



American Association  
for Wind Engineering

# THE WIND ENGINEER

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

July 2007



Hurricane Ernesto was a category 1 hurricane that caused 14 fatalities. Find out about the other hurricane's and typhoon's on page 7.

## PROGRESS REPORT ON NATIONAL RESEARCH INITIATIVES TO REDUCE IMPACTS OF WIND HAZARDS

### PART 1. NHRI ACT OF 2007

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Force on Hurricane Science and Engineering. The Task Force was established by the Board in December 2005, to summarize current activities, identify gaps and opportunities and recommend priorities for action within a national agenda, related to hurricane science and engineering research.

In response to recommendations of the Report, a Congressional Bill was nearly simultaneously introduced in March 2007, in U.S. Senate (S.931) and in U.S. House of Representatives (H.R. 1832). This legislature was subsequently slightly amended and reintroduced in the U.S. House of Representatives (H.R. 2407), in May 2007, as the National Hurricane Research Initiative Act of 2007 (Act).

One of the general implementing recommendations (for NHRI) included in the Report reads as follows (p. 19): "The Board notes that the National Windstorm Impact Reduction Program (NWIRP), which was modeled after NEHRP but has yet to receive funding, may be an appropriate administrative home for NHRI. However, it is important that the hurricane research agenda proposed herein *not be diluted* within the broader context of a general windstorm program, but rather be constructed in a manner that supports and is synergistic with it." In view of this statement, it is anticipated that as the Congressional action on H.R. 2407 and related bills progresses, the

(Continued on page 2)

### 1. Introduction

In January 2007, the National Science Board (Board) has formally released a report entitled 'Hurricane Warning: The Critical Need for National Hurricane Research Initiative' (Report). The Board, established by Congress in 1950, provides oversight for, and establishes the policies of, the National Science Foundation. It also serves as an independent body of advisors to the President and Congress on national policy issues related to science and engineering research and education. The Report presented an agenda for nation-wide action – a National Hurricane Research Initiative – that would provide urgently needed hurricane science and engineering research and education involving a broad range of entities and stakeholders in the United States. It resulted from actions (carried out in 2006) by the Task

### In this Issue:

|  |    |
|--|----|
| Progress Report on National Research Initiatives to Reduce Impacts of Wind Hazards | 1  |
| The Hanukah Eye Storm of December 2006   | 2  |
| Symposium on Emerging Developments in Multi-Hazard Engineering                     | 6  |
| Summary of Information from the API  | 6  |
| Hurricane and Typhoon Chronical  | 7  |
| Presidents Corner  | 8  |
| AAWE Membership Application/Renewal Form   | 10 |
| AAWE Contact Information   | 11 |



Americas Conference on Wind Engineering to be held in Beautiful Puerto Rico.

*(Continued from page 1)*

inter-relation/synergy between NWIRP and NHRI will be discussed. In this context, the content of H. R. 2407 is summarized in this contribution, to provide background information for members of wind engineering community. In a follow-up write-up (Part 2), a broader comparison of the proposed NHRI and NWIRP will be presented.

## **2. National Hurricane Research Initiative Act of 2007**

The Act requires the Under Secretary for Oceans and Atmosphere of the Department of Commerce (Under Secretary) and the Director of the National Science Foundation (Director) to establish three programs:

- National Hurricane Research Initiative
- National Infrastructure Database
- National Hurricane Research Model

The goals of these programs, stipulated by the Act, are discussed below.

## **3. National Hurricane Research Initiative (NHRI)**

The mission of the NHRI is to develop and carry out research in cooperation with other specified federal agencies. The research objective are to be compatible with the findings of the Report. The Act requires NHRI to (1) make recommendations to the National Science Board and the National Oceanic and Atmospheric Administration Science Advisory Board on such research; (2) assemble the science and engineering expertise of State or local government agencies or departments and nongovernmental entities (including universities and colleges and other research and academic institutions), through a multi-entity effort focused on: (i) improving hurricane and other severe tropical storm forecasting capabilities, including formation, track, and intensity change; (ii) durable and resilient infrastructure; and (iii) mitigating impacts on coastal populations, the coastal built environment, and the natural coastal environment, including but not limited to, coral reefs, wetlands, and other natural systems that mitigate hurricane wind and storm surge impacts.

The following research areas are listed in the Act as

eligible to be funded under the umbrella of this legislation:

- **PREDICTING HURRICANE INTENSITY CHANGE** - Research to improve understanding of: (i) rapid change in storm size, motion, structure, and intensity; (ii) storm internal dynamics; and (iii) the interactions of the storm and its environmental conditions, including the atmosphere, ocean, and land surface.
- **UNDERSTANDING OCEAN-ATMOSPHERE INTERACTIONS** - Observations, theory and modeling, to improve understanding of air-sea interaction in high wind speeds.
- **PREDICTING STORM SURGE, RAINFALL, INLAND FLOODING, AND STRONG WINDS PRODUCED BY HURRICANES AND TROPICAL STORMS DURING AND AFTER LANDFALL** - Research to understand, model, and predict rainfall, flooding, high winds, the potential occurrence of tornadoes, and storm surge, including probabilistic modeling and mapping of risk.
- **IMPROVED OBSERVATIONS OF HURRICANES AND TROPICAL STORMS** - Research to improve measurements of hurricanes and tropical storms through mobile radar platforms, Global Positioning Systems technology, unmanned vehicles, ground-based and wireless sensors, oceanic remote sensing technologies, and air-deployed ocean profilers and floats to improve our understanding of the complex nature of storms and their interaction with the ocean and land.
- **ASSESSING VULNERABLE INFRASTRUCTURE** - Research to develop a national engineering assessment of coastal infrastructure, including infrastructure related to levees, seawalls, drainage systems, bridges, water and sewage systems, power, and communications, to determine the level of vulnerability of such infrastructure to damage from hurricanes and to determine strategies to reduce such vulnerabilities.
- **INTERACTION OF HURRICANES WITH ENGINEERED STRUCTURES** - Research to improve understanding of the impacts of hurricanes and tropical storms on buildings, structures, and housing combined with modeling essential for guiding the creation of improved building designs and construction codes in locations particularly

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vulnerable to hurricanes.

- **RELATIONSHIP BETWEEN HURRICANES, CLIMATE, AND NATURAL ECOSYSTEMS** - Research to improve the understanding of complex relationships between hurricanes and climate, including research to determine the most effective methods to use observational information and numerical model simulations to examine the impacts on ecosystems over long and short periods of time, including but not limited to impacts on coral reefs, wetlands, and other natural systems that mitigate hurricane wind and storm surge impacts.
- **TECHNOLOGIES FOR DISASTER RESPONSE AND RECOVERY**- Research to improve emergency communication networks for government agencies and non-government entities and to improve communications between such networks during disaster response and recovery, including cyber-security during disaster situations and the ability to improve damage assessments during storms.
- **EVACUATION PLANNING**- Research to improve the manner in which hurricane-related information is provided to, and utilized by, the public and government officials, including research to assist officials of State or local government in determining the circumstances in which evacuations are required and in carrying out such evacuations.
- **COMPUTATIONAL CAPABILITY**- Research to improve understanding of the efficient utility of multiple models requiring sharing and interoperability of databases, computing environments, networks, visualization tools, and analytic systems beyond what is currently available for transitioning hurricane research assets into operational practice and to provide access to robust computational facilities beyond the facilities normally accessible by the civilian research community for the hurricane research enterprise, including data acquisition and modeling capability during hurricane events.

The Act mandates cooperation among the participants in this Initiative, coordinated by DOC (Under Secretary) and NSF (Director). The participating entities shall include Federal agencies/departments (NASA, NIST, DHS/FEMA, DOE, DARPA, EPA, USGS, and Army Corps of Engineers), as well as research institutes, universities, and disaster-response or nongovernmental organizations with

the expertise and capabilities to carry out the purposes of the NHRI. The overall national coordination of the NHRI, as a formal program with a well defined organizational structure and execution plan, is to be provided by the White House Office of Science and Technology Policy, through the National Science and Technology Council. A 10-year authorization of appropriations is \$285 million for each of the fiscal years 2008 through 2018.

#### **4. National Infrastructure Database (NID)**

The Act mandates the Under Secretary and the Director to establish a NID, for the purposes of:

- cataloging and characterizing the physical, social, and natural infrastructure in order to provide a baseline for developing standards, measuring modification, and determining loss;
- providing information to Federal, State, and local government officials to improve information public policy related to hurricanes and tropical storms; and
- providing data to researchers to improve their ability to measure hurricane impacts, separate such impacts from other effects, both natural and anthropogenic, make effective recommendations for improved building codes and urban planning practices, and develop effective procedures for responding to infrastructure disruption.

The Act requires the NID to be a virtual, cyber environment that uses existing capabilities and facilities, and establishes new capabilities and facilities, as appropriate, to provide an interoperable environment and the necessary metadata and other resources needed by users of that Database. The authorized appropriation for this component is \$20 million for each of the fiscal years 2008 through 2018.

#### **5. National Hurricane Research Model (NHRM)**

The Act directs the Under Secretary and the Director to develop a NHRM to conduct integrative research and to facilitate the transfer of research knowledge to operational applications, including linking relevant theoretical, physical, and computational models from atmospheric, oceanic, economic, sociological, engineered infrastructure, and ecologic fields, conducting experimental research to under-

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(Continued from page 3)

stand the extensive complexities of hurricanes, training of the next-generation hurricane researchers and forecasters, and obtaining measurable results in a comprehensive framework suitable for testing end-to-end integrative systems. It is postulated that the NHRM shall be a physically distributed and highly coordinated working environment in which research from the National Hurricane Research Initiative can be experimentally substantiated using suitable quantitative metrics, and where a culture of interaction and collaboration can further be promoted, including: (1) facilities and cyber infrastructure; (2) software integration; and (3) data collection platforms and data provisioning systems. The authorization of appropriations is \$130 million for each of the fiscal years 2008 through 2018.

## 6. Remarks

Recent Congressional and other national initiatives geared towards better understanding of hurricanes and other wind hazards, their impacts and mitigation of undesired impacts of strong winds, are encouraging. Members of wind engineering community are urged to get involved in related discussions and other actions aiding this process. It is hoped that these developments will lead to conditions conducive to timely appropriation of research funds urgently needed to reduce property and human losses, within a reasonable time framework.

Thirteen deaths were attributed to the storm in the Puget Sound region which includes the Seattle-Tacoma, Washington urban centers [Green et al. (2006)]. The primary cause of death was smoke inhalation or carbon monoxide poisoning for families in their homes using improperly ventilated generators. Although many public service announcements were made regarding the dangers of smoke inhalation and carbon monoxide poisoning, most of the families who died were immigrants who spoke little or no English. Other deaths are attributed to drowning, and trees falling on occupied cars or trailers. More than two hundred residents of Seattle made claims against the city for flood damage caused by the overloaded storm-water and sewage system [Chan (2007)].

Sustained wind speeds for the region are provided in Table 1 [Mass (2007)]. Although the wind speed values do not differ by much, and the gusts were also comparable for the 1993 and the 2006 events, the damage for the latter event was noticeably higher.

| Location in Washington State       | 1993 Wind Speed [mph] | 2006 Wind Speed [mph] |
|------------------------------------|-----------------------|-----------------------|
| Tacoma                             | 62                    | 69                    |
| Renton                             | 74                    | 51                    |
| SeaTac Airport                     | 64                    | 69                    |
| Boeing Field (Seattle area)        | 70                    | 56                    |
| West Point Light                   | 60                    | 70                    |
| University of Washington (Seattle) | 69                    | 55                    |
| Everett-Paine Field                | 67                    | 66                    |
| Smith Island                       | 52                    | 76                    |
| Bellingham                         | 59                    | 55                    |

Wind speed comparison [Mass (2007)]

Power outages were more extensive and lasted longer than in 1993. Soil saturation has been blamed for the additional prolonged damage. The two month period preceding the wind storm was very wet. Indeed, the precipitation for several locations broke all-time records. The combination of saturated soils with strong winds generally results in the uprooting of many Northwest trees such as the Douglas Fir. In addition, new construction in previously forested areas contributed to the exposure of older trees that had been sheltered previously.

An example of tree-related damage in the Seattle area on December 15<sup>th</sup> is shown in Figure 1. Numerous houses were crushed by falling trees; the exact numbers are not available at this time.

## The Hanukkah Eve Storm of December 2006

By: Dorothy A. Reed, Professor of Civil Engineering  
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### Background

On December 14, 2006, a winter storm hit the Pacific Northwest region. Affecting communities from northern Oregon to southern British Columbia, this storm was named the Hanukkah Eve Storm by the Pacific Northwest Meteorological Society. This event was a mid-latitude cyclone with winds that occur roughly once in ten years [Mass (2007)]. The most recent storm in the region with winds of this magnitude was the Inauguration Day storm of January 1993. However, the damage in urban areas in 2006 was much greater than that incurred in 1993. Power outages were extensive and most roadways were blocked by fallen trees and debris.

(Continued on page 5)

(Continued from page 4)



Figure 1. Tree has fallen over both house in background and roadway in foreground. City workers have just used chainsaws to remove a section of the trunk in the foreground.

Power outages were extensive. Figure 2 shows a plot of customer outages for December 2006 for Puget Sound Energy. Over 700,000 customers lost power in the storm; 159 substations were out and 85 transmission lines were out. Because the storm occurred during the holiday season, affected residents were particularly unhappy. Service teams faced challenges in the restoration of power delivery systems because many streets were blocked by trees and storm debris. A restoration model of the form

$$R = 1 - e^{-bt} \quad (1)$$

where

$R$  is restoration of outages in percent with 100% representing full restoration;  
 $t$  is time in days; and  
 $b$  is a coefficient determined through data analysis

was fit to the data in Figure 2. Using linear regression, the coefficient  $b$  was determined to be 0.51 for the Puget Sound Energy (PSE) data with an  $R^2$  goodness of fit value of 86 percent. The model and data are plotted in Figure 3. Because the model is not consistent with the data for the mid-range of four to eight days, a two-part restoration model is under investigation.

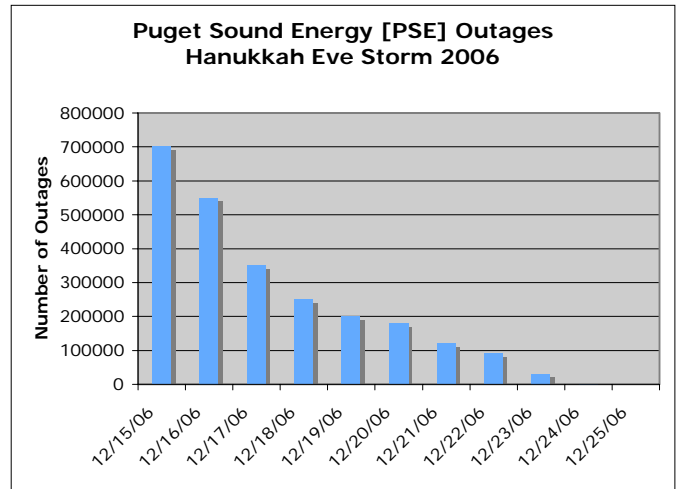


Figure 2. Puget Sound Energy [PSE] Outages for the Hanukkah Eve Storm.

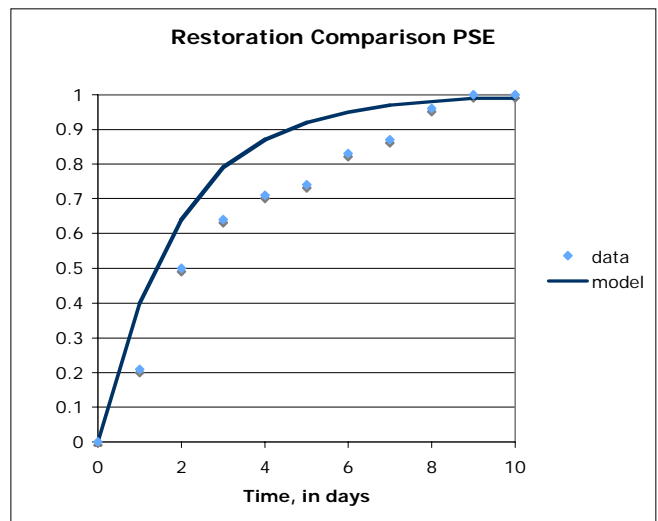


Figure 3. Restoration analysis for the data of Figure 2.

**Summary**

Winter storm damage can be severe. Most of the damage is to the interdependent lifelines such as the power delivery system, the transportation grid and the wastewater system. Evidence of the closed-loop interdependencies as described for hurricanes between power delivery and transportation [e.g. Krimgold et al. (2006)] was apparent for this storm. Power outages can create difficulties in the winter due to low temperatures. Air quality suffers during periods of extended outages due to smoke from fireplaces [Gilroy (2007)]. Unfortunately, the few

(Continued on page 6)

(Continued from page 5)

deaths that occurred were primarily attributed to carbon monoxide poisoning or smoke inhalation. Investigations of the infrastructure damage are ongoing at the University of Washington. Additional data on the Pacific Northwest climate may be found at a website maintained by Wolf Read at <http://oregonstate.edu/readw>.

### Acknowledgements

The writer would like to thank Puget Sound Energy for providing outage data for the storm for analysis.

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## Symposium on Emerging Developments in Multi-Hazard Engineering

AEI, the Architectural Engineering Institute of ASCE, and MCEER (University at Buffalo) in cooperation with the Steel Institute of New York will organize the Symposium on Emerging Developments in Multi-Hazard Engineering on September 18, 2007 at the McGraw Hill Auditorium in New York City. Recent events such as the attacks of September 11, 2001, the Asian tsunami in December 2004 and Hurricane Katrina have highlighted the need for solutions when two or more hazards simultaneously threaten communities and their infrastructure. To address the complications that arise from events where multiple hazards occur, the symposium will consider multi-hazard engineering from the perspectives of risk,

reliability, design, analysis, cost benefit, lifecycle costs and structural health monitoring. Blast, earthquake, wind, flood and wave surge will be among the specific hazards discussed.

Topics to be explored include lessons learned from 9/11 and Hurricane Katrina, fundamental measures to improve disaster resilience, multi-hazard engineering in Los Angeles and New York City, Federal Emergency Management Agency multi-hazard risk assessments and improving resilience of transportation infrastructure. Nationally recognized researchers and practitioners from industry, academia and government will discuss a variety of solutions and applications, including adapting technologies developed for specific hazards to multi-hazard problems and developing new technologies to mitigate a variety of threats. The goal of the symposium is to establish an integrated risk assessment framework for multi-hazard environments and address assessment and mitigation of risk from competing low probability high consequence hazards. For more information on the AEI-MCEER Symposium on Emerging Developments in Multi-Hazard Engineering, or to register online, visit: <http://mceer.buffalo.edu/meetings/aei/default.asp>.

## Summary of Information from the American Petroleum Institute (API)

By Bob Bailey

During the 2004 and 2005 hurricane season, higher waves and stronger winds than anticipated were recorded in deeper areas of the Gulf of Mexico (GOM). The oil and natural gas industry has therefore moved away from viewing the GOM as a uniform body of water. A central portion of the GOM is now understood as a gathering spot for warm currents that can strengthen storms, making it more hurricane-prone. As a result, the metocean data for the GOM has been updated, prompting API to reassess its applicable Recommended Practices. API has subsequently published three new interim documents to help the industry apply the latest understanding of metocean conditions in and around the GOM to make its offshore facilities more survivable during hurricane season. The new documents include Bulletin 2INT-MET, *Interim Guidance on Hurricane Conditions in the Gulf of Mexico*, which provides updated metocean data for four regions of the Gulf, including wind velocities. Final recommended practices based on this and other bulletins are expected next year. More information can be obtained from API at their website: [www.api.org](http://www.api.org)

## 2006 Hurricane and Typhoon Chronicle

### 2006 North Atlantic Hurricane Season

| Name                     | Date          | Maximum Category on Saffir-Simpson Scale | Maximum Wind Speeds | Affected Areas   | Fatalities | Estimated Overall Losses (US\$ m) | Estimated Insured Losses (US\$ m) |
|--------------------------|---------------|--|---------------------|--|------------|-----------------------------------|-----------------------------------|
| Tropical Storm Alberto   | 10-14 June    |  | 110 km/h            | Cuba. USA: FL, NC, SC  | 1          |                                   |                                   |
| Tropical Storm [unnamed] | 17-18 July    |  | 85 km/h             |  |            |                                   |                                   |
| Tropical Storm Beryl     | 18-21 July    |  | 90 km/h             |  |            |                                   |                                   |
| Tropical Storm Chris     | 1-5 Aug       |  | 100 km/h            |  |            |                                   |                                   |
| Tropical Storm Debby     | 21-27 Aug     |  | 85 km/h             |  |            |                                   |                                   |
| Hurricane Ernesto        | 24 Aug—1 Sept | 1  | 120 km/h            | Cuba. Dominican Republic, Haiti. USA: DE, FL, MD, NC, NJ, NY, SC, VA | 14         | 500                               | 245                               |
| Hurricane Florence       | 3-12 Sept     | 1  | 150 km/h            | Bermudas, Canada   |            |                                   |                                   |
| Hurricane Gordon         | 11-20 Sept    | 3  | 195 km/h            |  |            |                                   |                                   |
| Hurricane Holone         | 12-24 Sept    | 3  | 205 km/h            |  |            |                                   |                                   |
| Hurricane Isaac          | 27 Sept—2 Oct | 1  | 140 km/h            |  |            |                                   |                                   |



The ICWE-12 was held in Cairns, Queensland, Australia, earlier this month.

(Continued on page 8)



### President's Corner

In this newsletter we are treated to some of the varied activities undertaken by the AAWE and its representatives. Bogusz Bienkiewicz gives us a

comprehensive update on the National Windstorm Hazard Reduction Program and the recent machinations in Washington with regard to its potential funding. The second half of this discussion will be in the September edition of the Newsletter. As if to highlight the importance of wind-damage mitigation, Dorothy Reed shows us what happened in the Northwest during December last year in her article about the Hanukah Eve Storm.

In the period between this and the last Newsletter we had a successful election for three new Board members (Kurt Gurley, Greg Kopp and Doug Smith) and a President Elect (Nick Jones). Congratulations to them all. In addition, a referendum on an amendment to our Bylaws to add to Article V, creating a Senior Executive Council made up of all our past presidents, was passed overwhelmingly. Thank you to all of you who participated in the ballot process, and a special thanks to all the candidates who so graciously offered their time and effort to improve our Association. I hope that the three unsuccessful candidates will run again in two years.

During ASCE Structures Congress in Long Beach the newly elected Board took the opportunity to meet in person and outlined activities and tasks for the next year. One of the new committees created was the Workshop Committee (Doug Smith, Greg Kopp and Leighton Cochran) which has the goal of organizing a small Workshop to facilitate student presentation of current research. Another committee will be reviewing our AAWE Bylaws to see if they need to be updated to accommodate, for example, more modern communication techniques. At the same Board meeting in Long Beach Steve Camposano (President and founder of one of our Corporate Members, High Velocity Inc., which makes hurricane storm shutters for highrise buildings)

offered to buy AAWE a copy of QuickBooks software to help us in our money management. The Board quickly accepted Steve's kind offer.

In early July many of us met in Cairns, Australia, for the 12<sup>th</sup> International Conference on Wind Engineering at the Cairns International Hotel. The conference was very well attended at this beautiful, tropical, seaside city. The Australasian Wind Engineering Society should be congratulated for organizing such a wonderful event. The idea of having a tourist day off midweek, during the event, was great concept that allowed many attendees to explore part of the Great Barrier Reef. The conference dinner was held on Green Island, just a few kilometers off-shore from Cairns. The three inaugural Davenport Medals were awarded to Drs. Nick Cook, Ahsan Kareem and Shuzo Murakami. Professor Davenport, who has been to every ICWE meeting since their inception, received a standing ovation from the attendees prior the medal announcement. At this event our own Kurt Gurley was presented with an International Association for Wind Engineering (IAWE) Junior Award for his extensive residential building work being done in Florida. The two other IAWE Junior Awards went to Luigi Carassale of Italy and Tetsuya Kitagawa of Japan. The IAWE General Assembly also elected Prof. Yukio Tamura to be the next IAWE President, and Prof. Giovanni Solari was thanked by all in attendance for his tireless work over the last eight years. Hopefully we will have some photos from ICWE-12 donated to the AAWE Newsletter in the next issue.

This newsletter continues to need articles from the members. Please send publishable items to me at [lcochran@cppwind.com](mailto:lcochran@cppwind.com) as Word files and image files for us to review and place in future editions. I would also ask the members to encourage others interested in wind engineering to join AAWE, either as individuals or as a corporation. Pass them this newsletter so they can use the rear pages to join.

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*The AWES dinner held at the aviary of the Cairns Casino on the last night of ICWE-12. Congratulations to AWES on a great conference in Cairns.*

# AMERICAN ASSOCIATION FOR WIND ENGINEERING

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**American Association  
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- 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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