

PROCEEDINGS OF THE 44TH ANNUAL HIGHWAY GEOLOGY SYMPOSIUM

**MAY 19-21, 1993
Tampa, Florida**

CO-SPONSORED BY

Department of Civil Engineering, University of South Florida

and

Florida Department of Transportation

CHAIRMAN OF LOCAL ARRANGEMENTS

**Pamela Stinnette
Department of Civil Engineering
University of South Florida
4202 E. Fowler Ave., ENG 118
Tampa, FL 33620**

2000

1000
2000
3000
4000

Greetings and Welcome

We're pleased that you have chosen to join us for the 44th Annual Highway Geology Symposium. It is our hope and endeavor that the next few days in the "Sunshine State" and the exchange of information at the Symposium will prove to be both professionally rewarding and personally enjoyable.

The Symposium has been co-sponsored by:

*The University of South Florida,
Department of Civil Engineering and Mechanics:*

*Dr. Wayne F. Echelberger, Jr., Department Chairman
Dr. Manjriker Gunaratne
Pamela Stinnette
Gray Mullins
Susan Lepore*

The Florida Department of Transportation:

*Ben G. Watts, Secretary of Transportation
Larry L. Smith, State Materials Engineer
William A. Wisner
Robert E. Goddard
Philip R. Marshall*

*A special thanks to Mr. Holton Harders, H. G. Harders and Son,
Panama City, Florida, for his help and providing the negative
from which the cover photograph was produced.*

We give our wholehearted thanks to the following sponsors. Their sponsorship has helped make the 44th Annual Highway Geology Symposium a real success.

Name	Contact	Sponsorship
Brugg Cable Products Inc.	Robert Thommen	Field Trip Lunch - Thursday
Hayward Baker, Inc.	Jim Hussin	Reception - Wednesday
Howard, Needles, Tammen & Bergendoff Corp.	Bob Smithem	Reception - Wednesday
Jim Stidham & Assoc.	Jim Stidham	Break - Friday
Law Engineering	Joseph Amon	Break - Wednesday
Post, Buckley, Schuh & Jernigan, Inc.	Gary Granata	Break - Wednesday
Professional Service Industries, JAMMAL Division	Sam Moussly	Lunch - Wednesday



137
138
139

Hayward Baker Inc.

137
138
139
140

137

44TH HIGHWAY GEOLOGY SYMPOSIUM MAY 19-21, 1993

TAMPA, FLORIDA

Program: TUESDAY, 18 MAY - 5:00 to 7:00 PM Registration (Holiday Inn)
WEDNESDAY, 19 MAY - 8:00 to Noon Registration (Holiday Inn)

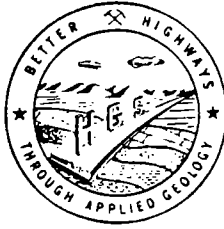
	Page
TECHNICAL SESSION I - Dr. Manjriker Gunaratne, Moderator	
8:30 AM - Welcome, Harry Moore HGS Steering Committee Chairman & Michael G. Kovac, Dean of USF College of Engineering	
8:40 AM - Opening Remarks, Pam Stinnette 44th Symposium Chairman	
8:50 AM - Keynote Address "Geology of Florida", Walter Schmidt, P.G., State Geologist	1
10:00 to 10:30 AM - Coffee Break, Sponsored by Law Engineering	
10:30 to Noon	
• Use of Aggregate in the Sunshine Skyway Bridge Project - Goddard & Wisner	6
• Resilient Modulus vs Strength in Cement Stabilized Base Courses - Jamil & Thornton	15
• Use of Foundry Waste Sand in Highway Construction - Javed & Lovell	19
• Effect of Fly Ash Quality on Concrete Durability - Zayed	35
12:00 to 1:00 PM Lunch, Sponsored by Professional Service Industries, Inc., Jammal Division	
TECHNICAL SESSION II - Mr. A. Gray Mullins, Moderator	
1:30 to 3:00 PM	
• A Roadway Problem in a Cavernous Karst Environment at the Florida Caverns State Park - Spencer	36
• Cover-Subsidence Sinkhole Evaluation State Road 434 - Longwood, FL - Foshee & Bixler	45
• Technical Related Analysis, Design, and Construction 4 Lane Highway over 8 to 20 feet of Peat - Yovaish & Law	60
• Highway Reconstruction Over an Expansive Subgrade Incorporating a High Strength Geosynthetic Moisture Barrier - Marienfeld	75
3:00 to 3:30 PM Break, Sponsored by Post, Buckley, Schuh & Jernigan, Inc.	
3:30 to 5:00 PM	
• Investigation for Landfill Expansion in a Bedrock Area, Southcentral Indiana - Pittenger & West	88
• A Study of Selected Landslides Along Cincinnati Roadways - Behringer & Shakoor	100
• Numerical Modeling of Sediment Erosion at Tidal Inlet Eridges - Ross & Vincent	118
• Field Trip Preview - Goddard	124
5:00-6:00 PM Reception, Co-Sponsored by Howard, Needles, Tammen & Bergendoff and Hayward Baker Inc.	
THURSDAY, 20 MAY	
8:00 AM - 5:00 PM - Field Trip; Field Trip Lunch Sponsored by Brugg Cable Products	
6:30 to 7:30 PM - Social Hour	
7:30 PM - Banquet: Holiday-Inn; Mr. Dewey Oliver & Mr. Joseph Blasewitz, Speakers	
FRIDAY, 21 MAY	
TECHNICAL SESSION III - Mr. A. Gray Mullins, Moderator	
8:30 to 10:00 AM	
• Mechanical Properties of Lunar Soils and Implications for a Lunar Base - Carrier	131
• Pennsylvania Turnpike Expansion: A Retrospect - Sokol & McCahan	138
• Laboratory Study on Properties of Rubber-Soils - Ahmed & Lovell	154
• Environmental Property Assessments for Highway Projects: Key Elements for Successful Program Implementation - Schneider & Bauer	157

10:00 to 10:30 AM Coffee Break, Sponsored by Jim Stidham & Associates

10:30 to Noon

- Overview of the Veterans Expressway - Smithem & Alberdi
- Construction of a Four-Lane Highway Embankment over a Contaminated Landfill - Madrid & Smith 175
- Predicting the Compressive Strength of Rocks from Aggregate Degradation -
Kasim & Shakoor 189
- New Precursor of Stick-Slip Movement of Rock Block - Chen, Lovell, Pyrak-Nolte & Haley 200
- Cement Amended Fly Ash as a Structural Fill - Marcozzi¹ 215

¹ Unable to attend.



Highway Geology Symposium

HISTORY ORGANIZATION AND FUNCTION *

Established to foster a better understanding and closer cooperation between geologists and civil engineers in the highway industry, the Highway Geology Symposium (HGS) was organized and held its first meeting on February 16, 1950, in Richmond, Virginia. Since then 39 consecutive annual meetings have been held in 26 different states. Between 1950 and 1962, the meetings were held east of the Mississippi River, with Virginia, Ohio, West Virginia, Maryland, North Carolina, Pennsylvania, Georgia, Florida, and Tennessee serving as the host states.

In 1962, the Symposium moved west for the first time to Phoenix, Arizona. Since then, it has rotated, for the most part, back and forth from east to west. Following meetings in Texas and Missouri in 1963 and 1964, the Annual Symposium moved to different locations as follows:

<u>Year</u>	<u>HGS Location</u>	<u>Year</u>	<u>HGS Location</u>
1965	Lexington, KY	1966	Ames, IA
1967	Lafayette, IN	1968	Morgantown, WV
1969	Urbana, IL	1970	Lawrence, KS
1971	Norman, OK	1972	Old Point Comfort, VA
1973	Sheridan, WY	1974	Raleigh, NC
1975	Coeur d'Alene, ID	1976	Orlando, FL
1977	Rapid City, SD	1978	Annapolis, MD
1979	Portland, OR	1980	Austin, TX
1981	Gatlinburg, TN	1982	Vail, CO
1983	Stone Mountain, GA	1984	San Jose, CA
1985	Clarksville, IN	1986	Helena, MT
1987	Pittsburgh, PA	1988	Park City, UT
1989	Montgomery, AL	1990	Albuquerque, NM
1991	Albany, NY	1992	Fayetteville, AR
1993	Tampa, FL		

Unlike most groups and organizations that meet on a regular basis, the Highway Geology Symposium has no central headquarters, no annual dues, and no formal membership requirements. The governing body of the Symposium is a steering committee composed of approximately 20 engineering geologists and geotechnical engineers from state and federal agencies, colleges and universities, as well as private service companies and consulting firms throughout the country. Steering committee members are elected for three-year terms, with their elections and re-elections being determined principally by their interests and participation in and contribution to the symposium. The officers include a chairman, vice chairman, secretary, and treasurer, all

of whom are elected for a two-year term. Officers except for the treasurer may only succeed themselves for one additional term.

A number of three-member standing committees conduct the affairs of the organization. The lack of rigid requirements, routing, and the relatively relaxed overall functioning of the organization is what attracts many of the participants.

Meeting sites are chosen two or four years in advance and are selected by the Steering Committee following presentations made by representatives of potential host states. These presentations are usually made at the steering committee meeting which is held during the Annual Symposium. Upon selection, the state representative becomes the state chairman and a member protem of the Steering Committee.

The symposia are generally for two and one-half days, with a day-and-a-half for technical papers and a full-day for the field trip. The symposium usually begins on Wednesday morning. The field trip is usually Thursday, followed by the annual banquet that evening. The final technical session generally ends by noon on Friday.

The field trip is the focus of the meeting. In most cases, the trips cover approximately from 150 to 200 miles, provide for six to eight scheduled stops, and require about eight hours. Occasionally, cultural stops are scheduled around geological and geotechnical points of interest. To cite a few examples, in Wyoming, the group viewed landslides in the Big Horn Mountains; Florida's trip included a tour of Cape Canaveral and the NASA space installation; the Idaho and South Dakota trips dealt with principally with mining activities; North Carolina provided stops at a quarry site, a dam construction site, and a nuclear generating site; in Maryland, the group visited the Chesapeake Bay hydraulic model and the Goddard Space Center; the Oregon trip included visits to the Columbia River Gorge and Mount Hood; the Central Mineral Region was visited in Texas; and the Tennessee trip provided stops at several repaired landslides in Appalachia. The Colorado field trip consisted of stops at geological and geotechnical problem areas along Interstate 70 in Vail Pass and Glenwood Canyon, while the Georgia trip in 1983 concentrated on highway design and construction problems in the Atlanta urban environment. The 1984 field trip had stops in the San Francisco Bay area which illustrated the planning, construction and maintenance of transportation systems. In 1985, the one day trip illustrated new highway construction procedures in the greater Louisville area. The 1986 field trip was through the Rockies of recent interstate construction in the Boulder Batholith. The trip highlight was a stop at the Berkeley Pit in Butte, Montana, an open pit copper mine.

At the technical sessions, case histories and state-of-the-art papers are most common with highly theoretical papers the exception. The papers presented at the technical sessions are published in the annual proceedings. Some of the more recent proceedings may be obtained from the Treasurer of the Symposium.

* Revised from the 41st Highway Geology Symposium Proceedings.



Highway Geology Symposium

STEERING COMMITTEE OFFICERS

- Mr. Harry Moore, Chairman 1993
Geologic Eng. Supervisor I
Division of Materials and Tests
Bureau of Operations
Department of Transportation
P.O. Box 58
Knoxville, Tennessee 37901
PH: 615/594-6219
- Mr. Charles T. Janick, Vice-Chairman 1993
Geotechnical Engineer
Materials & Testing Division
Bureau of Construction & Materials
Department of Transportation
1118 State Street
Harrisburg, Pennsylvania 17120
PH: 707/787-5404
- Mr. Earl Wright, Secretary 1993
Engineering Geology Section Supervisor
Geotechnical Branch
Division of Materials
Department of Highways
Transportation Cabinet
Frankfort, Kentucky 40622
PH: 502/564-2374
- Mr. Russell Glass, Treasurer Appointed
Area Geologist by Chairman
Geotechnical Unit
N.C. Department of Transportation
P.O. Box 1951
Asheville, North Carolina 28802
PH: 704/298-3874

NOTE: Officers' terms expire at conclusion of
1993 Symposium.



Highway Geology Symposium

H.G.S. STEERING COMMITTEE MEMBERSHIP LIST

NAME	TERM EXPIRES
Mr. David Bingham 3713 Lancelot Court Raleigh, N.C. 27604 PH: 919/876-0416	1993
Mr. Vernon Bump Division of Engineering Dept. of Transportation Pierre, South Dakota 57501 PH: 605/773-3401	1993
Mr. Richard Cross New York State Thruway Authority 200 Southern Boulevard P.O. Box 189 Albany, N.Y. 12201-0189 PH: 518/471-4277	1994
Mr. John B. Gilmore Colorado Hwy. Dept. 4340 East Louisiana Denver, Colorado 80222 PH: 303/757-9275	1992
Mr. Russell Glass N.C. D.O.T. P.O. Box 1951 3279 Geotechnical Section Asheville, N.C. 28802 PH: 704/298-3874	1993
Mr. Joseph A. Gutierrez Vulcan Materials Company P.O. Box 4195 Winston-Salem, N.C. 27105 PH: 919/767-4600	1994
Mr. Richard Humphries Golder & Associates 3730 Chamblee Tucker Rd. Atlanta, Georgia 30341 PH: 404/496-1893	1994

Mr. Charles T. Janick 1994
PA. Dept. of Transportation
1118 State Street
Harrisburg, Pennsylvania 17120
PH: 707/787-5404

Dr. C. William Lovell 1995
Professor of Civil Engineering
Purdue University
Grissom Hall
West Lafayette, Indiana 47907
PH: 317/494-5034

Mr. Harry Ludowise 1992
6308 NE 12th Avenue
Vancouver, Washington 98665
PH: 206/693-1617

Mr. Henry Mathis 1992
Manager, Geotechnical Branch
Kentucky Dept. of Highways
Frankfort, Kentucky 40622
PH: 502/564-2374

Mr. Willard McCasland 1994
321 Sahoma Terrace
Edmond, Oklahoma 73013
PH: 405/341-9395

Mr. Marvin McCauley 1994
CA. Dept. of Transportation
5900 Folsom Boulevard
Scaramento, California 95819
PH: 916/739-2480

Mr. Verne McGuffey 1992
New York D.O.T.
Bldg. 7 State Campus
1220 Washington Avenue
Albany, New York 12232
PH: 518/457-4710

Mr. Harry Moore 1994
Tennessee D.O.T.
P.O. Box 58
Knoxville, Tennessee 37901
PH: 615/594-6219

Mr. Gary Riedl 1992
Wyoming, Hwy. Dept.
P.O. Box 1708
Cheyenne, Wyoming 82002-9019
PH: 307/777-7450

Mr. Sam I. Thorton 1993
University of Arkansas
Dept. of Civil Engineering
Fayetteville, Arkansas 72701
PH: 501/575-6024

Dr. Terry West 1994
Associate Professor
Earth & Atmos. Sci. Dept.
Purdue University
West Lafayette, Indiana 47907
PH: 317/494-3296

Mr. W. A. Wisner 1993
Florida Dept. of Transportation
P.O. Box 1029
Gainesville, Florida 32602
PH: 904/372-5304

Mr. Earl Wright 1993
Geotechnical Branch
Kentucky Dept. of Highways
Frankfort, Kentucky 40622
PH: 502/564-2374

Mr. Terry Yarger 1994
Montana Dept. of Highways
2701 Prospect Avenue
Helena, Montana 59620
PH: 406/444-6280

FLORIDA

Florida Geological Survey, Bureau of Geology, Florida Department of Natural Resources, 903 West Tennessee Street, Tallahassee, Florida 32304-7795.
Phone 904-488-4191

HISTORICAL SEQUENCE OF ORGANIZATION NAME:

Office of State Engineer and Geologist, 1852-55
State Geologist, 1886-87
Florida Geological Survey, 1907-71
Florida Bureau of Geology, 1971-83
Florida Geological Survey, 1983-present

NAMES AND TITLES OF ORGANIZATIONAL DIRECTORS AND DATES SERVED:

State Engineer and Geologist

Francis L. Dancy, 1852-55

State Geologists

John Kost, 1886-87
E. H. Sellards, 1907-19
Herman Gunter, 1919-58

Robert O. Vernon, 1958-71
Charles W. Hendry, Jr., 1971-88
Walter Schmidt, 1988-present

HISTORY OF THE FLORIDA GEOLOGICAL SURVEY

The origin of the Florida Geological Survey can be traced to the year 1852, when the office of State Engineer and Geologist was authorized by the legislature. "General" Francis L. Dancy, a former militia officer and mayor of St. Augustine, was chosen to head this office. Although Dancy did not have geological training, his extensive experience in engineering was useful to his office's responsibility to drain lowlands for agricultural development. In November 1855, Dancy requested \$500 to do soil tests in various parts of the state, whereupon the legislature abolished his post.

The discovery in the 1880's of commercially valuable phosphate deposits in Florida prompted Governor E. A. Perry to appoint Dr. John Kost, a medical doctor and amateur geologist, as State Geologist in 1886. Dr. Kost completed studies of phosphate and

other minerals in 1887. Dr. Kost's request to the legislature to extend his tenure and duties met the same fate as his predecessor's.

In 1907 enabling legislation was passed creating an autonomous, permanent Florida Geological Survey, and an office of State Geologist, with four support staff positions. The new Survey was given latitude to formulate its own choice of studies and research.

A reorganization of state government in 1933 placed the Florida Geological Survey under the newly-formed State Board of Conservation. The Survey remained essentially autonomous. State government was reorganized again in 1971. The Florida Geological Survey was placed in the Department of Natural Resources and its name changed to the Bureau of Geology. In 1983 the legislature reestablished the name of Florida Geological Survey, leaving unchanged its position in the department's hierarchy. Significantly during fiscal

year 1986-87 the Florida Geological Survey celebrated its 78th year of service to the state. It is the oldest state agency functioning under both its original establishing legislative statute and its original title.

STATE GEOLOGISTS

E. H. Sellards: 1907-19

Since passage of the 1907 law, there have been five state geologists. The first was Dr. Elias Sellards, who for 2 years was Assistant Paleontologist with the Kansas Geological Survey. He received his B.A. and M.A. degrees from the University of Kansas and his Ph.D. from Yale University. He taught geology and mineralogy at Rutgers University and, in 1904, became an instructor at the University of Florida.

While at the University of Florida, Sellards devoted a considerable amount of time to the study of Florida's underground water resources, a subject of special concern to the state's agricultural interests. Water resources studies subsequently became a primary focus of the early work done by the survey staff. These early investigations, which included the underground water supply of central Florida and a survey of road materials, were directed toward serving Florida's economic needs. In later years, the emphasis became more academic and expanded to include paleontology and general Florida geology.

Under Sellards' guidance, the Geological Survey continued as a permanent part of state government. After Sellards' resignation in April of 1919, he joined the Bureau of Economic Geology of the State of Texas. His former student and staff assistant, Herman Gunter, assumed the position of State Geologist.

Herman Gunter: 1919-1958

Herman Gunter's association with the Florida Geological Survey spanned

almost 52 years--a length of service unmatched by any other Florida State Geologist. Gunter graduated from the University of Florida with a B.S. degree in 1907 and in that same year joined the Survey staff. His advancement to director in 1919 ensured that the position was staffed by someone well versed in Florida geology.

As the Geological Survey's second director, he changed the survey's emphasis somewhat by making its reports more diverse and less academic in outlook and by more closely relating the Geological Survey's work to the needs of state government. In his role as administrator, Gunter encouraged cooperation with the state's public schools and enlarged the Geological Survey's museum and library. Gunter acted on the belief that a primary purpose of the Florida Geological Survey was to serve as a highly accessible source of information on Florida geology.

Under Gunter's direction, the Florida Geological Survey initiated a conservation campaign aimed at exposing the gross damage being done to the state's underground and surface water supplies by careless drilling practices and misuse of water. His interest in the preservation of the water resources of Florida also propelled him to the forefront as an opponent of the Cross Florida Barge Canal (originally conceived as a sea level ship canal across Florida).

Gunter also began work on the investigation of Florida's mineral resources. He sought and obtained funding for a cooperative venture with the U.S. Geological Survey to complete topographic mapping of the state.

It was also largely through his efforts that the legislature authorized and funded the construction of a geologic center comprised of the Florida State University's Department of Geology and the Florida Geological Survey. The proximity of these entities,

which are housed next to each other on the campus of Florida State University, has provided for a cooperative use of scientific equipment and library facilities and has encouraged an open and stimulating exchange of ideas between the university and the survey over the years. This relationship has enhanced opportunities for student employment at the Florida Geological Survey and has benefited the survey staff by supplying skilled, knowledgeable graduate students to assist in areas involving practical geological research.

His contributions to geologic research were formally recognized by the University of Florida in 1944, when he was awarded an honorary Doctorate of Science. His accomplishments laid a firm foundation for the future. In recognition of his service, the Florida Geological Survey building on the campus of Florida State University was named the Gunter Building.

Robert O. Vernon: 1958-71

Herman Gunter's successor was Robert O. Vernon, who joined the survey as an Assistant State Geologist in 1941. Vernon received his B.S. from Birmingham Southern College, his M.S. from the University of Iowa, and his Ph.D. from Louisiana State University.

Emphasizing geologic research, Vernon conducted or participated in a large number of investigations concerning Florida geology. Part of his research emphasis resulted in the expansion of the cooperative program in water resource investigations between the Florida Geological Survey and the U.S. Geological Survey.

Recognizing the need for conservation of Florida's limited water resources, much of his time was spent informing the public about Florida geology and hydrology through numerous publications, public forums, and presentations to schools and civic organizations. The Florida statutes

relating to conservation of water resources are principally the direct result of Vernon's efforts.

In November of 1971, Vernon resigned as State Geologist and accepted the position of Director of the Division of Interior Resources in the Department of Natural Resources. Robert Vernon is remembered as a dedicated professional who devoted many years of effort to Florida geology.

Charles W. Hendry, Jr.: 1971-88

Upon Vernon's resignation in 1971, Charles W. "Bud" Hendry, Jr., assumed the post of State Geologist. An employee of the Florida Geological Survey since 1949, Hendry held a number of positions including draftsman, stratigrapher, director of water resources investigations, and Assistant State Geologist. In addition to earning his B.S. from Florida State University, Hendry had the distinction of receiving the first M.S. degree in geology awarded by the Florida State University.

Under Hendry's direction the Oil and Gas Section significantly upgraded Florida's oil and gas regulations, providing better protection for the environment and conserving oil reserves. Seeing a state-wide need for geologic data to assist planners, Hendry had an environmental geology map series completed.

Walter Schmidt: 1988-Present

In 1985 Walter Schmidt was appointed Chief of the Florida Geological Survey and assumed the post of State Geologist in March 1988, upon Hendry's retirement. Schmidt did his undergraduate work at Florida Institute of Technology and the University of South Florida. His masters and doctoral work were carried out at Florida State University, with his doctoral dissertation specifically dealing with Florida Neogene stratigraphy.