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American Association for Wind Engineering

THE WIND ENGINEER

NEWSLETTER OF AMERICAN ASSOCIATION FOR WIND ENGINEERING

Bogusz (Bo) Bienkiewicz, Editor July 2002

Participants of Engineering Symposium to Honor Alan G. Davenport *(see p. 5)*

In this issue:

Symposium to Honor Alan G. Davenport for his 40 Years of Contributions

An Engineering Symposium was held at the University of Western Ontario in Canada, June 20 – 22, 2002, to honor Dr. Alan G. Davenport for his many pioneering contributions to the understanding and solution of problems in wind engineering and many other engineering fields. Dr. Alan G. Davenport received his schooling in South Africa, and both his B.A. and M.A. in Mechanical Sciences from Cambridge University,

Alan Davenport and Representatives of MBMA- (Photo: Mike Mikitiuk)

England, in 1954 and 1958 respectively. In 1957 he received his M.A.Sc. in Civil Engineering from the University of Toronto before returning to England to get his Ph.D. in Civil Engineering from the University of Bristol in 1961.

Appointed to the Engineering Faculty of The University of Western Ontario, London, Ontario in 1961, Dr. Davenport is now Professor Emeritus and a former Chairman of the Civil Engineering Group. He was the founder of the Boundary Layer Wind Tunnel Laboratory and has been the Director since its establishment in 1965. This laboratory received early recognition and prominence for its research in wind engineering. As well as contributing to the scientific understanding, it has carried out innovative design studies for major structures; many of the tallest buildings and largest bridges in the world have been studied at Western. The laboratory has also been active in wind/wave studies and atmospheric dispersion.

In his research, Dr. Davenport has pioneered the application of boundary layer wind tunnels to the design of wind sensitive structures, the description of urban wind climates and other problems involving the action of wind. He also has contributed to the fields of meteorology, environmental loads, structural dynamics and earthquake loading. He developed the world's first statistically based seismic zoning map for Canada. He is author of over 200 papers on various subjects and has lectured around the world.

Dr. Davenport has acted as engineering consultant on many major structures, including the world's tallest and longest; the World Trade Center in New York City, the Sears Building in Chicago, the CN Tower in Toronto, and recently the proposed new 3,300 m span Messina Straits Crossing in Italy, Normandy bridge in France, the Storebaelt bridge in Denmark and the Tsing Ma bridge in Hong Kong. His consulting activities have extended to major buildings, towers, buildings, offshore structures and pipelines throughout the world. He has contributed internationally to design standards.

Many former students and associates in the many projects from around the world that Dr. Davenport was involved in attended the Symposium. The participants came from over 24 different countries and spanned the time history of his contributions. The photo on page 5 shows most of the participants in the Symposium.

Dr. Davenport was an early pioneer in the use and construction of boundary layer wind tunnels. The photo on page 6 shows a young Dr. Davenport and Dr. Jack Cermak with a model of the World Trade Center Towers in a boundary layer wind tunnel.

The Symposium included sessions on Wind Effects on Large Structures, Wind Effects on Bridges, Wind Loads on Low Buildings, Environmental & Numerical Problems and Historical & Anecdotal Perspectives. Among the features of the Symposium was the inclusion with registration of a CD-ROM that contained a selected collection of papers authored by Dr. Davenport.

The Symposium brought together many persons who interacted with Dr. Davenport over the years.

Manufactured Homes Study Boosts Support for New NC Law

The following article was prepared by Mr. Kevin E. Barber, Vice President, Communications, Institute for Business & Home Safety

A new law aimed at improving the installation of manufactured homes takes effect Aug. 1 in North Carolina.

The release of a study of manufactured homes in 2001 by Blue Sky Foundation of North Carolina, in collaboration with the Institute for Business & Home Safety, helped boost support for House Bill 355. The study was designed to determine if manufactured homes have been installed in accordance with manufacturers' recommendations and North Carolina and HUD requirements.

Because of U.S. Dept. of Housing and Urban Development regulations, the North Carolina Department of Insurance and manufactured home industry were looking for regulatory changes to assure quality installation of manufactured homes. The survey results provided data supporting the need for such changes and new continuing education requirements.

Blue Sky Foundation surveyed 100 existing manufactured homes in four North Carolina counties. Ninety-eight of the homes were in the coastal counties of Dare, New Hanover and Carteret. The two remaining homes were inland in Catawba County.

The survey showed that

- 32 homes exceeded maximum allowable pier spacing. This was determined by pocket penetrometer tests of soil-bearing capacity at each home site.
- 18 homes had damage to masonry piers. Damage included cracking, leaning and space between frame and pier.
- 45 homes were installed with incorrect ground anchors, as determined by a torque probe test of the home-site soil.
- 63 homes had anchor heads out of contact with the ground.
- 93 homes had loose straps.
- 61 homes had incorrectly installed straps.
- only 19 of 93 homes that should have had stabilizer plates at the anchors had them.

As the results make plain, most of the manufactured homes failed to comply with manufacturers' installation requirements and state and HUD regulations for manufactured housing. Most of the problems could have been corrected at the time of installation. Poor inspection processes or lack of inspections no doubt contributed to the results.

Though the study looked at only 100 manufactured homes in four counties, and therefore was not meant to represent the state of affairs in the manufactured housing market throughout North Carolina, the study results supported the legislature's decision to pass HB 355. Most of the homes in the study had been manufactured and installed after the state adopted regulations that included the Federal Manufactured Home Construction and Construction Safety Standards.

Among other things, HB 355 puts the state in control of the inspection process for manufactured homes. The state department of insurance had been responsible for promulgating set-up regulations, with enforcement left to the discretion of local authorities. HB 355 makes the DOI the final authority and coordinator for the enforcement of set-up regulations. It also requires local governments to enforce the DOI regulations.

The State Administrative Procedures Act has also allowed the DOI to require all manufactured home set-up license holders to obtain four hours of continuing education credits annually. That requirement is also slated to go into effect in August.

In addition to inspecting the structures, researchers also interviewed homeowners. Most homeowners said their building had sustained little or no damage from recent hurricanes. However, most of the homes were in areas where recent hurricane winds were less than the minimum design wind speed for HUD wind zones.

The study found many footers to be too small for the loads they carry. Footers that are too small can reduce their capacity by as much as 36 percent. Incorrect anchors can reduce the capacity of the anchor by as much as 50 percent as well and this problem affected nearly half the homes.

The homeowners have been lucky. Damage could be extensive if the homes are battered by winds at or exceeding the minimum design parameters with poor set-up installation and maintenance.

What is the Wind?

A summary of the Report "Wind Speeds in the ASCE 7 Standard Peak-Gust Map: An Assessment" by E. Simiu, R. Wilcox, F Sadek and J. Filben. NIST Building Science Series 178.

A major product of an NSF-sponsored program in wind engineering between Colorado State University (CSU) and Texas Tech University (TTU) was the generation of a peak-gust wind speed map for the continental U.S. and Alaska. This map was adopted for use in the 1995 and subsequent versions of the ASCE 7 Standard *Minimum Design Loads for Buildings and Other Structures* (ASCE *7-95, 98),* and is referred to herein as the ASCE 7 peak-gust map.

The ASCE 7 peak-gust map differs from the ASCE 7-93 wind map in three major ways:

First, it provides values of 50 yr peak 3 s gust speeds, instead of 50 yr fastest-mile wind speeds, as was the case for the ASCE 7-93 wind map. Based on research conducted at Texas Tech University for five National Weather Service stations (Lubbock, TX; Amarillo, TX; Kansas City, MO; Minneapolis, MN; and Syracuse, NY), a ratio between 3 s peak-gust speeds and the corresponding fastest-mile wind speed of about 1.2 was judged to be reasonable. If this ratio is used, 3 s speeds of 38 m/s *(85* mph) and 40 m/s (90 mph) correspond approximately to 31 m/s (70 mph) and 33 m/s *(75* mph) fastest-mile speeds, respectively.

Second, it is based on analyses of data for sets of stations ("superstations"), rather than on analyses of data for individual stations. In principle, the aggregation of individual stations into superstations has the advantage of yielding estimates based on larger data sets and therefore having smaller sampling errors. This advantage is real, however, only if the aggregation into superstations is sound from a statistical and meteorological viewpoint.

Third, with the exception of hurricane-prone areas and areas of special winds, the ASCE peak-gust map is divided into two adjacent wind speed zones. In the first zone, comprising the entire conterminous United States, except for California, Oregon, and Washington, the specified 50 yr 3 s peak gust speed is 40 m/s (90 mph). The second zone comprises these three states, for which the specified speed is 38 m/s *(85* mph). The changes in design wind speeds entailed by the use of the ASCE 7 peak-gust map instead of the ASCE 7-93 map have the following consequences:

For areas for which (a) the ASCE 7-93 Standard specified a *31 m/s (70 mph) 50 yr fastest-mile speed* (corresponding in accordance with the proposed wind speed ratio to an approximately 37 m/s (84 mph) 3 s peak-gust speed) and (b) the ASCE 7 peak-gust map specifies a *40 m/s (90 mph) 50 yr 3s peak gust*, the ASCE 7 peak-gust map entails an *increase* in wind loads by a factor of about $(90/84)^2$ = *1.15*. In structural engineering terms this increase is significant, and it would be equivalent to increasing the wind load factor from 1.6 to 1.84, or from *1.5* to 1.72.

For areas for which (a) the ASCE 7-93 Standard specified a *36 m/s (80 mph) 50 yr fastest-mile speed* and (b) the ASCE 7 peak-gust map specifies a *38 m/s (85 mph) 3 s peak gust*, the ASCE 7 peak-gust map entails a *decrease* of the wind loads by a factor of $(85/96)^2$ = *0.78*. This factor is even smaller for the considerable areas where the actual peak-gust wind speed is larger than 36 x 1.2 = 43 m/s (96 mph).

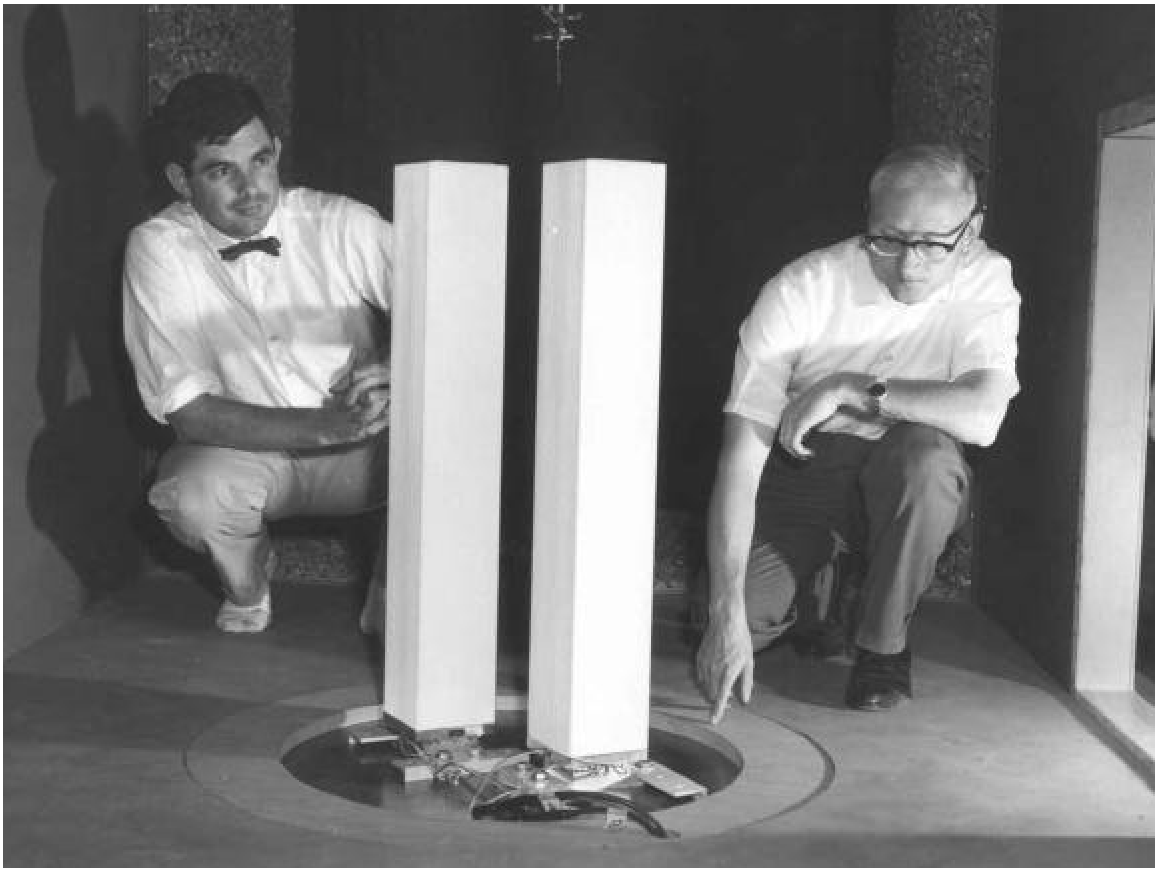
One feature of the superstations used in the development of the ASCE 7 peak-gust map is that the overwhelming majority contain stations included in at least two superstations. The inclusion of the same stations in more than one superstation tends to weaken differences between superstations by biasing results of the statistical analyses, and is therefore inappropriate for statistical analysis purposes. To better understand the importance of this feature, the authors of this report, with assistance of Dr. J. Peterka of CPP, performed analyses of alternatively aggregated superstations, in which no station appears in more than one superstation.

From this study the following conclusions were drawn:

- The ASCE 7 peak-gust map division of the conterminous United States into two adjacent wind speed zones -- with the exception of hurricane-prone areas and zones of special winds -- does not reflect correctly the differentiated extreme wind climate of the United States. The methodology used to develop the map tends to average out real wind climatological differences among stations, for the following reasons:
- The estimation of the speeds specified in the ASCE 7 peak-gust map was originally based on the use of superstations so composed that, in 80 % of the cases, component stations belong to more than one superstation.
- Superstations were in many instances composed of stations with different physical geography and meteorological features.
- For a number of stations, legitimate wind speed data (i.e. data for which there is no reason to believe that they entailed recording or measurement errors) were omitted from the record. The omission of such data biased extreme speed estimates and eliminated correct estimates that did not conform to the speeds arbitrarily assigned to those stations in the ASCE peak-gust map.
- In the development of the map, its authors used off-the-shelf smoothing software that lacks the capability to account for physical geography and

(Continued on page 9)

Participants of the ENGINEERING SYMPOSIUM to Honor ALAN G. DAVENPORT for his 40 Years of Contributions, The University of Western Ontario, June 20-22, 2002 (*Photo: Alan Noon)*



Alan Davenport and Jack Cermak Examine Model of the World Trade Center Towers (1964)

Alan Davenport and Mike Gaus Relive Old Times (2002) (Photo: Alan Noon)

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, 757-258-1273, voice) or Bo Bienkiewicz (bogusz@engr.colostate.edu, 970-491-8232, voice).

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American Association for Wind Engineering

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

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meteorological differences. Such differences are readily apparent to human operators and played a significant role in the development of the ASCE 7-93 wind map.

- Therefore, the approach used for the development of the ASCE 7 peak-gust map creates multiple biases in the estimation of the speeds for large numbers of stations. These biases by far outweigh any theoretical advantages that might be obtained from a reduction of the sampling errors.

Thus the ASCE 7 peak-gust map, on a national scale, can overestimate wind loads in some instances and could underestimate losses due wind loads in others. Therefore the wind map to be included in future versions of the ASCE 7 Standard needs to be improved substantially with respect to the current map. The improved map should be based on estimates that benefit from the experience accumulated in the development of the current and earlier wind maps. Its developers should utilize and make public the requisite data and other relevant information, and promote the early public scrutiny of the data and methodologies proposed for the development of the map.

One result of this project is the availability of all of the data used for the original estimates from which the ASCE 7 peak gust map was derived. This data is available on a CD from Texas Tech University or can be downloaded from the following ftp site: ftp.nist.gov; user name: anonymous. Use your e-mail address as a password. The files are located in the subdirectory: "pub/brfl/emil/NISTTTU".

Wind Resistance of Light-Frame Wood Structures

T. Reinhold[1] , E. Judge[2] and E. Sutt[3]
[1]Clemson University, [2]SC Sea Grant Consortium, Charleston, SC, [3]Stanley Fastening Systems, East Greenwitch, RI

This note presents results of two studies that directly relate to the performance of roof decking and roof to wall connections as a function of age, design, and construction conventions.

One of the studies involved field tests of more than 15 houses that were the subject of a Federal Emergency Management Agency and State of South Carolina flood buyout program. The houses, constructed between 1950 and 1993, were damaged in flooding caused by Hurricane Floyd. However, the roof structures were unaffected by the flooding and most of the wall structural members were similarly unaffected. The testing of these houses that relates to this note include:

- Fastener withdrawal tests for the nails used to attach the planking or plywood sheathing to the roof structural members.
- Vacuum chamber tests of 1.2-meter by 2.4-meter (4-foot by 8-foot) planking and sheathing specimen.
- Uplift tests of roof to wall connections, including rafter and truss systems attached with toenail connections and various strapping products.

The second series of tests that form the basis for observations presented in this note involved component and panel tests of plywood and Oriented Strand Board sheathing products attached using nails and screws. These tests were conducted in the laboratory and were focused primarily on developing a better understanding of the relationship between panel uplift capacity and capacities estimated from individual fastener tests or from various design procedures currently being used in the U.S.

Design of fastener schedules for roof sheath products seems to have been historically based more on minimizing warping of the members and on providing shear capacity than on uplift considerations. Consequently, wood planking was attached with two or more fasteners to each roof structural members depending on the width of the planking. Roof sheathing panels were originally attached with fasteners spaced at 15-centimeters (6-inches) to structural members located along the edges of the panel and spaced at 30-centimeters (12-inches) to intermediate structural members.

A review of the literature shows that two design procedures have been used to estimate the uplift capacities of roof decking products. The first has been to sum up the resistances of all the fasteners used to attach the panel or member, and set this equal to the design load for the entire panel or member. The second involves the calculation of the loads on individual fasteners based on the tributary area associated with the fastener. In this approach, the design capacity of the individual fastener must exceed the design load calculated for its associated area. It is common practice to increase the allowable design loads on fasteners when the design is for wind and seismic loads. The laboratory test results clearly demonstrated that the uplift capacity of roof sheathing is approximated best using the tributary area approach and that the use of increases in allowable loads can produce non-conservative fastener designs for uplift. The results also demonstrated that head pull-through capacities must be taken into account when fasteners with increased withdrawal capacity, such as screws or ring-shank nails, are used to attach sheathing products.

The field tests demonstrated a difference in uplift capacities for planking and sheathing products. Vacuum chamber tests of panels and segments of planking extracted in the field produced ultimate uplift capacities of between 10 and 22 kilo-Pascals (200 and 450 psf) for the planking specimen and between 5 and 11 kilo-Pascals (100 and 230 psf) for the panel products. The lower capacity numbers for the planking came from a specimen with nominal 1x6 planking attached to 2x6 rafters spaced at 0.6-meters (24-inches) using nominal 8d fasteners. The highest uplift capacity for the planking was obtained from a specimen with 1x8 planking attached to 2x6 rafters at 0.4-meters (16-inches) using 2-8d nails and 1-16d nails per connection. The lowest uplift capacities for panel products were obtained for 11 mm (7/16th-inch) OSB panels attached with staples at an average spacing of 180 mm (7 in.). The higher panel uplift capacities were obtained using 13 mm (½-inch) plywood sheathing attached with 8d nails at an average spacing of 200 mm (8 in.) along the interior structural members. Although building codes have allowed sheathing to be installed with 6d nails spaced at 15 cm (6-in.) along the edges and 30 cm (12-in.) along interior members, none of the roof sheathing products on these houses was attached using 6d nails.

The most surprising finding from the field tests of roof to wall connection uplift was the fact that in many tests, splitting of the rafters along their length limited the uplift capacity to values lower than the ultimate capacity of the toenail connections. This suggests that significant improvements in uplift capacity for rafter systems will be required over the rafter straps instead of strapping that is nailed into the sides of the rafters. (*For more info please contact T. Reinhold: tim.reinhold@ces.clemson.edu).*

President's Message

Threats seem to be a major item in the news lately, with terrorism receiving top billing. Although the terrorist threat is certainly one that needs vigorous attention, it is hoped that other threats, such as natural hazards, do not get pushed into the background as a result. Natural hazard threats have been with us for a long time and are not likely to go away in the future. Human and economic losses due to wind and other natural hazards have been substantial over the years and will still be a serious problem unless vigorous efforts are taken to reduce the losses and threats. This is particularly so as U.S. and world populations continue to expand and congregate in hazard prone areas such as coastal regions.

The dilemma facing the research component of wind engineering continues. Support for longer-range wind engineering research has continued to dwindle and many of the research facilities at universities that played an important role in developing the knowledge base for standards, such as the ASCE 7 are in danger of disappearing. The construction of structures that stretch the state-of-the-art regarding wind behavior have largely been made possible through the development of this knowledge base. Perhaps such a good job was done, so that no more knowledge building is needed for wind engineering. Although I certainly do no think this is the case. Somehow we need to do a more effective job in getting the message across that there is still a lot that needs to be discovered regarding impacts of wind and associated water effects, and that the building of an improved knowledge base is essential for mitigating wind losses for new and existing structures. Any suggestions on how to be more effective in conveying this message to those who control the purse strings for wind engineering research would be welcome.

11th ICWE Update (from www.icwe.ttu.edu)

The deadline for paper abstracts is October 31, 2002. The abstract formatting instructions are expected to be specified on the 11th ICWE website. The authors will be notified by 15 January, 2003, whether their papers have been accepted for presentation. In order to provide an opportunity for the maximum number of people to present, each person will be limited to no more than two presentations.

The authors of the accepted abstracts will be requested to submit an 8-page paper by April 1, 2003. Formatting information the paper will be forthcoming. Following the conference, authors are free to submit their papers to the journal of their choice, as no journal submittal of conference papers as a group is planned.

From the Editor

Contributors to this Newsletter:

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President's Message - *M. Gaus*

Contributions to the AAWE Newsletter by AAWE members and other readers of the Wind Engineer are very welcome. Please forward your contributions and other materials suitable for publication in the Newsletter to B. (Bo) Bienkiewicz, at bogusz@engr.colostate.edu.

Wind Engineering and Related Conferences - July 2002 Update

2002
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
E-mail: 11icwe@wind.ttu.edu
http://www.icwe.ttu.edu

SEPTEMBER 16 - 18
International Workshop on Wind Effects on Trees
Karlsruhe, GERMANY
Contact: B. Ruck
E-mail: ruck@uka.de
http://www.ifh.uni-karlsruhe.de/ifh/science/aerodyn/windconf.htm

2004
MARCH 31 - APRIL 2
International Conference on Building Envelope Systems Technology, ICBEST (2004)
Sydney, AUSTRALIA
Contact: J. Perry
E-mail: icbest2004@bigpond.com.au

2005
Americas Conference on Wind Engineering
Baton Rouge, LA, USA
Contact: M. Levitan
E-mail: levitan@hurricane.lsu.edu

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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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