

LARRY TANNER, A RESEARCHER WITH THE WIND SCIENCE AND ENGINEERING RESEARCH CENTER, OPERATES THE "TORNADO CANNON," OR A HIGH-POWERED DEBRIS LAUNCHER, TO TEST VARIOUS BUILDING MATERIALS, SUCH AS SHEETROCK AND CONCRETE, TO HELP ENGINEERS DESIGN BETTER STRUCTURES WHERE PEOPLE CAN SURVIVE THE MISSILES OF DEBRIS THAT CAUSE DEATH AND DAMAGE IN TORNADOES. /// PHOTOS BY JOEY HERNANDEZ



# STRUCTURAL INTEGRITY

THE WIND SCIENCE AND ENGINEERING RESEARCH CENTER TESTS BUILDING MATERIALS FOR STRUCTURAL INTEGRITY AGAINST MISSILES OF DEBRIS THAT FLY IN TORNADOES AND MAJOR WIND EVENTS. USING A DEBRIS LAUNCHER, SCIENTISTS ARE FINDING WAYS TO BUILD BETTER SHELTERS. BY MODELING WIND FLOW ON STRUCTURES THROUGH EXPERIMENTS IN WIND TUNNELS, THE W.I.S.E. SCHOLARS ARE ENSURING SAFETY FROM THE STORMS THAT NATURE BRINGS. /// BY JEROO FOSTER

The mobile home park was not outfitted with warning sirens, storm shelters or an evacuation plan for its residents. Downburst simulations, debris cannons, vortex analysis and wind loads were more than likely not on the minds of Eastbrook Mobile Home Park residents in Evansville, Indiana, on Nov. 6, 2005. With little knowledge of what was knocking on their front doors, 20 people lost their lives, and 80 homes were destroyed after midnight.

Larry Tanner, P.E., a Texas Tech University lecturer in civil engineering and research associate with the Wind Science and Engineering Research Center (WISE), traveled to Indiana to study the effects and damage of the storms to the mobile home structures. Tanner made three key findings that came somewhat as a surprise while he was investigating the aftermath of the incident. He discovered that in some instances, the mobile home straps were loose and that many of the straps did not align with the anchors that were provided, while some straps that were anchored gave way because of intense wind loads. Shockingly enough, Tanner revealed that some of the homes were not anchored at all. "I haven't a clue why so many were not anchored," Tanner says. "Concrete pads were provided for each home and most pads contained anchoring loops cast into them. Still, some units were not connected. Mobile homes, at best, are marginally safe in high winds when anchored to the Earth and are very susceptible to even moderate winds if unanchored."

At Texas Tech, Tanner spends time researching the effects that tornadic winds have on engineered structures such as mobile homes. For the last two years, the Wind Science and Engineering Research Center researchers have conducted studies using such instruments such as actual mobile homes, cargo airplanes and wind tunnels. "They set up and anchored a mobile home unit with underpinnings and then flew in an Air Force C-130 basically to blow on it," Tanner describes. "The houses had instrumentation to accurately measure wind pressures, and even though they collected decent data, our wind generator, the C-130, could not provide the type and strength of wind in a tornado. The resulting analysis was for straight-line winds, more typical of hurricanes, rather than the tight oscillating winds that occur in tornadoes."

Utilizing wind-tunnel technology offers a solution to this research dilemma. Chris Letchford, Ph.D., a pro-

fessor of civil engineering, manages the wind tunnel at Texas Tech and is a key figure in the creation of two crucial simulations for the research of tornadoes and extreme thunderstorm winds—the downburst simulator and the tornado-vortex simulator. Using these two facilities, wind tunnel research can be applied to these two extreme wind events to overcome lack of knowledge about them. "We've actually put buildings in a vortex that looks like a tornado and measured the pressures on the buildings caused by the wind flow, and we've done the same thing in the downburst simulator," Letchford says. "We've come up with innovative modeling of these types of winds, which cause most of the damage throughout the majority of the country."

Researchers document the simulations conducted at Texas Tech very similarly to the way actual disasters are analyzed. Photography is utilized to accurately observe storm effects, and those images then are coordinated with data collected by instrumentation. Between full-scale observations and model-scale simulations, investigators are able to come to a better understanding of what occurs in these extreme events and also what could be strengthened in manufacturing procedures and in further research.

Tanner utilizes the data sets that are collected using wind-tunnel technology and other instruments to



CHRIS LETCHFORD, PH.D., SITS IN A WIND TUNNEL WITH A MODEL STRUCTURE. WITH HIGH TECHNOLOGY, HE CAN DETERMINE WIND FLOW AND STRUCTURAL INTEGRITY OF BUILDINGS.



PHOTOS BY ARTIE LIMMER

adequately inform the proper authorities responsible for the production of manufactured buildings. "Part of my role is to try to educate the public," Tanner says. "My responsibility in the Indiana storm investigation was to try and learn something, and through post-analysis reports, to increase awareness that will influence the industry. The mobile home industry is not governed by building codes because it falls under the jurisdiction of the United States Housing and Urban Development Administration (HUD). Only in the last 10 years have manufacturers developed some good standards." Mobile homes are manufactured with guidelines related to where the

structures will be located. Homes placed in coastal regions are designed for stronger, hurricane-type wind loads, while inland homes are built to withstand lower pressure winds. Ironically, mobile home construction is one of Indiana's major industries.

Although regulations concerning strapping and anchoring mobile homes to the ground are set by state and federal agencies, they are not stringently enforced in some areas. Tanner believes that educating the public is one of the more important aspects of his job. When researching the effects of storms, such as the series that hit Evansville, Indiana, Tanner is concerned with the storms' abilities to affect society.

"I believe most people that live in mobile homes recognize that their homes are not a safe refuge," Tanner says, "and if they recognize that, then surely they should develop a plan as to what they should do if severe weather becomes threatening."

Wind events, as Tanner likes to describe serious weather conditions that involve extreme winds, are looked at in a different light given the tornadoes and hurricanes of 2005. Even so, proper documentation and storm-effect analysis made by researchers at Texas Tech, as well as adherence to suggestions given to agencies would make mobile home residents safer and more aware when these wind events occur. ■



SMALL PLASTIC TUBES MEASURE WIND PRESSURE, WHICH DETERMINES LOADS ON BUILDINGS.