THE CHRONICLE OF THE WIND ENGINEERING RESEARCH COUNCIL

the Wind Engineer

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Wind Speeds in the Carolinas During Hurricane Hugo

by P.R. Sparks *

Introduction

As Hurricane Hugo made landfall near Charleston, SC, shortly before midnight on September 21, 1989, the National Hurricane Center forecast sustained winds of 135 mph. It was generally not made clear to the public that this speed was an estimate, that it applied only over the ocean or right on the shoreline and then only in one small area, Bulls Bay, about 20 miles north of Charleston.

When the extent of the damage was revealed in the Charleston area many believed 135 mph to be too low and that the 5 local anemometers, indicating even lower speeds, were badly out of calibration. The National Hurricane Center stands behind 135 mph and added a gust value of 160 mph.

Reported Wind Speeds

Ground observations were reported as sustained and gust speeds by the National Hurricane Center and the National Weather Service. These were usually based on special reports in which the wind speed indicator had been observed for approximately one minute to determine the sustained speed, with the corresponding maximum gust noted. No mention was made in the official reports that the measurements were made at heights from 10 ft. to 384 ft., in exposures ranging from within a wooded area to open ocean. The reports included values from one anemometer in which samples were taken only for 2 minutes every hour and from another which sampled for 1 minute every 10 minutes.

The National Hurricane Center supported its estimate of 135 mph with a non-standard report from a ship in the Sampit River 35 miles north of Bulls Bay. The reported speed appeared to be inconsistent with damage in the area. Nevertheless 135 mph became the official maximum and appeared in almost every article written about the hurricane.

Wind Speed Analysis

With considerable effort and a certain amount of luck, Powell of the Hurricane Research Division of NOAA, Marshall of NIST, Murden of the Citadel, Charleston and the author were able to collect strip-chart records from 7 stations plus a computer summary from one other. From these it was possible to compute 10-15 minute means and observe the corresponding peak gusts. It became clear from these records that the reported highest sustained wind speeds might be questioned. These ranged from less than the highest 10-minute average to close to the expected maximum 1-minute average. Therefore for other reporting stations, where no continuous records were available, only the gust values were normally accepted as valid measurements. The sustained values were used only if they were less than the expected 10-minute mean, based on conventional gust factors. This occurred at inland stations where the storm became very gusty. The sustained value was then used as the 10-minute mean. When only a sustained value was reported it was taken as a gust.

In addition to the ground observations, aircraft measurements were made at 12000 ft., the most useful being those made between 1 hour and 20 minutes before landfall. These measurements showed a highly asymmetric wind field, but one which could be accounted for by separating the wind speeds into components associated with rotation, about the eye of the hurricane, and translation, due to the forward motion of the storm.

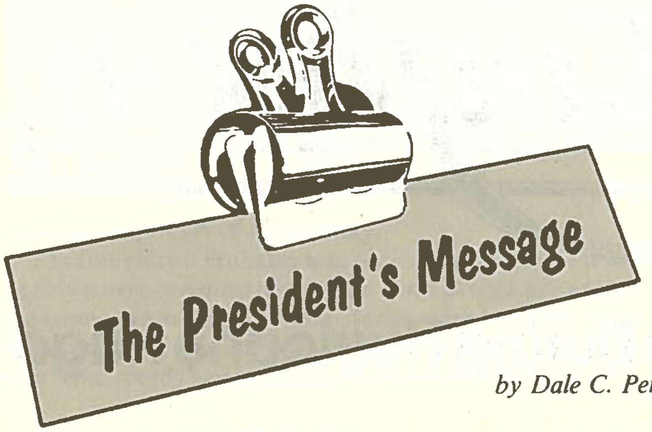
The rotational component near the ground could be determined from the anemometers in Charleston, which, being near the path of the center of the storm, experienced essentially only that component.

From these measurements the maximum 10-minute rotational component at 33 ft. in open country was found to be 55% of the aircraft measured rotational component. An open country boundary layer, applied to the upper atmosphere stream in which the storm was traveling, indicated that only about 40% of the translational speed of the storm would be experienced near the ground. This difference was to be expected since hurricane rotations have been observed to have maximum values below 12000 ft., while a conventional boundary layer does not.

Using a wind field model based on the relative rotational wind speeds measured by the aircraft, the observed maximum rotational speed on the ground and a standard boundary layer reduction for the the translational component, including appropriate backing of the wind direction, it was possible to predict wind speeds where no observations had been made. Where continuous observations were available the model was able to predict wind speeds accurately from 1 hour before landfall to 2½ hours after landfall, for stations as far as 85 miles north east of Charleston to 90 miles inland. The fact that the same model could be used for such a period confirmed the unusual characteristic of Hugo - that it did not weaken for more than two hours after landfall and produced very rare wind conditions in the inland areas of South Carolina.

* Department of Civil Engineering, Clemson University

Contd. on page 8



by Dale C. Perry

During the past four years under the able leadership of past president Kishor Mehta and the Board of Directors, the Wind Engineering Research Council dramatically improved its professional posture in both the engineering and meteorological communities. Concurrently its membership, both individual and corporate, continued to increase and provide a sound financial base.

At a recent Board of Directors Meeting a new 5-year plan was approved which when implemented will provide increased benefits to its membership and further enhance the image of WERC. Central to the plan is a pro-active course of action designed to:

- *establish a technical information center to promote the interchange of information among research workers, practitioners, and disaster preparedness officials*
- *promote general public awareness of wind engineering*
- *seek cooperation among specific state and federal agencies for the purpose of addressing societal problems in wind engineering*
- *develop strategies for increasing the level of research monies available for addressing the needs of the wind engineering community*
- *monitor the U.S. Code and Standards Processes with a view toward assisting in the development of improved wind load provisions to mitigate damage*
- *continue to promote conferences, meetings and symposia*

To achieve the above objectives, nine standing committees were appointed. The specific committees, charges and chairmen are listed below. Increased participation by the membership of WERC is urgently needed. Please contact the Council office if you wish to become active with one or more of the committees. To ensure a proper balance between researchers, practitioners, and special interest groups, committee memberships are subject to the approval of the Board of Directors.

Let all of us get behind the efforts of the Standing committees and make the next decade one of increased progress to meet the needs of the wind engineer community and benefit society at large. Hurricane Hugo serves as a reminder that there is still much to be done. Encourage your associates who are not currently members of WERC to join and become active - the benefits are many!

WERC STANDING COMMITTEES 1990 AND TASKS

Awards Committee (Jack Cermak, Chairman)
- Administer WERC Awards Program.

Codes and Standards (Jim McDonald, Chairman)
- Monitor the US Code and Standards Processes and assess adequacy of current wind load provisions for mitigating wind damage.
- Identify and publicize need for modifications in model building codes and material specifications.
- When appropriate, prepare resolutions for consideration by the Board in support of, or opposition to, pending legislation relating to state and national wind load provisions.

Meetings and Conferences (Leon Kempner, Chairman)
- Develop a five-year plan of conferences, meetings, and symposia to be sponsored or co-sponsored by WERC.
- Identify host for 7th US National Conference on Wind Engineering.

Membership (Joe Colaco, Chairman)
- Actively seek to enlarge the corporate, individual, and student membership of WERC.

Planning and Coordination (Ahsan Kareem, Chairman)
- Establish dialogue with other WERC standing committees for the purpose of coordination.
- Review and update WERC five-year plan.
- Formulate strategies for increasing level of research funding.

Publications (Peter Sparks, Chairman; Herb Saffir, Editor of *Wind Engineer)*
- Approve all WERC publications.
- Publish *Wind Engineer.*
- Initiate publications and prepare responses to published materials on wind engineering issues.
- Interact with Public Awareness Committee.

Public Awareness (Dick Marshall, Chairman)
- Promote public awareness of wind engineering.
- Seek cooperation among specific state and federal agencies for the purpose of addressing societal problems in wind engineering.
- Identify individuals and agencies to provide quick response materials on wind engineering issues.
- Assist the Board in developing strategies for increasing the level of funding for wind engineering.

Technical Information (Art Chiu and Nick Isyumov, Co-Chairmen)
- Submit to Board recommendations on programs and activities to gather, disseminate, and archive technical information.
- Develop guidelines for full-scale measurement programs.
- Archive full-scale and wind-tunnel measurements of natural wind and wind-induced structural behavior.
- Document wind damage produced by severe storms.
- Re-establish *Wind Engineering Research Digest.*

USDNDR (Jon Peterka, Chairman)
- Serve as WERC representative for all appropriate USDNDR activities.
- Seek ways for WERC to be involved in Decade programs and initiatives.
- Inform Board and membership of USDNDR programs.

Wind Load Provisions of the Standard Building Code

*by Rick Vognild, P.E.**

In 1986, after four years of code change proposals and committee study, a comprehensive new section on wind loads was approved for inclusion in the Standard Building Code (SBC), published by the Southern Building Code Congress International (SBCCI).

New provisions in SBC Section 1205 consist of four main parts:

1. Load criteria for low and midrise buildings, 60 feet and less in height, patterned after research sponsored by the steel industry at the University of Western Ontario.
2. Load criteria for buildings over 60 feet high, based on ANSI A58.1-1982.
3. Load criteria for special structures.
4. Loads based on wind tunnel studies.

Loads from each of these parts are based on the latest ANSI 0.02 probability wind map (50-year mean recurrence interval), but SBCCI chose not to use any of the exposure categories in A58.1. For low buildings, the equivalent exposure is "almost-C" for main building members and components. For buildings over 60 feet high, the "standard" exposure is B, with a separate "coastal" exposure equivalent to C.

Prior to the current SBC wind section, SBCCI developed wind loads using ANSI A58.1-1972. In this phase, the review committee selected the 100-year map combined with Exposure C coefficients, but minus the ANSI gust response factors. Component loads were retained from earlier code editions that we think "borrowed" coefficients from the South Florida Building Code. Prior to 1985, SBC also allowed use of NAVFAC DM-2 for one and two family dwellings.

For the past two years, SBCCI has had a "deemed-to-comply" committee working on prescriptive requirements for small residential buildings that typically are nonengineered. The SBCCI Board of Directors will decide whether to publish the resulting document as an SBCCI standard.

**Manager, Codes & Standards, Southern Building Code Congress International.*

Announcement and Call for Papers

TORNADO SYMPOSIUM III

Norman, Oklahoma, April 2-5, 1991

Tornado Symposium I was held at the University of Wisconsin in 1970 and Symposium II at Texas Tech University in 1976. The time is right for Tornado Symposium III, a forum to review the advances of the last decade and to focus on the opportunities about to unfold as the National Weather Service begins a wholesale modernization of its observing systems.

Tornado Symposium III will occur on the 17th anniversary of the jumbo outbreak of tornadoes and will commemorate the appointment of Dr. T. T. Fujita as Merriam Distinguished Professor by the University of Chicago. The meterological community in Norman, including the National Severe Storms Laboratory (NSSL), the OKC National Weather Service Forecast Office, the WSR-88D Operational Support Facility, and the University of Oklahoma (OU) School of Meteorological Studies (CIMMS) and the Center for Analysis and Prediction of Storms (CAPS), will serve as hosts for the symposium. Sponsors include the NOAA Storm Program Office, the National Science Foundation, OU/COMMS, OU/C/APS, COMET, the Wind Engineering Research Council, the national Weather Association, the American Meterological Society, the American Geophysical Union, and the Institute for Disaster Research at Texas Tech University.

The symposium will begin in the afternoon on Tuesday, April 2nd. Formal presentations will conclude at noon on Friday, April 5th. Then, in the afternoon of Friday, April 5 there will be three concurrent workshops: one on wind engineering aspects of damage assessment and control, one on numerical modeling of tornadoes and tornadic storms, and one on warning and preparedness.

The symposium will comprise 12 formal sessions:

- Tornado theory (including waterspouts, landspouts)
- Numerical modeling
- Hurricane-spawned tornadoes
- Physical models and analogs
- Tornado forecasting (including characteristics of the environment)
- Tornado detection and warning (including radar signatures and algorithms)
- Tornado observations
- Damage surveys
- Climatology, Hazards, and Risk Assessment
- Engineering for occupant safety
- Containment of hazardous material
- Building codes and standards

Each session will begin with an invited review paper by a distinguished expert, to be followed by other invited papers and a limited number of contributed papers. Authors who wish to contribute a paper should notify the program committee by September 15, 1990. The program committee will accept abstract, in standard AGU Format (copy available on request) until December 1, 1990.

WERC contact members:

J. Golden,
(301) 927-7858, FAX (202) 673-5355

J. McDonald,
(806) 792-8757, FAX (806) 742-3488

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A Reporter's Hurricane Survival Kit

or

Even if you can't see the wind you can report it accurately

Prepared by the Wind Engineering Research Council, August 1990

BACKGROUND:

In response to numerous inaccuracies that have characterized the reporting of past hurricanes, particularly Hurricane Hugo in 1989, the Wind Engineering Research Council (WERC) has prepared this guide for use by the news media. The guide defines certain terms regularly used by meteorologists and engineers to describe extreme events such as a hurricane. The guide also points out some common misconceptions and certain items that one should be aware of when reporting on wind speeds and damage.

WERC is a non-profit professional organization whose mission is the promotion of wind engineering research and the dissemination of research findings. The discipline of wind engineering encompasses problems related to wind loads on buildings and structures, societal impact of wind storms such as hurricanes and tornadoes, dispersion of urban and industrial pollution, wind energy and related topics.

SOME USEFUL DEFINITIONS:

ANEMOMETER - An instrument used to measure wind speed. Several types of anemometers are in use, the most common being mechanical anemometers that employ either a propeller or a set of rotating cups. Most of these devices will not survive wind speeds in excess of 150 mph. Some specially designed mechanical anemometers are rated at wind speeds up to 200 mph.

BOUNDARY LAYER - A region extending upward from the ground surface to a height of several hundred feet in which the wind speed is slowed by the ground roughness (buildings, trees, hills, etc.). In fact, the wind speed becomes zero right at the ground surface. Beyond the top of the boundary layer the wind speed is fairly uniform. Typically, the wind speed at a height of 30 feet is 60-70 percent of the speed near the top of the boundary layer.

GUST SPEED — The maximum speed averaged over a period of from 1 to 5 seconds. Generally, the gust speed is 20 to 30 percent higher than the corresponding sustained speed.

HURRICANE - A tropical cyclone in the North Atlantic region with wind speeds in excess of 73 mph. Hurricanes are known as typhoons in the Western North Pacific and as cyclones in the Bay of Bengal, the South Pacific (Australia) and the Western Indian Ocean.

MEAN RECURRENCE INTERVAL — The number of years, on average, that would elapse before a hurricane of approximately the same intensity would revisit a given location.

SAFFIR-SIMPSON HURRICANE SCALE — A numerical scale used to rate the intensity of hurricanes from 1 (least intense) to 5 (most intense). The scale considers factors such as wind speed, type and intensity of damage, and height of storm surge.

STANDARD EXPOSURE — The conditions under which official wind speed measurements are made. In particular, standard exposure means an anemometer height of 10 meters (33 feet) in flat, open terrain typical of airport locations.

STORM SURGE — The gradual increase in coastal water depth as a hurricane approaches land. The increase in depth depends on several factors such as wind speed and direction, barometric pressure, coast-line geometry and normal water depth.

SUSTAINED SPEED — The wind speed averaged over a period of one minute. Unless stated otherwise, a reported wind speed is assumed to be a sustained speed.

TORNADO — A very intense funnel-shaped storm (vortex) with a diameter that is typically less than 1,000 feet. The tangential speeds in a tornado are the highest known wind speeds and may exceed 200 mph. Although tornadoes usually are associated with intense thunderstorms, they can be spawned by hurricanes.

SOME USEFUL TIPS:

1. Hurricane forecasts often refer to wind speeds measured by aircraft at heights well above the atmospheric boundary layer. Therefore, the effects of ground roughness are not accounted for and the actual near surface winds may be significantly less.
2. There is a strong tendency for people experiencing hurricane winds to grossly overestimate the speeds. As an example, many people on St. Croix in the U.S. Virgin Islands believe the gust speeds in Hurricane Hugo were 250 mph or higher. Post-storm investigations by experts in meteorology and wind engineering indicate these speeds did not exceed 155 mph. Likewise, wind speeds based on actual measurements in Charleston, South Carolina, are substantially less than the speeds reported by the news media and widely believed by the residents of that city.
3. In general, wind damage in typical built-up areas will commence at gust speeds of about 70 mph. Shingles and siding will come off, trees will begin to lose limbs or be uprooted, and overhead traffic lights and signs may come down.
4. Wind loads increase with the square of the wind speed. Therefore, if damage commences at gust speeds of 70 mph, the wind load will double at a speed of about 100 mph, not 140 mph. For speeds of 250 mph, the corresponding wind load would be almost 13 times greater. At this speed one would not expect to find anything but bare ground after the storm.
5. Because of their large variation from one location to another, it is all but impossible to characterize surface wind speeds in a hurricane on the basis of a single measurement. Only from careful post-storm assessments of anemometer records and wind damage can the true distribution of surface wind speeds be ascertained. For this reason the Saffir-Simpson scale is the preferred preliminary measure of hurricane intensity.
6. If someone tells you they measured speeds in excess of 150 mph, or if they tell you the sustained speeds were higher than the gust speeds, be prepared to ask some questions. Ask to see the measurement site, the anemometer and the stripchart record if such a record is available. Ask about their qualifications as a weather observer and who calibrated the anemometer. Unless the site exhibits the characteristics of a standard exposure, the readings are automatically suspect.
7. There is a widespread misconception of mean recurrence interval, sometimes called the "return period." A 300-yr storm means that a storm of this intensity would be expected

to happen about once every 300 years. It could happen more frequently or less frequently. It could happen more than once in the same year. Many people believe such a storm cannot happen within the next 300 years. Not true!

8. Contrary to popular belief, storm surge does not take the form of a large wave suddenly engulfing a coastal area. The rise in water level may extend over several hours. However, wind-generated waves are superimposed on the storm surge and normal astronomical tides may increase the net water depth.
9. Remember, if the wind speeds sound too high for a hurricane, they probably are.

WIND SPEED CONVERSION TABLE

miles per hour (mph)	knots (kt)	meters per second (m/s)
60	52	27
80	70	36
100	87	45
120	104	54
140	122	63
160	139	72
180	156	80
200	174	89

8th International Conference on Wind Engineering

July 8-12, 1991, London, Ontario, Canada

The International Association of Wind Engineering is sponsoring the 8th International Conference on Wind Engineering. The Wind Engineering Research Council, Inc. is Co-sponsor of this Conference.

Hosted by the Boundary Layer Wind Tunnel Laboratory of the University of Western Ontario, the Conference will focus on: wind forces on structures such as bridges, towers, building and transmission lines; the structure of wind in the boundary layer; the climate of extreme winds; the action of wind and waves on offshore structures; reliability and risk; windstorm disaster reduction; codes and standards for wind loading; the suppression of wind-induced vibration; case studies; model/-full-scale comparisons; wind tunnel techniques; applications of computational fluid dynamics; air infiltration/energy conservation; atmospheric pollutants; pedestrian level winds and effects on people; behaviour of glass under wind loading; acceleration of buildings and occupant comfort; snow loading and drifting.

Authors are invited to submit 2-page summary papers by October 1, 1990, and will be notified of acceptance prior to February 1, 1991. Full papers must be submitted by May 31, 1991.

For further information about the program and submission of papers, contact:

Dr. A.G. Davenport, Director
The Boundary Layer Wind Tunnel Laboratory
The University of Western Ontario
London, Ontario N6A 5B9, Canada
Telephone: (519) 661-3338
Fax: (519) 661-3339

"Nothing Beats Long-Term Mutual Respect and Coordination...."

Marilyn Quayle, wife of the Vice President, summed up good natural disaster preparedness by saying, "Hurricane Hugo proved that nothing beats long-term, mutual respect and coordination in responding to natural disasters." Speaking at the National Hurricane Conference, held at the Hyatt Regency Hotel in Houston, Texas, on 18 April, Mrs. Quayle cited time and again instances where cooperation among all levels of public and private sector had served to minimize, if not avert, the human suffering, damage, and destruction of natural disaster.

In attaining the level of coordination necessary, Mrs. Quayle urged ongoing and cooperative efforts among local, state, and federal governments and businesses and individuals and upgrading of technology for predicting, identifying, and reporting natural disasters. She was quick to point out that even a child renders an invaluable service when he or she takes home information acquired at school and passes it on to the rest of the family. Businesses, she pointed out, should coordinate the acquisition and storage of contingency response materials and the availability of engineers to assess damage in order that citizens would not re-enter dangerous structures. On the governmental level, she asked for a continuation and enhancement of identification, communication, and reaction programs, pointing out that successful implementation would require complete coordination among the various agencies involved.

The greatest element of risk in a matter of natural disaster, Mrs. Quayle said, is the element of surprise. While no one can predict when and where an earthquake or tornado will strike, contingency response methods can be worked out. She urged all involved not to complacently resign themselves to the finality of such unpredictable disasters, but to think toward response and restoration. None of these efforts, she went on, can be possible without the efforts of researchers, engineers, and other professionals who devote their lives to searching for new methods for predicting, identifying, and reporting data to service officials who have direct contact with the public.

Solicitation for Host for 7th US National Wind Conference 1993

WERC is actively seeking interest from university researchers and educators in wind engineering to host and administer the 7th US National Wind Conference to be held in 1993.

Traditionally, this national conference is held once every four years at a university involved in wind engineering research. The host institute administers the conference, with costs being paid mainly through registration fees. In the past, the National Science Foundation also has contributed to the conference by providing funds for a selected group of speakers and attenders. Normal enrollment is approximately two hundred people, for the three-to-four-day conference. The format of the conference will be left to the discretion of the conference chairman, who will receive advice and input from the WERC Board.

Individuals interested in hosting the conference should forward a request for particulars to:

Dr. Dale C. Perry, President
Wind Engineering Research Council
Post Office Box 10029
College Station, Texas 77842

Bowen Named Deputy Assistant Director of National Science Foundation

WERC extends congratulations to Dr. Raymond M. Bowen, the new Deputy Assistant Director for Engineering, of NSF. Bowen brings to NSF extensive experience as a mechanical engineer and university administrator. Although he was on sabbatical at Rice University for the 1989-1990 academic year, Dr. Bowen's official position of record is with the University of Kentucky where he has served as Dean of Engineering since 1983. In 1982, Bowen joined the NSF staff as Director of the Mechanical Engineering and Applied Mechanics Division, ENG, where he served for one year.

Prior to his NSF tour, he spent 16 years as Professor of Mechanical Engineering and Mathematical Sciences at Rice University. Bowen has a distinguished record of service with numerous professional organizations and boards.

Cermak Elected to Grade of Honorary Member in the American Society of Civil Engineers (ASCE)

Dr. Jack E. Cermak, University Distinguished Professor, Fluid Mechanics and Wind Engineering, was one of ten eminent civil engineers elevated to Honorary Member status within ASCE. Honorary Membership in ASCE is the highest distinction that members of the civil engineering profession can bestow on their peers.

Dr. Cermak has conducted pioneering research in simulation of atmospheric boundary layers that resulted in development of unique boundary-layer wind tunnels. This provided a means for modeling wind effects on buildings and structures as well as the dispersion of air pollutants. His work established wind engineering as a new engineering discipline.

Dr. Cermak will attend a special ceremony on 7 November 1990 in San Francisco to receive his certificate of Honorary Membership.

An Editorial Comment

After several years undergoing revision, the authoritative Minimum Design Loads for Buildings and Other Structures (formerly ANSI A58.1) has been revised and reprinted under the auspices of the American Society of Civil Engineers. The Standard, ASCE 7-88, is now in print and is available from ASCE, 345 East 47th Street, New York N.Y. 10017 (Cost $24.).

The Standard is the only nationally recognized voluntary standard on structural loads in the U.S., giving requirements for dead, live, soil, wind, snow, rain and earthquake loads.

Final draft of the Standard was completed in December 1988 and publication was completed in July 1990. The Standard has modified the wind load requirements of the 1982 Standard, somewhat, changing some of the pressure coefficients, updating internal pressure requirements, and making other significant changes. The Standard, developed by the consensus method, was prepared by a committee made up, in part, of WERC members including Committee Chairman Ed Cohen and Sub-committee Chairman for the wind load section, Kishor Mehta.

The editor recommends the Standard for all structural engineers, wind engineers and code-writing authorities involved in any way with wind criteria for building design and other structural design.

Herbert S. Saffir, P.E.
Editor

UK Organizes Wind Engineering Society

A new society being organized in the United Kingdom has as its objectives the stimulation of wind engineering research and the promotion of the dissemination and application of research findings. The first General Meeting has been scheduled for September 26, 1990 at the Building Research Establishment.

The membership subscription for Associates is £20 ($37.44 U.S.) and applications should be forwarded together with remittance to:

The Secretary
Wind Engineering Society
Dr. C. Baker
Department of Civil Engineering
University Park
Nottingham NGR7 2RD, England

Computational Wind Engineering

*by Dr. Ted Stathopoulos**

Conventionally wind effects on structures have been studied either in full scale tests or in experiments carried out under simulation conditions in wind tunnels. More recently, CFD has also been applied for the solution of wind engineering problems such as the assessment of wind pressures on buildings and wind conditions in the buildings' environment. Computer modelling has a high potential and several advantages in comparison to the wind tunnel experimentation. Nevertheless, careful validation of the computer algorithms is vitally important. However very few computational studies in wind engineering have attempted comparisons with experimental data for validation purposes.

In this respect, some progress has been made at the Centre for Building Studies of Concordia University in Montreal, where a new computer code named "TWIST" (Turbulent Wind Simulation Technique) has been developed. Extensive computations and comparisons have been made for a single building exposed to normal wind flow conditions. Various feasibility studies have also been performed to address the wind directionality effect, to model the multiple building configurations and to develop a micro-computer version of TWIST.

Most of the research in the area of computational wind engineering has taken place outside North America, in places such as Japan, Australia, Germany and the United Kingdom. ASCE has recognized the need to assess the current situation and to enhance activities for the development of CFD in Wind Engineering in North America. Its Aerodynamics committee has established a subcommittee on numerical flow modelling and a technical session is being organized for the 1991 Structures Congress in Indianapolis. Other activities such as preparation of a state-of-the-art report of the techniques and applications of CFD to problems of interest in wind engineering will follow.

* *Centre for Building Studies, Concordia University, Montreal, Quebec.*

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Update on Metal Building Performance in Hurricane Gilbert

The April 1989 *Wind Engineer* displayed a photograph of a new preengineered metal building on Isla Cancun which was stripped of cladding by Hurricane Gilbert. Mr. Gil Harris of MBMA informs us that a team of industry engineers were subsequently dispatched to Cancun to investigate the failure. In conversation with Mexican engineers they learned that the building was considered to be a temporary structure to warehouse the furniture and other furnishings for the Sheraton Hotel under construction. As such, the building may have been designed for a lower level of performance than for a permanent structure.

CRAY SUPERCOMPUTER

MOUNTAIN VIEW, Calif. –NASA's Ames Research Center has received the world's first **Cray Y-MP 8128 supercomputer.**

It has the largest main memory of any Cray Y-MP supercomputer built to date and represents a major upgrade in computing capability at Ames. It is being installed at the Numerical Aerodynamic Simulation (NAS) facility at Ames. The NAS facility is a national computer laboratory which provides hardware and software support for computational fluid dynamics and other large-scale computational disciplines.

The facility is used primarily for the flight simulation of aircraft and aerospace vehicles by government, industry and university researchers throughout the nation.

The Cray Y-MP 8128 has 128 million words of mainframe central memory. In addition, the system has 256 million words of high performance secondary memory through its solid state storage device memory. It uses the Cray Research operating system UNICOS, based on AT&T's UNIX System V, and a suite of compilers, utilities and other software tools.

The Cray Y-MP 8128 system replaces the Cray Y-MP 832 supercomputer installed at Ames in 1988. It has four times as much memory as the older machine. The Cray Y-MP has performed at sustained speeds or more than one billion calculations per second.

First Italian Conference on Wind Engineering

The Italian Association for Wind Engineering (ANIV), Italian Section of the International Association for Wind Engineering (IAWE), was founded in 1988 with the aim of promoting studies and researches in the field of Wind Engineering and of spreading this matter in the Italian scientific and technical sectors. The first president of ANIV is Prof. Giuliano Augusti.

ANIV has organized the First Italian Conference on Wind Engineering. The Conference will be held in Florence, Italy, 28-30 October 1990. Language of the Conference is Italian; special English lectures wil be given by international experts.

Further information may be obtained from:

Prof. Ing. Paolo Spinelli
President of the Conference
Dip.to di Ingegneria Civile
University of Florence
Via S. Marta 3
50139 Florence (Italy)

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James R. McDonald .... Texas Tech University
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Contd. from front page

Table 1 gives the best estimates of maximum wind speeds and recurrence intervals based on observed speeds corrected for height, exposure, fetch and averaging time or the use of the wind field model.

Was Hugo the Storm of the Century?

For Bulls Bay it probably was, for some inland areas it was probably worse; but most of the wind damage took place in the Charleston area where the wind speeds were less than those recommended by the American National Standard and where higher wind speeds had been recorded in 1885, 1893 and 1911.

How Windy Was it in Bulls Bay?

Table 1 indicates that for an ocean exposure the gusts were approximately 145 mph. An independent analysis by Powell suggests the same figure. Such gusts would be associated with a maximum 1 minute average in the same exposure of about 120 mph. - a speed with a recurrence interval of 100 years.

Recording and Reporting Problems

From a wind engineering perspective the recording and reporting of wind data in the United States is far from satisfactory. The experience in Hugo is a clear example of the problems. Not a single anemometer was located at the standard height and exposure and no attempt was made to correct the readings before publication. Some official anemometers were as low as 10 ft. in areas where the nearby forest was 4 times that height and others were clearly affected by adjacent buildings. No station made a fastest-mile recording upon which design wind conditions are based. Estimates of fastest mile at some stations differed significantly depending upon whether the mean or gust speed was used to make the assessment. In the reported form the data recorded in Hugo could not be added to the historical records.

Having abandoned fastest-mile recorders, the National Weather Service and other official reporting agencies now use the 1-minute average, to determine steady wind speeds. Yet at stations with strip-chart recorders they have the capacity of reporting in the international format of 10-minute means and peak gusts. Automatic stations could be programmed to do the same. The present systems of sampling for 1 minute every 10 minutes or 2 minutes every hour is unsatisfactory

In South Carolina there was an area of over 7000 square miles in which the winds were almost certainly gusting to over 100 mph and within which there was not one reporting station. The National Weather Service has commented that this posed a significant problem to forecasters trying to obtain information during the storm.

Clearly a properly located and calibrated grid of anemometers would greatly assist both the meteorologist and the wind engineer, provided that the data are recorded in a form acceptable to both. There is an internationally agreed format in which this can be done and it is essential that the new automatic stations being developed by NWS conform to that standard

Table 1. Estimated Maximum Wind Speeds and Recurrence Intervals

	Mean[1] (mph)	Fastest-mile[2] (mph)	Local Gust[3] (mph)	Approx. Recurrence Interval (years)
Beaufort area[6]	37	47	50-60	6
Charleston area[4]	73	95	100-130	50
Bulls Bay[7]	83	108	115-145	100
Georgetown area[7]	62	80	85-110	20
Myrtle Beach area[5]	62	80	85-110	20
Columbia[4]	50	65	70-80	25
Camden[5]	63	82	85-100	80
Sumter[5]	76	99	105-120	250
Florence[6,8]	49	64-68	70-85	20-30
Charlotte[5,8]	41	51-75	80-95	6-250
Hickory[6,8]	38	49-70	75-85	6-85

[1]Equivalent hourly mean, standard conditions
[2]Standard conditions
[3]Range from suburban to open country (ocean exposure for onshore winds)
[4]Based on more than one local continuous record
[5]Based on one local continuous record
[6]Based on one local periodic observation
[7]Based on wind field model
[8]Gust factors non-standard, fastest-mile and recurrence interval estimated from mean (lower value) and gust (upper value)

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