Keeping the Roof On

It's impossible to prevent all the damage caused by a hurricane's wind, rain, and storm surge, but a new idea based on math may prevent some of the wind damage done to homes. Ingeniously designed sheets connected to a roof and anchored to the ground before a storm allow some of a severe storm's wind to pass through and redirect the force so that it pushes down on the roof and counterbalances the forces pushing up. The greater the wind, the greater the downward force. The sheets were created using clever engineering combined with mathematical models built on differential equations, vector analysis, and trigonometry. In a test of prototypes during a hurricane with 110 mph winds, the roof where the sheets were installed held firm while houses next door lost portions of their roofs or entire additions.

Traditional attempts to maintain a roof's structural integrity, e.g. ropes or straps, are static—unable to adjust as wind speed increases. Those devices often fail during a storm when strong winds induce uplift and a roof acts like an airplane wing. Because the sheets are semi-permeable, they take a computable fraction of the wind load. The connected straps get tightened, redistribute that load to the roof, and counteract the uplift. In addition to being effective, the sheets are fairly inexpensive—costing much less than a roof—and easy to install—taking 2–3 hours to install several sheets.

For More Information: :
"Elastic model for a wind-protection membrane," Martin J. Körber and Stefan Siegmund, *Journal of Wind Engineering and Industrial Aerodynamics,* Vol. 165 (2017), pp. 131–136.
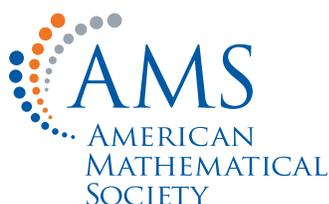

Main image: Hurricane Harvey damage, © William Luther/San Antonio Express-News via ZUMA Wire. Inset: Illustration of home with wind-protection membranes, S. Siegmund & M. Eggers.

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