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NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

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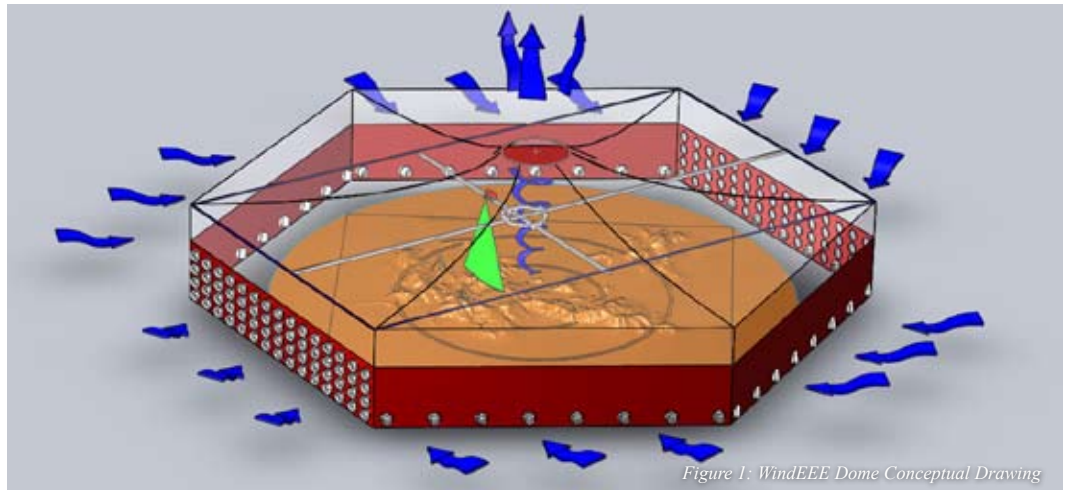


Figure 1: WindEEE Dome Conceptual Drawing

THE WIND ENGINEERING, ENERGY AND ENVIRONMENT (WINDÉEE) DOME AT THE UNIVERSITY OF WESTERN ONTARIO: CONCEPTUAL DESIGN

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At the end of June 2009, the Canada Foundation for Innovation (CFI) and the Ontario Research Fund (ORF) awarded Western the funding to build the world's first hexagonal wind tunnel – the Wind Engineering, Energy and Environment (WindEEE) Dome. The WindEEE dome represents a technological break-through in the study of wind-related phenomena. It has the capability to physically simulate both large and local high intensity wind systems over complex terrain, and to simulate their effects on buildings and structures, wind turbines, wind and solar farms, as well as the transport of pollutants.

According to Munich Re America, the five-year average insured loss due to thunderstorm activity (tornados and downbursts) in North America is of the order of \$6 billion. In Canada alone, those losses are of the order of \$200 million. Thunderstorm activity causes the majority of insured property loss in the U.S. out of all natural catastrophes. However, at present we do not design or test buildings and structures to this type of local high intensity winds.

In order to provide 20% penetration as proposed by the Brussels Agreement (2007), Canada, as well as many other countries around the world, will have to dramatically step-up their wind energy production. However, many existing wind farms produce 15% less than their projected annual Capacity Factor of 30%. Errors in modeling of the near-surface wind fields, primarily in the presence of complex topography or in estimating wake and array effects, are the main factors associated with these prediction differences.



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In order to address these important economic problems, the Wind Engineering, Energy and Environment (WindEEE) Dome was proposed. The facility will be capable of physically simulating wind systems such as tornados, downbursts, gust fronts, and low level nocturnal currents. The Dome's large scale will allow for high resolution wind simulations representing extended areas and complex terrain. This highly innovative and versatile facility will have applications to wind energy, wind engineering, environmental impact studies, meso- and micro-scale numerical modeling, risks analysis, economics, and policy making.

The WindEEE Dome will complement, but will be quintessentially different from, other international wind related facilities, such as the wind tunnels located at NASA Ames and Iowa State University in the USA; NRC in Ottawa; and Milan Polytechnic, Nantes and the Danish Maritime Institute in Europe. The WindEEE dome will also complement full scale testing capabilities, such as those offered at the Silsoe Building in the UK, the Institute for Business & Home Safety (IBHS) facility in South Carolina or the Wall of Wind at Florida International University.

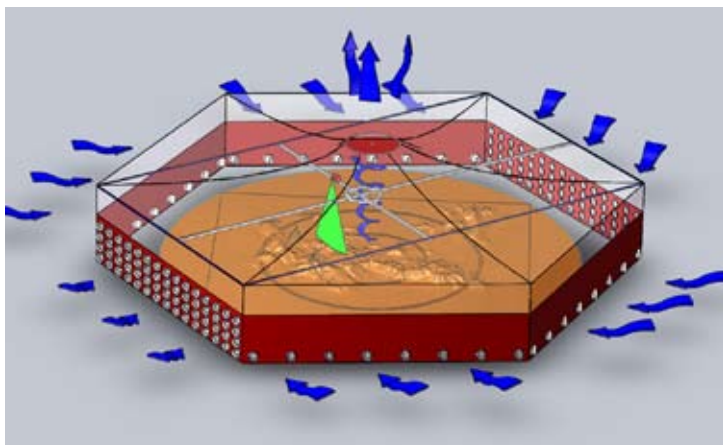


Figure 1: WindEEE Dome Conceptual Drawing

WindEEE is based upon a large (25m in diameter) hexagonal test chamber (i.e. a dome) with an array of specialized fans mounted on the walls and the ceiling (Fig. 1). The fans will be activated using a sophisticated control strategy to provide time-varying and spatially-varying flow fields in the test section. This will enable the reproduction of swirling, sheared, or other flows at scales similar to what would occur in nature. In addition, this new facility will also be capable of testing full-scale elements such as solar panels, small wind turbines, or even large wind turbine blades in sheared and time-dependent air flows.

Local storm systems, such as downbursts or tornados, have complex space-temporal characteristics. Downbursts can be generically simulated as impinging jets [1]. The initial high density jet formed at the cloud base produces ring vortices. These vortices impact the surface, creating a region of intense wind speed (with both horizontal/radial and vertical components) at heights less than 5% of the initial jet diameter. Therefore, large impinging jet facilities are needed to simulate downburst-like flows in a laboratory setting to achieve the desirable measurement resolution. A tornado, simulated as a swirling flow with a suction aloft, shows a large variability of

flow structure as a function of Swirl Ratio [2]. Both tornados and downbursts present limited Reynolds number dependency above critical values involving, again, large laboratory scaling [3].

The main research themes proposed for WindEEE are related to the characterization of these local storm systems in the surface layer, and their effects on buildings and structures. WindEEE will also facilitate research related to the aerodynamic improvement of wind turbine components, and optimization of wind farm layouts and power output predictions.

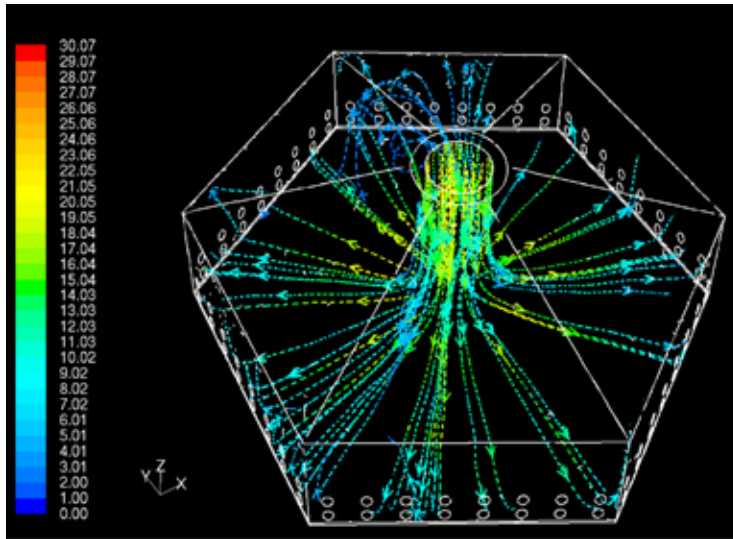
Computational Fluid Dynamics (CFD) simulations, employed during the conceptual design phase, suggest using a matrix of 0.8m diameter direct drive axial fans with downstream guide vanes, each providing 30 m/s air speed distributed in rows of 8 fans at the base of each of the walls of the hexagonal test chamber. A set of larger 6 fans will be installed in the ceiling and connected to a plenum box. The opening of the plenum will be fast triggered and mounted on a guillotine fast traversing system that will translate over ± 2.5 m at a maximum speed of 3 m/s.

The ceiling fans, combined with the system of fans on the six peripheral walls, will be manipulated to produce a variety of axisymmetric wind fields. By combining inflow at the ceiling level and radial outflow at the peripheral walls, downburst-like wind fields will be produced (Fig. 2a). Alternatively, by combining outflow at the ceiling, and radial and tangential inflow at the peripheral boundaries, tornado-like wind fields will be produced. In addition, one of the six peripheral walls will have a matrix of 60 fans (4 rows of 15 fans each). This wall of fans will be operated in conjunction with two sets of porous side walls to provide straight flows at large scale (approximately 14m across and 3.8m in height). These fans will be capable of producing sheared flows (Fig. 2b), and will be actuated (using rotating vanes) at 1 Hz, producing nominal turbulence intensity of the order of 17%, and thus simulating full-scale atmospheric conditions. Moreover, these fans will be 80% reversible; using an opening in the dome will produce reversed outside flow which will be used to test large-size full-scale components, solar panels and wind turbine blades.

Current meso-scale and micro-scale numerical models fail when it comes to simulating near-ground local storms, or the effects on complex topographic landscape and urban terrains. The WindEEE Dome will allow the testing of model structures directly in their terrain at typical scales of 1/500. For this purpose, the test chamber floor will be divided into concentric circular zones around the central test zone of ~ 5 m (at ~ 5 m increments) to allow for progressive floor model detail. In the central zone, representative terrain models will be produced using CNC machining.

State-of-the-art, time-resolved Particle Image Velocimetry (PIV) will be employed to determine the surface wind field [4] and a Particle Tracking Velocimetry (PTV) system to characterize the large flow scales of motion.

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**Figure 2a:**

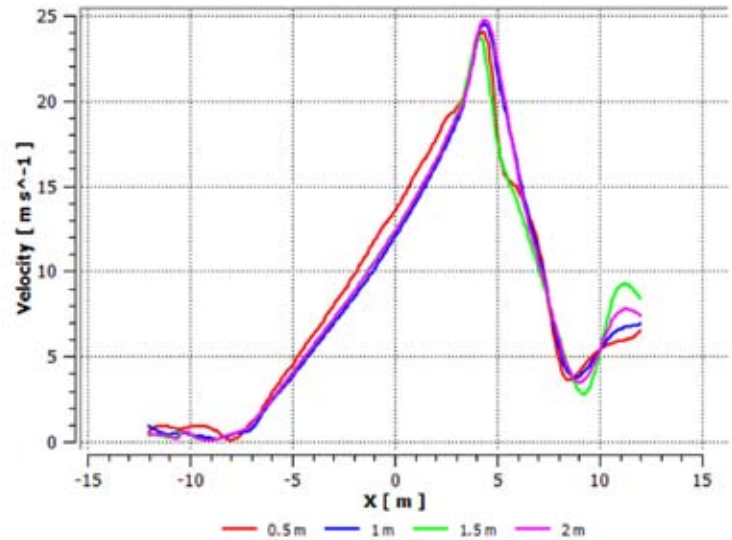
a) Downburst-like flow showing path-lines of velocity magnitude in m/s

We also plan to use the WindEEE Dome to study the structural performance of large Horizontal Axis Wind Turbines (HAWT) under localized wind storm conditions, such as Low Level Currents (LLC) or thunderstorms, in order to increase the accuracy of the Maximum Foreseeable Loss (MFL) estimations. WindEEE will be able to generate realistic, time- and spatially-varying wind fields via the peripheral fan arrays and control systems, in conjunction with realistic scaled terrain and structural models. With an improved understanding of the time-varying load on these structures, design strategies can be refined to avoid catastrophic failures at one extreme, and over-engineering at the other, both of which can have negative economic impacts on power generation and distribution.

Currently, the blades of wind turbines are only tested under straight flow conditions. The WindEEE Dome will enable the testing in wind flows spatially and temporally similar to real wind conditions. Full scale and/or large sections of wind blades will be tested under sheared and turbulent conditions.

The conceptual design proposed by Western has now been tested and optimized. Extensive CFD simulations have demonstrated the feasibility of 6 test cases [5]: 1) straight flow for uniformity, 2) boundary layer flow by vertical shear, 3) horizontally uniform shear flow, 4) downburst-like flow with translation, 5) tornado-like flow with translation, and 6) reversed outside flow for full-scale testing. These simulations have proven the feasibility of the conceptual design, and will form the basis for the engineering design of the facility.

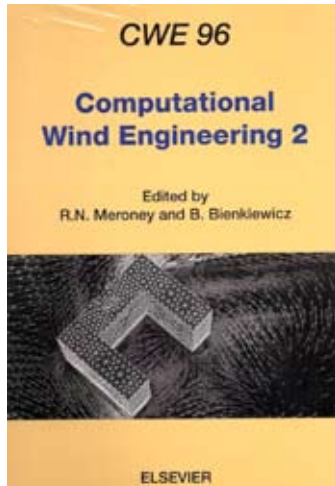
The testing of an approximately 1/12 scale model facility is currently being undertaken as further proof of the concept, a benchmark of the CFD results, and in order to firm up the control system. The results of the testing will be presented once they become available.

**Figure 2b:**

Horizontally sheared flow showing cross-flow velocity profiles at various stations.

1. Hangan, H. and Kim, J.D., Numerical characterization of impinging jets with application to downbursts. *Journal of Wind Engineering and Industrial Aerodynamics*, Volume 95, Issue 4, pages 279-298, 2007.
2. Hangan, H. and J.D. Kim, J.D., Swirl Ratio Effects on Tornado Vortices in relation to Fujita Scale, *Wind and Structures*, Volume 11, Number 4, pages 291-302, 2008.
3. Xu, Z. and Hangan, H., Scale, boundary and inlet condition effects on impinging jets with application to downburst simulations, *Journal of Wind Engineering and Industrial Aerodynamics*, Volume 96, pages 2383–2402, 2008.
4. Rasouli, A., Hangan, H. and Siddiqui, K., PIV measurements for Complex Topographic Terrain, *Journal of Wind Engineering and Industrial Aerodynamics*, DOI 10.1016/j.jweia.2009.06.010, 2009.
5. Dodiptla N. and Hangan H., Preliminary Numerical Simulations of Wind Fields in the WindEEE Dome Facility, Fifth International Conference on Computational Wind Engineering (CWE2010), Chapel Hill, N.C., USA, May 2010.

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INGS: COMPUTATIONAL
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We have unexpectedly located 15 additional copies of the proceedings of the 1996 Symposium on Computational Wind Engineering held at Fort Collins, CO. Although these books are being offered at prices ranging from \$460 to \$515 elsewhere, we are prepared to sell new sealed copies of the publication for \$250 to support a Wind Engineering Scholarship at Colorado State University.

The Second International Computational Wind Engineering Symposium was held in Colorado, USA during August 1996 and presented papers on the popular application of CFD concepts. These proceedings contain a set of invited papers providing state-of-the-art reviews on subjects such as CFD turbulence models, bluff body aerodynamics, terrain aerodynamics and building aerodynamics. Individual session papers reflect on recent methodologies and innovations on CFD techniques applied to flow about bluff bodies immersed in shear layers, bridge aerodynamics, air pollution aerodynamics, mesoscale predictions of flow over complex terrain and the application of advanced numerical method strategies to these topics. The book is fully referenced and includes abstracts of all papers not yet published as well as written discussions of questions submitted during ten subject sessions.

- **Co-Editors:** Robert N. Meroney and Bogusz Bienkiewicz
- **Hardcover:** Special English Edition of Journal of Wind Engineering and Industrial Aerodynamics, Volumes 67 and 68, 1016 pages, 1997.
- **Publisher:** Elsevier Science; 1 edition, 1998.

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**CHRIS
LETFORD**

Chris Letchford is on the move again! Demonstrating that he is a 'dynamic person' with a natural period of about 4 years, Chris will leave the Head of School of Engineering at the University of Tasmania in Australia after almost 4 years to take up the Chair of the Department of Civil and Environmental Engineering at Rensselaer Polytechnic

Institute in Troy NY in early 2011. Sadly, Peter Allen's "I still call Australia home" no longer applies as Chris and his wife return to the US. Clearly the 8 years at Texas Tech planted a strong affinity with the US and Chris is pleased to be sampling yet another Great State! RPI is the oldest engineering-degree-awarding institution in the English speaking world and this year celebrates 175 years since it first awarded a Civil Engineering degree. Notable alumni include Washington Roebling (bridge), George Ferris (wheel), Ralph Peck (soils) and the first environmental engineering program in the US. While snow loading via Mike O'Rourke has been one focus of the department in the past, with Dave Rosowsky as Dean, Chris hopes to make wind engineering a key school strength in the future.

OLD NEWSLETTERS ON YOUR SHELF

Some of our older AAWE members may be able to help with a small project I am working on for our membership. Do you have any old AAWE Newsletters collecting dust on a shelf or in a filing cabinet? If you explore our www.aawe.org website and go to the archived newsletters (Information → News → Archived Newsletters) you will see many of our past publications in PDF format. I think we may be missing many of the older issues that form part of our collective history. The oldest I have on the site currently is April 1989. If you have an issue from any year that you do not see on the website, please send me a PDF of it. If you cannot scan a PDF just mail the hardcopy to me and I will scan it and mail it back to you. I hope can help me complete our Newsletter collection. I don't even know how far back they go – 1970s? My mailing address is below.

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NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

SECOND AAWE WORKSHOP ON BEAUTIFUL MARCO ISLAND, FLORIDA

Leighton Cochran
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In August AAWE held its second Workshop aimed at disseminating recent wind-engineering research to AAWE members and other attendees. With both practitioners and researchers present, this is a fine example of technology transfer. The three-day event was held at the beachside Marriott Resort and Spa at Marco Island on the southwest tip of Florida. The organizers, Kurt Gurley and Steve Camposano did a brilliant job negotiating a very economical stay at one of Marriott's best properties. All attendees were impressed with the location and the Workshop dinner, held at the award-winning Bistro Soleil. That night was truly memorable. As is the tradition, our Workshops are small events held in one room, so that everyone can see all the presentations. The papers presented, from both students and practitioners, were top quality. Many of the papers presented may be downloaded from the members section of the AAWE website (www.aawe.org). After a strenuous day of absorbing the latest research, attendees retired to the pool bar or went jet skiing in the Everglades. The AAWE Members and Board would like to thank Steve, Kurt and their student helpers for organizing a great Workshop in such a beautiful place. Rumor has it that the next Workshop might be in a seaside area of New England. Keep an eye on the AAWE Newsletter to see how this evolves.





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AAWE THANKS THE SPONSORS OF THE SECOND AAWE WORKSHOP -
HELD ON MARCO ISLAND IN AUGUST.



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Senior Analyst I - Wind Technologies Systems-Washington DC

Requisition #1273BR

Job/Research Summary

Analysis at NREL aims to increase the understanding of the current and future characteristics, roles, and interactions of government, markets, and technologies. The Strategic Energy Analysis Center staff, based in Washington, D.C. and Golden, Colorado, have capabilities that span a wide range of renewable energy technologies. Our wind and hydropower analysis group supports advanced technologies that convert more of the nation's wind into electricity.

Job Duties

- Foster teaming with NREL analysts, National Wind Technology Center staff, and other laboratory wind analysts to facilitate flow of results and insights from projects to DOE Wind and Hydropower Technologies Program (WHTP).
- Develop model input data and evaluate modeling approaches for wind and water technology in generation capacity expansion models such as NEMS, MARKAL, and ReEDS.
- Develop methodologies and data capture approaches for estimating cost of energy under various technology improvement and market evolution scenarios.
- Coordinate and team with DOE consultants to harmonize analysis activities, develop data reporting and management systems, and provide support to WHTP metrics, project tracking, planning and general analysis activities.

Required Education and Experience

Relevant Master's and 6 years experience or equivalent relevant education/experience.

Preferred Qualifications

Master's degree in economics, engineering, or policy field, or equivalent relevant experience. 6 years of relevant science, policy, market, or technology analysis experience. Demonstrated knowledge of practices, techniques, and problem solving methodologies in policy, market, economic, and/or technology analysis. Demonstrated leadership in one or more areas of team, task, or project lead responsibilities. Growing demonstration of independent work. Very good interpersonal and communication (oral and written) skills. Experience in project and deliverable management. Experience with direct client interaction.

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Submit Your Resume

For more details on our Senior Wind Analyst position, please go to:

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If you have any questions, please contact Penny Hunt at penny.hunt@nrel.gov or call 303-384-7569.

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING



Partha Sarkar and John Gaynor open the Chapel Hill Workshop.

INTERNATIONAL WORKSHOP ON WIND ENGINEERING RESEARCH AND PRACTICE: CURRENT STATE-OF-THE-ART AND FUTURE NEEDS/PLANS

PARTHA SARKAR

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A two-day workshop “International Workshop on Wind Engineering Research and Practice: Current State-of-the-Art and Future Needs/Plans” was held on 28 and 29 May 2010 as a post-symposium event in conjunction with the Fifth International Symposium on Computational Wind Engineering at Chapel Hill, North Carolina, USA. The goal of this workshop was to bring together prominent structural/wind engineers and meteorologists from academia, industry, and government, along with research program managers and policy makers for: (a) reviewing the current state-of-the-art of wind engineering research and practice, (b) preparing short-term and long-term research needs and plans, and (c) formulating recommendations that will help in facilitating technology/knowledge transfer. The workshop included presentations by twelve distinguished speakers, namely: Leighton Cochran, Kurt Gurley, Hui Hu, Ahsan Kareem, Greg Kopp, Mark Levitan, Kishor Mehta, Mark Powell, Ted Stathopoulos, Panneer Selvam, Tetsuro Tamura and Yukio Tamura. They delivered 30 to 40 minute lectures in various fields to cover broad topics such as wind characteristics and wind hazards, full-scale/field measurements, wind tunnel measurements, computational wind engineering, building codes, tornado-related design needs, etc. In addition to the 12 speakers, there were several participants (24) from universities, industries and government organizations who participated in this workshop. The workshop included one group discussion session on Day 1 of the workshop, where the participants interacted in three separate groups to discuss specific topics, and a 1.5-hour panel discussion session on Day 2 of the workshop, in which a group of 7 panelists led the discussion on wind engineering research needs and the challenges of the transfer of knowledge into practice for improved wind resiliency. The speakers and participants were from six countries (USA,

Austria, Canada, Denmark, Japan and South Korea) which added the international flavor to this workshop. The two-day workshop was scheduled from 8:00 a.m. to 5:30 p.m. on Day 1 (May 28) and 8:00 a.m. to 2:15 p.m. on Day 2 (May 29). It was organized and chaired by Dr. Partha P. Sarkar, Professor in the Department of Aerospace Engineering at Iowa State University and co-chaired/co-organized by Mr. John Gaynor, Director, Office of Policy, Planning, and Evaluation at NOAA (National Oceanic and Atmospheric Administration). The workshop was sponsored by a NOAA grant (NA06OAR4600230) to Iowa State University. The electronic proceedings of this workshop in the form of a CD-ROM, that includes (a) the technical papers presented by the speakers, (b) three group reports that were the outcome of the group discussions, and (3) a summary report of the panel discussion, can be obtained by a written request to Partha Sarkar at ppsarkar@iastate.edu.



FIRST AAWE STUDENT CHAPTER FORMED

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A group of students in the Wind Science and Engineering Research Center at Texas Tech University have worked together over the last few months to form the first student chapter of AAWE. We are honored to have the blessing of the American Association for Wind Engineering in the formation our TTU chapter. Below are some of our goals and intentions:

- Mentoring new and interested students in Wind Science and Engineering
- Assisting students in networking with AAWE members and organizations
- Assist students in aligning their research goals with internship opportunities
- Provide a place to meet and discuss new and innovative research
- Disseminate safety information to the public through fun, informative events

Our organization will work to facilitate the needs of the students and streamline some processes. This first AAWE student chapter wishes to thank the AAWE Board for approving the concept and the student members look forward to meeting all the AAWE members at future conferences and workshops.

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

PRESIDENT'S CORNER



When I am not being President of AAWE my “day job,” as many of you know, is being Dean of the Engineering School at Johns Hopkins University. One of the most exciting aspects of that job is that I preside over a number of truly remarkable developments that are occurring both at the boundaries of traditional engineering disciplines and between engineering and other fields.

Areas such as biomedical engineering—which combines of engineering with clinical medicine and has resulted in the development of revolutionary new devices and procedures and deepened our understanding of diseases—have led to entirely new ways of thinking about the future of medicine. One of the most promising developments to emerge in this area is an approach the practice of medicine called “individualized health.” Beyond simply combining technology with clinical practice, this requires consideration of a host of other important issues, such as bioethics, health policy, economics, and a rethinking of standard clinical practices. This is no easy task, but I assure that it is possible to do and will be truly life-changing, in every sense, when it’s done successfully.

You may be wondering why I am sharing this with you. My answer is that what prepared me for my role at Johns Hopkins and enables me to see the promise in new interdisciplinary approaches to engineering is that I was trained as a wind engineer. I “grew up” in a field that is inherently multidisciplinary and, because of this, I can recognize and understand opportunities and needs in a broad spectrum of other domains. As I reflect on where our field is and where we need to go, I can’t help but think that today we are where biomedical engineering was perhaps a decade ago. We have accom-

plished much, for example, by combining structural engineering and aerodynamics; just as we now perform surgeries that were once considered impossible, we also routinely erect structures that were inconceivable mere decades ago.

But there is more to be done. Our technical accomplishments and advances have not yet succeeded in fully mitigating the impact of wind hazards. While we were blessed with a relative benign hurricane season this year, the number of storms was noteworthy and one cannot help but feel that we have merely dodged a bullet. I believe that our ability to truly eliminate the risks we face each year from wind hazards requires the same type of transformational approach to engineering that has occurred in medicine.

We need to reach even further across disciplinary boundaries if our technical advances are going to make a significant impact in hazard reduction. And though we have talked about this and we have tried it, so far, we have achieved only limited success. Now, we must rededicate ourselves to collaborating effectively with social scientists, responders, owners, and policy makers if we want to make a difference. I believe that revolutionary change in our field is possible and that leadership for such an effort can be found within our community. And just as in fields such as bioengineering, this is no easy task, but it is possible and will be truly life-altering when it’s done successfully!

Sincerely,

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American Association
for Wind Engineering

EDITOR'S NOTE

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As 2010 come to a close, please visit our website and renew your individual, student or corporate membership for 2011 - www.aawe.org. The timely arrival of membership dues is essential to keeping AAWE in good financial shape. It assists in the management of Workshops and Conferences and contributes to student attendance to those events. Thank you.

I would also like to thank Reagan Reynolds at CPP for composing such a well-designed AAWE Newsletter in recent years for all of us to enjoy.

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**American Association
for Wind Engineering**

Established in 1966

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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