STANDING STRONG

ENGINEER ADVOCATES HOME DESIGNS THAT PROTECT AGAINST WIND AND WATER

Last fall, as remnants of Hurricane Noel barreled north toward New York and New England with winds approaching 80 miles per hour, NJIT faculty member Rima Taher sat riveted to her television screen. As Noel brutalized homes and terrain, she witnessed the vast damage that can be caused by storms packing less than the punch of a full-blown hurricane. A civil engineer who researches, writes and teaches about the best ways for anyone — especially architects — to contend with nature's most destructive elements, she did not take the drama lightly.

WICKED WEATHER

"All I could think was 'Watch out!'," says Taher, a university lecturer at New Jersey School of Architecture (NJSOA). "Hurricanes and gale force storms can be wicked, no matter where someone lives, and it's a good idea for everyone to respect them. Just because you live in the Northeast and not on the Gulf of Mexico, don't think you are safe. Nor'easter storms can be wicked too. They can strike North Atlantic coasts with near-hurricane winds, threatening lives and property as horrifically as storms in Gulf waters." Further, as Taher cautions, many experts project that climate change will spawn increasingly severe storms in all parts of the world.

Taher drives home such lessons daily at NJSOA as she teaches future architects what they must know to pass licensing examinations and build better, stronger homes. The author of a new book about structural systems focused on helping architects prepare for licensing exams, Taher adds her expertise to that of other NJIT faculty and alumni who are working to keep people safe when storms and other natural disasters strike. (See sidebar, "Safer Schools, Faster Evacuation.")

"Design of Low-Rise Buildings for Extreme Wind Events" by Taher, published in the March 2007 *Journal of Architectural Engineering*, highlights recent findings in this area. As Taher reports, investigators at the Center for Building Science and Technology (CSTB) in Nantes, France, performed extensive wind research and tested reduced-scale home models at their sophisticated wind-tunnel facility. The CSTB researchers ultimately developed a "cyclonic" or hurricane-resistant dwelling design. Taher participated in this research and worked on the structural aspect of the cyclonic design to improve resistance to wind pressures as well the forces from flood-driven waters that often accompany hurricanes.

Rima Taher

PHOTO: KAI CHAN

Taher's journal paper details structural guidelines and recommendations for the design and construction of hurricane-resistant homes based on the CSTB findings and other research. Related reports are also available at the NJSOA library.

Testing wind effects on structures using wind tunnels originated in the early 1960s, with the Boundary Layer Wind Tunnel Laboratory at the University of Western Ontario, Canada, being a pioneer. Taher also cites related research conducted by other organizations, such as: the Wind Engineering Research Center at Texas Tech University, the Wind Engineering Research Center of Tokyo Polytechnic University, the Wind Engineering and Fluid Laboratory at Colorado State University, the Natural Hazards Modeling Laboratory at the University of Notre Dame, and the Wind Simulation and Testing Laboratory at Iowa State University.

SAFER SCHOOLS, FASTER EVACUATION

Three NJSOA-educated architects formed the core of a Jacobs Engineering Group Inc. design team that won Honorable Mention in the 2008 Millennium School International Design Competition, based in the Philippines. The team, which placed fourth in the competition, included Brian D. B. Novello, a third-year student and intern at Jacobs' office in Morristown, New Jersey, Muhammad H. Hussain '02 , an architectural designer based in the company's Houston office, and Benjamin P. Bakas '03, an architectural designer in the Morristown office. The goal of the competition is to spur the design of disaster-resistant schools for developing countries that are prone to hurricanes, typhoons, floods, earthquakes and other natural disasters.

At NJIT, transportation researchers have developed an evacuation plan for Cape May County, New Jersey, in the event of a major hurricane threat. The study determined how much time would be required to evacuate the county, as well as the effectiveness of the existing lane-reversal plan on New Jersey's 47/347 highway corridor. The researchers proposed improved traffic evacuation plans, based on results which indicate that extending the current lane-reversal plan further south could dramatically reduce the time required to evacuate the county.

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TAKING ARCHITECTURAL ACTION

Taher received a doctorate of civil engineering in building science and technology with honors in 1986 from the Ecole Nationale des Ponts et Chaussées, as well as a master's in the same discipline. She has a bachelor's in civil engineering and urban planning from the Institut National des Sciences Appliquées de Lyon. Closer to home, NJIT students regard the trail-blazing engineer as one of the best. In 1999 she received NJIT's Teaching Excellence Award in the category of Instruction by a Special Lecturer.

Another special forte for Taher is helping to educate the public. For example, in response to NJIT publicity about her expertise, U.S. Senator Robert Menendez sought her participation at a flooding conference organized by his office in August 2007. The aim of the conference was to help find solutions to flooding problems in New Jersey, the state's number-one natural hazard.

"Certain home configurations and roof types can make a big difference," Taher says in succinctly summarizing the wealth of research efforts. "Most people don't realize this, but design and construction practices could be modified, and certain aerodynamic features could be incorporated into residential and commercial construction relatively easily and economically. It is critical for people in storm-prone regions to know that there are better design practices and construction methods as well as materials that can significantly reduce wind forces and, consequently, damage from extreme wind events." (See sidebar, "Top Storm Design Tips.")

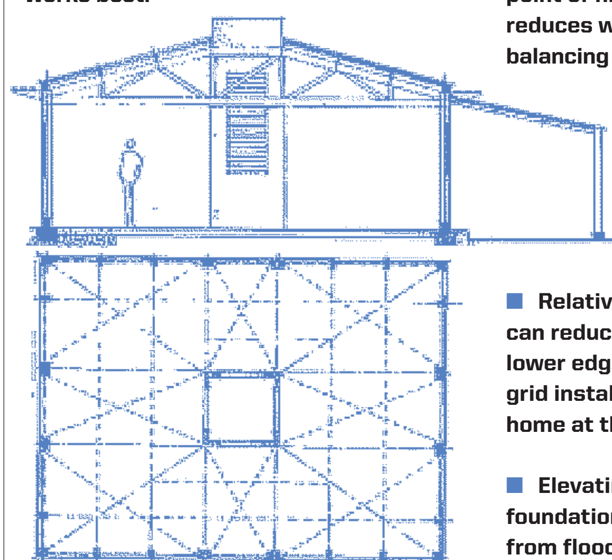
Taher looks forward to helping to translate these concepts into structural reality. She invites builders and developers interested in prototype construction to contact her at NJIT, and to learn more about how they can promote building designs that provide greater shelter from the forces of nature. ■

Author: Sheryl Weinstein is public relations director at NJIT.

TOP STORM DESIGN TIPS

Following are examples of design features that can significantly increase storm resistance:

- **A square floor plan – or better, a hexagonal or octagonal plan – with a roof that has four or more panels (hip roof). A hip roof with four slopes performs better under wind forces than a gable roof with two slopes. Research and testing show that a roof slope of about 30 degrees works best.**



Storm-resistant "cyclonic" home design

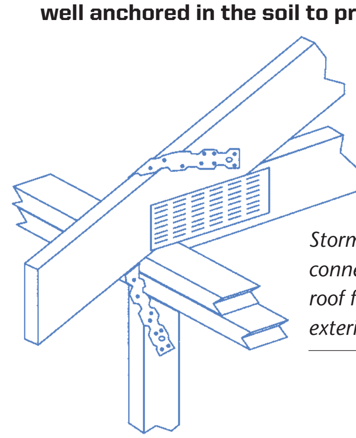
- **Special attention to all connections, not just between roof and walls. Wind forces on a roof tend to be uplift forces, which is why roofs are often blown off during an extreme wind event. Connections between the structure and its foundation as well as between walls must be strong. Complete structural failure is often a progressive process, with the failure of one structural element triggering the failure of another, and leading to a total collapse.**

- **Aerodynamic features to counter the higher wind pressures that typically affect areas on a building such as the roof ridge, corners and eaves. For example, a central shaft connecting the structure's internal space and the roof ridge, which is the point of highest depression, significantly reduces wind pressures on the roof by balancing internal and external pressures.**

- **Limiting roof overhangs to counter wind uplift forces that could trigger a roof failure. Roof overhangs should be limited to about 20 to 25 inches.**

- **Relatively inexpensive features that can reduce wind stresses at the roof's lower edges, such as a notched frieze or grid installed around the perimeter of the home at the level of the roof gutters.**

- **Elevating the structure on an open foundation to reduce the risk of damage from flooding and storm-driven water. For best results, piles must be braced and well anchored in the soil to prevent scour.**



Storm-resistant connection for roof framing and exterior wall

ILLUSTRATION: COURTESY OF FEMA