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the Wind Engineer

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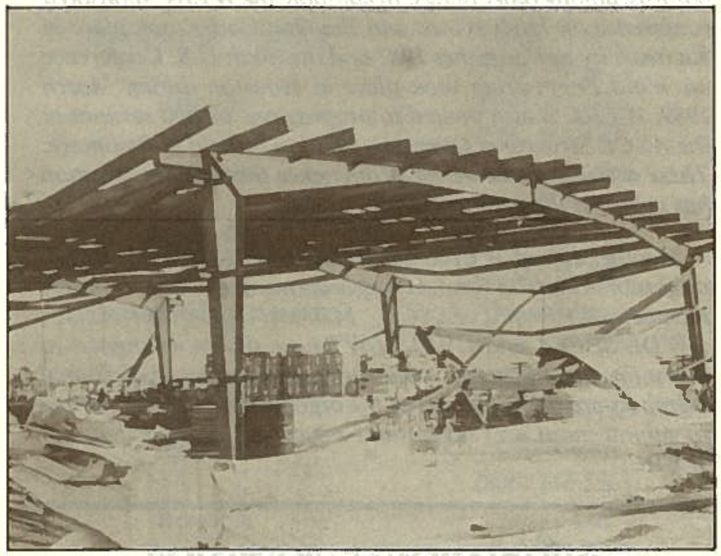
Hurricane Gilbert with maximum winds gusting to 200 mph spreads destruction

Storm Surge and Wave Action Damage to Hotel Buildings Sited Near Water at Isla Cancun



New Preengineered Metal Buildings on Isla Cancun Stripped of Cladding.

Photographs and descriptions are excerpted from *"The Strange Life of Hurricane Gilbert September 11-19, 1988"* by Dale C. Perry[1], James R. McDonald[2] and Richard E. Peterson[3].

Hurricane Gilbert swept across the Caribbean September 11-19, 1988 and caused severe structural damage in Jamaica, the Yucatan Peninsula of Mexico, and Texas. Gilbert was the first Category 5 Hurricane on the Saffir-Simpson Scale to make landfall in the western hemisphere since Camille in 1969. Before hitting the Yucatan Peninsula, the National Hurricane Center estimated gust winds up to 200 mph. Measured steady surface winds in Cozumel were reported to be 150 to 160 mph (fastest-mile speeds).

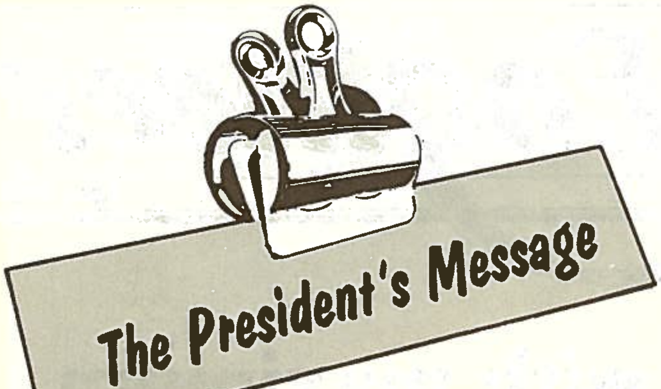
Perry, McDonald and Peterson conclude that should a similar storm having the intensity of Gilbert strike the U.S. Gulf Coastline, wind damage would be much more severe because of:

- infrequent use of reinforced concrete and masonry construction,
- use of lightweight roof systems,
- common practice of gravel ballast on built-up roofs, and
- popularity of light-framed residential construction sited near the shoreline.

[1] *Chairman, Civil Engineering Department, Pratt Institute, Brooklyn, N.Y.*

[2] *Director, Institute for Disaster Research, Texas Tech, Lubbock, Texas*

[3] *Chairman, Atmospheric Science Group, Texas Tech, Lubbock, Texas.*



by Kishor Mehta

The WERC has grown during the past few years in size and stature. WERC has been called to provide input in the organization of the International Decade of Natural Disaster Reduction, to talk to the press during the scare of Hurricane Gilbert striking the U.S. coast and to assist in formulating FEMA's plans for lifeline damage mitigation in natural hazards, among other things. In addition, the WERC sponsored conference on High Winds and Building Codes took place in Kansas City in November 1987 and the Sixth U.S. Conference on Wind Engineering took place in Houston during March 1989. WERC is also invited to propose one or two sessions at the ASCE Structures Congress, 1990, to be held in Baltimore. These activities indicate the prominence that the organization has achieved through the years.

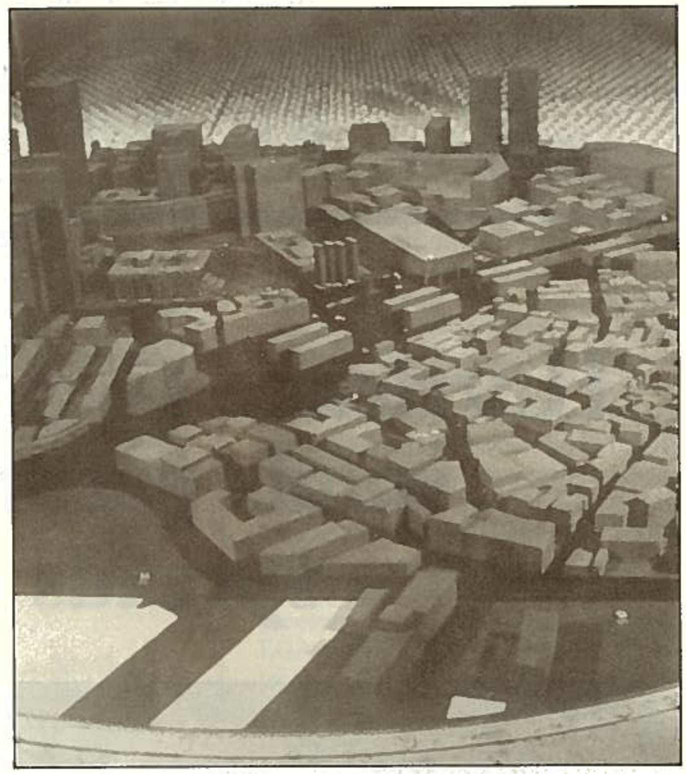
Membership of WERC has increased in 1988: close to 125 professional members and six corporate members. The corporate members CPP inc., ESSCO, MBMA, Robertson Assoc., RWDI, SBCCI, and UWO BLWT have shown willingness to invest in the future of wind engineering. The professional members are the backbone of the organization and are invited to submit input and suggestions regarding future activites of WERC.

INTERNATIONAL WORKSHOP ON SENSORS HELD AT NIST

An International Workshop on Sensors and Measurement Techniques for Assessing Structural Performance was held at the National Institute of Standards and Technology (formerly National Bureau of Standards) September 8-9, 1989. The objective of the workshop was to review the state-of-the-art in structural response measurements, related sensors and measurement techniques, and to establish a research agenda for dealing with the identified needs. Four theme papers addressed the topics of seismic effects; wind effects; effects due to occupancy, traffic, snow and other loads; and sensor technology.

Approximately 40 people attended the workshop which was jointly sponsored by the National Science Foundation and NIST. Additional information on the workshop and the availability of workshop proceedings can be obtained from Dr. Richard Marshall, Center for Building Technology, NIST, Gaithersburg, MD 20899.

R. Marshall



Wind Tunnel Model Study of Central Artery and Third Harbor Ventilation Buildings for Boston

The Commonwealth of Massachusetts, in cooperation with the Department of Transportation, Federal Highway Administration, has proposed depressing and widening the Central Artery through central Boston. The Bechtel/Parsons Brinkerhoff joint venture has been selected by the Commonwealth of Massachusetts to manage the Central Artery and Third Harbor Tunnel Project, under the direction of the Massachusetts Department of Public Works.

The underground sections of the Central Artery and the Third Harbor Tunnel will be ventilated. Six to eight ventilation buildings are planned for the project. Two of the building sites, Parcel 7 and Boston Edison, are located in congested, heavily populated areas in downtown Boston. The complicated flow patterns associated with these sites clearly indicate the need for physical modeling of vent building air quality impacts.

Colorado State University has conducted a wind tunnel model study under the direction of Dr. Robert N. Meroney, Director of the Fluid Dynamics Laboratory, to determine the best exhaust stack location and height such that the recirculation of the exhaust to the fresh air intake and the exhaust gas concentration at ground level and the nearby defined elevated receptors are minimized.

The photograph shows views of a 1:384 scale model of the downtown Boston district surrounding the Parcel 7 ventilation building site. The model is installed in the Environmental Wind Tunnel of the Fluid Dynamics and Diffusion Laboratory at Colorado State University. Upwind suburban buildings are represented by genric block roughness, and the wind field is also conditioned with vortex spires and a barrier at the test section entrance.

An Editorial Comment

The Sixth U.S. National Conference on Wind Engineering, recently held at the University of Houston, can be deemed a great success in terms of interest and attendance. Commendations to all involved in administering the Conference!

In the opinion of the Editor, one of the problems with the 3 day Conference was the fact that few practicing engineers attended the Conference; most of the attendants were in the research field. Many of the papers lacked relevance to the practice of engineering. Dr. Alan Davenport, Director of the University of Western Ontario Wind Tunnel, summed this up in one of the key-note lectures:

"What I think is that many of our very sophisticated and wonderful descriptions of how the wind works have not been discussed in terms of the actual structures that they are affecting."

Research information provided at a conference such as this must be transmitted to the practicing engineer.

Herbert S. Saffir, P.E.
Editor

WERC AWARDS

At the recent Board of Directors meeting of the Wind Engineering Research Council, held in Houston in March 1989, the following awards were proposed by Dr. Jack Cermak, Chairman of the Awards Committee and approved by the Board:

I. **W.E. Service Award**

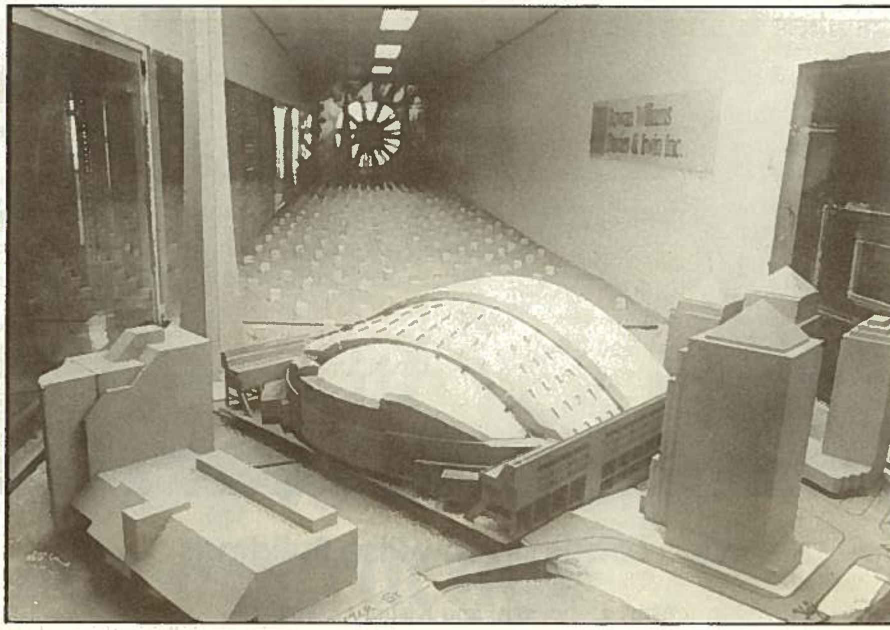
Frequency: every two years with presentations at U.S. National WE and International WE Conferences

Purpose: recognition of outstanding WE service through organization of conferences, technical sessions at engineering society meetings, workshops and seminars; publications; practice and/or research; and service related to WERC activities and objectives.

II. **W.E. Research Award**

Frequency: every year with presentations at U.S. National WE Conf., and conferences or technical-sessions co-sponsored by WERC with other organizations.

Purpose: recognition of outstanding research within last one or two years by a young investigator.



Toronto SkyDome Snow Loading Simulation

To predict snow loads that could arise from drifting on the 200-metre-span, retractable roof of the Toronto SkyDome, Rowan Williams Davies & Irwin Inc. (RWDI) developed a powerful new tool. It is a combination of wind tunnel, water flume and computer-simulation techniques which quantitatively predicts redistribution of snow on roofs as a result of drifting caused by wind.

In the past such information has not been available for unusual roofs and a number have experienced snow loading problems.

A 1:200 scale model of the retractable roof SkyDome in Toronto, Ontario is slated to be constructed in time for the 1989 baseball season. This model was used to measure wind velocity distribution over the roof.

Rowan Williams Davies & Irwin Inc. (RWDI) of Guelph, Ontario, Canada won a national award of merit from the Association of Consulting Engineers of Canada for studies to predict snow loads on the 200 metre roof.

Wind tunnel, water flume and computer simulation techniques were combined to quantitatively predict snow redistribution as a result of drifting by wind.

Dr. Peter Irwin of RWDI directed this study.

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Activities at the Hurricane Research Division of NOAA

by Mark D. Powell, Ph.D.[1]

From July through November, the National Oceanic and Atmospheric Adminstration's (NOAA) two P-3 aircraft "flying laboratories" support the annual field research programs of the Hurricane Research Division, (HRD) a part of the Atlantic Oceanographic and Meteorological Laboratory in Miami. The aircraft are maintained and operated by the NOAA Office of Aircraft Operations, which is based at Miami International Airport. Scientists at HRD follow a program of basic and applied research that is directed toward gaining a better understanding of the structure and behavior of hurricanes through analytical and theoretical studies. The ultimate objective is to develop improved methods for hurricane prediction.

Several experiments are planned for this hurricane season, including: (1) a study of the environmental flow surrounding hurricanes and its interaction with the vortex, (2) the water budget and energetics of a storm, and (3) the influence of rainband convection on the detailed structure of the boundary layer. The aircraft are fully equipped to measure and record winds, temperature, humidity, pressure, radar reflectivity, and cloud microphysical quantities. Wind instrumentation includes: (1) a data system based on dual inertial navigation units, (2) a tail-mounted (3-cm wavelength) Doppler radar that scans helically, perpendicular to the aircraft track, to measure the motion of raindrops from which winds are derived, (3) a stepped-frequency microwave radiometer (SPMR), being developed by the University of Massachusetts, for measuring surface winds, and (4) a Hasselblad vertical camera system for documenting sea state and surface wind direction.

When a hurricane threatens land, HRD sends "hurricane chase" teams to the projected U.S. landfall points while the aircraft support the National Hurricane Center's (NHC) operational requirements for high-resolution reconnaissance measurements. The aircraft are equipped with a satellite link to transmit near-real-time data to forecasters at NHC (Coral Gables, Florida). Chase teams record radar measurements from the nearest National Weather Service radar sites and collect available meteorological data. Recently they have made detailed balloon soundings with the assistance of a mobile lab and team from the National Severe Storms Laboratory (Norman, Oklahoma) of NOAA.

Depending upon the reconnaissance flight altitude and the availability of surface data, detailed studies can be made on the changes in wind structure of the boundary layer during landfall. The most recent landfall studies included Hurricanes Frederic (1979) and Alicia (1983). Current boundary layer studies include: (1) investigation of mixed-layer modification by downdraft transport of cold, dry air in hurricane rainbands and subsequent recovery processes, (2) comparisons of flight-level wind measurements with surface observations from oceanic platforms during hurricanes, (3) response of the oceanic temperature and current mixed-layer fields to the hurricane, (4) development of algorithims for real-time transmission of SPMR and airborne Doppler radar wind measurements to NHC, and (5) objective assimilation and analysis of surface wind observations from land, ship, buoy, and aircraft sources in near-real-time.

[1] *Meteorologist, Hurricane Research Division, NOAA, Miami, Florida.*

1989 "Man-of-the Year" Robertson

Leslie Robertson received a well deserved honor from McGraw-Hill's ENR by being designated as their 1989 Man-of-the-Year; extensive photographs and a lead article described Robertson's achievements in the February 23, 1989 issue of ENR. "Man-of-the-Year" covers the entire building and construction industry. Robertson, principal in the structural engineering firm of Leslie E. Robertson Associates, New York, N.Y., was one of the founders and a past member of the Board of Directors of WERC. Robertson has the distinction of having designed three of the five tallest buildings in the world. His accomplishments were lengthened last year by the topping out of the Bank of China building in Hong Kong, the tallest building outside of the U.S. and the tallest with a composite structural system.

WERC Board Meeting, March 1989

The WERC Board met on March 7th in Houston. One significant item was development of a five year plan for WERC activities; Dale Perry is developing the proposed plan. WERC will sponsor a session at the 1990 ASCE Structures Congress to be held in Baltimore. WERC has been invited to provide input for the International Decade for Natural Hazard Reduction. Next WERC Board meeting will be held in Denver, Colorado, July 15-16, 1989.

NSPE 1989 Engineering Achievement Award

The National Society of Professional Engineers (NSPE) announced the ten top U.S. engineering achievement in the Society's 23rd annual Outstanding Engineering Achievement Awards competition. One of the awards was for the Fluid Dynamics and Diffusion Laboratory (FDDL) of Colorado State University under the pioneering work of the developer and director, Dr. Jack Cermak, P.E. Cermak, Distinguished Professor at Colorado State University, and past President of WERC, developed ways to test the effects of wind on a structure, and vice versa, before the structure is built. The CSU wind tunnel simulates the earth's atmospheric boundary layer as distinct from aeronautical wind tunnels simulating smooth flow.

New Cable-Stayed Bridges and Aerodynamics

Dr. Robert H. Scanlan of Johns Hopkins University was the aerodynamics consultant on the new $92 million cable-stayed bridge being constructed over the Houston Ship Channel near Baytown, Texas. The wind tunnel testing program was described in the October 1988 issue of THE WIND ENGINEER. Scanlan was also the aerodynamics consultant on the new Dames Point Bridge in Jacksonville, Florida, the longest cable stayed bridge in the U.S. Scanlan is a past member of the Board of Directors of WERC.

WIND TUNNEL FACILITIES IN NORTH AMERICA

This is a continuing list of wind tunnels available throughout the world. Supplements will be provided in future issues of the WIND ENGINEER.

NAME	LOCATION	TYPE OF WORK	CONTACT
CPP Inc.	Fort Collins, Colorado	Commercial	Jon Peterka (303) 491-8344
Wind Dynamics Lab.	Raleigh, North Carolina	Commercial	Tim Reinhold (919) 876-0018
RWDI	Guelph, Ontario, Canada	Commercial	Peter Irwin (519) 823-1311
Colorado State University	Fort Collins, Colorado	Commercial, Research	Bob Meroney (303) 491-8574
University of Western Ontario	London, Ontario, Canada	Commercial, Research	Nick Isyumov (519) 661-3338
University of Minnesota	Minneapolis, Minnesota	Research	Cesar Farell (612) 627-4598
MIT	Cambridge Massachusetts	Commercial, Research	Frank Durgin (617) 253-2270
FHWA Aerodynamics Lab.	McLean, Virginia	Research	Harold Bosch (804) 661-6581
VPI & State University	Blackburg, Virginia	Research	Henry Tielman (703) 961-6891
Clemson University	Clemson, South Carolina	Research	Peter Sparks (803) 656-3000
University of Houston	Houston, Texas	Commercial, Research	Ahsan Kareem (713) 749-1559
National Research Council of Canada	Ottawa, Canada	Commercial, Research	Robert Wardlaw (613) 993-1156
Texas Tech University	Lubbock, Texas	Research	Jerry Dunn (806) 742-3563
University of Missouri-Columbia	Columbia, Missouri	Research	Henry Liu (314) 882-2779
Johns Hopkins, University	Baltimore, Maryland	Research	Robert Scanlan (301) 338-7138

ANSI Update

Minimum Design Loads for Building and Other Structures, ANSI A58.1-1982 is in the final stages of revision by the American Society of Civil Engineers (ASCE) Technical Council on Codes and Standards (TCCS) Committee on minimum design loads. The wind load provisions of ANSI 1982 are refined to clarify definition of Exposure D, to modify pressure coefficients on the underside of overhangs, to update internal pressure requirements, to advance applicability of Table 4 and to explain uncertainties in the Appendix. The revision has been subjected to the consensus process of the committee. After the public comment, responses and resolutions, the standard will be published as an ASCE/ANSI standard, possibly by August, 1989.

K. Mehta

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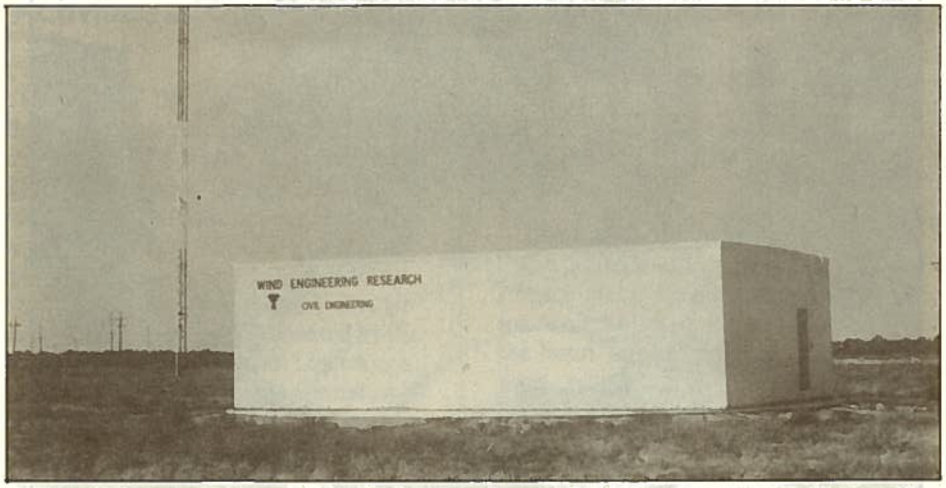

Wind Loads on Low-Rise Buildings

by
Marc L. Levitan[1] and Kishor C. Mehta[2]

Each year, strong winds are the cause of billions of dollars in damage and many injuries, mostly associated with ordinary low-rise buildings. In order to improve the performance of these structures in high winds, a greater understanding of the wind and how it interacts with the building must be achieved. A major research project is underway at Texas Tech University which will help bring about an enhanced understanding of wind loads.

Using National Science Foundation grants totalling more than $280,000, a full scale experimental facility has been constructed near the main campus in Lubbock. The Wind Engineering Field Research Laboratory, as it is called, has three main components: a test building, a data acquisiton building, and a tower for mounting meteorological instrumentation. Objectives are to obtain a reliable database for external pressures on building surfaces and internal pressures in the building.

The test building is a 30x45x13 ft prefabricated metal building which has the ability to be rotated, thus providing the researchers with positive control over the wind angle-of-attack. The building was constructed on a rigid frame undercarriage. The undercarriage has a wheel assembly at each corner, and the wheels rest on a circular steel track embedded in the concrete slab. A set of hydraulic jacks at each corner raises the building several inches, allowing it to be rotated. Weighing roughly 16,000 lbs, the building can be rotated by four persons, although for convenience a motorized system requiring only one operator is being installed.

Wind pressures on the surface of the building are measured using differential pressure transducers. One side of each transducer is connected to a line supplying ambient atmospheric pressure, which is used as the reference pressure. The other side of each transducer is connected to a pressure tap on the surface of the building. Two different types of transducers are used, fixed silicon diaphragm and variable reluctance. Both types are extremely accurate, measuring pressures to within ±0.14 psf.

A 160 ft tall guyed tower is used as a platform for the meteorological instrumentation. Booms are provided at the 13, 33, and 70 ft levels, which extend 6 ft away from the tower. Wind speed is monitored at all four levels using three-cup anemometers. Wind direction vanes are located at 33 and 160 ft. Temperature is measured at the bottom and top of the tower. Barometric pressure and relative humidity are measured at the 13 ft level.

The data acquisition system is housed in a small concrete block building, located within the test building. The system consists of an IBM PC XT with a 12 MHz 80286 main processor, math co-processor, internal 20 Mb hard drive and EGA graphics. The analog voltage signals from all instruments are converted to digital form using a MetraByte DAS 8 High Speed Analog to Digital Converter. This system can handle up to 128 different instruments, with a total sampling rate of 1200 samples per second. The system can be set on automatic, where the instruments are monitored continuously, and a data acquisition run is triggered when the wind speed reaches a preset threshold level. Most analysis of the data is performed in the office using an IBM PS/2 Model 60, equipped with 3 Mb of RAM, a 44 Mb internal hard drive and a Bernoulli RCD. For computationally intensive analysis procedures, the data is uploaded to the university's VAX 8650, and then downloaded to tapes for permanent storage.

[1] *Graduate Student, Dept. of Civil Engineering, Texas Tech University, Lubbock, Texas.*

[2] *Professor of Civil Engineering, Texas Tech University, Lubbock, Texas.*

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