



American Association
for Wind Engineering

THE WIND ENGINEER

MARCH 2005

“Powerless” to Acquire Ground Truth in Tropical Cyclones

*Forrest Masters, PhD and Collette Blessing
Florida International University*

“As usual, there were no official surface anemometer measurements of wind speeds even approaching the intensity estimate near the landfall location... Instrument failures remain a chronic problem in landfalling hurricanes.”

Excerpted from the National Hurricane Center’s Hurricane Charley Tropical Cyclone Report
Authors: R.J. Pasch, D.P. Brown and E.S. Blake,

Introduction

The United States operates a variety of weather observations to monitor ground level wind speeds. One of the largest and most widely used networks is the Automated Surface Observation System (ASOS), operated by the National Weather Service (NWS) and the Federal Aviation Administration (FAA). It consists of approximately 1100 observation suites located at airports and other open-exposure locations and is described by the NWS as “the nation’s primary surface weather observing network.” The ASOS system records surface meteorological conditions and provides minute-to-minute weather updates to the FAA to inform pilots of diminishing weather conditions. This

platform is the successor to the Automated Weather Observation System (AWOS) previously used by the NWS as the primary means of surface observations. The 200 AWOS suites operating today have many of the same capabilities as the ASOS but lack the advanced systems self diagnostics that promote system efficiency and reduce failure rates.

While these weather monitoring stations are useful for normal operation—as tools for meteorological prediction, assessment of flight level conditions, air pollution studies, and climate monitoring in agrarian regions—they are unreliable for measurement in extreme wind events. Tree branches succumbing to high winds (> 40-60 mph) commonly disrupt power service, and absence of backup power prevents further data collection. Stations can also fail from debris impact and wind loading—particularly due to damage to the structure supporting the anemometry (Powell et al., 1993).

This study evaluates the performance of the AWOS/ASOS platform during the landfall of twelve named Atlantic tropical cyclones during 1998-2004. The methodology, results and implications follow. Recommendations are also offered to improve the current platform.

Station Selection and Standardization of Data to Common Height, Duration Exposure

A complete ground observation consists of the wind speed, the height of the recording instrument and a measure of the upwind terrain, since wind velocity is deeply sensitive to height and surface roughness. Accordingly, this section describes the selection and standardization procedure applied to the data. The following notation is used to describe the mean wind speed:

$$\bar{U}(T, z, z_0),$$

where T = averaging time (s), z = observation height (m), and z_0 = roughness length (m).

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UPDATE - 10th Americas Conference on Wind Engineering -

May 31-June 4, 2005
Baton Rouge, Louisiana, USA

The Tenth Americas Conference on Wind Engineering promises to be an exciting meeting with a wide range of technical activities for wind engineering researchers and practitioners alike.

INVITED SPEAKERS

The conference is very pleased to announce a strong lineup of Invited Plenary Session speakers. We have three of the foremost experts on hurricanes in a special session scheduled fittingly for the afternoon of June 1, the first day of the Atlantic Hurricane Season). State-of-knowledge reviews will be presented in the areas of: hurricane wind speeds by Dr. Mark Powell, NOAA Hurricane Research Division; hurricane loss modeling by Dr. Larry Twisdale, Applied Research Associates; and hurricane hazard mitigation by Dr. Timothy Reinhold, Institute for Business and Home Safety.

The June 2 Plenary Session features an international theme appropriate for the Americas Conference on Wind Engineering. Professor Joaquim Blessman will present aerodynamic studies conducted in support of the Brazilian wind code, following an introduction and brief presentation about the International Association for Wind Engineering by regional coordinator Dr. Ahsan Kareem.

Dr. Leighton Cochran of Cermak Peterka Peterson, Inc., will discuss the state-of-the-art/state-of-the-practice in wind tunnel testing techniques in the June 3 plenary session.

TECHNICAL SESSIONS

Over 150 technical papers will be presented during the meeting, in four parallel tracks, including one dedicated to practicing professionals. Two poster sessions will also be held.

EXHIBITORS

Many exhibitors will participate, with some giving presentations in Exhibitor Showcase sessions.

SHORT COURSES

A variety of short courses, ranging from 1-4 hours in length, provide learning opportunities covering:

- ASCE 7 and IBC wind load provisions
- Design of roofs in high wind areas
- Hurricane resistant retrofits
- Specifying hurricane resistant products
- What a practicing engineer needs to know about wind tunnel testing
- Wind-induced dynamics
- and several more—see conference web site.

SPECIAL SESSIONS

The conference will feature a number of special sessions, including one- to two-hour sessions on:

- Building performance in Hurricanes Charley & Ivan
- National Wind Hazard Impact Reduction Program
- ASCE 7 Forum—review of changes in ASCE 7-05 and discussion of future directions for the standard
- Draft Wind Provisions of new National Standard on Design and Construction of Storm Shelters

TECHNICAL TOURS

Several technical tours will be available on May 31 and June 1, including:

- LSU Wind Tunnel Lab
- Louisiana House (demonstration home featuring hurricane resistant construction and safe room)
- Hurricane resistant glass manufacturing facility

COMPANION TOURS

Outings are planned to an antebellum plantation home and local museums and shopping areas.

CONFERENCE HOTEL

The Sheraton Hotel and Convention Center in downtown Baton Rouge is the site of the conference. Located along the Mississippi River, the unique site has easy access to several restaurants, museums, and a Riverboat Casino. **PLEASE MAKE YOUR RESERVATIONS BY HOTEL CUTOFF DATE MAY 5.** There are several other large conferences in town on the same days and hotel rooms are filling up fast.

FOR MORE INFORMATION

Web: www.10ACWE.lsu.edu

Email: 10ACWE@hurricane.lsu.edu

Phone: +1 (225) 578-4813

AAWE NEWS AND UPDATES

Cochran Named President-Elect

The results of the officer election have been reported by AAWA Secretary/Treasurer Steve Cai. Congratulations to our new President-Elect Dr. Leighton Cochran, and new Board Members Mr. James Delahay, Dr. Jon Galsworthy, and Dr. Timothy Reinhold. Thanks go out to the Board Members they are replacing, Mr. Tony Gibbs, Dr. Nicholas P. Jones, and Mr. Thomas L. Smith, for their efforts in support of AAWA over the past four years.

Dr. Bogusz Bienkiewicz is commended for his excellent service and leadership as President over the past two years. His column at right summarizing recent AAWA accomplishments provides a clear demonstration of his successful term in office.

Partha Sarkar Joins Board

Dr. Partha Sarkar, Associate Professor of Aerospace Engineering and Wilson Chair at Iowa State University, was recently appointed to the AAWA Board of Directors. He fills the unexpired term of Dr. Mark Powell, who stepped down last summer. Partha is no stranger to AAWA; he previously served as Secretary/Treasurer for several years.

Partha is also Director of the Iowa State Wind Simulation and Testing Laboratory. His research interests are of aerodynamics of long-span bridges and stay-cables and wind tunnel and full-scale testing of engineering structures.



IAWA Approves AAWA Membership

As noted in the last newsletter, AAWA submitted an application to become a member organization in the International Association for Wind Engineering (IAWE). That application has now been approved. The first Regional Assembly for the Americas Region of IAWE will be held at the 10th Americas Conference on Wind Engineering, on June 1, 2005.

It is with great sadness that we announce the passing away of Jack Cermak's wife, Helen, on March 12, 2005.

Message from the Past President

Bogusz Bienkiewicz

As the election process and transition of assignments to new AAWA officers is near completion, I would like to express my gratitude to all the current and past AAWA officers, for their contributions to our association and for their dedicated service to AAWA members and wind engineering community in general. My thanks go also to all the AAWA members who got involved in activities of our organization and to those who provided feedback on initiatives undertaken by the AAWA officers. On a personal note, I would like to state that it was honor for me to serve as the AAWA President and as AAWA officer.

Having completed my term as AAWA President, I thought it would be instructive to take a retrospective look at AAWA accomplishments, over the past few years, in the area of service to AAWA members and contributions to wind engineering community. Highlights of this overview are presented hereafter:

AAWA Newsletter – The Wind Engineer

This newsletter has been published on a regular (bi-monthly) basis since January 2000. Printed copies were distributed to AAWA members and to a broader audience, that included legislators (in U.S. House and the Senate), various federal agencies, and other entities in public and private sectors. Electronic version was published on the AAWA website. Thanks are due to all the authors of articles submitted for inclusion in the newsletter. These contributions significantly enhanced content of this publication. Persons interested in getting involved in editing and distribution of the newsletter are encouraged to contact Marc Levitan, the current AAWA President and Editor of the newsletter.

AAWA Website

In addition to the AAWA newsletter, publications of interest to AAWA members, and to wind engineering community in general, have been posted on the

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Texas Tech's Research Activities During Hurricanes Charley, Frances, and Ivan

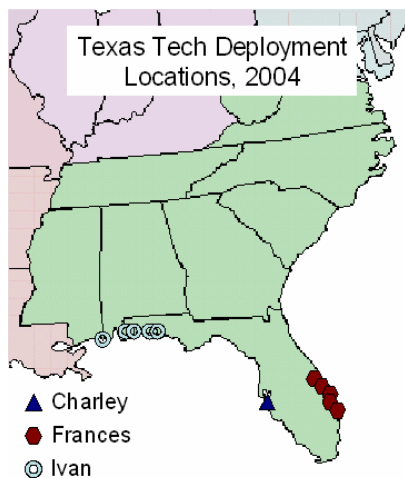
Becca Edwards, Texas Tech University

Texas Tech University's Hurricane Intercept Team deployed instrumentation in three of 2004's landfalling hurricanes: Hurricanes Charley, Frances, and Ivan (see map below). Texas Tech also deployed two Shared Mobile Atmospheric Research and Teaching Radars (SMART Radars) in Hurricane Frances. Each mobile instrumented tower recorded wind speed and direction data at 10 m as well as barometric pressure, relative humidity, and temperature. Two of the towers featured wind instrumentation at multiple levels and all of the platforms sampled data at a rate of 5-10 Hz.



Hurricane Charley

The team deployed one tower at the Sarasota International Airport in Sarasota, FL shortly before Hurricane Charley made landfall approximately 45 miles to the south in Port Charlotte as a category 4 hurricane. Because of Charley's compact inner core and landfall location, the wind speed data collected by Texas Tech in Sarasota were of only minimal tropical storm strength and will not be discussed in this article.



Hurricane Frances

Five instrumented towers and two mobile SMART Radars (pictured below) were deployed by Texas Tech for Hurricane Frances. The experimental plan was to spread the towers along the coast in hopes of



sampling the eye and eyewall of Hurricane Frances and to position the two SMART Radars in such a way that they could both sample the hurricane's wind-field during the landfall. Four towers were deployed in Titusville, Melbourne Beach, Vero Beach, and Fort Pierce, Florida. The two SMART Radars were deployed at the Space Coast Airport in Titusville and the Merritt Island Airport. A summary of the tower deployment sites and maximum 1-minute sustained and 3-second gust speeds recorded is provided in the table below. The two SMART Radars were used to document the internal boundary layer and to characterize hurricane planetary boundary layer (HPBL) rolls or wind streaks. Several hours of dual-Doppler data, which provides a 3-D view of the wind-field were collected during Frances' landfall. The meteorological, wind, and radar data collected during Hurricane Frances represents the most complete characterization of a hurricane landfall that Texas Tech has achieved since the program began in 1998. The towers in Fort Pierce, Sebastian, Vero Beach, and Melbourne Beach all experienced some part of the eyewall and passage of

Observations from Hurricane Frances	
Location	Max 1-min mean (3-s gust) m/s
Space Coast Regional Airport, Titusville, FL	30.98 (40.10)
Flutie Athletic Complex, Melbourne Beach, FL	31.41 (39.30)
Vero Beach Municipal Airport, Vero Beach, FL	30.29 (37.74)
St. Lucie County International Airport, Ft.	34.45 (42.61)

the eye is reflected in the data from Fort Pierce and Vero Beach. Even the northernmost tower, in Titusville, recorded a 3-second gust well over hurricane strength and a 1-minute sustained wind close to hurricane strength.

Hurricane Ivan

Like Frances, the experimental goal for Hurricane Ivan was to sample the eyewall and eye of the hurricane. Towers were placed in Gulfport, Mississippi; Fairhope and Gulf Shores, Alabama; and Destin, Florida. A summary of the deployment sites and

Observations from Hurricane Ivan	
Location	Max 1-min mean (3-s gust) m/s
Gulfport-Biloxi International Airport	22.92 (31.93)
Fairhope High School, Fairhope, AL	21.72 (33.11)
Jack Edwards International Airport, Gulf	39.23 (45.72)
Destin-Ft. Walton Beach International Airport,	30.96 (39.82)

wind speed observations is provided in the table. Considerable damage to the hangars was visible at the Jack Edwards Airport in Gulf Shores, Alabama

where the Texas Tech tower recorded a 1-minute sustained wind speed of 36.23 ms⁻¹ and a 3-second gust of 45.72 ms⁻¹.



TTU graduate students deploying instrumented tower.

Effects of Wind-Induced Motion of Tall Buildings on Occupant Comfort

Submitted by Dr. Peter Hitchcock

The CLP Power Wind/Wave Tunnel Facility (WWTF) at The Hong Kong University of Science and Technology is conducting ongoing research into people's perception of and response to tall building motion in strong wind. We have recently implemented an exciting and much needed research programme; an online survey where individuals can report their experience with wind-induced tall building motion in a completely confidential and privacy protected environment

If you have ever experienced wind-induced motion in a tall building please log on to our survey and tell us about it!

www.wwtf.ust.hk/motsim/

The knowledge acquired from the results collected will be used to further the understanding of the acceptability of tall-building motion, which remains one of the most contentious issues for tall building design due to the lack of broadly accepted international criteria.

In addition to the web survey, we have recently brought online a tall building Motion Simulator (as shown in photographs below) to accurately reproduce the motions that are experienced by tall buildings ranging from 50m to 500m during severe wind storms such as typhoons. The Simulator is currently being used in an extensive research programme of people's responses to motion and will be used in combination with the survey results to formulate guidelines for tall building design.



“Powerless” to Acquire Ground Truth

(Continued from page 1)

Note that the term “standardized” implies that $T = 60$ s (consistent with the National Hurricane Center (NHC) definition of a “sustained” wind speed duration), $z = 10$ m (as deemed by the World Meteorological Organization) and $z_0 = 0.03$ m (open exposure in ASCE 7-02) or equivalently, by the established notation: $\bar{U}(60,10,0.03)$.

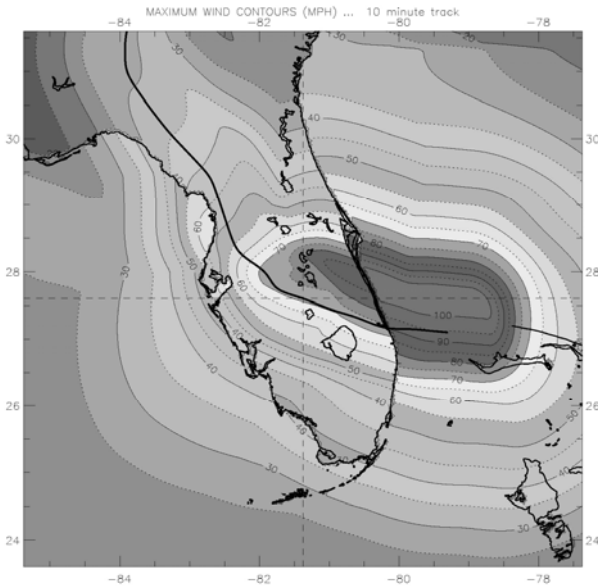


Figure 1. H^* Wind maximum sustained wind swath for Hurricane Jeanne (courtesy of the NOAA Hurricane Research Division)

First, Hurricane Research Division (HRD) H^* Wind (Powell et al, 1998) maximum standardized wind swaths were generated for each storm and layered with an ARC-GIS map of AWOS/ASOS stations (Figure 1 illustrates an example). Stations inside of the area that experienced ≥ 35 mph sustained one-minute wind speeds were selected for analysis. Table 1 provides the number of stations analyzed in each storm, the maximum standardized wind speed (see next section) observed by one or more of these stations, and the official surface wind estimate provided by the NHC in the Tropical Cyclone Reports.

Second, the peak 120 sec sustained wind speed $\bar{U}(120, z, z_0)$ and its associated direction were extracted from the National Climatic Data Center (www.ncdc.noaa.gov) for each of the chosen sites.

Table 1. Number of stations analyzed per storm and the corresponding maximum (standardized) observed and NHC estimated wind speeds

Case	Year	Tropical Cyclone	Stations Analyzed	60-s Sustained Wind (mph)	
				Obs.	Est.
01	1998	Bonnie	17	75	109
02	1998	Earl	15	47	81
03	1999	Bret	7	49	115
04	1999	Floyd	37	84	104
05	1999	Irene	20	58	75
06	2002	Lili	18	61	92
07	2003	Claudette	12	62	92
08	2003	Isabel	54	70	104
09	2004	Charley	17	90	144
10	2004	Frances	53	71	104
11	2004	Ivan	47	71	121
12	2004	Jeanne	36	82	121
Total			333		

If the station operated normally during landfall, this observation represents the peak wind speed measured at that site. If the station failed to report, it represents the highest wind speed measured before/after the station ceased responding.

Third, a z_0 value was assigned to the observations. Based on the direction associated with the maximum wind speed, z_0 was linearly interpolated from values in the HRD Tropical Cyclone Wind Exposure Documentation Project (Powell, 2004), which provides z_0 values for each cardinal (N, S, E, W) and ordinal (NE, SE, SW, NW) direction. Sites not included in the database were assumed to be open ($z_0 = 0.03$ m) exposure.

Fourth, the wind speeds were adjusted to a standard height of 10 m via manipulation of the log-law:

$$\bar{U}(120, 10, z_0) = \bar{U}(120, z, z_0) \frac{\ln(10/z_0)}{\ln(z/z_0)} \quad (1)$$

Fifth the peak wind speeds were adjusted to an open exposure through a shear velocity conversion and the log-law (3-5) via the method provided in Simiu and Scanlan (1996):

$$u_* = \frac{\bar{U}(120,10, z_0)}{2.5 \ln(10/z_0)} \quad (2)$$

$$u_{*OPEN} = u_* \left(\frac{0.03 \text{ m}}{z_0} \right)^{0.0706} \quad (3)$$

$$\bar{U}(120,10,0.03) = 2.5 \cdot u_{*OPEN} \cdot \ln(10/0.03) \quad (4)$$

Finally, these values were converted from a 120-s duration to a standard 60-s duration through the gust factor relationship:

$$\bar{U}(60,10, z_0) = 1.04 \cdot \bar{U}(120,10, z_0) \quad (5)$$

Determination of Site-Specific Peak Wind Speeds

If the station operated normally throughout landfall, the estimated peak wind speed is identical to the value determined by Eq. 5.

If the station failed to report during landfall, the wind speed was estimated from portable instrumented towers deployed by the Florida Coastal Monitoring Program (shown in Figure 2) and the Texas Tech Wind Engineered Mobile Instrumented Tower Experiment if they were located on-site. At the remaining sites, the maximum wind speed was estimated from wind swaths generated from the H*Wind. Comparison to the Vickery et al. (2000) model employed by HAZUS-MH hazard loss estimation software is also underway. These results will be published in the upcoming 10ACWE (Blessing and Masters, 2005).

Results

The evaluation of the AWOS/ASOS system during 12 hurricane landfalls indicates high failure rates, attributed primarily to power outages (see Figure 3). At the onset of tropical storm force winds, almost 25% of the stations failed to report. At Saffir-Simpson Category 1 wind speeds, more than 85% of the stations ceased to communicate. All stations that experienced Saffir-Simpson Category 2 wind speeds failed.

Implications

As the primary surface weather observing system in the United States, the AWOS/ASOS stations fulfill a vital role in the documentation of hurricane catastrophes, particularly for (1) monitoring of decaying weather conditions and forecast verification, (2) in-

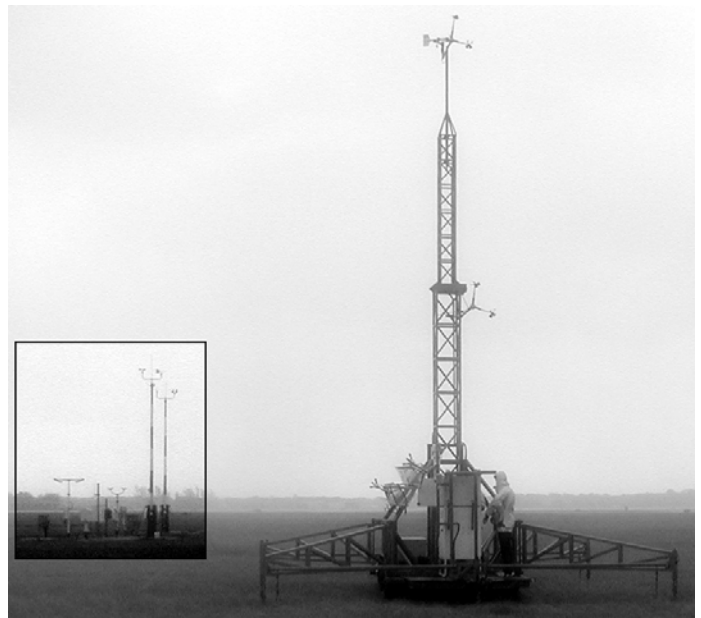


Figure 2. FCMP Tower and the KVRB ASOS at the Vero Beach Municipal Airport. The station failed to report from 25/2337Z – 27/1253Z. During that time, the FCMP tower recorded a peak gust of 106 mph

gestion into and verification of surface wind field models, (3) direct comparison of observed damage in nearby communities to actual (vs. estimated) wind speeds, and (4) response and recovery efforts coordinated by federal, state and local agencies seeking to determine the breadth and degree of impact. Ultimately, the failure of these stations has a wide impact on how professionals perceive, plan and react to hurricane impacts.

Recommendations

Since the inception of the AWOS/ASOS system, several action items concerning the improvement of the ASOS platform were discussed at the Office for the Federal Coordinator for Meteorology Interdepartmental Hurricane Conferences. The authors echo their concerns and suggest the following:

Issue 1: Increased Back-Up Power

Problem. The supply powers the system for up to two additional hours if the heaters do not activate

Solution. Either draw power from the FAA backup power system or increase the backup power supply to a 10-hour capacity

Issue 2: Enhanced Data Archiving

Problem. The system writes raw data to a 12-hour circular buffer, such that the 13th hour overwrites the 1st hour, the 14th hour overwrites the 2nd, etc. The NCDC dials into the station to pull data 3-4 times per day

Solution. Add new code to the data acquisition software that writes data to a non-perishable memory for later retrieval. This part of the program should activate or “trigger” when power is lost and/or a wind speed threshold is reached

Acknowledgements

The authors wish to thank Scott Kiser, Tropical Cyclone Manager for the National Weather Service, Dr. Mark Powell, Atmospheric Scientist at the AOML Hurricane Research Division, Dr. Pablo Santos, Science Operations Officer at the Miami Weather Forecast Office, Dr. Peter Vickery, Project Engineer at Applied Research Associates, Inc., and Dr. John Schroeder, Assistant Professor at Texas Tech University for their assistance during this project.

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Performance of AWOS/ASOS Stations in Tropical Cyclones

Bonnie (1998), Earl (1998), Bret (1999), Floyd (1999), Irene (1999), Lili (2002), Claudette (2003), Isabel (2003), Charley (2004), Frances (2004), Ivan (2004) and Jeanne (2004)

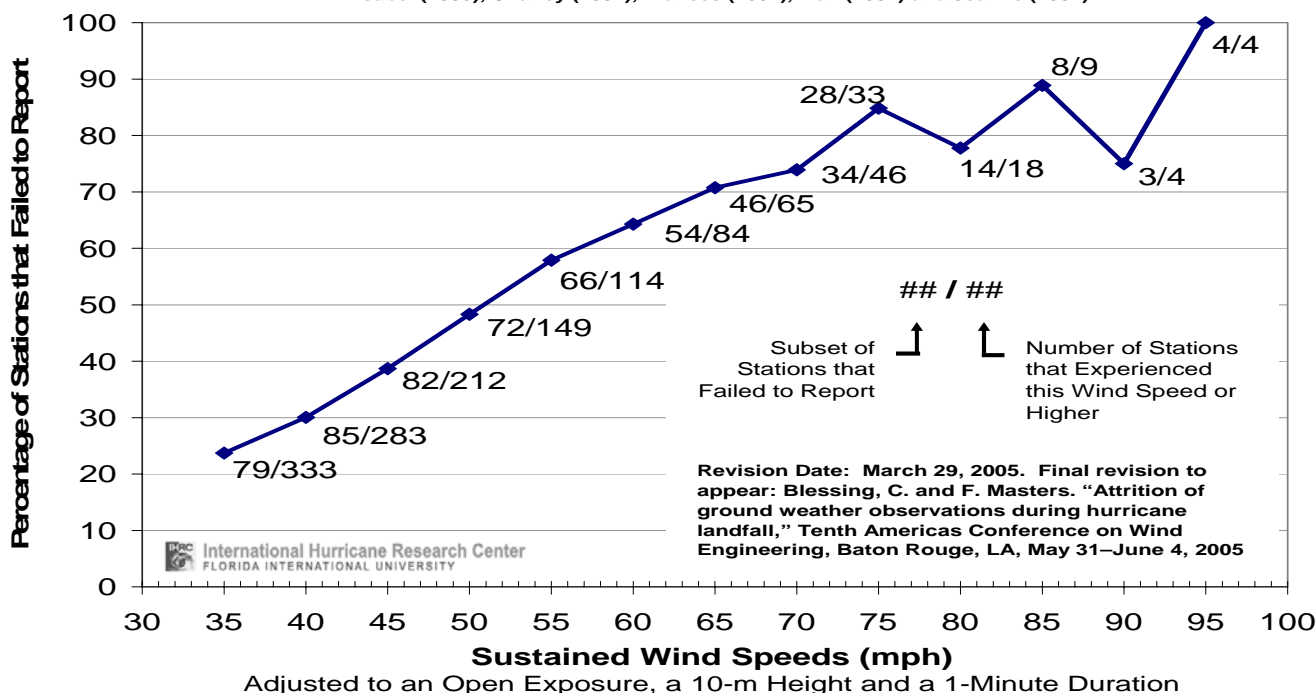


Figure 3. Percentage of stations that failed to report during twelve tropical cyclone landfalls during 1998-2004

Message from the Past President

(Continued from page 3)

AAWE website. Links have been provided to various internet resources relevant to wind engineering. Our thanks go out to Mike Gaus who has served for several years as the webmaster of the AAWE website.

AAWE Awards Committee

This committee was established in 2004. Under leadership of Chris Letchford it has developed guidelines for two Graduate Student Awards - The Dick Marshall Award and the Bob Scanlan Award - and a Distinguished Service Award. The committee had issued a call for nominations for 2005 awards and it is currently in a process of reviewing the received nominations. The recipients of the 2005 AAWE awards will be announced during the 10th Americas Conference on Wind Engineering.

The 10th Americas Conference on Wind Engineering

The next quadrennial conference will be held in Baton Rouge, Louisiana, May 31 – June 4, 2005. AAWE serves as the main sponsor of this meeting. The AAWE officers have participated in evaluation of proposals submitted by various groups interested in organizing 10ACWE. Upon their recommendation, Louisiana State University was chosen to host 10ACWE. Marc Levitan, AAWE President, serves as the Chair of this conference. It is hoped that many AAWE members will attend this conference. An AAWE general membership meeting is scheduled to be held during conference, on Wednesday, June 1.

AAWE Membership

The AAWE membership exhibits steady growth. However, concerted effort will be needed to accelerate this trend. Participation of all the AAWE members will be required to ensure a successful membership drive. Activities in this area have been recently significantly enhanced by initiatives undertaken by Steve Cai, the current AAWE Secretary/Treasurer. It is in interest of us all to accelerate growth of our association and to provide assistance to Steve in his membership drive efforts.

AAWE Participation in IAWE

In 2004 AAWE formally joined the International Association for Wind Engineering (IAWE). Several past and current AAWE officers have been involved in start-up and ongoing activities of IAWE. As the scope of IAWE activities expands, AAWE participation in these initiatives will grow. Ultimately international coordination by IAWE will lead to improved standing and world-wide recognition of potential of national and regional wind engineering communities to improve mitigation of adverse effects of wind hazards and to enhance harvesting of benefits of wind.

AAWE Participation in Efforts to Establish NWIRP

Over the years, a number of AAWE officers and members have been involved in initiatives geared towards establishment of a national wind hazards reduction program. A notable progress in this area has been accomplished in the past couple of years. As a result of efforts coordinated by the Wind Hazards Reduction Coalition, spearheaded by ASCE and assisted by AAWE, legislature calling for establishment of the National Wind Impact Reduction Program (NWIRP) was introduced and passed in Congress, and subsequently signed into law by President Bush in October 2004. The concept for the NWIRP was proposed in a AAWE report prepared in collaboration with ASCE and submitted to Congress during a testimony (on behalf of AAWE) before House Science Committee. This and other AAWE contributions to the legislative process led to significant enhancement of AAWE standing as a viable entity assisting federal efforts to mitigate wind hazards. It is anticipated that AAWE will be invited by federal authorities to participate in development of the NWIRP action plan and in its implementation.

Summary

As it can be seen from the above (selective) summary, significant progress has been accomplished in key areas of AAWE activities. It is my belief that with enhancements in talent and energy provided by incoming AAWE officers and by expanded AAWE membership the outlook for continued significant progress in the above and in new areas is excellent.

Call for Abstracts—Indian Society for Wind Eng **3rd National Conf. on Wind Engineering**

The Indian Society for Wind Engineering will hold its Third National Conference on January 5-7, 2006, in Kolkata.. One page abstracts are due April 30, 2005. For more information, see their web site at www.jadavpur.edu/conference/ncwe06.htm.

PhD Assistantships - Vortex Modeling

Doctoral research assistantships are available beginning June 1, 2005 or thereafter, for a 5-year project on computational vortex dynamic modeling of underlying mechanisms in tornadoes, hurricanes and low wind speed problems. The project is especially concerned with investigations vortex induced resonance problems. Knowledge in computational continuum mechanics and/or mesoscopic approaches is essential. The project also has an experimental component. Applications will be accepted until position is filled but those received before May 3, 2005 will be given priority. For more information, please contact Dr. J.B. Frandsen, Louisiana State University, frandsen@lsu.edu, www.fsi.lsu.edu.

35th Anniversary of TTU Wind Program

Texas Tech University's Wind Science and Engineering (WISE) Research Center began with the damage investigation of the Lubbock, Texas tornado, which devastated the city on May 11, 1970. That tornado, and Hurricane Celia striking Corpus Christi, Texas later that same year, prompted the further study of effects of tornadoes and hurricanes on buildings. Over the past 35 years, working with many other organizations and individuals, the WISE Center has conducted damage investigations, developed shelter designs, established a full-scale field laboratory, measured hurricane winds, and pioneered many other research projects.

As part of the commemoration of the 35th anniversary of the Lubbock Tornado, a reception recognizing the donation of the late Dr. Ted Fujita's archive to Texas Tech University's Library will be held on Tuesday, May 10, 2005. Honored guests include Dr. Kaz Fujita (son of Dr. Fujita) and Dr. Greg Forbes (Storm Analyst for the Weather Channel and former student of Dr. Fujita). The archived material will be preserved and available to the public for future research. See www.wind.ttu.edu.

Wind Engineering and Related Conferences & Committee Meetings

2005 SEI Structures Congress

April 20-24, 2005, New York City
www.asce.org/conferences/structures2005/



3rd Annual World of Hurricane Protection Trade Show and Conference

May 5 - 6, 2005 Orlando, Florida
www.worldofhurricaneprotection.com

Florida Governor's Hurricane Conference

May 9-13, 2005, Tampa, Florida
www.flghc.org

Storm Shelter Committee Meeting

ICC/NSSA Consensus Committee on Storm Shelters
May 9-10, 2005, Tampa, Florida
www.iccsafe.org/cs/standards/is-stm.



WINDPOWER 05

May 15-18, 2005, Denver Colorado
www.awea.org/wp05.html

10th Americas Conference on Wind Eng

May 31-June 4, 2005, Baton Rouge, Louisiana
www.10ACWE.LSU.edu

4th European-African Conf on Wind Eng

July 11-15, 2005, Prague, Czech Republic
www.itam.cas.cz/eacwe2005/

6th Asia-Pacific Conference on Wind Eng

September 12-14, 2005, Seoul, Korea
<http://apewe-vi.kaist.ac.kr/>

AMERICAN ASSOCIATION FOR WIND ENGINEERING

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**American Association
for Wind Engineering**

Membership Application/Renewal

Membership Year: 1 January - 31 December 2005

Dues (Check appropriate category):

Individual Membership: \$50 ____, Student \$10 ____

Corporate Membership; \$500 or more: ____ .

Note— Corporate memberships can include up to five individual members.

Complete one form for each individual member.

Please make checks or other payments (in U.S. \$ equivalents only) payable to American Association for Wind Engineering and mail to:

Dr. Steve Cai

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Your Wind Engineering Interests _____

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