New Tests Coming for Roof Coverings

Giant simulator will better show how roofs hold up in storms

Today's most powerful hurricane simulators allow wind engineers to put an entire installed window or soffit assembly to the test against hurricane-force wind and wind-driven rain. But a simulator in the planning stages may dwarf today's models.

The Tampa-based Institute of Business and Home Safety (IBHS), an insurance-industry-funded building safety group, is in the final stages of negotiations on a site for a $25 million, 30,000-horsepower machine that can power winds at 140 miles per hour through a wind tunnel large enough to hold a full-scale, two-story, 2,200-square-foot house. That's far larger and more powerful than current simulators, which are powered by motors whose horsepower is measured in the thousands rather than tens of thousands.

Current simulators, like this one at the University of Florida (above), can only test individual building assemblies. By contrast, IBHS's planned simulator (left) will be big enough to hold an entire house.

Tim Reinhold, vice president for engineering at IBHS, says wind engineers need the super simulator — which he hopes will be operational before the start of the 2010 hurricane season — to test full-scale roofs and homes rather than single building components or isolated assemblies. According to Reinhold, for many types of structural connections as well as for roof shingles or tiles, testing a scaled-down version of the assembly gives misleading results. One reason is that small-scale assemblies always end up stiffer than those on real homes.

The IBHS's initial goal with the simulator will be to learn more about how to make roof coverings better able to survive hurricanes.

Today's roofs are already much better than those installed a decade or two ago. In the 16 years since Hurricane Andrew, wind engineers have learned better ways to fasten roof framing and sheathing. Now, those engineers have turned to newly built homes' last major vulnerability: wind-driven rain, which finds its way inside after roof tiles or shingles have been damaged.

"Water intrusion is where we still have the big issues," Reinhold says.

Damage surveys done in Florida by University of Florida engineers and other groups following Hurricanes Charley, Frances, and Jeanne in 2004 revealed a pattern: Homes built to the state's then-most-recent 2002 building code experienced less damage than homes built under earlier codes. But the surveys also revealed that even in the newest homes, rain sometimes poured through roofs with damaged coverings, crept through roof vents or soffits, or seeped through window frames. In the worst cases, enough water found its way in to soak walls, collapse ceilings, and ruin furnishings, causing tens of thousands of dollars in damage.

In the four years since the '04 storms, researchers have identified some causes and devised some solutions — though they indicate others may be years away.

NEW SOFFIT REQUIREMENTS

One success story generated by this research has to do with soffits. Before Hurricane Charley, says Reinhold, "nobody was paying attention to soffits." That changed quickly after surveys found that Charley's winds damaged or blew out soffits in 75% of homes with claims. Soffit failure also occurred in later hurricanes in other states, including Katrina.

Research revealed problems with common installation techniques. For example, soffits were often stapled to vinyl J-channel rather than screwed to a wood backing.

As a result, Florida Building Commission officials agreed to require that soffits be built to withstand the same wind pressures as adjacent walls. The change made it into the 2007 version of the Florida Building Code, and other states are likely to follow. Reinhold says an American Society of Civil Engineers wind subcommittee has recommended the same upgrade for the 2010 update of ASCE 7: Minimum Design Loads for Buildings and Other Structures. That's the document all model codes reference for their live load requirements, including loads imposed by snow, seismic activity, and wind.

NEXT UP: ROOF COVERINGS

A bigger challenge for researchers is roof coverings. Roughly 95% of all homes that reported damage from Hurricanes Charley, Frances, and Jeanne experienced loss of either shingles or tile, Reinhold says. At Category 2 hurricane wind speeds of 90–110 miles per hour, older roofs were much more likely to suffer damage ("there was a big jump in damage for shingles over 10 years old," says Reinhold), but when winds began to approach 130 miles per hour, newer shingles were almost as likely to blow off as old ones. And Reinhold notes that there are no data yet on how the newer shingles will fare after several years on the roof.

In other words, he says, even the best shingle doesn't eliminate the need for a good underlayment that will repel water if the roof cover gets damaged.

> For many types of structural connections as well as for roof shingles or tiles, testing a scaled-down version of the assembly gives misleading results. The new machine will be able to blow winds of 140 miles per hour through a wind tunnel large enough to hold a 2,200-square-foot house.

Even a partial underlayment system could make a huge difference. A Louisiana State University analysis shortly after Hurricane Katrina found that simply sealing the joints between sheets of roof decking could have prevented over $1 billion in water damage. But the goal, says Reinhold, should be to have a permanent backup system in place, one that repels water for long enough to prevent major interior damage until crews can replace shingles or tiles.

Florida lawmakers responded last year by voting to require secondary water protection on reroofing of existing buildings, sparking a controversy about whether traditional felt is sufficient or should be replaced with more advanced and expensive synthetic water-repelling membranes or peel-and-stick membranes, Reinhold says. A compromise appears to be taking shape that will allow 30-pound felt attached to decking in a tightly nailed pattern using cap fasteners rather than staples.

CURRENT TEST METHODS FALL SHORT

In the longer term, researchers hope to address big gaps in knowledge about the performance of shingles and tiles. For example, Reinhold says that current tests do not realistically mimic the wind forces bearing down on the corners or edges of shingles or tiles — both common failure locations. Those locations experience "a rapidly varying pressure fluctuation, and no one has looked at that aspect," Reinhold says.

Moreover, no current tests account for the effects of age, he says. After the '04 storms, substantially more homes with decade-old or older shingle roofs required reroofing jobs, he says. But tests now focus exclusively on virgin shingles, unexposed to the elements. New shingles are designed to be more storm-worthy, but, says Reinhold, the question is how long they will stay that way.

The new IBHS simulator may answer that question. Depending on how much funding IBHS can raise from insurers, says Reinhold, the institute would like to build several test homes that can be placed into the simulator every year or so to see how their materials hold up over time.

Reinhold explains, "We would like to have a whole cul-de-sac where we roll these houses out and let them age, and then go and test them again." — *Aaron Hoover*