AMERICAN ASSOCIATION FOR WIND ENGINEERING
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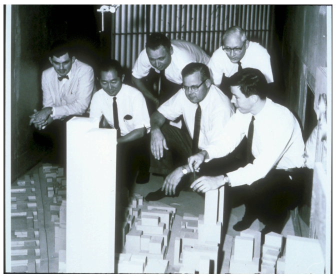
American Association for Wind Engineering

THE WIND ENGINEER

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

Bogusz (Bo) Bienkiewicz, Editor

January 2002



Researchers and designers involved in wind engineering testing of the World Trade Center models at Colorado State University (left to right): A. Davenport, M. Yamasaki, M. Levy, J. Skilling, J. Cermak, L. Robertson. *(Courtesy of J. Cermak)*

In this issue:

Wind Hazard Bill Introduced in U.S. House of Representatives

On December 20, 2001, the Hurricane, Tornado and Related Natural Hazards Research Act was introduced in the U.S. House of Representatives, by Reps. Dennis Moore (D-KS) and Melissa Hart (R-PA). The bill has been assigned number H.R. 3592 and the progress in the legislature may be tracked through the Library of Congress site at http://thomas.loc.gov.

The Wind Hazards Coalition, spearheaded by the American Association of Civil Engineers, and Rep. Moore have been working on the legislation for several months. This effort included negotiations with the affected federal agencies as well as with other organizations. AAWE is a member of the Coalition and it has been actively participating in the above activities. This involvement has been reported in the past issues of The Wind Engineer.

The introduced legislation would establish a National Wind Hazard Reduction Program that would seek a measurable reduction in losses of life and property due to wind hazards over a 10-year period. This bill authorizes $175 million for the program, over three years.

AAWE will continue to be involved in activities of the Coalition and will provide assistance to the Coalition and Congressional staffers, and to other entities, as requested. We will continue to inform the AAWE members about activities in this area and on progress in the legislation, through this newsletter and via direct communication.

In the meantime, the AAWE members are urged to encourage Congressmen in their districts to join the Congressional Wind Hazards Reduction Caucus and to support this legislation. For further information please contact B. Bienkiewicz (bogusz@engr.colostate.edu), who serves as the AAWE Congressional liaison and a contact person with the Coalition (www.windhazards.org).

Another Above-Average Hurricane Season (www.fema.gov)

November 30 marked the end of the 2001 Atlantic hurricane season that began on June 1. The first hurricane did not develop until September 8, the latest date in 17 years. The last hurricane lingered past the end of the season. Although above average in the number of named storms, the 2001 season was the second consecutive year without a land-falling hurricane in the United States. Most of the season's damage came from the remnants of Tropical Storm Allison. The storm claimed 41 lives.

(Continued on page 2)

Named Storms and Hurricanes of 2001

	Named Storms	Hurricanes	Major Hurricanes*
2001	15	9	4
Average	10	6	2

*steady winds of more than 110 mph

WIND LOAD RESEARCH NEEDS FOR ASCE 7

By Jon Peterka,
Member ASCE 7 Wind Loads Task Committee

Chapter 6 of ASCE 7 contains minimum design wind loads for buildings and structures, and has been adopted by the International Building Code for adoption by the three model building codes in the U.S. It thus represents the wind load provisions which will be adopted soon by most building jurisdictions. The standard is written and maintained by a volunteer committee that has no budget for research to support development of new or modified provisions. The committee has assembled an informal list of research needs to guide interested parties. A partial listing of these is outlined below. Some of the listed items are under active codification by the Task Committee with (sometimes insufficient) currently available information.

1. Usability

   a. The Task Committee has committed to improvement of the ease and accuracy of use of the standard as a high priority. Methods to accomplish this are needed.

   b. Develop information to provide a basis for or against changing the standard from a nominal 50-year load basis with a load factor of 1.6, to a strength design basis with load factor of 1.0. This includes handling of both LRFD and allowable stress design.

   c. Develop simplified design provisions to extend those now in the standard.

2. Wind Speed and Exposure Specification

   a. Develop a surface roughness model which is easily used in codified form and which improves the ability to accurately specify wind speeds for buildings in a variety of settings.

   b. Determine additional sites where Exposure D could be converted to exposure C.

   c. Improve the prediction of design wind speeds in all regions, but particularly in Alaska, in the Caribbean, and in other mountainous areas.

   d. Develop a publicly available Monte Carlo method for hurricane design speed prediction.

   e. Perform field measurements to better understand the structure of all strong wind phenomena, but particularly near hurricane eye-walls and in thunderstorms.

3. Wind Loads for Low-rise and High-rise Buildings

   a. There are significant differences in wind load as specified by Figures 6-3 and 6-4. These differences need to be resolved to produce a unified wind loading with accurate transition between low-rise and high-rise buildings.

   b. Develop new or improved wind load provisions for parapets, overhangs, canopies, rooftop structures, and other appurtenances.

   c. Perform field measurements on all types of structures whose intent is to validate wind-tunnel tests or to better understand the wind loading and ultimate reliability of structures.

4. Wind Loads for Low-rise Buildings

   a. Determine whether or not the 10 psf minimum load may be decreased for the Main Wind Force provisions for some low-rise buildings.

   b. Develop wind loads for Main Wind Force Resisting Systems and for Components and Cladding for a variety of plan shapes with and without setbacks.

   c. Develop improved wind loads for gable and hip roofs with and without overhangs.

   d. Develop provisions for roofs of open structures with a variety of blockages or walls (improved provisions based on the Australian Wind Load Standard are currently in development by the committee).

   e. Develop an improved wind load model for domes. Provisions have recently been adopted, but they are based mostly on older data and still need new research.

5. Wind Loads for High-rise Buildings

   a. Develop an improved model for torsion for high-rise buildings, which can also be extended to low-rise buildings (an improved model has recently been approved for adoption, but further development is desired).

   b. Develop a model for crosswind excitation of slender structures.

   c. Develop wind load provisions for buildings under construction.

6. Windborne Missiles

   a. Continue the ongoing specification of windborne missiles.

   b. Perform additional field investigations of missile generation in high winds.

ASCE Medal to Honor Jack Cermak

ASCE's Engineering Mechanics Division and its Structural Engineering Institute have established the Jack E. Cermak Medal to recognize the lifetime achievements of this researcher and educator in the field of wind engineering and industrial aerodynamics. The medal will be awarded for outstanding contributions to research or practice in wind engineering. It will consists of a plaque with an ASCE medallion, a certificate, and a cash honorarium. This new award is being funded by Cermak's friends and colleagues. For more information contact the Honors and Awards of ASCE, www.asce.org, (ASCE News, August 2001).

New Wind Engineering Book

A new wind engineering book, "Wind Loading of Structures" by John D. Holmes has been recently published (June 2001) by Spon Press. The book's goals are to assist the practicing engineer in understanding the principles of wind engineering and to provide guidance on the successful design of structures to counteract wind loading problems. The first half of the book covers principles of meteorology, statistics and probability, as well as aerodynamics and structural dynamics. The second half describes qualitatively and quantitatively the nature of wind loads on various structures, including low-rise and tall buildings, large stadium roofs, towers and chimneys, bridges, transmission lines, free-standing walls and roofs, and antennas. Special features of the book include coverage of extreme winds in tropical and sub-tropical climates of over 50 countries, and detailed coverage of internal as well as external wind pressures on buildings. In addition, a comparison of the provisions for wind loads in six major national and international codes and standards is presented. This 368-page book should be of interest to wind, structural and civil engineering researchers and practitioners. More info on the book and how to order can be found at www.sponpress.com.

Investigation of Engineered Building Wind Failures

By Joseph E. Minor

Abstract

In the wake of recent disasters, investigations of building failures have become important to building code officials, building trade associations, the insurance industry, engineers and architects, and the legal profession. The paper outlines four general types of wind damage investigations and discusses their respective roles in reporting on and influencing construction practice. Principles to guide the investigation of wind-damaged engineered buildings are outlined.

Introduction

The writer has been involved with the investigation of more than sixty damaging windstorm events dating from 1970 through 1995 (Minor and Mehta, 1979). Investigations early in this time period related failure modes to building classifications (Minor, Mehta and McDonald, 1972). Insights into building failure modes that emerged from the damage data correlated well with then new building code initiatives such as those offered in early drafts of ANSI A58.1 (ANSI, 1972). Overall pressure, local pressure, internal pressure and wind-borne debris were identified as the principal wind effects to be addressed in designing buildings. Field investigations in more recent years served to reinforce these prior observations.

In 1992 the damage caused by Hurricane Andrew stimulated a flurry of damage surveys by many types of organizations. The insurance industry, the housing industry, and building trade associations were especially active. These investigations broadened the general understanding of building failure mechanisms, but this plethora of damage surveys revealed some weaknesses in documentation and reporting processes.

Wind Damage Investigations

Four general types of damage documentation have been conducted following windstorms: (1) “windshield” surveys, (2) walk-through documentation, (3) detailed documentation, and (4) the analysis of engineering buildings. Surveys through the windshield of an automobile or aircraft may have visual impact, but contribute little to the understanding of causes of building failures. Walk-through documentation, commonly accomplished only with a camera, can preserve data and illustrate behavior. However, this type of survey is often incomplete or produces misleading observations. Care must be exercised to not prejudge causes of failure because unknown factors such as material properties and connection strengths can mislead the investigation. If dimensions, material samples and other data are not taken in a walk-through investigation, critical calculations cannot be performed subsequently.

The most useful surveys involve detailed documentation, including the recording of important dimensions, the securing of samples for later analysis and the recording of pertinent data about the building site. Detailed documentation can be used to establish the cause of building failures. This approach is essential if the investigation is to be used to influence design practice, building codes, the marketplace, insurance issues or expert opinion. The detailed documentation process is tedious and time consuming both in the field and subsequently in the office. Investigators will find that they will be restricted to documenting only a few buildings of interest in a given windstorm and that large amounts of office time will be required to fully develop the investigation. The detailed documentation of non-engineered building failures in windstorms is addressed in a companion paper in this conference (Phang, 1999). Principles guiding the detailed analysis of engineered buildings are outlined below.

Assessment of Surveys

Following Hurricane Andrew, Saffir (1993) offered an opinion that “Investigations (which) rely on photographic surveys, which become the basis for reports prepared by investigating engineers and professionals from other disciplines, . . . are wholly unsatisfactory for practicing structural engineers.”
(Continued on page 9)

Wind Engineering

Topics of wind engineering practice and research within the scope of AAWE activities include the following:

WIND LOADING ON STRUCTURES

Local loading on the building envelope, mean and dynamic response, bluff body aerodynamics, vortex-shedding, galloping and flutter, fatigue life estimates, effects of architectural details, impact of wind-driven missiles, curtain wall analysis, design loads, codes, and specifications, uncertainty analysis.

DYNAMICS OF WIND SENSITIVE STRUCTURES

Dynamics of tall buildings, long-span bridges, transmission lines, towers and stacks, chaotic vibrations and aeroelasticity, mitigation of structural motion.

SOCIO-ECONOMIC FACTORS

Damage assessment and mitigation, insurance, legal considerations, risk assessment, cost-benefit analysis.

BOUNDARY-LAYER WINDS

Distribution of wind speeds and temperature, turbulence characteristics, orographic and urban effects.

SEVERE STORMS

Engineering micrometeorology, thunderstorms, hurricanes, tornadoes, extra tropical cyclones, down slope winds, extreme wind statistics, post-disaster inspections.

PHYSICAL MODELS

Wind-tunnel facilities, criteria for simulation, wind characteristics for complex geometry, structural response, diffusion and dispersion, special facilities, pedestrian comfort, snow drifting, wind energy.

COMPUTATIONAL WIND ENGINEERING

Atmospheric surface-layer , turbulence, calibration, validation, effects of incident turbulence, near-wake flows, flow past and loading on buildings and structures.

FULL-SCALE STUDIES

Instrumentation development, meteorological variables, wind pressures on building envelopes, structural response, pollutant concentration.

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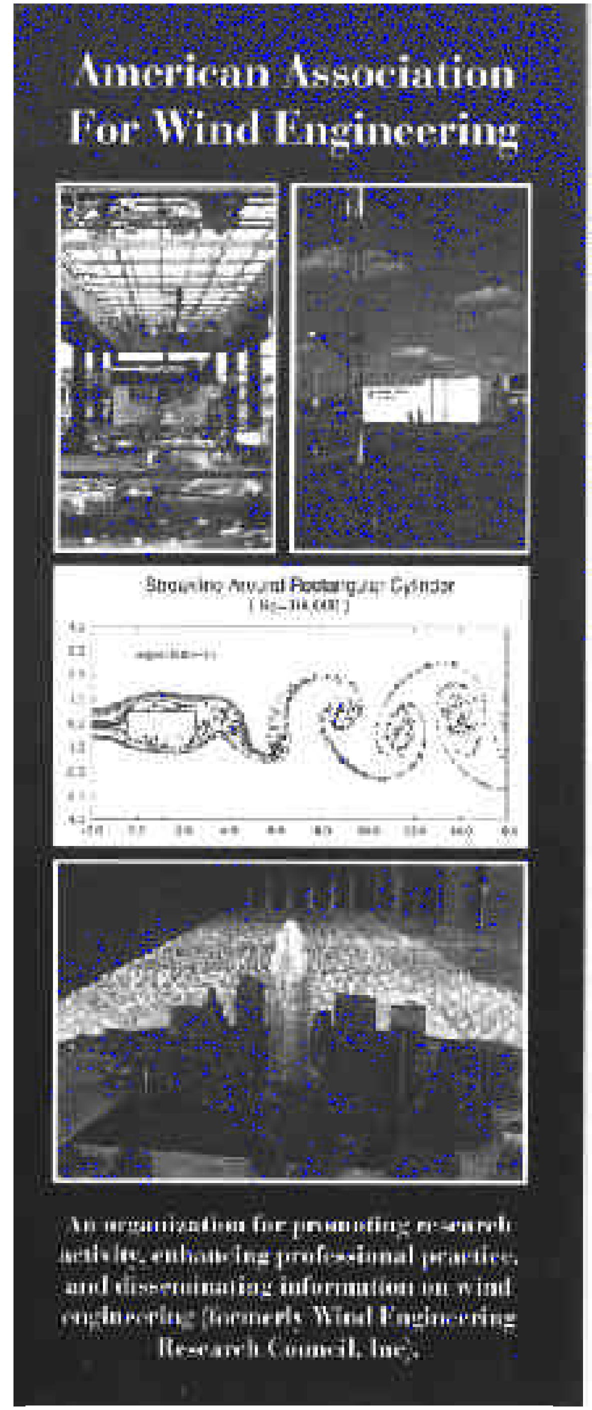

www.aawe.org

Purpose

The American Association for Wind Engineering (AAWE), formerly Wind Engineering Research Council, Inc., has promoted and disseminated research results in the field of wind engineering since 1970. In 1983 it was incorporated as a non-profit professional organization. The multi-disciplinary field of wind engineering encompasses problems related to wind loads on buildings and structures, societal impact of hurricanes and tornadoes, risk assessment and cost-benefit analysis, codes and standards, dispersion of urban and industrial pollution, wind energy, and urban aerodynamics.

The primary objectives of the AAWE are:

* Stimulate research efforts in wind engineering;
* Encourage the exchange of information among researchers and practitioners;
* Assess and prioritize leading-edge research in wind engineering;
* Provide advice to governmental agencies and other interested parties on wind research efforts and needs;
* Maintain communication with similar organizations in other countries and international organizations;
* Develop and execute plans for learning from future windstorms and hurricanes by gathering post-disaster data and analyzing and disseminating information.

Related Fields of Application

Aerospace Engineering, Agricultural Engineering, Architecture, Chemical Engineering, Civil Engineering, Engineering Mechanics, Environmental Engineering, Mechanical Engineering, Meteorology, Oceanography, Offshore Engineering, Structural Engineering, and others.

Activities

The AAWE organizes periodic national conferences dealing with wind engineering research and practice. These meetings consist of reports on current research and discussion by working groups on directions for future research and research implementation. The proceedings of the national conferences are published for the benefit of researchers and practitioners. In addition, a newsletter reporting on activities and forthcoming events in wind engineering is published bi-monthly. The AAWE serves as a voice of the wind engineering community and provides a forum for review of national needs in wind engineering research and practice.

The AAWE has co-sponsored numerous meetings called for by other organizations in the United States and abroad. These include topical meetings dealing with tornadoes, hurricanes, probabilistic methods, structural control, computational wind engineering, International Conferences on Wind Engineering, International Conferences of Structural Safety and Reliability, ASCE Specialty Conferences on Structures and Probabilistic Methods, and others.

Membership

Membership in AAWE provides a means of communicating with engineers, architects, meteorologists and other professionals having an interest in wind engineering. Conference proceedings, white papers, a newsletter, and a web site provide up-to-date information on new developments, trends, and activities in this field.

Annual membership dues are:

Individual Member	$50
Student Member	$10
Corporate Member	$500 or more

For further information and membership application please visit: www.aawe.org

AMERICAN ASSOCIATION FOR WIND ENGINEERING

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American Association for Wind Engineering

OBJECTIVES

The American Association for Wind Engineering (AAWE) was established in 1966. The objectives of AAWE are: (1) the advancement of the science and practice of wind engineering and (2) the solution of national wind engineering problems through transfer of new knowledge into practice.

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WHY YOU SHOULD JOIN:

AAWE provides networking opportunity with U.S. wind engineering community through regular and special publications, e-mail communication, internet resources, and technical meetings.

HOW TO JOIN

Fill–in the Membership Application/Renewal Form and forward it to AAWE Secretary/Treasurer. For more information visit AAWE web site or contact Mike Gaus (mgaus@gausassoc.com, 716-689-4914, voice) or Bo Bienkiewicz (bogusz@engr.colostate.edu, 970-491-8232, voice).

Get involved in formulating
National Wind Hazard Reduction Program

Please Post

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American Association for Wind Engineering

Membership Application/Renewal

Membership Year: January 1, 2002 - December 31, 2002

Dues (Check appropriate category):

Individual Membership: $50___, Student $10 ____

Corporate Membership; $500 or more: ___ . Corporate membership 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:

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He recommends using competent structural engineers, analyzing design plans and computing the apparent loads which caused structural distress or failure. The present writer has been asked to perform engineering analyses of damaged buildings. In some cases the buildings were previously documented in a "walk-through" survey, while in others the damaged buildings were examined in detail during first-time visits. In both situations, oftentimes it was found that initial judgments were not correct, or there was more to the assessment of building response than was immediately apparent.

The Analysis of Engineered Buildings

If the results of a survey are to be used to influence design practice, change building codes, promote a product, resolve insurance disputes, pursue litigation, contribute to research, or support some other worthwhile objective, a detailed engineering analysis is the only way to proceed. Saffir (1993) notes that "No benefits can accrue to an individual structural engineer or code-writing authority without such rigorous and detailed stress analyses." The following procedure outlines principles for the analysis of engineered buildings following a damaging windstorm.

Set Objectives: It is important to have an understanding of why a team is being committed to the field and what is to be done with the survey data upon return. Many field surveys have gone unreported because this commitment was not made in advance. After a few initial surveys by the writer and his colleagues, it became a part of their standard procedure to set objectives for field surveys before leaving the office. Field teams were assigned specific topics (e.g., manufactured housing, metal buildings, performance of window glass) and work commenced only if there was a commitment to finalizing the analysis upon returning to the office.

Plan Field Work: Sufficient time must be allocated to conduct full, complete and detailed surveys. Operating in the field under post-storm conditions is difficult, at best, and investigators often underestimate the amount of work that can be accomplished. Documentation time should be measured in days, not hours. If a topical analysis is being pursued (e.g., the analysis of a specific type of roofing system or the performance of a specific type of material) planning should include the selection of sample buildings for study from the population of available damaged buildings. If a single engineered building presents a unique opportunity for analysis, a systematic documentation plan should be scheduled to assure completion. If a detailed documentation is to be performed, it is essential that permission be obtained from the building owner or manager.

Perform Field Work: Field work must be systematically executed according to plan. The investigations should proceed with several working theories as to building performance, while exercising care not to prejudge failure modes. Critical dimensions should be recorded, material samples may be taken, and pertinent data regarding the building site must be obtained. It is often easier to obtain information on the building code in force at time of construction while in the field. Damage to the surrounding area should also be recorded.

Perform Office Work: Analysis done in the office must use established engineering principles. Plans and specifications should be obtained to confirm construction details and establish material properties. A record of the wind field (wind speeds and directions) that affected buildings being studied is an essential part of the analysis process. A consulting meteorologist or wind engineer should prepare this record. Loads that affected the building and building components should be calculated.

Report Results: Results of a field investigation are often offered as justification for changing a building code, for using one product over another, for defining failures for insurance purposes and for forming expert opinion. Hence, it is essential that windstorm damage reports be factual and complete. Reports must use statistics and mathematical calculations as may be appropriate to establish the validity of the sample of buildings studied and the accuracy of the technical conclusions reached. Most importantly, it should be published in a forum that permits peer review.

(Continued on page 10)

Conclusion

Experience suggests that while "windshield" surveys and walk-through documentation may be useful for illustration purposes, meaningful conclusions cannot be advanced without accompanying detailed analyses. Experience also indicates that detailed documentation surveys require considerable time and effort to fulfill requirements for completeness and accuracy. It is recommended that organizations or individuals that contemplate the conduct of field surveys following a damaging wind event

- Carefully consider the objectives of the survey in advance,
- Plan field activities before leaving the office,
- Budget for the necessary office time following field activities and
- Publish reports in peer reviewed forums.

References

ANSI, "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures," ANSI A58.1, American National Standards Institute, New York, NY, 1972.

Minor, J.E. and Mehta, K.C., "Wind Damage Observations and Implications," *Journal of the Structural Division, ASCE,* Vol. 105, No. ST11, Proc. Paper 14980, November 1979, pp. 2279-2291.

Minor, J.E., Mehta, K.C. and McDonald, J.R., "Failures of Structures due to Extreme Winds," *Journal of the Structural Division, ASCE*, Vol. 98, No. ST11, Proc. Paper 9324, November 1972, pp. 2455-2471.

Phang, M., "Investigation of Non-engineered Building Wind Failures," *Proceedings, 1999 ASCE Structures Congress* (New Orleans, LA, April 18-21, 1999), ASCE, Reston, VA, 1999.

Saffir, H.S., "Evaluation of Structural Damage Caused by Hurricanes," Phase 1 Final Report, SBIR/Division of Industrial Innovation Interface 01/93-09/93, National Science Foundation, Washington, DC, 1993.

A. G. Davenport Symposium (AGD 2002)

According to Second Announcement of the AGD 2002 Symposium, as of the end of December, 2001, about 160 pre-registrants have expressed interest in the conference. The abstract review is expected to be completed by late January 2002 and the authors will be notified by early February 2002.

Overall Program

Wednesday, June 19, 2002

5:30 p.m. - 9:30 p.m.: Registration & Reception
Delegates and accompanying persons are invited to register and enjoy a drink and a light supper in the new Laboratory extension (currently under construction) to provide a "Wet Lab" facility. Tours of all the Laboratory facilities will be available.

Thursday, June 20, 2002

Morning: Technical session
Mid-day: Lunch in honor of Prof. Barry Vickery
Speaker: Prof. Bill Melbourne
Afternoon: Technical session
Evening: Reception and dinner
Speaker: Prof. A. G. Davenport

Friday, June 21, 2002

Morning: Technical session
Mid-day: Lunch in honor of Prof. Nick Isyumov
Speaker: Mr. Hal Iyengar
Afternoon: Technical session
Evening: Reception and dinner
Speaker: Dr. Les Robertson

Saturday, June 21, 2002

Morning: Non-technical session - papers of a historical and anecdotal nature to recall Alan's widespread contributions.
Mid-day: Box lunch and bus trip to Stafford Festival to attend musical "My Fair Lady"

Remarks

Due to the chosen venue for the technical sessions, no more than 185 delegates will be accepted to the technical sessions from outside the Laboratory. Accepted presenters and special guests are assured registration; all others will be on a first come, first served basis. For more information please visit: www.blwtl.uwo.ca .

New Publications from ASCE

ASCE has published two new books that should be of interest to AAWE members:

Guide to the Use of the Wind Load Provisions of ASCE 7-98 by Kishor C. Mehta and Dale C. Perry.

In the Wake of Tacoma: Suspension Bridges and the Quest for Aerodynamic Stability by Richard Scott.

For more information please visit the ASCE publications website (www.pubs.asce.org) or contact Betsy Shepard at ASCE Publications (eshepard@asce.org), ph: 800-548-2723 ext. 6266 or 703-295-6266.

Web Links to Wind Engineering Associations/Societies

American Association for Wind Engineering
www.aawe.org
Australasian Wind Engineering Society
www.awes.org
Japan Association for Wind Engineering
wwwsoc.nii.ac.jp/jawe/index-e.shtml
UK Wind Engineering Society
www.homeusers.prestel.co.uk/gaylard/WES
European Wind Engineering Association
www.ear-iawe.org

Wind Engineering Courses

Engineering for Extreme Winds: 2002—A Short Course
February 6-8, 2002, Texas Tech Univ., Lubbock, TX, Info (ph): 806 -742-7202 ext. 270.

Wind Engineering and Related Conferences - January 2002 Update

2002

APRIL 4-6
ASCE/SEI Structures Congress & Exposition
Denver, CO, USA
E-mail: fcharney@schnabel-eng.com
http://www.asce.org/conferences/structures2002

APRIL 15-17
Mitigating Severe Weather Impacts in Urban Areas - A National Symposium
Houston, TX, USA
http://www.rice.edu/flood

MAY 21– 25
3rd East European Conference on Wind Engineering
Kiev, Ukraine
E-mail: vgr@ihm.kiev.ua

MAY 30-31
Hurricane Andrew 10-Year Anniversary Conference
Miami, FL, USA
Contact: R. Alvarez
E-mail: alvarez@fiu.edu
http://www.ihc.fiu.edu

JUNE 19-21
A.G. Davenport Symposium (AGD 2002)
London, Ontario, Canada
E-mail: agd-conf@blwtl.uwo.ca

AUGUST 21-23
2nd International Symposium on Advances in Wind and Structures (AWAS'02)
Taejon, Korea
E-mail: technop@chollian.net

SEPTEMBER 4-6
5th UK Conference on Wind Engineering
Nottingham, U.K.
E-mail: wes02@pfconsultants.co.uk
http://www.pfconsultants.co.uk/wes2002

2003

MAY 29-JUNE 1
ASCE/SEI Structures Congress & Exposition
Seattle, WA, USA
Contact: C. W. Roeder
E-mail: croeder@u.washington.edu

JUNE 2-5
11th International Conference on Wind Engineering,
Lubbock, TX, USA
Contact: K. Mehta
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AAWE
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.

Established in 1966

Corporate Members of AAWE:

Boundary Layer Wind Tunnel Laboratory, Univ. of Western Ontario
www.blwtl.uwo.ca

Cermak Peterka Petersen, Inc.
www.cppwind.com

Factory Mutual Engineering and Research Group
www.factorymutual.com

Lockheed Martin Technologies Co.
www.lmco.com

Rowan Davies Williams & Irwin Inc.
www.rwdi.com

Wind Engineering and Fluids Laboratory, Colorado State Univ.
www.windlab.colostate.edu

Wind Engineering Research Center, Texas Tech Univ.
www.wind.ttu.edu

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