American Association for Wind Engineering

THE WIND ENGINEER

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

In This Issue

International Association for Wind Engineering

WIND ENGINEERING RESEARCH NEEDS

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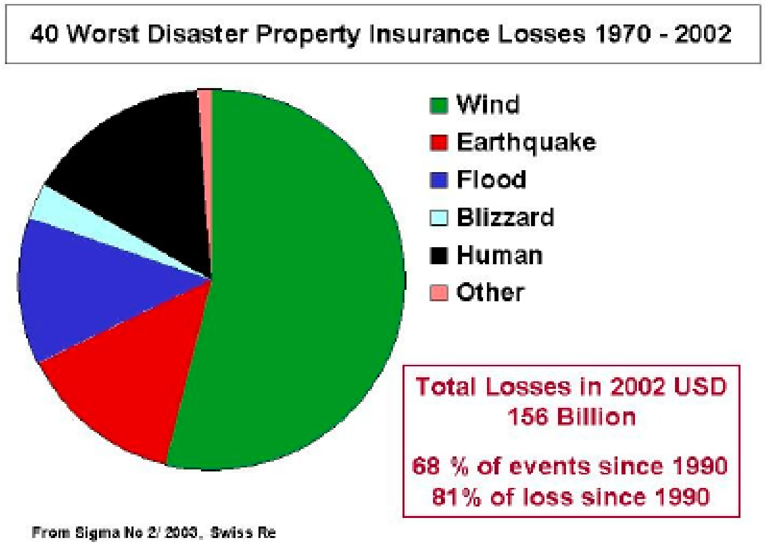

Figure 1: Insured losses from wind events are substantially larger than other causes.

Wind storms are one of the greatest natural causes of damage and loss of man-made structures and material. They come in various forms but hurricanes, tornadoes and downbursts produced by thunderstorms, extra-tropical depressions and local topographically induced phenomena such as down-slope winds are the main types of wind to be considered. Major events like Hurricanes Andrew and Katrina cause loss of life, injury and tens of billions of dollars worth of damage in one single event. They are in the news for many weeks. Also, every year the local extreme winds caused by thunderstorms routinely cause death and destruction on a smaller scale but much more frequently. Although there have been significant advances in knowledge of the effects of wind on structures since the early 1960s, it is true to say that much of this has been gained on a shoestring budget. Funding for wind research has been tiny compared with that thrown into seismic-engineering research, despite the fact that in North America losses due to wind storms have historically far outweighed those due to earthquakes (Figure 1).

Wind is also a very significant source of clean energy and wind farms are proliferating in many countries including the USA. The technology is developing rapidly not only in terms of the hardware but also in areas such as assessing the best sites, predicting and maximizing the power that can be obtained, dealing with environmental concerns such as noise, and tying the wind energy sources into the conventional power grids. In future the further development of effective wind power systems will require considerable research effort. Countries that have the most active research programs in wind power are most likely to become the leaders in providing equipment and services on a worldwide basis.

Much of the knowledge gained in the impact of wind on structures has come from project specific studies on large structures such as tall buildings, stadiums and arenas, and long span bridges. For these projects the research takes place in an ad hoc manner and the funding for this is absorbed within the design costs of each project. Often the wind engineering budget per project is in the $100,000 to $1,000,000 range. This "hidden" research funding, while allowing some advances to be made in small steps, does tend to be mostly of limited scope, because in the end the needs of the project must take precedence over any more lofty long term research goals. As a result the advances in general knowledge of the behavior of wind, wind statistics and wind loading of structures has been slow and sporadic. To make major advances a protracted and persistent research effort must be maintained over many years and have stable funding.

The vast majority of structures are not tall buildings, long span bridges, stadiums or arenas and do not receive the type of special attention the big projects receive. Funding for wind engineering research into this great majority of structures and the code wind provisions by which they are mostly designed has been pitifully small in the USA. As a result most structures are built using relatively crude information on wind loading, and this is because of the scarcity of research funding for this field. A similar situation exists for snow loading, which is closely linked to wind since most of the highest loading occurs in drifts caused by the interaction of snow with wind. With the above as background the following subjects are seen as in great need of future research.

1. The wind loading of buildings is highly sensitive to shape. Very few shapes are handled in standards like ASCE-7. As a result designers are frequently uncertain how to interpret the standard for their particular building, because it does not look like any of the shapes for which load provisions are given. Added to this is the fact that the limited wind provisions that are given in ASCE-7 and other North American codes and standards are based on wind tunnel tests done over 30 years ago. Since then the technology of wind tunnel testing has advanced and can produce much more data, faster and with greater precision. Therefore, an extensive program of wind tunnel testing to establish design pressure coefficients for a wide range of different shapes is needed. One specific example has been suggested by the ASCE Committee on Special Structures: their Tensioned Fabric Structures Task Committee has pointed out the lack of any useful design, wind-load data in ASCE-7 for the dual-curvature smaller roofs (saddle and cone shapes) that form a huge part of that industry.

2. Wind loading is also sensitive to the surroundings of a building. Clearly the surroundings can be highly variable. Therefore, in parallel with item 1, research is needed into the uncertainties caused by this variability and the way that these can be accounted for in the code provisions for wind and the associated load factors. This topic needs a research team with expertise not only in wind loading and wind tunnel methodology but also in structural liability and risk. A test program with a range of potential surroundings is needed in order to establish realistic values of parameters like coefficient of variation that are used in structural reliability assessments. To establish appropriate levels of reliability achieved by code loads and load factors, Monte Carlo simulation methods should also be applied.

3. The analysis of extreme meteorological wind data has in the past mostly assumed that all wind data can be treated as part of a single population of events. In reality the events are due to several different types of phenomena such as outlined in the first paragraph. Research is needed into the consequences for design loads of analyzing the different types of wind storm as distinct populations. The vertical profiles of wind velocity and turbulence tend to differ in the different storm types and this could make current assumptions inaccurate for some types of structure.

4. In recent years substantial advances in meteorological modeling have been made, primarily as a result of developments in the field of weather forecasting. Research into how these techniques might be applied to improving the wind maps in North America could bring substantial benefits. Currently the wind maps are based on highly simplified analyses of ground based data obtained at airports. Regional differences tend to be lost in the scatter caused by local anomalies of the weather station and its surroundings. Advanced meteorological modeling tools can be used to detect true regional differences and eliminate scatter resulting from use of local ground based data alone.

5. The classification of exposure categories is still left much to the judgment of individual designers. They have to judge how rough the terrain is upwind of a site for each direction of importance, and they rely on simplistic descriptions given in code documents. With current GIS technology, satellite information and databases such as Google Earth it should be feasible to go to a web site, feed in your latitude and longitude and obtain on line a terrain roughness category or exposure coefficient as a function of height for any given wind direction. The development of this technology is feasible and would bring many benefits in improved consistency and accuracy. The choice of exposure category is one of the major sources of uncertainty in predicting wind loads from code provisions.

6. Wind tunnel tests on scale models are relied on heavily for determining wind loads on buildings, especially the larger structures. However, there are only a few rare cases where the real structure has been instrumented during or after construction so as to measure the wind loads and structural response. Information from such an instrumentation program provides invaluable guidance on the accuracy of existing prediction methods and ways to improve them. In the absence of a good body of full scale data current prediction methods probably err on the conservative side, which causes additional construction cost and use of more resources than necessary. Billions of dollars can potentially be saved annually by in construction by spending a few tens of millions on structural monitoring programs focused on wind.

7. Similar to or in conjunction with (6) above, full scale building monitoring could also lend valuable information to structural engineers in developing structural models that better represent the actual building properties, including stiffness and the degree of cracking allowed for various return periods from serviceability to ultimate limit state.

8. Research needs to continue into the response of structures to tornado and thunderstorm downburst winds. This area of research is fairly new but methods of simulating these winds at small scale have been explored using specially designed wind tunnels and look promising. Tornados and thunderstorm downbursts are a significant cause of damage each year and ways of reducing this could pay big dividends. The impact of these winds on code requirements needs to be accounted for in a more rational way than is currently the case.

9. One area that has not received enough attention is the way that many ordinary low-rise structures actually respond to wind and snow loads. The detailed load paths and mechanisms of failure of many low rise structures built using traditional materials and methods are not well understood. Past research has shown that relatively small changes can have a dramatic impact on this type of structure's ability to withstand extreme loads. One example is the simple use of hurricane straps to secure the roofs of houses in hurricane areas. For the cost of a few dollars major improvements in safety are achieved.

10. The changing climate of the earth has the potential to alter the frequency and strengths of extreme wind and snow storms. Research into these effects is still at the rudimentary stages and this topic needs to be more vigorously pursued.

11. The snow load provisions in codes and standards are relatively primitive compared with the structural analysis software currently available to determine the effect of a given load. Thus, the potential benefits of the advanced structural software go to waste due to the low level of accuracy of the inputs. The heaviest snow loads are the drifting, i.e. through the interaction with wind. Therefore there are great potential benefits to be gained by developing improved knowledge of this interaction and through further developing methods for predicting extreme snow loads under different climate conditions.

12. The field of wind energy has a number of research needs. Methods for predicting the power available from a given site, taking into account the local terrain, do exist but need substantial improvement. Methods based on the full power of the latest Computational Fluid Mechanics and weather forecasting tools need to be explored. As well many aspects of wind turbine behavior are not fully understood, particularly their dynamic response to fluctuating wind loads, which if well researched could lead to substantially improved overall lifetime performance.

13. The installation of small turbines on buildings is becoming more popular but their performance in the complex air flows near a building is often disappointing due to lack of understanding of these airflows. Widespread use of such small installations is unlikely to take place until such problems are understood and solved.

14. The application of Computational Fluid Dynamics methods in wind engineering looks promising. It is already being used for a number of special applications such as flow over complex terrain, the comfort of pedestrians around buildings and wind loads on individual products such as satellite dishes. Continued development of these methods could lead to better understanding of many of the problems in wind engineering.

The tools and knowledgeable experts to do the above research exist but funding to put them to work has been missing. As a result the wind (and snow) provisions in even the most advanced standards such as ASCE-7 are not nearly as effective as they could be. The beneficial societal impact of the improved knowledge coming from such a program would be enormous, saving many lives and injuries and reducing by billions of dollars every year the cost of construction and the cost of damage from wind storms.

Marc Levitan has moved

After 18 years at Louisiana State University, Marc Levitan has moved - trading in crawfish, zydeco and hurricanes for crab cakes, C-SPAN and snowstorms. Marc joined the National Institute of Standards and Technology in Gaithersburg Maryland early this year. He is filling a newly created position, expanding NIST's longstanding wind engineering research capabilities. Marc is heading up the Research and Development for the National Windstorm Impact Reduction Program (NWIRP) at NIST's Engineering Laboratory. The Program includes both wind engineering and storm surge research. He'll also be coordinating activities with the other NWIRP agencies (FEMA, NOAA, and NSF) and the broader wind engineering community. Additionally, Marc will be working closely with the Engineering Laboratory's new Disaster and Failure Studies Program on post-storm investigations. His new coordinates are (301) 975-5340 or marc.levitan@nist.gov.

WIND ENERGY UPDATES

Health and Safety Summit USA
September 8th – 9th, 2011 | Dallas, Texas

Design your EHS strategy from industry best practice to avoid citation, ensure staff safety and maximize productivity.

Wind Energy Update (WEU) provide business intelligence to the ever growing wind energy industry in the form of focused reports, B2B conferences and exclusive news reporting and analysis.

The most pressing and immediate change affecting the industry today, we've been told, are the new regulations and standards that the US Department of Labor (OSHA) are set to implement across the wind industry. These relate to the way health and safety is monitored in the construction and operation & maintenance aspects to work.

To provide some much needed understanding of what is required and what is being and what has been done, WEU have assembled a panel of experts of those who have involvement in the day to day operation and maintenance work performed on a wind farm to tackle previously uncovered aspects of the industry, including:

Latest Update on Industry Regulation Shifts: Ensure adequate safety margins and regulatory compliance and understand why this is critical to your customers, employees and shareholders

Arc Flash Evaluation & Prevention: Examine the various methods for evaluating and eliminating arc flash to help safeguard personnel and prevent damage to your equipment

Lock-Out/Tag-Out: Learn about OSHA's regulation on "energized" machinery, and examine lock-out/tag-out concepts, procedures, devices, and electrical control systems to protect your employees

Cultivating Confined Space Safety: Discuss how to educate workers on safe practices required for confined space entry in wind towers

Wind Turbine Ergonomics and Design for Safety: Understand what safety systems are required to protect your employee's long term health at work and what R&D is being done to engineer out design faults while meeting the needs of the customer

Best Practice Safety Strategies Explored: Learn about the safety strategies developed by firms operating in the wind space which will not only help you see a rise productivity, but also a decline in injury

Working at Height & Fall Protection: Understand the requirements for working at height and how, with the correct PPE, climbing best practices, and equipment inspection you can prevent injury

The expert speakers include: Department of Labor (OSHA), Duke Energy, Edison Mission Energy, AES Wind Generation, BP Wind Energy, GE Energy, Vestas, Siemens Energy, Suzlon, and many more…

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AAWE Student Chapter

By Joseph Dannemiller, TTU
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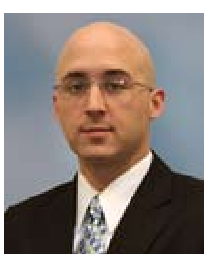
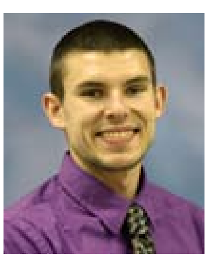
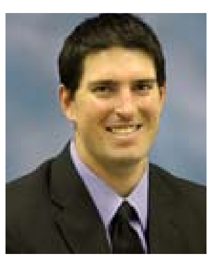
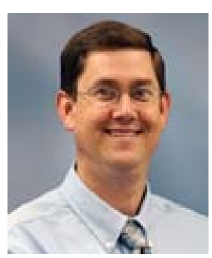
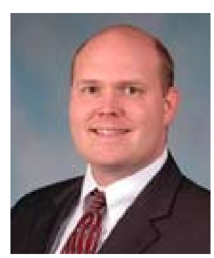
The AAWE Student Chapter at Texas Tech University has now been officially recognized by the University and has elected officers. The Chapter currently has ten members and is pursuing avenues to recruit more. We are seeking multiple partnerships with other student organizations and have already formed a partnership with the American Meteorological Society (AMS) Student Chapter at Texas Tech University to assist them with the logistics, operations and in supplying man power for their annual Severe Weather Awareness Day event. This is a free event held at the Lubbock Science Spectrum where the public is encouraged to attend and learn about extreme weather, the risks associated with extreme weather, and mitigation techniques. Presentations and informational pamphlets are distributed by the National Weather Service, while an IMAX film and practical experiments are aimed at kids of all ages.

We greatly appreciate the support we have received from everyone at AAWE in helping us get this first student Chapter off the ground. We have had elections and our officers are:

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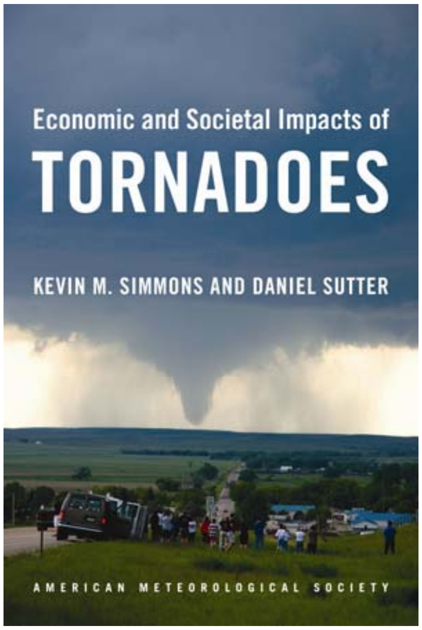

Economic and Societal Impacts of Tornadoes

by Kevin M. Simmons and Daniel Sutter

© 2011, 296 pages in paperback
ISBN 13: 978-1-878220-99-8
AMS Order Code: ESIT
List price: $30 AMS Member price: $22

AVAILABLE NOW
(See ordering information below)

FOR ALMOST A DECADE economists Kevin M. Simmons and Daniel Sutter have been studying the economic impacts and social consequences of the approximately 1,200 tornadoes that touch down across the United States annually. During this time, they have compiled information from sources such as NOAA and the U.S. Census in order to examine the casualties caused by tornadoes and to evaluate the National Weather Service's efforts to reduce these casualties.

Featuring:

- Social science perspective of tornado impacts
- Evaluation of NWS warnings
- Statistical analysis of effectiveness of warning lead time, shelters, and more

Their study will prove fascinating to many groups, from meteorologists to social scientists to emergency managers. Indeed, this book will help people from high levels of government to emergency managers do their jobs more effectively, and demonstrate to society the value of their efforts. Everyone studying severe weather, policy, disaster management, or applied economics should have a copy.

KEVIN M. SIMMONS is the Corrigan Chair of Economics at Austin College. In 2010 he served as a Fulbright Scholar with the International Center for Geohazards in Oslo.
DANIEL SUTTER is associate professor of economics at the University of Texas—Pan American and a senior affiliated scholar of the Mercatus Institute.

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Ph.D. Graduate Assistantships in Engineering for Hurricane Research

Donald W. Clayton Graduate Program in Engineering Science
Louisiana State University, Baton Rouge, LA

Beginning Fall 2012, research assistantships are available for students interested in pursuing Ph.D. degrees in LSU's multi-disciplinary Donald W. Clayton Graduate Program in Engineering Science. Financial support includes a tuition waiver (including non-resident waiver) and stipend for up to four years contingent on satisfactory academic and research performance. Students should have a strong analytical background and a desire to conduct hurricane-related research. At a minimum, students must possess a bachelor's degree in engineering, computer science, geography or related field.

Funding opportunities are available for students interested in pursuing **hurricane-related research**, including computational and statistical analysis of hurricane damage data, building damage visualization, remote sensing damage assessment, and hurricane damage modeling.

The Donald W. Clayton Graduate Program in Engineering Science allows students to pursue graduate study and research in interdisciplinary areas that cross two or more disciplines in different departments or in program areas not currently associated with existing departments. This interdisciplinary program spans the fields of engineering, science, business, and even law. The college accepts qualified students with bachelor's or master's degrees in engineering or a pure or applied science to work toward a Ph.D. in this interdisciplinary program.

Interested students are encouraged to email a letter of interest and resume to Dr. Carol Friedland (friedland@lsu.edu). Fellowship funding through the College of Engineering is also available for outstanding students on a competitive basis. Information about the Engineering Science program is available at http://www.eng.lsu.edu/academics/gradprogs/engrsci/overview.

President's Corner

This year may be easily called the year of mega-disasters, many that have made historical records. First, we had a mega earthquake of magnitude 9.0 followed by a tsunami in Japan on March 11, 2011 that killed more than 14,700 people and caused a nuclear meltdown. It was followed by a very active tornado season in the US with an EF3 tornado in Mapleton, Iowa on April 9, 2011, where 60% of the town was destroyed, an EF4 tornado hitting a major city and a major airport at St. Louis, Missouri on April 24, 2011 and a mega-tornado outbreak with several tornadoes (200+) including EF4 and EF5 tornadoes occurring across four states - Alabama, Mississippi, Georgia and Tennessee on April 27, 2011 that caused millions of dollars of property loss and 300+ casualties. It is heartbreaking to see such losses in colossal proportions. AAWE regrets the loss of so many lives and wishes well to all those who were affected by these disasters in the US and Japan. These disasters remind us how vulnerable is mankind and questions our assumptions in risk-based engineering design. What can we do to minimize the loss of so many lives in the future? I believe that there needs to be a paradigm shift in our thinking when designing residential, commercial and critical facilities for extreme events. This should pose as a challenge, particularly to the younger generation of wind and structural engineers. I am glad to report that a team of researchers from several universities including David Prevatt from the University of Florida (AAWE Board Member), Larry Tanner and Daan Liang from Texas Tech University, Chris Karstens from Iowa State University, John van de Lindt from University of Alabama at Tuscaloosa, Rakesh Gupta from Oregon State University were able to survey the tornado damage that occurred on April 27. They will report their findings once they piece them together. I took the Japanese quake personally because I flew out of Narita airport in Japan on March 10, 2011, narrowly escaping the disaster by barely 22 hrs. I was there to attend the 5th International Symposium on Wind Effects on Buildings and Urban Environment, held at Tokyo, Japan on March 7 and 8, 2011. It was well attended by many international participants including three prominent members of our community from the US (Kishor Mehta, Ahsan Kareem and Bob Meroney) who also narrowly escaped the disaster. The reason it was personal because the disaster affected many of our Japanese colleagues in wind engineering with whom I had just met and interacted.

With regards to AAWE business, I am pleased to announce that AAWE has offered partial support to cover the travel cost of 19 students and 11 professionals (faculty/post docs) from 11 universities across US and Canada to attend the 13th International Conference on Wind Engineering (ICWE13). This travel support was made possible primarily through a NSF grant to Prof. Nicholas Jones at JHU and some additional funds from AAWE. I want to thank Prof. Jones and the AAWE Board of Directors for their roles in making it possible. This type of support for students could easily make a difference between their attending this conference or not. I fondly recall when I attended my first ICWE in 1991 as a graduate student, where I heard the talks of Prof. Alan Davenport, Prof. Manabu Ito, Prof. Toshio Miyata and many other internationally known researchers that shaped my future. As you know that ICWE is held every four years at a location that is rotated in a sequence through three regions of the world (Asia-Pacific, Americas, and Africa-Europe). The past ICWEs are listed here for your reference: ICWE1 in UK (1963), ICWE2 in Canada (1967), ICWE3 in Japan (1971), ICWE4 in UK (1975), ICWE5 in USA (1979), ICWE6 in Australia and New Zealand (1983), ICWE7 in Germany (1987), ICWE8 in Canada (1991), ICWE9 in India (1995), ICWE10 in Copenhagen, Denmark (1999), ICWE11 in Lubbock, USA (2003), ICWE12 in Cairns, Australia (2007). The next (ICWE14) is scheduled to be held in the Americas (i.e. North, South or Central) in 2015. Thus, IAWE is seeking proposals from individuals or groups who want to be potential contenders for hosting this event. The proposals are due by July 10, 2011. Please contact me or Dr. Leighton Cochran immediately if you are interested in submitting a proposal.
Lastly, I want to remind you that ATC-SEI/ASCE is jointly organizing the "Advances in Hurricane Engineering Conference" at Miami from October 24-26, 2012 (close to twenty years since Hurricane Andrew) in cooperation with AAWE and several other organizations. The call for paper was opened on May 5, 2011 (announcement was sent earlier). I encourage all of you to participate in this important conference.

Sincerely,

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American Association for Wind Engineering

Objectives:

- The advancement of science and practice of wind engineering.
- The solution of national wind engineering problems through transfer of new knowledge into practice.

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