THE CHRONICLE OF THE WIND ENGINEERING RESEARCH COUNCIL

the Wind Engineer

Volume 5, No. 1

May, 1991

# NASA Wind Tunnel Rehabilitation Program

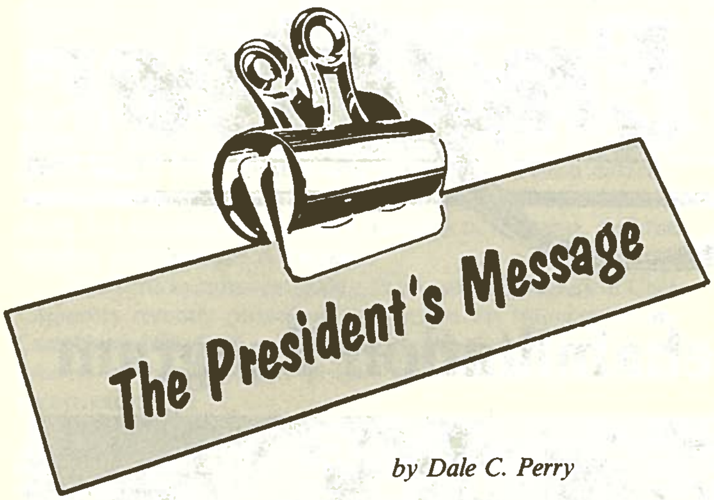
*Aerial view of Ames' Unitary Plan Wind Tunnels. The Unitary Plan Wind Tunnels are a national research facility dedicated to providing quality data from wind tunnel model tests for NASA, U.S. aerospace industry, and the Defense Department. The unitary consists of three wind tunnels linked by a common drive motor system and covers a speed range of Mach .3 to 3.5 (.3 to 3.5 times the speed of sound).*

NASA's Ames Research Center at Moffett Field, California is undertaking a $160 million program to modernize its Unitary Plan and 12-foot Pressure Wind Tunnels.

Since their completion in the 1940s and 1950s, the Ames wind tunnels have tested models of almost every significant commercial and military aircraft and every manned spacecraft in the nation, including models of the space shuttle and the Apollo.

The unitary complex was designated a National Historic Landmark by the National Park Service because of "its significant associations with the development of the American space program."

*Continued on page 8*



*by Dale C. Perry*

The tornado and hurricane season is once again upon us. Damage and deaths inflicted by recent tornados in the midwest serve as a reminder that we are not doing enough to mitigate the effects of severe storms.

Although the membership of WERC has grown steadily during the past decade, there still exists a pressing need to expand the active participation and include a broader class of individuals and organizations impacted by the wind threat. Emergency planners, practitioners, building code officials, and others engaged in developing standards and building codes are encouraged to join the organization and share their experience and knowledge with us. The increasing demands being placed on the tax dollar have resulted in a decrease in research monies available and we must work harder to justify expenditures and identify a favorable cost/benefit ratio to those who fund research.

In order to expand our membership please describe the benefits of participation in WERC and pass on a copy of this *Wind Engineer* to an interested party. Of interest to our membership is the fact that a Wind Engineering Reference Library (WERL) has now been established at the College of Architecture, Texas A&M University. The Library will archive as much informaiton on wind engineering as possible, e.g., texts, proceedings, codes, and references. The intent is to create a central reference location of wind engineering information available to anyone seeking such documents.

## National Science Foundation: Program Related to Wind Engineering

Since W.E.R.C. members have an interest in activities of the National Science Foundation, the program desription developed by N.S.F.'s Engineering Directorate for *Natural and Man-Made Hazard Mitigation* is given in the *Wind Engineer* in its entirety. Formerly administered by Dr. Michael Gaus, it is now handled by Dr. J. Eleonara Sabadell for NSF:

This Program supports research activities that strengthen the knowledge base on: (1) the physical phenomena underlying natural hazards such as hurricanes and tornadoes, floods and droughts, landslides, subsidence and other ground failures; (2) the understanding of their interactions with and the impacts on populations, the natural environment, and structures; (3) the necessary techniques for better assessing the nature, magnitude, risk and cost of the impacts of these hazards; (4) the prediction of natural hazard occurrences; and (5) the creation and dissemination of the engineering and scientific information needed for mitigating and preventing the consequences of these kinds of disasters.

Advances are expected to be realized in areas such as: the ability to understand and measure the influence of human actions on the atmospheric, hydrologic and geomorphic extreme events already mentioned, and on the trends and consequences of these changes; real-time predictive capabilities; methods for identifying, assessing, managing and communicating risks; estimating the probability of extremely rare events; the application of expert systems and artificial intelligence in natural hazard mitigation and the use of advanced information storage/retrieval systems; the physical and mathematical simulation of these natural hazards and benchmark field experiments; the understanding of the consequences of multiple natural hazards; new designs, materials, codes and building techniques to withstand extreme natural events; the knowledge of the consequences of natural and technological disasters when combined; and the development of advanced, economic and quality instrumentation and of network systems.

## HONORS

**Jon Peterka** received the WERC Wind Engineering Research Award for his outstanding research accomplishments in the past two years, both as a professor at Colorado State University and as a principal of Cermak-Peterka-Peterson.

**Herbert S. Saffir** received the WERC Outstanding Wind Engineering Service Award in recognition of his long-term efforts to improve understanding and characterization of extreme hurricane winds, for his long-term efforts to improve wind provisions in codes and standards and for his contributions to WERC including his development of and service as editor of the *Wind Engineer*.

**Dale L. Compton**, director of NASA's Ames Research Center, was selected for the Silicon Valley Engineering Hall of Fame award. The award is presented annually by the Silicon Valley Engineering Council, which represents professional engineering societies and promotes the engineering profession and education in the valley.

Compton, a mechanical and aeronautical engineer, was cited as a pioneer in planetary atmosphere entry, hypersonic aerodynamics and physics of high temperature gases, and in earth sciences. As director of Ames, he leads one of the largest research and development programs in Silicon Valley.

# Surface Wind Measurements Proposed by the Automatic Surface Observing System

*by*
*Mark D. Powell*
*NOAA Hurricane Research Division*

The National Weather Service (NWS) is modernizing and restructuring its facilities. As a part of this process, many manual surface observing stations are scheduled to be replaced by automated ones over several years; the national network will be called the Automatic Surface Observing System (ASOS). Surface observations include wind speed, wind direction, sea-level pressure, temperature, dew point, precipitation, cloud types, cloud ceilings, and present and past weather. Since all observations are automated, new technologies are being developed to replace many tasks that had been performed by trained observers over the past century. As a new system, ASOS is destined to have growing pains; they are showing up already. Based upon preliminary information gathered by the author, the system may have much to offer those interested in the extreme wind climate for engineering and design; it also has some drawbacks.

The wind observations of interest are the hourly and high-resolution. Both types of wind measurements will be available from anemometers at a standard level of 10 m, primarily at airport locations near the aircraft landing touchdown zone. Hourly observations will be transmitted onto the national data base and available through the local weather service office or subscription to a weather information service, such as Zephyr. They will consist of the 2-min average wind speed and direction taken 2 min before the hour. Under certain conditions, information on the character of the wind (gust or squall) and peak gusts (a gust is defined as the peak 5-s average wind speed) will also be transmitted. A daily summary will be prepared for the climatic record, which consists of a daily mean (computed as the average of the 24 hourly observations) and the peak 2-min and 5-s mean speeds, directions, and times of occurrence for the day.

High-resolution data will be of most use to researchers for study of extreme wind episodes and preparation of extreme wind climatology. Unfortunately, anemometer traces will no longer be available; however, high-resolution data will be available each minute and consist of a 2-min average wind speed and direction, with the peak 5-s average speed and direction over the past minute. Unfortunately, the stations have no built-in emergency backup power capability unless the site has it available; however, if power is lost during severe weather, the data are stored in nonvolatile memory for as long as 5 years. High resolution data will be off-loaded and made available through an intermediary source for external users. The data will be stored onsite for 12 h before being written over. The National Climatic Data Center is looking at archiving the high-resolution data for 30 days, after which they would be destroyed if no study episodes are identified.

Over the past few months, as preliminary information about ASOS measurements became available, many potential users have suggested improvements and augmentation for the system. The Office of the Federal Cordinator for Meteorological Services and Supporting Research (OFCM) and the National Weather Service Office of Meteorology have shown interest in documenting the needs of potential users of surface wind data from ASOS. The portion of the meteorological community concerned with hurricane research and operational forecast and warning needs recently endorsed the recommendation to the OFCM and the NWS.

The following sampling recommendation for automatic stations serves the interests of the hurricane operations and research community:

Sampling Recommendation

- Adopt World Meteorological Organization (WMO) 10-min averaging at the 10-m level for hourly observations.
- Record consecutive 1-min means from 5-s block averages and permanent archival of those data by NCDC.
- Send peak 1-min and peak 5-s averages during the past hour with hourly observation.
- Have the ability to interrogate a 10-min mean, peak 1-min average and peak 5-s average every 10 min under specified criteria.

## New NSF Publication

The newly updated *Directorate for Engineering Program Descriptions (NSF90-111)* is now available upon request from NSF. This document describes the focus areas and requirements for each funding program currently supported by the seven divisions of ENG, and includes phone numbers for each division.

Copies of the *Directorate for Engineering Program Descriptions* can be ordered from the NSF Forms and Publications Unit; 1800 G Street, N.W., Washington, DC 20550; telephone (202) 357-7861. To order through electronic mail, address requests to pubs@nsf (Bitnet) or to pubs@nsf.gov (Internet).

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# The Impact of Structural Damage Due to Hurricanes and the Prospects for Disaster Reduction

*A.G. Davenport*
*Director, The Boundary Layer Wind Tunnel Laboratory*
*The University of Western Ontario, London, Canada*

## INTRODUCTION

There are many factors that can influence the seriousness of a disaster, ranging from the degree of preparedness and planning to the availability of relief and post-disaster assistance. In the case of tropical storms (hurricanes, typhoons and cyclones), however, a primary agency of the disaster is the failure and unserviceability of buildings and structures. Amongst these are homes, refuges, hospitals, schools, industrial buildings, communication towers, and power lines. Apart from the personal injuries which the structural damage causes, it deprives people of shelter, disrupts essential post-disaster services such as hospitals and communications, cripples important contributors to the economy, such as the manufacturing, tourist and agricultural industries and impedes relief and recovery. The evidence suggests that most of this structural damage is preventable at little or no cost.

These remarks are illustrated by reference to the impact of Hurricane Gilbert on the island of Jamaica. This storm earned the distinction of being the "hurricane of the century" (an accolade transferred to Hugo a year later). It devastated Jamaica and Cancun in the Yucatan peninsula before finally dissipating in southern Texas. The loss of life was only 45 (11 shot for looting by the police) and injury was low, thanks in part to the effectiveness of warning systems; but the property damage and the contingent losses were severe. In Jamaica the economic losses were roughly $2 to 3 billion (U.S.), equal or greater than the annual GDP.

This paper examines the performance during Gilbert of various types of structure and the impact their failure had on the severity of the disaster. Since improved wind resistance is the key to reducing the disaster, instances are cited where the structures have performed well and their survival factors are indicated. We also examine the protection that codes provide against storms the intensity of Gilbert. We affirm the need for governmental enforcement of codes in the design of structures essential to post-disaster service; but the implementation of codes more widely is likely to require, in addition, the support of other sectors and organizations. We draw attention to the special needs of the construction industry for the skills and information to improve disaster resistance.

## THE STORM

'Tropical Storm Gilbert' became 'Hurricane Gilbert' on the morning of Sunday, September 11th, 1988, when it was still six hundred miles from the eastern extremity of Jamaica. It travelled towards Jamaica at a steady speed of approximately fifteen miles per hour and reached the island at approximately 11 a.m. on September 12th. The central pressure was 963 mb, and the eye diameter (roughly twice the radius to maximum winds) was about 25-30 miles.

The storm track lay along the centreline of the island and the region of strong winds affected all parts of Jamaica. The eye left Negril at the westerly extreme at approximately 8 a.m. on September 13th.

Windspeeds in the storm were monitored by aircraft from the NOAA National Hurricane Center, Coral Gables, as well as anemometer recordings in Jamaica at Norman Manley Airport, Kingston and Sangster Airport, Montego Bay. Although the recordings were interrupted by damage to the instruments, the evidence suggests that in open areas close to the coast the sustained windspeeds (averaged over about 10 minutes) at 10 metres height were approximately 85 to 95 mph while the peak gusts were in the range 130 to 140 mph. Windspeeds on the north coast, to the right of the track, were somewhat higher than on the south coast.

These windspeeds are similar to the design windspeeds in Jamaica; that specified by the Jamaican Building Code is a 3-second gust speed of 125 mph, and that specified by CUBIC, the Caribbean Uniform Building Code is a "once-in-50-year" 10 minute mean wind speed of 83 mph; higher windspeeds with longer return periods are appropriate for structures strategically important in post-disaster recovery. It seems Gilbert very closely represented the 'design windstorm'.

Terrain and topography can significantly modify the windspeed. Winds near the surface approaching the land off the sea would first be retarded by the rougher terrain covered by trees and houses. Speed-up would occur over hillcrests; and, in the lee of hills, there would be a sheltering effect.

## STRUCTURAL DAMAGE AND ITS IMPACT

### AN OVERVIEW

The following summarizes the nature and extent of some of the structural damage during Gilbert and the impact it had on the recovery after the storm.

Buildings suffered most through the loss of roofing. In some cases the entire roof system was removed due to lack of adequate anchorage of the roof structure to the walls. In other cases the sheeting was removed through the failure of the purlins or the fasteners. Walls stood up much better, a fact which undoubtedly saved lives. Roof trusses and rafters anchored by the standard hurricane straps to the wall top plates performed universally well.

Of the total losses on the island it has been estimated that approximately 40% was damage to houses. Roughly 130,000 (or 1 house in 4) suffered significant damage. All types were affected, ranging from simple 'chattel' houses made from poles and scrap material, to housing estates built through government agencies and the larger more expensive houses, particularly those near the crests of hills, such as the Beverley Hills and Redhills areas near Kingston. Without roofs, water damage from the torrential rains was extensive and crippled the capacity of families to recover. Other buildings which suffered serious structural damage included those essential for post disaster recovery, such as hospitals, refuges, communication centres and police stations.

Significant damage was reported to ten hospitals including the Princess Margaret Hospital at Morant Bay, a hospital for chest diseases, the University Hospital, the new hospital at Montego Bay and the hospital at Mandeville. In each instance, the community was faced not only with the replacement of the structure, supplies and costly medical equipment, but also with the loss of facilities to treat those injured in the storm and the patients already admitted for care.

Other buildings, such as schools and churches which were designated and used as refuges, were also badly damaged. More than 500 of the island's 580 schools were reported damaged. Churches also suffered; in one instance in Kingston, an entire roof was blown off a church inside which 400 people were sheltering. These experiences further compounded the distress of those made homeless by the storm and will make the task of encouraging the population to take shelter in future storms, more difficult.

Other essential structures destroyed included communication towers and buildings. Early in the storm the roof of the main international telephone exchange was damaged, the switching equipment was drenched with water, and external communications to outside countries was cut off. This confused accurate reporting of conditions on the island and delayed the despatch of relief and supplies. Internally, communications were cut by the failure of the 300 ft tower at St. Catherine's Peak carrying the main microwave repeaters for the island. Towers at the police headquarters in Kingston and at the military base at Newcastle were destroyed, interfering with the essential military and police communications. Other towers at radio and television stations on the island were also damaged, preventing broadcast of warnings and bulletins.

Public utilities such as power and water were interrupted for many days - weeks in the inland regions. Although the main high voltage distribution network on the island, which was carried on steel towers, survived the storm intact, 50% of the wooden utility poles were destroyed both by wind, and fallen trees and branches. Steel light standards were extensively damaged. Water supply was interrupted in many regions, in one instance, for example, due to the collapse of a roof over a reservoir facility.

There was extensive damage to industrial buildings throughout the island. Principally these were older buildings but there were numerous examples of newer buildings which had been destroyed. The loss of these structures had a direct impact on the productivity of the economy and jeopardised both the income of the workers and the acquisition of capital to re-establish the industry.

Although damage to larger office buildings in downtown Kingston was relatively light, there was extensive glass breakage. Because of this, water damage to computer systems and records was in several instances serious. One insurance company lost records on its policyholders.

Losses to the agricultural industry contributed significantly to the measure of the disaster. In addition to the very heavy crop damage - to bananas, citrus, sugar, coffee and coconut palms - there was widespread damage to structures such as storage sheds, and chicken houses (the occupants of which were decimated). This left a community which was accustomed to being self reliant for food, suddenly dependent on imports.

## THE PROSPECTS FOR REDUCING THE DISASTER

The evidence suggests that the root cause of this disaster was the failure and unserviceablility of structures due to wind action. Improved wind resistance is therefore the logical starting point in any effort at disaster reduction.

Amongst the essential requirements to achieve this goal is the establishment of appropriate construction codes or standards, education and training in their use, and their application in practice. In many instances, such as in buildings critical for post-disaster services and recovery, the enforcement of design standards in new construction and the upgrading of old construction is essential. This is not easy and may require special efforts to achieve. Close inspection of the damage in Gilbert showed that the achievement of adequate wind resistance in many instances would have required only minor design modifications, negligible cost in material, but better inspection.

With respect to construction codes, Jamaica is fortunate in having available not only the Jamaican Building Code (first published in 1983), but also the recently introduced Caribbean Uniform Building Code (CUBIC). Both of these are suitable codes; however, neither has been officially enacted and their effectiveness is considerably reduced.

The CUBIC code is directly based on the new ISO standard for wind resistance; it incorporates a recent study on the risk of hurricane windspeeds in the Caribbean, approaches to determining the modification to the wind speeds due to terrain and topography, the influence of dynamic response of the structures to wind turbulence, and recent wind tunnel studies carried out in state-of-the-art 'boundary layer' wind tunnels. The provisions for the dynamic response and the speed up over hills would have both been highly significant in the definition of the appropriate design windspeed for the St. Catherines Peak tower.

Standards for roofing materials exist in the literature, but, judging by the wide range of materials and techniques employed and the widespread losses, do not appear to have reached all contractors and influenced practice sufficiently. The development of suitable standards and construction guides may require further attention. At least one very effective set of guidelines for the construction of small houses has been prepared.

Aluminum sheeting suffered the most extensive damage. The advantage of this material is that it is mined and manufactured locally and its cost is highly competitive with steel sheeting and other roofing systems. Reasons for the losses include the use of grades of material which were brittle and prone to tearing at the heads of fasteners; the gauge of the material was too thin; fasteners lacked washers, were too few or were inappropriately spaced; purlins were spaced too far apart; and there was insufficient attention to pressures at eaves and overhangs. These deficiencies can be addressed straightforwardly but to do so requires the framework of effective standards, and where these are not available, appropriate testing. Some of the responsibility for providing these standards must rest with the industry itself.

## The Case of the Whistling New York Building

After receiving hundreds of complaints about a high-pitched whistling noise, the New York City Department of Environmental Protection (NYDEP) levied a fine of $880 against the owner of the 72-story Cityspire development in midtown Manhattan.

Gerald Denaro, an administrative law judge for the city's Environmental Control Board, said at a hearing that wind blowing around the 800-foot-high green dome of Cityspire was responsible for whistling noises that have irritated midtown residents.

The source of the noise was not initially known, but NYDEP inspectors traced it to the louvered dome atop the 800-ft.-high building. The high-pitched whistle occurs when winds gust through the louvers of the eight-sided dome.

The dome was attached to the flat, square top of the 4-year-old building last August, and the NYDEP said it began to receive complaints about that time. "Some of the complaints have come from people as far as one and a half miles away from Cityspire," said Ian Michaels, a spokesperson for the NYDEP.

James P. Cowan, an acoustical engineer testifying for the owner said wind-generated building noise "happens regularly" in the city.

Whether the acoustic properties of new high-rise buildings are being considered, when subject to wind, is another point for the boundary layer wind tunnel engineers to consider.

## NIST MERGERS

The National Institute of Standards and Technology has combined two main units that cover items pertaining to the building community. The former Centers for Building Technology and Fire Research now have become the Building and Fire Research Laboratory.

The move is part of a broad reorganization at NIST. Richard N. Wright, who headed the building technology center, has been named director of the new laboratory. The deputy director is Jack Snell, former chief of the Center for Fire Research.

## Hurricane Hugo ... A continuing Saga

The *Wind Engineer* highlighted the effects of Hurricane Hugo in its January, 1990 article, "Hurricane Hugo: With Total Damages Over Ten Billion Dollars," by Herbert S. Saffir, P.E., and in its Summer, 1990 article, "Wind Speeds in the Carolinas During Hurricane Hugo" by Peter R. Sparks.

In an article entitled "Structural Damages Caused by Hurricane Hugo in Puerto Rico," by Dr. Leandro Rodriguez, Dr. Carlos I. Pesquera, and Dr. Ricardo Lopez, in the November, 1990 publication of the Colegio de Ingenieros de Puerto Rico, Dimension, some comments on the storm's effects in Puerto Rico are given. Readers of the *Wind Engineer* may be interested in these statements:

"Early in the morning of September 18, 1989, Puerto Rico was hit by Hurricane Hugo, which inflicted heavy damage, especially to the northeastern coast. The towns of Ceiba, Fajardo, Luquillo and Rio Grande suffered the full force of the winds because the southwestern part of the storm's eye passed over them. Maximum wind velocities of 104 miles per hour were recorded at Roosevelt Roads Naval Station on the east coast, with gusts up to 120 miles per hour. In the San Juan area, wind velocities of 84 miles per hour were recorded by the San Juan National Weather Service Office at the Luis Munoz Marin Airport with gusts up to 92 miles per hour. Much of the damage caused by Hurricane Hugo was attributed to the wind, as the expected heavy rains never materialized."

The article goes on to discuss building code performance:

"The failures of all the cases studied in this project could be traced to lack of design, incorrect design or poor construction. Not one case could be identified as resulting from a deficiency of the Building Code applicable in Puerto Rico.

Correct design and construction were synonymous with good performance while the lack of any one of these components meant poor performance and failure.

Concrete houses and buildings in general withstood Hugo excellently while facades and curtainwall withstood poorly. Metal type connections for wood houses survived well but the same cannot be said of nail connections. Other elements that withstood Hugo's strong winds badly were light poles, electric line poles, roof insulation and impermeabilization materials."

The authors suggested the following recommendations for the building code:

1. An overload factor for the design of connections and secondary elements for lightweight structures should be included in wind design. These lightweight structures are the most sensitive to the effect of hurricanes. Uncertainty about wind pressure in local areas and the negative consequences that a local failure brings to the total structure sufficiently justify the utilization of this recommended overload factor. In addition, the possibility of a wind velocity higher than the design velocity is always present and its effect on pressure is not linear.
2. Small wood houses are very sensitive to gusts of wind that could generate velocities higher than anticipated. In these cases, the complete structure should be designed with an overload factor.
3. Corner column foundations of lightweight structures, as in industrial buildings, should be designed for a local pressure that will take into consideration the higher suction developed at these points They should be designed for a pressure greater than that affecting main members and foundations.

## New Books

### *Of Interest to the Wind Engineering Community*

*Wind Engineering, A Handbook for Structural Engineers*, by Henry Liu, past member of the board of directors of WERC, and Professor of Civil Engineering at the University of Missouri, Columbia, Missouri.

Presents information on wind as a factor in structural design, focusing on the treatment of wind loads in building codes and standards. Covers high winds and severe storms, extreme wind probability, wind characteristics, pressures and forces on buildings and other structures, dynamic responses, and wind-tunnel tests. Prentice Hall, Prentice Hall Building, Englewood Cliffs, NJ 07632. 1990. 209 pages. $45.20.

## International Decade for Natural Disasters Reduction

*by J. Eleonora Sabadell, National Science Foundation*

On December 1989, the United Nations General Assembly passed a resolution designating the 1990s as the International Decade for Natural Disasters Reduction (IDNDR). The proposal was submitted by 93 countries, including the United States, and approved by consensus of the Assembly. A United Nations Secretariat for the IDNDR has been constituted, with headquarters in Geneva, Switzerland.

In response to this action, Alan Bromley, Science Advisor to the U.S. President, gave to the Committee on Environmental and Earth Sciences (CEES) of the Office of Science and Technology for the President, chaired by Dallas Peck, the responsibility of forming a Subcommittee for Natural Disaster Reduction. Approximately 20 federal agencies are members of the new Subcommittee; the National Science Foundation is represented by J. Eleonora Sabadell and William A. Anderson of ENG's Division of Biological and Critical Systems (BCS).

The Subcommittee is preparing a report to the CEES describing present and future interagency, domestic, and international activities for the national decade. Several federal agencies, including NSF, are also funding the National Research Council of the National Academy of Sciences to carry out complementary activities in this area on behalf of the Federal Government.

Future NSF activities in the IDNDR and the Subcommittee for Natural Disaster Reduction will be announced in the *Wind Engineer.*

## MINUTES
## BOARD OF DIRECTORS MEETING
## WIND ENGINEERING RESEARCH COUNCIL

**6 November 1990**
**San Francisco, California**

1. The meeting was called to order at 6:16 p.m. by President Dale Perry. The following officers, directors and guests were present:

   Dale Perry, President
   Jim McDonald, Director
   Peter Sparks, Director
   Jack Cermak, Committee Member
   Bob Scanlan, Committee Member
   Arn Womble, Engineering Student

2. The minutes of the previous meeting held in Charleston South Carolina, on 19 September 1990, were distributed. Item 4 was modified to read:

   *"It was announced that Jack Cermak has ended his term on the (Awards) Committee ... Dorothy Reed was appointed to fill the vacancy left by Jack Cermak's departure."*

   The minutes were approved as amended. Jim McDonald was asked to record the minutes of the San Francisco meeting.

3. Action Plans of the various WERC committees were discussed.

   AWARDS COMMITTEE
   The committee had no recommendations to make at this time. Bob Scanlan reported that the committee is functioning. Perry requested the committee solicit, select and present appropriate awards at the ASCE Structures Congress in Indianapolis in April, 1991.

   A suggestion was made that the Awards Committee study the feasibility of adding a student award.

   The Awards Committee was asked to study the feasibility of establishing a Jack Cermak Award in Wind Engineering through ASCE. Such an award requires a $25,000 endowment before the award can be presented. The WERC Board enthusiastically endorsed the establishment of the award.

   CODES AND STANDARDS COMMITTEE
   A proposed action plan was discussed at length. The group suggested that the action plan be devoted to contacting the insurance industry with the goal of determining what insurance companies know about wind and what technology the organization can furnish to them.

   PUBLICATIONS COMMITTEE
   A draft of the Publications Committee Action plan was discussed. The Board consensus was that major lead articles for the *Wind Engineer* be submitted in a timely fashion.

   PUBLIC AWARENESS COMMITTEE
   Action plan of the Public Awareness Committee was approved by the Board.

   MEMBERSHIP COMMITTEE
   A sample letter to be sent to potential corporate members was presented. After reviewing the letter the Board felt that WERC could not deliver some of the services promised. The Membership Committee was urged to rewrite the letters and tailor them to the individual company being contacted.

   USDNDR COMMITTEE
   Committee was urged to publish an article on USDNDR activities in the *Wind Engineer.*

4. Other Business

   Peter Sparks reported on the Conference: Hugo, One Year Later. He said comments on the conference were generally favorable. The proceedings will be published soon.

   President Perry was asked to write a letter to the Committee on Natural Disasters objecting to the new procedures for post-disaster investigations. The new procedures require a written report within 30 days after the disaster and allow for very little analysis of the data.

   Perry stated that he would contact Dr. Sabadell at NSF on behalf of WERC regarding funds for travel to the 8th International Conference on Wind Engineering in London, Ontario.

## Editorial Comment

With all the articles and papers written about Hurricane Hugo and the ensuing structural damage, it may be timely to point out that much of this damage resulted from poor design practices and poor construction practices, not from extreme winds. With poor quality design and construction, the model study in a boundary layer wind tunnel is of no value, and the detailed wind analysis is wasted.

In efforts to enhance quality, the American Society of Civil Engineers recently published their guide on **"Quality in the Constructed Project"**, a needed guide for all concerned in the process of completing a project from conception to final construction.

In historical perspective, the interest in obtaining quality goes back to about 2500 B.C. where the **Code of Hammurabi** in Babylon said:

"If a builder has built a house for a man and has not made his work sound, and the house which he has built has fallen down and so caused the death of the householder, that builder shall be put to death. If it causes the death of the householder's son, they shall put that builder's son to death. If it causes the death of the householder's slaves, he shall give slave for slave to the householder. If it destroys property, he shall replace anything that it has destroyed; and, because he has not made sound the house which he has built and it has fallen down, he shall (re) build the house which has fallen down from his own property.

If a builder has built a house for a man and does not make his work perfect and a wall bulges, that builder shall put that wall into sound condition at his own cost."

This should emphasize that Wind Engineering without conscientious and continuing efforts in design and construction is of not much value to the finished project.

Herbert S. Saffir, P.E.
Editor, WIND ENGINEER

### *Wind Tunnels*

*Continued from page 1*

The Ames program is part of a $300 million NASA wind tunnel revitalization program to modernize tunnels at NASA's three aeronautical centers: Langley in Hampton, Virginia, Lewis in Cleveland, Ohio, and Ames in Moffett Field, California. Each of NASA's wind tunnels is different and provides unique testing capabilities.

The unitary complex is comprised of three test sections capable of test speeds from about 200 miles per hour to over 2000 miles per hour. They are 11' x 11', 9' x 7', and 8' x 7' in size. The fastest air flow occurs in the smallest test section. All three test sections use one common drive motor system.

These wind tunnels came to be named the Unitary Plan Wind Tunnels through an Act of Congress in 1949. After World War II, it was determined that the United States lagged behind Germany in several key aeronautical technologies. Two different plans, one by the National Advisory Committee for Aeronautics (NACA – the precursor of NASA) and one by the Air Force, were advanced to remedy the shortage of transonic and supersonic test facilities. These two plans were combined into one plan and became the National Unitary Plan Wind Tunnel Act of 1949. Facilities were to be constructed at all three NACA research centers – Ames, Langley, and Lewis – and at the new Air Force Arnold Engineering and Development Center in Tullahoma, Tennessee.

Herbert S. Saffir, P.E.

## Letter to the Editor:

I was very pleased to see the article: "A reporters hurricane survival kit" in the *Wind Engineer*. It contains very useful information for the media, but I noticed one inaccuracy listed as the first item under the heading: "some useful tips". Hurricane forecasts are issued to the public, media and intergovernmental agencies in advisory bulletins. The wind speeds contained in these advisories refer to the maximum sustained surface wind speed. They do not refer to the maximum flight level wind speed. For example, in Hurricane Hugo, advisories contained wind speeds of **135 mph** prior to landfall in the mainland U.S. while the NOAA reconnaissance aircraft measured maximum winds of **160 mph** at the 12,000 ft. level. The forecaster determines the maximum sustained surface wind speed by evaluating aircraft and surface observations, pressure-wind relationship, satellite intensity estimates and other considerations.

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255 University Drive
Coral Gables, Florida 33134
PRINTING ........... Hilton Graphics

**Published periodically by the**
**Wind Engineering Research Council, Inc.**
**P.O. Box 10029**
**College Station, Texas 77842**

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P.O. Box 10029
College Station, TX 77842