Development of the EF-Scale for Tornado Intensity

Tornado intensity in terms of wind speed is rated indirectly from building and structure damage because random nature and the short life of tornadic storms make measurements difficult. Dr. Theodore Fujita, Professor of Meteorology at the University of Chicago developed Fujita F-scale, F0 to F5, to rate intensity of tornado in 1971. With new damage documentation of tornado damages the F-scale needed to be upgraded. The Enhanced Fujita EF-scale was developed with a consensus among meteorologists, engineers and insurance personnel. The EF-scale uses 28 different damage indicators (DI) and several degrees of damage (DOD) for each DI. The elicitation process is used to assign wind speeds, expected, upper, and lower bound, for each DOD in every DI. The presentation contains documentation of the development process of the EF-scale and the motivation for the same with the background of the F-scale. Wind speeds in the F-scale and the EF-scale are correlated to preserve the previous database. The EF-scale overcomes the shortcomings of the F-scale of too few damage indicators, postulation of damage irrespective of building characteristics, and the high wind speeds assigned to F4 and F5 ratings. The U.S. National Weather Service implemented use of the EF-scale beginning February 2007.


Professional Profile:
Dr. Kishor Mehta is Program Director for the Hazard Mitigation and Structural Engineering at the National Science Foundation since 2011. He received B.S. and M.S. in Civil Engineering from the University of Michigan and Ph.D. in Structural Engineering from the University of Texas at Austin. He has been on the faculty at Texas Tech University since 1964. He is former Director of the Wind Science Engineering (WISE) Research Center at Texas Tech. He was elected to the Distinguished Member of the American Society of Civil Engineers in 2002 and to the National Academy of Engineers in 2004. He has been Principal Investigator on many research projects including the 10-year long, NSF funded Cooperative Program on Wind Engineering (with Colorado State University) and the NIST/Texas Tech Cooperative Program for a Windstorm Mitigation Initiative. In these programs he led a research team of faculty and students from civil and mechanical engineering, atmospheric sciences, architecture, mathematics and economics. He chaired the committee of ASCE which produced the ASCE 7 for wind loads for 20 years. At Texas Tech he developed a doctoral degree program in Wind Science and Engineering with funding from the NSF’s IGERT Program; the degree was approved in July 2007. To date 20 students are granted Ph.D. degrees in Wind Science and Engineering.
**Research Frontier (work in progress):**

**Multiple Hazard Mitigation of Infrastructure**

**Goal:** Prevent natural hazard from becoming community disaster

One of the goals of Resilient and Sustainable Infrastructure (RSI) cluster within CMMI/ENG at NSF is to prevent natural and man-made hazard from becoming a disaster. To achieve this goal the HMSE program seeks fundamental research to mitigate impacts of natural and anthropogenic hazards on civil infrastructure and to advance the reliability, resiliency, and sustainability of individual building/structure as well as at community scale. Hazards may include earthquakes, tsunamis, hurricanes, tornadoes and other loads, as well as explosive and impact loading. Resiliency of building/structure includes structural and non-structural systems in totality in case of an impact by any hazard. Sustainability relates to meeting the needs of the present without compromising the ability of future generations to meet their own needs. Research should integrate structural and architectural engineering with discoveries and advances in other science and engineering fields, such as earth and atmospheric sciences, material science, mechanics of materials, sensor technology, computational modeling and simulation, economics and behavioral sciences. Research in structural and architectural engineering is needed that extends beyond matured construction materials into investigations of smart and sustainable materials and technologies, and considers the structures in their entirety. Some of the concepts will be illustrated using windstorm hazard.

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