home in front of the fans to investigate where wind exerts the most pressure on manufactured homes. Wind blew across a floor covered in metal flaps and blocks that simulate buildings and trees and create turbulence. As the model rotated on a disk in the middle of the room, a tangle of black wires inside measured how much pressure was exerted onto the walls, roof, and corners.

From a trailer just outside the facility's entrance, lab manager Walter Conklin ran the experiment over a live feed. "When we're at 157 mph, everything shakes [in the trailer]. You feel it," he said. To produce 200 mph in the new facility, he says they'll need twice as much electricity.

For now, the new FIU facility is going by NICHE, mercifully short for National Full-Scale Testing Infrastructure for Community Hardening in Extreme Wind, Surge, and Wave Events. It will be 40 feet tall, Chowdhury says, twice the height of the Wall of Wind's home, to test two-story buildings.

"We will know what survives and what doesn't survive," says Chowdhury. "Think about being in the year 2050, and this facility's testing has told us that 'at 200 mph these kinds of structures can stand up to those winds, but these cannot,' and a storm forecast is even close to that level of wind, then we will know what works."

Eight other universities and one private company are collaborating with FIU on the prototype. NICHE will combine in-person observations at disaster sites, computer simulations, and experiments like those at FIU to improve understanding of how to design buildings.

"Having a facility like FIU's that can test a full-scale structure and how it withstands water and wind—that can save lives," says David Merrick, director of the Emergency Management and Homeland Security Program at Florida State University in Tallahassee.

It will also likely redefine the standards for how to build hurricane-proof homes.

(Learn more about how scientists predict storm surge.)

Stronger homes for stronger storms

“At some point, there will be a stronger need for innovation and radical change in the way we build,” says FIU civil engineer Ioannis Zisis, via email.

“Radical,” he acknowledges, sounds extreme but doesn’t mean everyone in south Florida will need to build a bunker. He describes walls reinforced with concrete, concrete roofs, and coverings that protect windows from flying debris.

But turning that science into on-the-ground home improvement will be another challenge, says Tracy Kijewski-Correa, a structural engineer at Notre Dame University and NICHE co-lead researcher.

Even with the threat of storms like Hurricanes Patricia and Dorian, hundreds of thousands of people have moved to hurricane zones along the East and Gulf coasts in the past decade. Florida in particular has seen a recent boom in population growth, according to U.S. Census data.

In a study published in 2019, Kijewski-Correa found that even those coastal residents who consider climate change a growing threat are unlikely to think their home would be destroyed by a storm.

Kijewski-Correa wants to see hurricane prone communities move faster to update their houses, adopting market-based measures like tax incentives to encourage residents to make life-saving improvements to their homes.

At best, she says, building codes help individuals survive storms but homes still face costly, structural damage. Implementing better upgrades can help save lives and livelihoods.

“If we don’t want these losses in a changing climate, we have to stop settling for survival,” she says.