Manmade 'wall of wind' used to test construction

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Each year, hurricanes cause tremendous destruction across the globe. A team of NSF-funded scientists at Southern Methodist University's (SMU) Intelligent Data Analysis Lab (IDA) has developed a new forecasting algorithm called the Prediction Intensity Interval model for Hurricanes (PIIH), to help better predict hurricane intensity. Credit: Kenzie Schott, Southern Methodist University

A Category 5 hurricane is a monster of a storm that most people would

want to avoid. But, civil engineer Arindam Chowdhury actually recreates those monster hurricane force winds in hopes of helping people better prepare for the real thing.

With support from the National Science Foundation (NSF), Chowdhury and his team at Florida International University (FIU) and the International Hurricane Research Center designed a 15-foot-tall "Wall of Wind," aptly nicknamed WOW. The wall is made up of 12 giant fans, which can create the intensity of a Category 5 hurricane with 157-mph winds if the fans are running at full blast.

The goal is to see if low rise structures and building materials can withstand the same wind forces the structures and materials would face in a full-blown hurricane. "Based on our testing of rooftop equipment, such as AC units on building roofs, we made recommendations that are now in the Florida Building Code," says Chowdhury.

"Our long-term goal is to prevent hazardous wind from becoming a disaster," says Kishor Mehta, program director for hazard mitigation and structural engineering within NSF's Engineering Directorate. "This facility enables engineers to collect precise measurements of wind interacting with buildings, in addition to the visible evidence of the vulnerability of building materials exposed to hurricane force winds. This combination of basic research and visual evidence will lead to safer, more cost effective construction."

Manufacturers come to FIU to put some of their products to the test. During one test, researchers attach a solar panel manufactured by Power Panel Inc. to the roof of a small building. The building is secured on a rotating turntable directly in front of WOW. The turntable allows researchers to rotate the structure and expose the solar panel to wind from all directions.

In a nearby trailer, researchers huddle around computers at an informal control center. With the click of a mouse, they crank up the fans to create a fake hurricane. "I'm going to go up to 60 mph," says the researcher who is at the controls. He uses a walkie talkie to warn his team members who are outside preparing the building and the solar panel. Hearing that, they move out of the way as the fans start to blow.

Rob Kornahrens, part owner of Power Panel Inc., sits in the control room glued to a monitor as the test gets underway. Fan speed is increased to 90 mph. "We want to make sure the glass insert stays within the frame," says Kornahrens. "Second thing we're looking for is that the whole unit stays on the racking itself. Third thing is the attachment of the racking to the building. We want to make sure that doesn't come off the structure."

So far, so good, and the fans are now blowing at 120 mph. The building is swaying. The solar panel is staying on the roof. Sensors on the building measure the pressures on the panels. Satisfied with this first round, Kornahrens asks: "Can we flip it around?" Researchers shut off the fans and rotate the turntable to expose another side of the panel to head winds.

"Now we can see the effect of the wind and get the data from all the directions," explains Chowdhury.

"I don't think we'll see any damage to the panel based on what I saw," says Kornahrens. He is pleased with the results and with the test itself. "This is great. You can't get this in any other kind of test!"

Next up, testing roof tiles and a new adhesive tile foam. "That foam really works with this good tile," says Manny Oyola with Eagle Roofing Products. He is with his supplier Riku Ylipelkonen of 3M, the company that manufactures polyfoam roof tile adhesive. They, along with another

roofing company owner, Tim Graboski, stand in the control room and watch WOW's forces on the roof tiles and foam.

The fans start to whirl, blowing 90, then 120, and finally 140 mph. The tiles and foam stay firmly on the roof and they pass with flying colors. But, does the building itself? Not so much. The entire structure lets loose from its foundation and flies off the turntable crashing in a nearby field. "It's a powerful machine," Chowdhury smiles, "even more powerful than I thought." On a serious note, Chowdhury says such foundation failures are rare.

Lessons learned on building materials and structures tested at WOW could help improve design and even save lives.

"The thing we feel good about is that 2012 is the 20th anniversary of Hurricane Andrew, the Category 5 hurricane that devastated south Florida, including Homestead," adds Chowdhury. "Today, we can simulate the hurricane strength of Andrew, learn from the tests and make changes to mitigate damages." Now, that's a WOW!

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