STATEMENT OF CAPABILITIES

PAVEMENT SYSTEMS RESEARCH LABORATORY

Department of Civil Engineering
College of Engineering
The University of Texas at Austin

September 1970

PREFACE

The purpose of this statement is to discuss the diverse capabilities within The University of Texas at Austin, primarily the College of Engineering, that are available for working with pavement design, research, and management problems.

Pavement design problems, one of the more complex civil engineering problems, are being approached in a relatively new manner at The University. Principles of systems engineering are being applied to pavement management problems, and a comprehensive conceptual framework for the pavement system has been developed. A team of competent engineers and technicians is available to make a coordinated attack on the problem. Some of the capabilities of the research team are described herein, including systems modeling of pavements, soil mechanics, instrumentation, pavement roughness, statistics, discrete-element slab analysis, dynamics, and materials characterization.

This document is divided into four major parts for easy reference:

(1) description of pertinent technical areas,

(2) description of facilities available,

(3) a selected list of related publications which reflect the technical capabilities, and

(4) short resumes of personnel available to work on programs of this type.

Additional details may be obtained by writing

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SECTION A

PERTINENT TECHNICAL RESEARCH AREAS

INTRODUCTION

The word "pavement" is used to describe a structure for supporting wheeled vehicles on the ground. In its broadest sense, it includes highways, airfield runways and taxiways, and track-supported systems.

By 1975 some 15 to 20 billion dollars will be spent on pavements for the Interstate Highway system and over three billion dollars is invested in airfield pavements maintained by the United States Air Force alone. Many billions more have been spent on secondary and primary roads, city streets, and on municipal airports. In the face of such large investments less than .01 of 1 percent of value is being expended on research to improve knowledge of pavements and the money spent has been expended on small projects in diverse locations throughout the United States. There has been, and is, a strong need to coordinate these efforts in order to solve this complex problem.

Since 1963 The University of Texas at Austin has been building a competent group of engineers and support personnel with a primary interest in pavements and related areas. In 1967 a systems analysis method for designing pavements was developed and a framework for considering the pavement design problem has now been established (Fig 1). At the present time it is felt that a systems engineering approach to pavement design is the only approach capable of handling the complexity of the problem, which ranges from a need for understanding of soil mechanics through ability to characterize materials, or from statistical and complex structural analysis, through an understanding of maintenance problems and the effect of economics.

The annual budget for pavement research and closely related activities at The University since 1963 has exceeded $300,000 and totals approximately $2,000,000. To date this work has been funded primarily through the Center for Highway Research by the Texas Highway Department and the U. S. Department of Transportation, Bureau of Public Roads.

Developments emanating from this research are discussed in detail in subsequent sections of this statement; they include a system for measuring and evaluating highway roughness, the prediction of present serviceability index, a system for weighing vehicles in motion at speeds of up to 60 miles per hour, a sophisticated discrete-element analytical method for slabs-on-foundation,

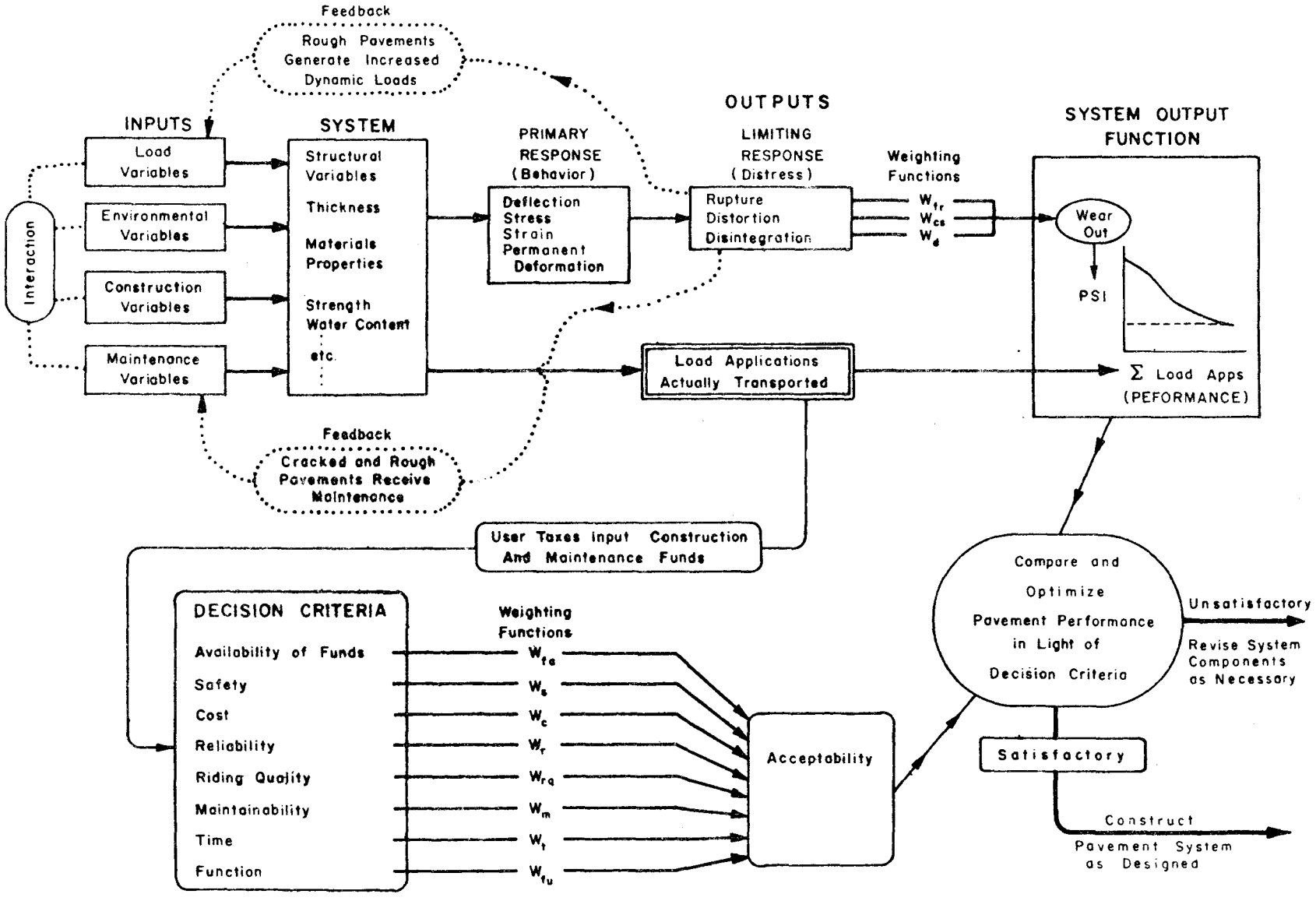


Fig 1. Block diagram of the pavement system (after Ref 1).

the development of the splitting tensile test as a tool for characterizing the tensile properties of paving materials; investigation of swelling clay factors and their effect on pavement performance; and the development of the pavement systems analysis discussed above, which is currently being implemented by the Texas Highway Department for use in preliminary design.

The staff, with primary responsibility in the pavement area, includes Drs. W. Ronald Hudson, Thomas W. Kennedy, B. Frank McCullough, and Mr. Harvey J. Treybig. They combine a variety of practical experience at the AASHO Road Test, the Texas Highway Department, and the Illinois Division of Highways, as well as broad background in the consulting engineering field, all of which relates to the pavement problem.

Expert capability in related areas is available from Drs. Lymon C. Reese and Stephen G. Wright, soil mechanics; Professor Hudson Matlock and Dr. C. Phillip Johnson, analysis; Professor J. Neils Thompson and Drs. Ervin S. Perry and James T. Houston, concrete materials; and Messrs. Harold H. Dalrymple and Roger S. Walker, electronics and instrumentation engineers.

The entire group can, and is willing to, apply its technical expertise and knowledge toward the solution of the variety of problems related to the pavement management system and its associated parts or subsystems. Direct support is provided by a large staff of technical, editorial, and secretarial help.

Supporting facilities include 30,000 square feet of laboratory and office space, a host of modern electronic and mechanical testing and measuring equipment, and ready access to a series of computers, including a CDC 6000 and SDS 930, as well as other digital and analog-to-digital devices.

PAVEMENT SYSTEMS MODELING

In the past 30 years, a great deal of time, money, and effort have been expended on pavement research, including the AASHO Road Test. Unfortunately, there has been little attempt to tie the many aspects of the pavement problem together. During the past two years, however, a group at the University has formulated an effective systems engineering approach to pavement research

and design, and has developed basic conceptual framework for structuring the pavement design problem. Figure 1, which is not intended to be a complete solution, illustrates the complexity and interactions of the problem, including factors such as maintenance, environment, and economics.

The work by this group is conducted for the National Cooperative Highway Research Program and for the Texas Highway Department, each of which has sponsored separate projects. Several publications are available for those desiring more information (Refs 1 through 5).

The work has proceeded past the conceptual stage, and working pavement systems models are currently being used to analyze, evaluate, and design flexible pavements. Available computer programs allow the designer to make an analytical systems analysis of pavement design over any given design period. The programs take into account initial construction cost, maintenance cost, users' cost, interest, and salvage cost. Thus, the designer may select an optimum design based on minimum cost, considering the total cost of all or any one of the above items. A similar set of models has been formulated for rigid pavements and is currently being evaluated. The systems approach is equally applicable to highway and airfield pavements and should in fact be applied to both. The staff currently involved in this research includes Drs. Hudson, Kennedy, and McCullough, Professors and Principal Investigators; Messrs. Harvey J. Treybig and David L. Posey, Staff Research Engineers; Mr. Joseph E. Kozuh, Resident Statistician; and Dr. Gerald Wagner, Consulting Statistician.

A staff of 15 graduate and undergraduate students are currently involved in the project. Cooperative research is being conducted with Mr. Frank E. Scrivner, Research Engineer, and Dr. C. Shih, Operations Research Specialist from the Texas Transportation Institute, College Station, Texas, Professor Ralph C. G. Haas, University of Waterloo, Waterloo, Canada, was a consultant on the project during 1970 as a Visiting Professor on the Civil Engineering staff of The University of Texas at Austin.

Drs. Hudson, Kennedy, and McCullough have served as consultants to Materials Research and Development, Inc., Oakland, California, on the development of the systems approach to pavement design for the National Cooperative Highway Research Program and are also involved in the analysis of airport pavement systems for the U. S. Corps of Engineers.

Computer facilities, testing laboratories, and statistical services, as well as many of the individual research topics described herein, are important in this area of research.

PAVEMENT ROUGHNESS MEASUREMENT AND EVALUATION

The staff has a long history of experiences in pavement roughness measurement and evaluation. At the present time, a Surface Dynamics Road Profilometer is available for evaluating pavement roughness at speeds of up to 60 miles per hour. The profilometer was originally developed by General Motors Corporation and does a resaonable job of measuring "true profile" for wavelengths of about 200 to 400 feet.

Data from the profilometer may be processed digitally to obtain summary statistics for characterizing the serviceability of pavements used in the pavement system output function (Fig 1), or they may be used directly as input for dynamic analysis programs as described in the section on dynamics. The device is also capable of definitively indicating undesirable characteristics in the pavement surface. Figure 2 illustrates the general process of roughness measurement and evaluation.

The staff who has been working in this area includes Dr. Hudson, Principal Investigator; Messrs. Walker and Dalrymple, Electronics and Instrumentation Engineers; Mr. Kozuh, Resident Statistician; and Dr. Freddy L. Roberts of Clemson University who worked on the project as a graduate student and was responsible for its operation in 1966-69. References 6 through 11 are technical papers which pertain to this general research topic.

ANALYTICAL METHODS FOR PAVEMENT SLABS

For the past six years work has been underway to develop a series of sophisticated discrete-element solutions for pavement slabs-in-place under static loads. Programs which have been developed for handling dynamic loads are discussed elsewhere. The methods developed for static loads allow for

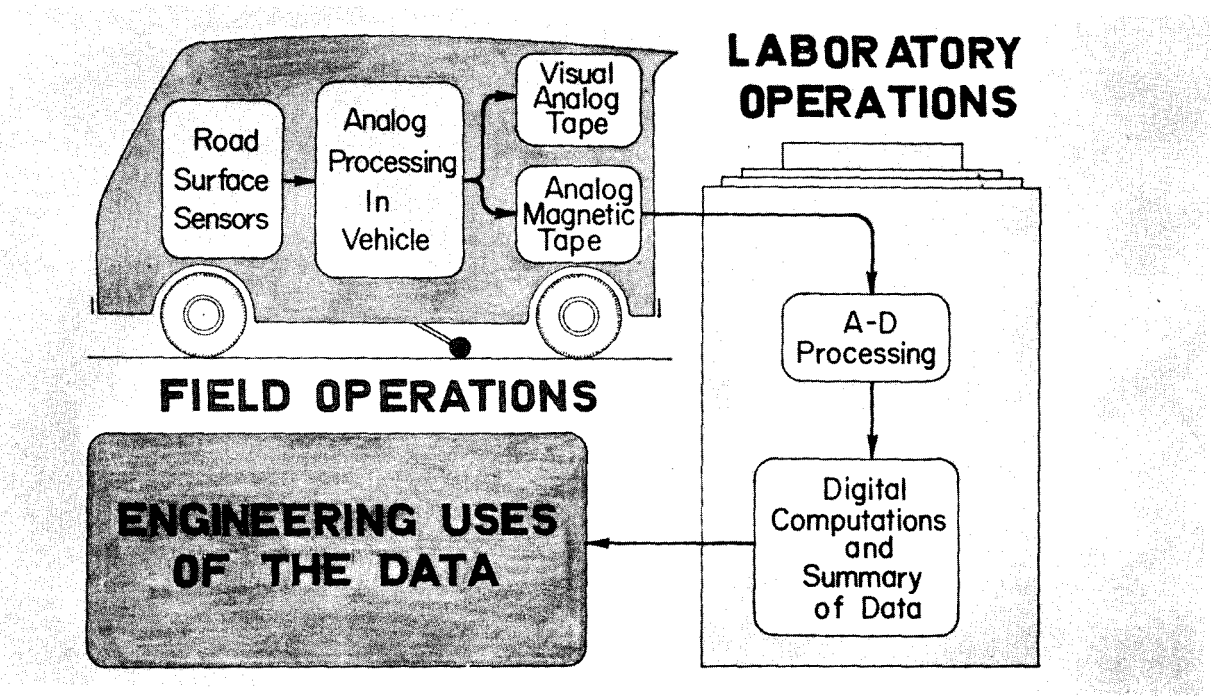


Fig 2. Schematic representation of operations of the Surface Dynamics Road Profilometer.

Fig 3. Surface Dynamics Road Profilometer.

freely discontinuous variations of input parameters such as bending stiffness and loads. Combination loading can be provided for and includes lateral loads and in-plane forces as well as applied moments or couples. Foundations or subgrade conditions can be easily varied to handle such diverse situations as loss of support, holes in the subgrade, and hard spots (Figs 4 and 5). Discontinuities or concentrated stiffnesses in the slabs, such as joints, cracks, or external ribs, can be modeled effectively by the freely discontinuous method to represent a real slab. The method applies not only to the general slab-on-foundation case, but can also be used for orthotropic plates as discussed in the section on bridges.

The discrete-element methods take full advantage of high-speed computer analysis and provide complete information on deflections, bending and twisting moments, stresses, and support reactions for the slab system. Figures 6 and 7 illustrate the problem of a complex bridge approach slab which has been modeled and solved by the discrete-element solution. It should be noted that this problem cannot be solved easily by influence charts, Westergaard methods, or other previously existing techniques. Several practical applications of the work have been made, including evaluation of the U. S. Corps of Engineers C5A test pavements and an evaluation of the effect of load placement position on rigid pavement design. Another application is the evaluation of a continuously reinforced concrete pavement runway at O'Hare Field pending discussions with City of Chicago engineers. References 12 through 16 pertain to this subject.

A staff headed by Professor Matlock and Dr. Hudson has supervised work in this area in recent years. Staff research engineers include Messrs. Treybig and John J. Panak. Consulting on complex computer programming problems is provided by Mr. Frank E. Endres. Approximately 20 graduate and undergraduate students have contributed to this work.

EVALUATION OF EXPANSIVE SOILS

Probably one of the most important economic problems in pavement design, construction, and maintenance in the United States today is the damage done

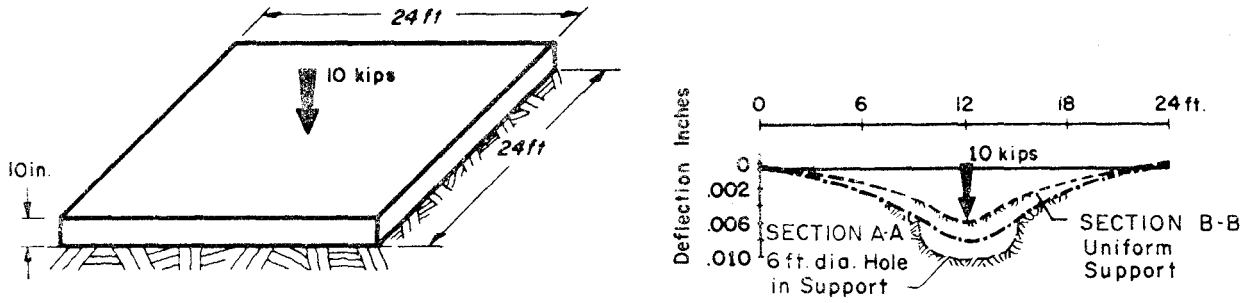


Fig 4. Pavement slab subjected to 10-kip wheel load at the center; with and without uniform subgrade support.

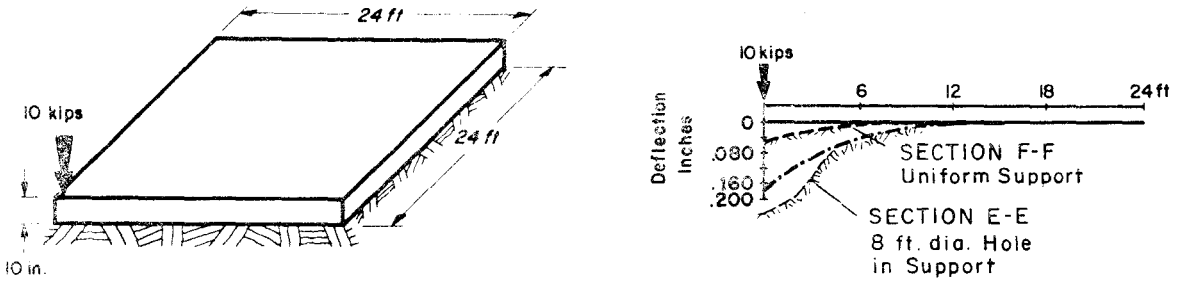


Fig 5. Pavement slab subjected to 10-kip wheel load at the corner; with and without uniform subgrade support.

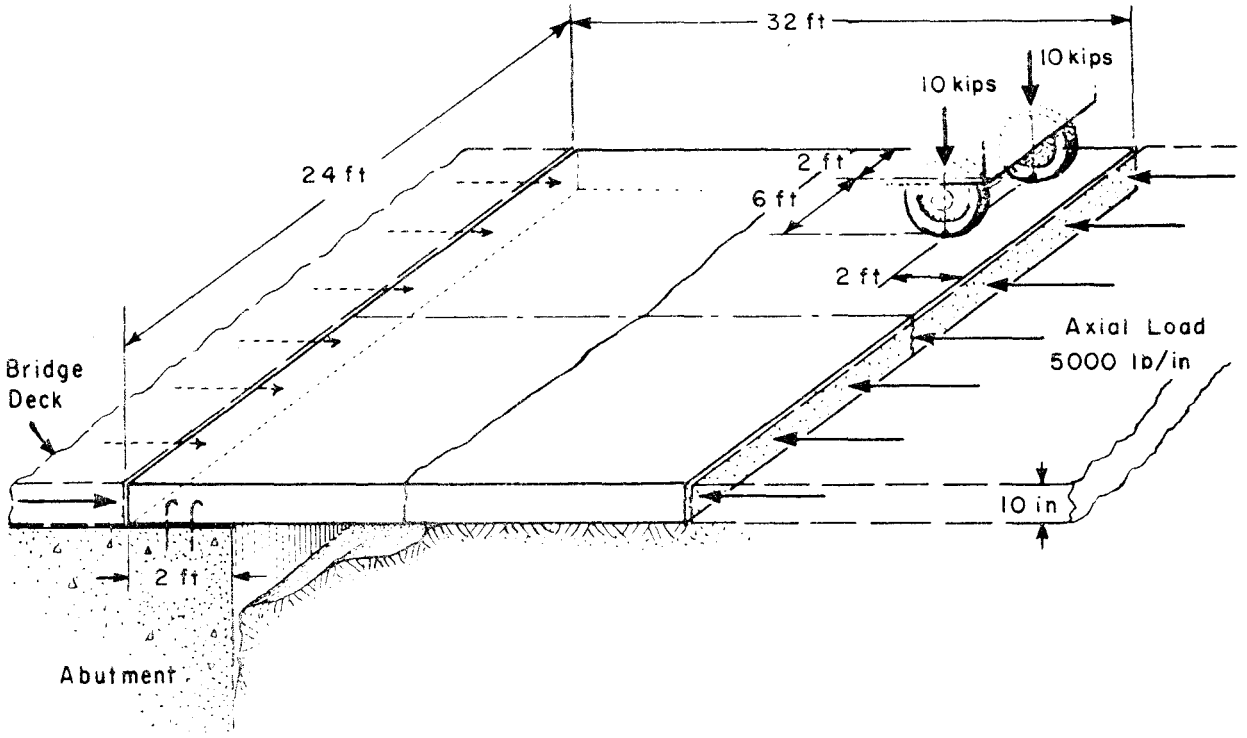


Fig 6. Bridge approach slab.

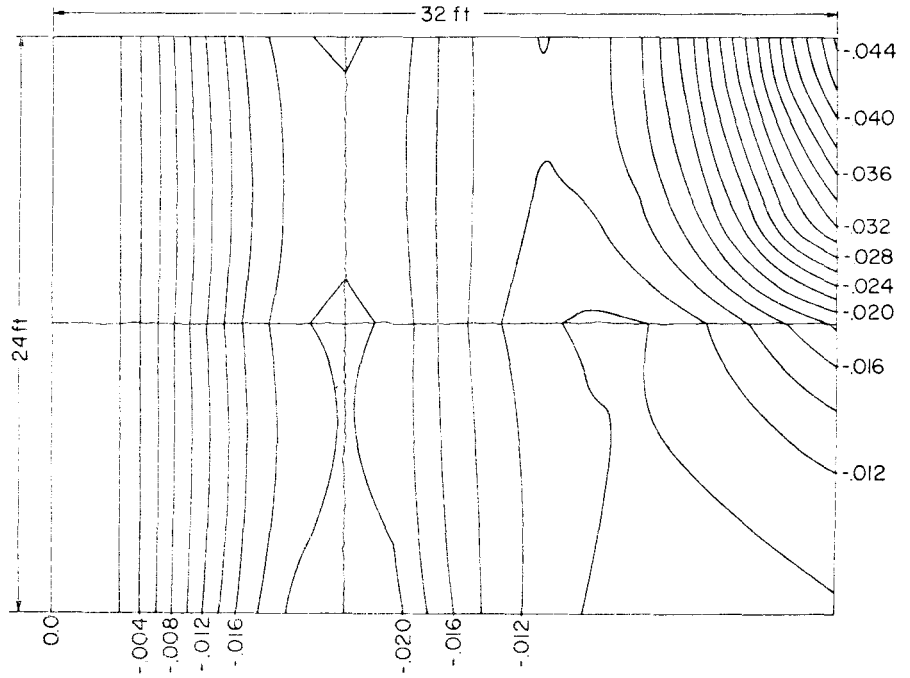


Fig 7. Deflection contour of bridge approach slab. Deflection in inches.

to pavements by uncontrolled swelling of underlying clay layers. This problem, while widely recognized, has never been well defined nor understood. A comprehensive program of research is currently underway to define the problem more precisely, develop pertinent theoretical and analytical approaches to a solution, and develop data-gathering procedures which can be used with realistic field information for use in the computer models. Computer programs are being evaluated which detail the movement of moisture through partially saturated clay soils and estimate the accompanying volume change. Data are being gathered from field installations at Atlanta, Texas, and San Antonio, Texas. The data correlate moisture changes with elevation changes at the surface and at depths. Current work is supported by the Texas Highway Department and is supervised by Professor Matlock and Dr. Hudson. The staff working on the project in recent years has included Dr. Robert L. Lytton, Professor Gordon Watt of the University of Saskatchewan, Saskatchewan, Canada, and Messrs. James N. Anagnos and John R. Wise. A number of reports have emanated from the work (Refs 17, 18, and 19).

DYNAMIC LOADING OF HIGHWAY STRUCTURES

Measurement and Prediction

Highway pavements and bridges are subjected to millions of repetitions of dynamic wheel loads, yet most design procedures are presently based on static loads and static strength tests of materials. Engineers have attempted to recognize the stochastic and dynamic nature of traffic loading by adding impact factors and fatigue life considerations, but such efforts have not been completely satisfactory because of a fundamental lack of understanding of the magnitude, rate of application, duration, and location of the forces produced by the wheels of moving vehicles.

In the past six years mathematical models for the single unit and articulated vehicles have been developed. The dynamic wheel forces produced by five different classes of vehicles can be predicted by these models for vehicle characteristics and road profiles and have been successfully validated by comparing predicted forces with forces produced by loaded test vehicles and

measured by 11 special transducers embedded in the pavement. The modeling techniques and the experimental techniques developed through this research are available for studying specific interactions between moving vehicles and various road surface profiles. Research on dynamic loading of bridges is currently in progress. References 20, 21, and 22 pertain to this work.

Theoretical Analysis

Current research efforts also focus on the theoretical analysis of pavement slab systems subjected to dynamic loads. Methods for predicting both the steady state and transient response of linear systems have been studied. The step-by-step transient solutions appear to be well-suited for the study and analysis of highway pavement problems. Furthermore, the numerical method for transient analysis has been extended to handle nonlinear foundation characteristics. The method has been used to study the effect of moving vehicle loads on slab foundation systems in which the foundation offers no resistance to the slab when it rises off the foundation (Ref 23).

Further extensions of the method are planned which would include the inelastic characteristics of the slab material and the representation of material damping in the discrete-element model. Work in this area has been conducted by Professor Hudson Matlock and Dr. Allen Kelly, now at Oklahoma State University.

FINITE-ELEMENT ANALYSIS CAPABILITIES

Structures

Current capabilities include finite-element programs for the static and stability analysis of three-dimensional structural assemblages of two-dimensional elements. These programs include automatic mesh generation actions to simplify the required input. Simultaneous use of a CRT (252 Display System) and the CDC 6600 provides for interactive graphic capabilities which further simplify mesh construction and provides for general plotting routines for

rapid interpolation of the results of the analysis. Highly efficient assembly and solution packages are sufficiently general so that other finite-element types, such as three-dimensional elements, may be easily included in the analysis. Future research interests include three-dimensional finite-elements and the analysis of dynamic response. The research staff includes Dr. Johnson, Professor Matlock, and Mr. Panak. References 24 through 28 pertain to this area.

Soils

In the past several years, Drs. Reese and Wright have been concerned with the development of methods for predicting the behavior of soil continua under plane-strain and axially symmetrical conditions (Refs 29 through 34). A number of computer programs have been developed for making such predictions and experimental studies have been conducted in the soil mechanics laboratories. The techniques and procedures which have been developed are potentially applicable in studies of pavement behavior. Dr. Reese has served as a consultant to Shell Oil Company and Shell Development Company, Houston, Texas, thus providing considerable experience in the application of the finite-element techniques for the characterization of soils.

TENSILE PROPERTIES OF HIGHWAY MATERIALS

Intensive investigations of tensile properties of asphalt-treated, cement-treated, and lime-treated subbase materials have been made by the staff through the Center for Highway Research. A highly developed loading head and a technique for performing indirect tensile tests on all types of materials was researched during these investigations. The specially designed loading head shown in Figs 8 and 9 is used in conjunction with the programmable MTS electrohydraulic control console which controls the loading system during static and dynamic tests. A horizontal deflection device which consists of two cantilevered aluminum arms instrumented with strain gages was also developed. The strain indicated in these arms during an actual test is converted to deflection output by a calibration constant and is plotted automatically by x-y plotter versus load. A multi-channel oscillograph recorder

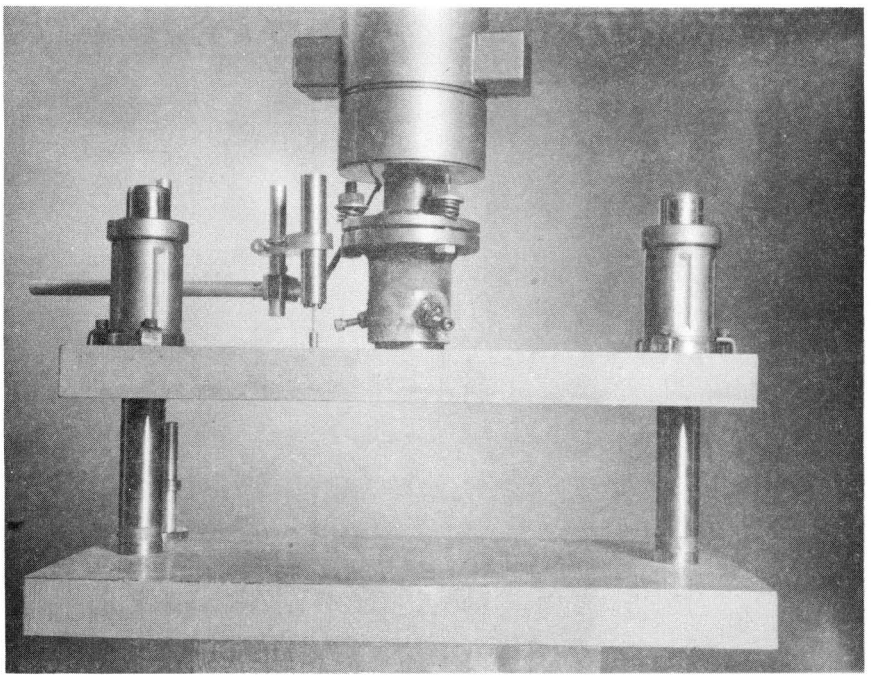


Fig 8. Loading head.

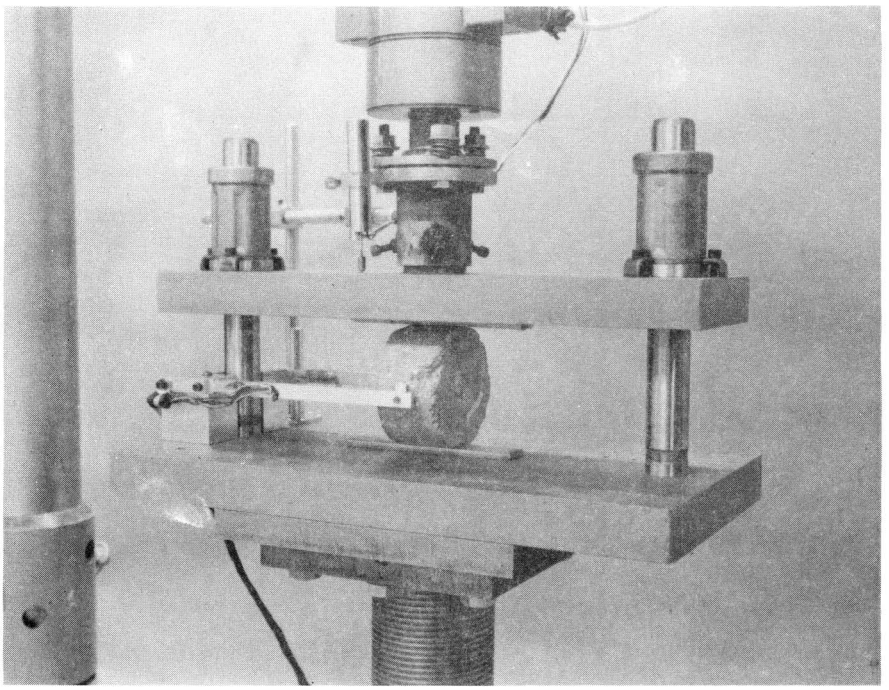


Fig 9. Loading head with lateral strain-gage device and cement-stabilized specimen.

and function generator have been added to the MTS equipment to produce the capability to conduct repeated loading tests and to record the data.

Principal investigators in this research are Drs. Hudson and Kennedy. Other research engineers include Messrs. William O. Hadley, James N. Anagnos, and Raymond K. Moore. Selected references include 35 through 45.

STATISTICS

Since January 1968 a library of statistical computer programs has been developed. Staff researchers have been involved in the use of experimental design and statistical analysis in research. The available programs include

(1) stepwise multiple regression (STEP-01),
(2) casewise multiple regression (CASE-01),
(3) nonlinear multiple regression (NOLI-01),
(4) factorial analysis of variance (FAOV-01),
(5) factorial covariance analysis (FACO-01),
(6) Hotelling T^2 test (TEES-01),
(7) Kolmogorov-Smirnov test (GAUS-01),
(8) time series analysis (TIME-01),
(9) phase analysis (FASE-01), and
(10) one-way unbalanced analysis of variance (WONE-01).

Individuals from many departments of The University and from several branches of the Texas state government have come to the staff to obtain professional guidance in the use of these computer programs.

The staff is a complete experienced professional team, including Dr. Wagner, Consulting Statistician, and Mr. Kozuh, Resident Statistician. Dr. Virgil L. Anderson of Purdue University has been a visiting professor and is currently a consulting statistician.

In general, all controlled experiments are developed according to the following logical sequence:

(1) Define and characterize the variables of interest and the research objectives.
(2) Select optimal experimental design to obtain necessary information with minimum time and expense.

(3) Perform thorough Statistical analysis of the data and identify significant effects and trends.

(4) Present, interpret, and communicate experimental findings and conclusions by means of reports, slides, recordings, and three-dimensional graphs.

INSTRUMENTATION AND MEASUREMENT

The research program has resulted in the acquisition of extensive instrumentation capability. This capability has been directed toward measurements related to materials research in the areas of pavement design, soil mechanics, weighing in motion, and traffic control.

Transducers have been developed for signal detection in several specialized programs where commercial transducers were not available or directly applicable. Extensive experience with basic measurements of acceleration, deflection, and strain under both laboratory and field conditions has been developed by the staff.

Results of long term studies of "creep" in concrete material under high triaxial load conditions and elevated temperatures, utilizing hydraulic test equipment designed and built specifically for this study, are in current use by staff researchers.

Transducers have been developed for embedment in concrete foundation structures under both long and short-term field tests.

Laboratory test facilities have been developed for soil and pavement material under static, dynamic, and fatigue test conditions. Facilities are available for both low and high temperature testing to simulate practical field conditions.

Standard laboratory testing machines are available for load ranges up to 400,000 pounds with National Bureau of Standards calibration equipment for maintaining equipment calibration.

Data recording procedures are adapted to project requirements from manual recording of static data to high-speed oscilloscopes and Polaroid cameras for bandwidth requirements to 100,000 Hz.

Digital conversion of short-term static and slowly varying dynamic data is accomplished with multichannel digital data acquisition equipment. This

procedure provides high integrity data to maximum resolution for digital computer analysis.

Slow to medium speed analog data are recorded on oscillographic and FM magnetic tape systems. The data are processed through high-speed analog-to-digital conversion equipment at The University for analysis by digital computer techniques. This process allows researchers the advantages of both the analog data and the facility of data in digital form. Data bandwidth for the above systems is zero to 10,000 Hz.

High-speed photography has been used as a supplement to measure phenomena in studies involving high-speed dynamic response.

Special purpose data systems have been designed for problems requiring sophisticated computer control and data transmission from remote locations. A complete staff of technicians is available under the direction of Mr. Dalrymple, Electronics and Instrumentation Engineer.

PAVEMENT REHABILITATION

Techniques have been developed that permit the evaluation of an existing pavement utilizing deflection measurements. These measurements are then converted into the material properties for use in the analytical programs. This capability permits an existing pavement to be evaluated as to future performance and its possible rehabilitation needs if increased loadings are expected. The concepts here are equally applicable to highways and airfield runways. Dr. McCullough has directed work where this capability was applied to an interstate highway pavement in Texas and a U. S. Air Force runway in Palmdale, California (Refs 46, 47, and 48).

ROAD SURFACE FRICTION - SKID RESISTANCE

Emphasis on highway safety has resulted in the development of skid resistance capabilities in both the field and the laboratory. Dr. McCullough initiated field evaluation of skid resistance (Ref 49), and other research (Refs 50 and 51) has lead to the development of equipment to study the wear charac-

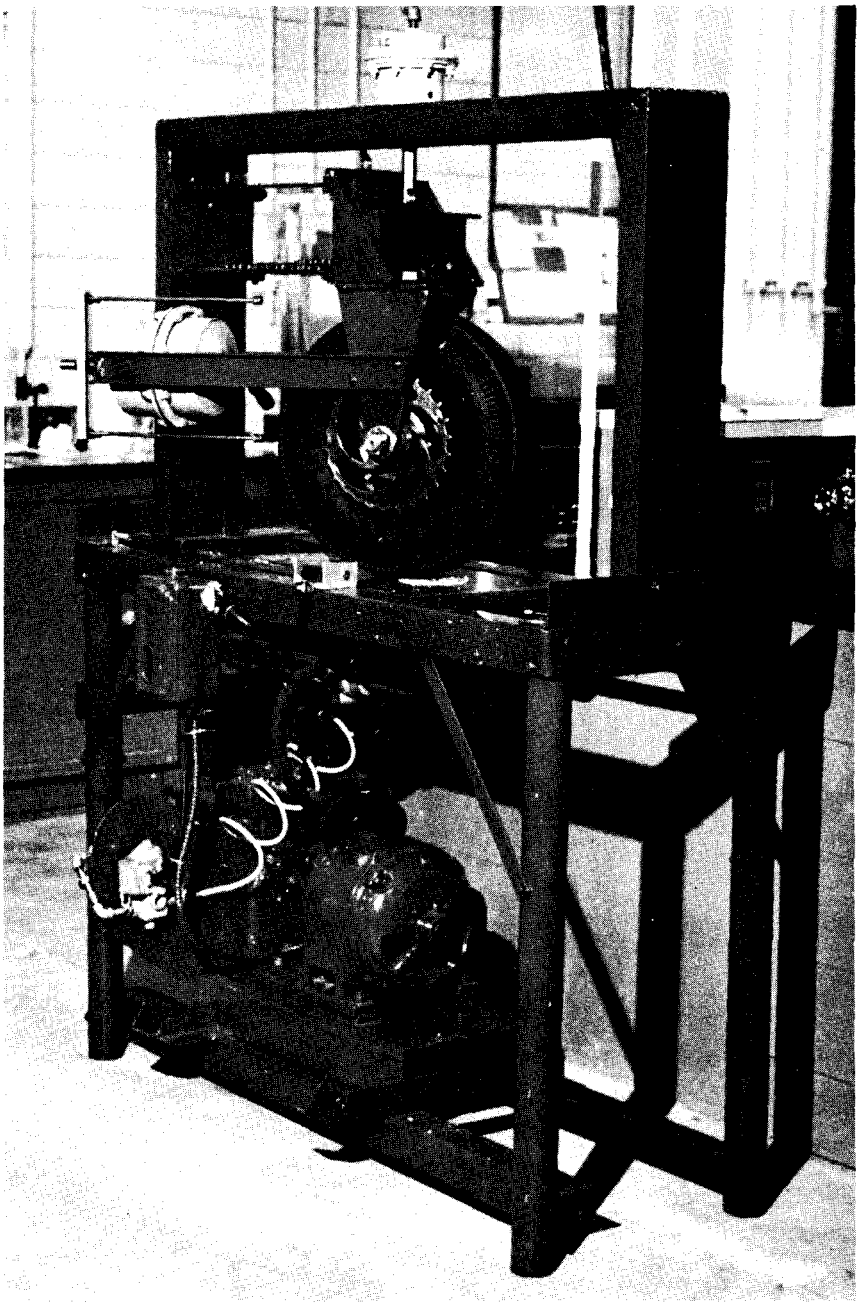


Fig 10. Pavement wear apparatus and friction-measuring device.

teristics of any paving material and to measure the coefficient of friction on the material at any time during its wear testing life (Fig 10).

The micro-profile of the roadway surface and in particular of the individual aggregate particles used to form the wearing surface has been measured (Ref 51). The equipment is capable of plotting the profile with a vertical accuracy of 42 micro-inches and a horizontal accuracy of 0.0033 inch (Fig 11).

In addition, field studies have been conducted to relate characteristics of the tire-pavement interface to wet weather conditions (Ref 52).

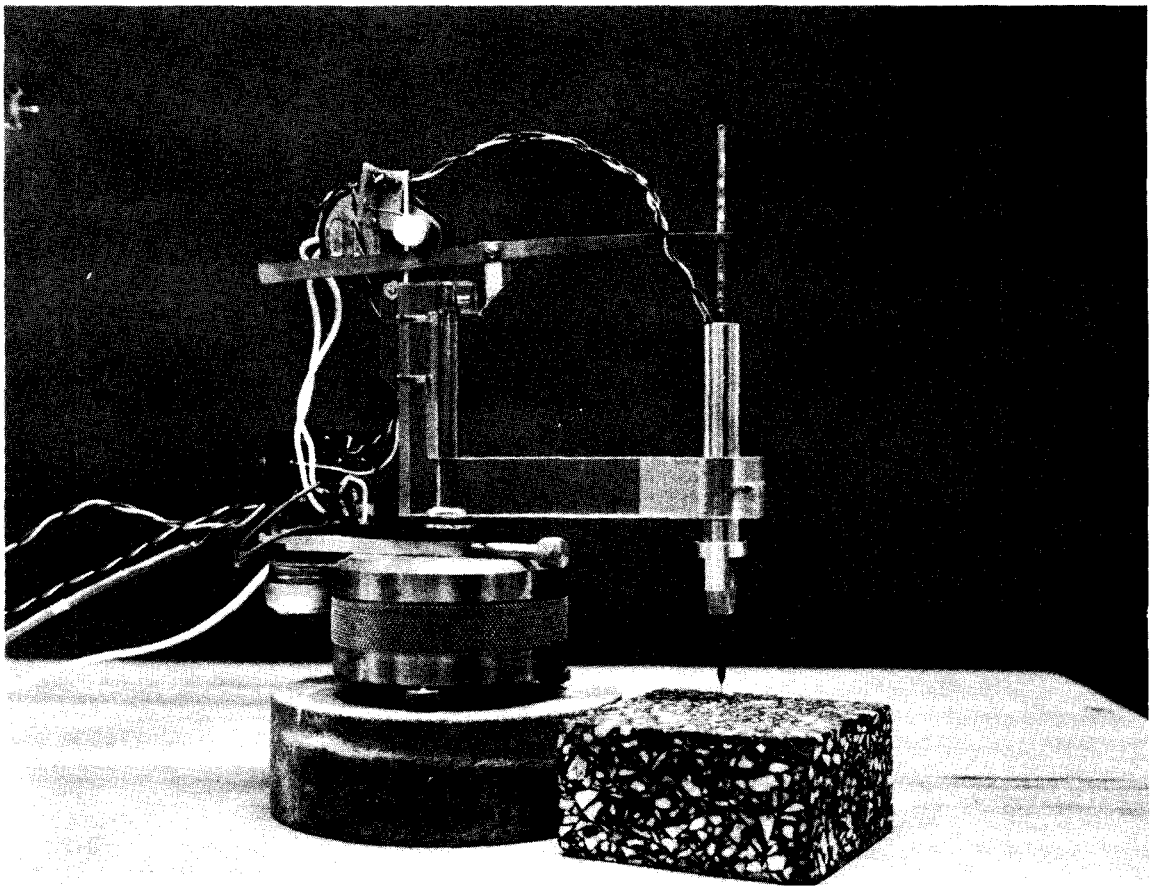


Fig 11. Micro-profile measuring equipment.

SECTION B

AVAILABLE FACILITIES

HIGHWAY MATERIALS LABORATORY

The highway materials laboratory is well equipped to handle and test a wide variety of materials commonly used for highway construction. This capability includes both untreated or unstablized material and stabilized materials modified with asphalt, cement, or lime. Available compaction equipment can produce 4 or 6-inch-diameter specimens using the impact method or automatic kneading method. Furthermore, these materials may be evaluated by standard testing procedures recognized by the highway industry such as the Marshall test, cohesiometer test, stabilometer test, unconfined compression test, and triaxial compression test. Dynamic testing may also be done using interval generation of load pulse waves or by charting the desired function on conductive chart paper on the program drum of the monitor console.

Other pertinent equipment available in the highway materials laboratory includes a vibratory sieve shaker, a Gilson vibrating screen shaker, soil pulverizer and girder, and aggregate bins. Nondestructive nuclear surface and depth probe instrumentation is available for field measurement of moisture content and wet density.

COMPUTER FACILITIES

The more modern and complete computer facility in this part of the country is available for use in its research programs. A new CDC 6600 computer system (Fig 1), which has a central core memory of 131,072 words and an additional 10 peripheral core memories of 4,096 words each, is included, along with a variety of input/output equipment, plotting equipment and test facilities. In addition, a hybrid computing facility is available which interfaces with SDS 930 and SDS Sigma 5 computers. This system can be used for smaller problems to be done on a individual basis or for student work and for high-speed analog-to-digital conversion.

A close association with the computational facilities of the Texas Highway Department gives the added possibility for use of an IBM multiple 360/50 computer system for backup work. Many of the pavement programs are developed for Texas Highway Department use and compatibility with various computer hardware is always a consideration.

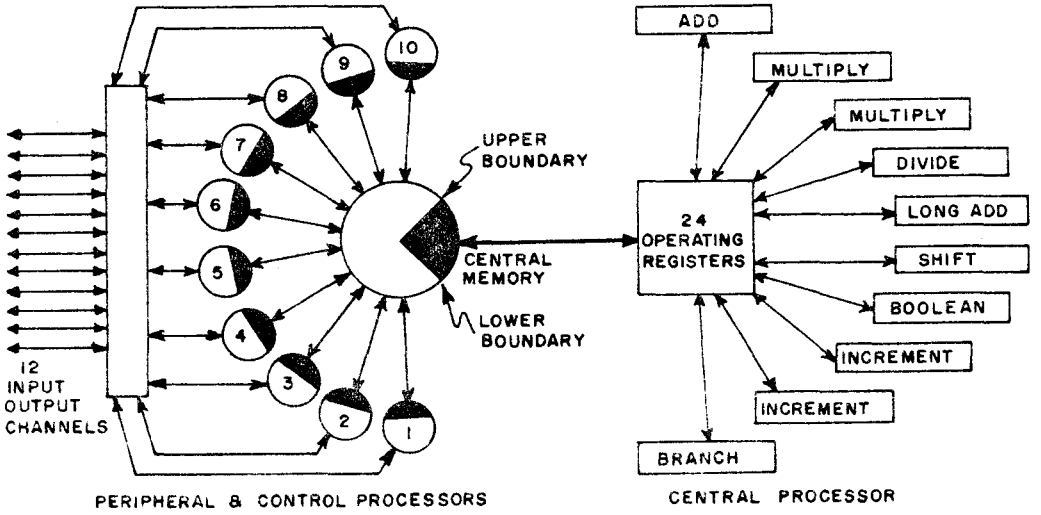


Fig 1. Block diagram of CDC 6600 system.

ENVIRONMENTAL ROOMS

Four rooms are available for tests which require controlled environmental conditions: two controlled temperature rooms, one controlled humidity room, and one 100 percent humidity curing room.

The controlled temperature rooms (Figs 2a and 2b) and the controlled humidity room have hydraulic and electrical connectors which allow simultaneous operation of three hydraulic rams and the taking of 24 different electrical measurements. These connectors allow the consoles, pumps, and recording equipment to be operated in the laboratory while ram and measurement operations are underway in the controlled environment rooms. Each room also has vacuum and compressed air outlets.

The temperature rooms are interconnected to allow cycling. Temperature is monitored by five thermocouples in each room, and temperatures can be recorded continuously on a strip chart. The floor areas are 254 and 239 square feet, and the volumes of the rooms are 1,852 and 1,729 cubic feet. The temperature range possible is from minus 20 degrees F to plus 140 degrees F, plus or minus 2 degrees. The temperature can be changed from one extreme to the other in eight hours.

The temperature in the humidity room is monitored by two thermocouples which is recorded on a strip chart. This room has a volume of 2,802 cubic feet and a floor area of 239 square feet.

The 100 percent humidity curing room is divided into two areas connected by a window. The floor spaces are 99 and 186 square feet and the volumes are 744 and 1,392 cubic feet.

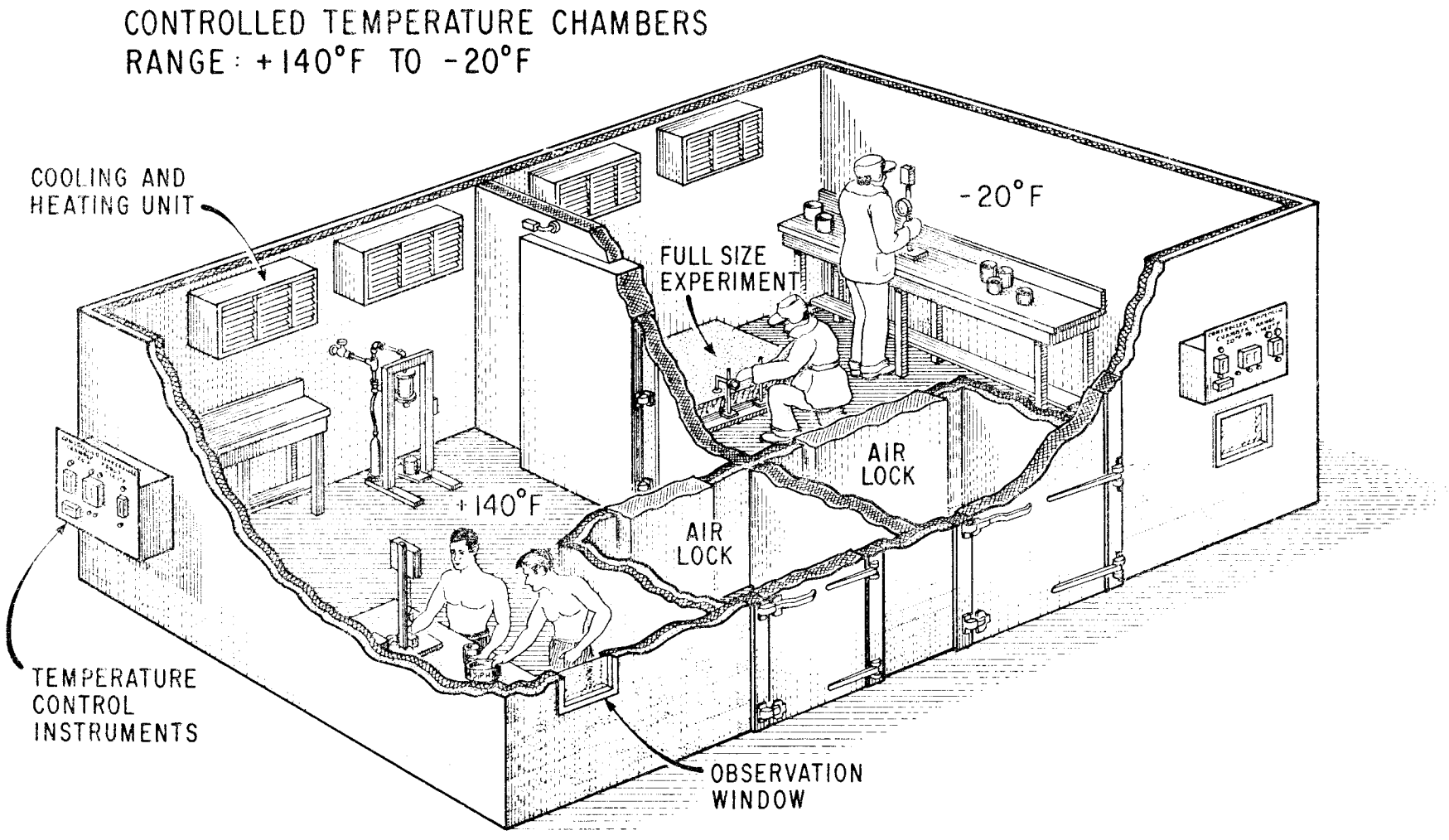


Fig 2a. Diagram of controlled temperature chambers.

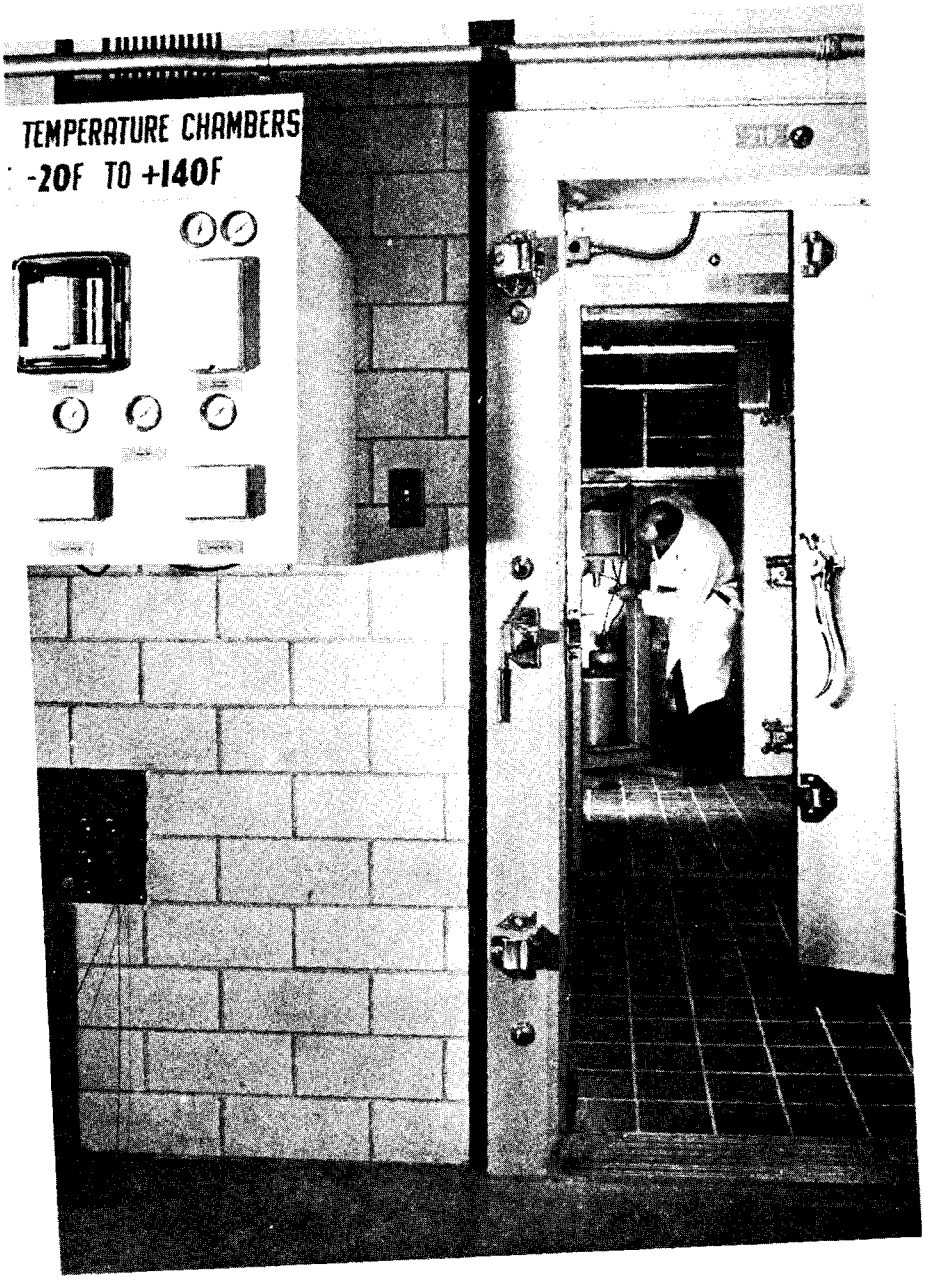


Fig 2b. Controlled environment room.

ASPHALT LABORATORY

A modern, well-equipped asphalt laboratory is available for research work in thermoplastic materials. Important equipment includes Hallikainen micro-viscometers (Fig 3), vacuum viscometers (Fig 4), kneading compactor, and automatic gyratory shear compactor (Fig 5), as well as the standard equipment necessary for penetration, viscosity, flash point, and other routine tests. Controlled environmental chambers, described elsewhere, are useful in conducting tests on asphalt materials as in the Research, Incorporated programmable load equipment. Specially designed and built controlled temperature water baths are a special feature in the all stainless steel work areas.

The highway materials laboratory is supervised by Mr. James N. Anagnos who has over 19 years of experience in highway materials technology.

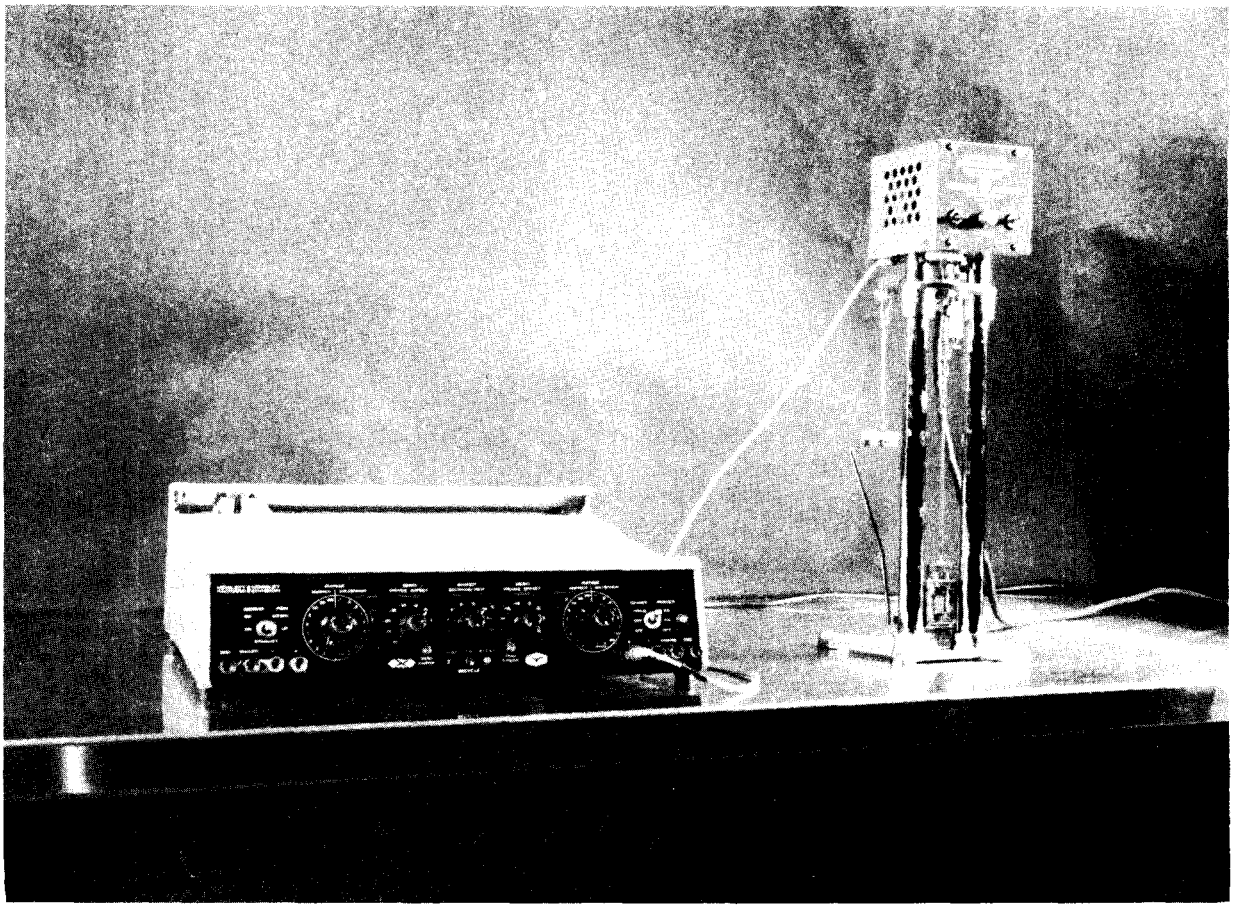


Fig 3. Sliding-plate micro-viscometer.

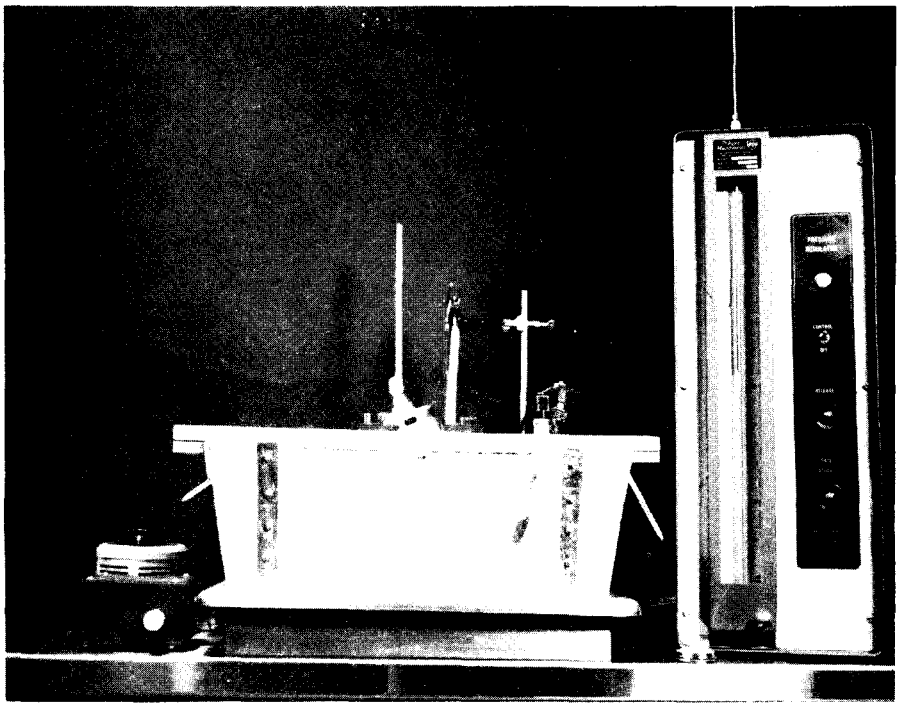


Fig 4. Vacuum viscometer.

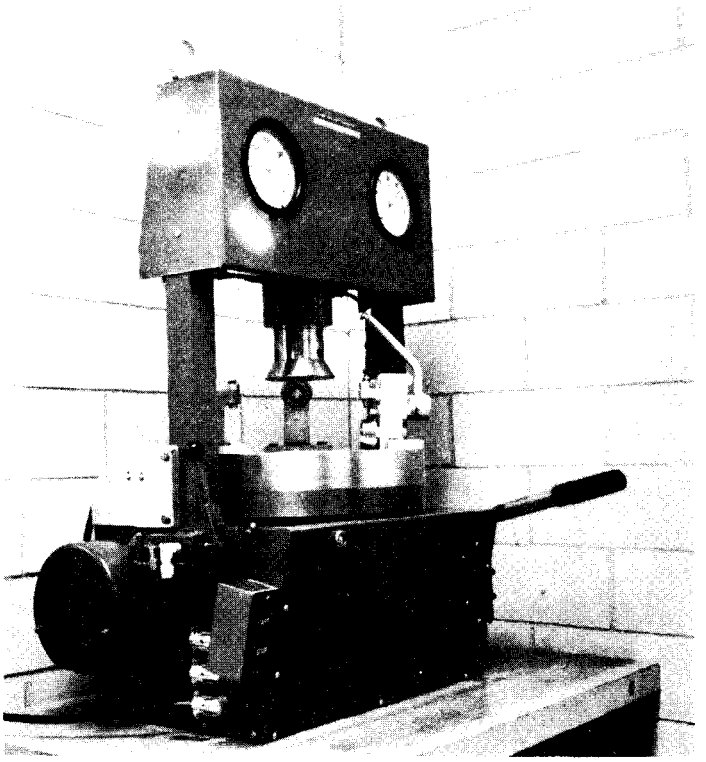


Fig 5. Automatic gyratory shear compactor.

PROGRAMMABLE HYDRAULIC TESTING EQUIPMENT

Three channels of programmable hydraulic testing equipment are available for general purpose testing and research in structural mechanics and in properties and behavior of materials.

The consoles are capable of closed-loop control using load cells, torque cells, pressure cells, strain gages, DCDT's, or linear potentiometers as the feedback parameters. Any of these modes may be controlled statically, dynamically (using sine, square, ramp, or triangular wave functions), or by random loading. Random loading is accomplished through a unit which controls using any function drawn on the chart paper. The three consoles may be connected together to permit biaxial or combined loading tests. Figure 6 shows a general view of the control console.

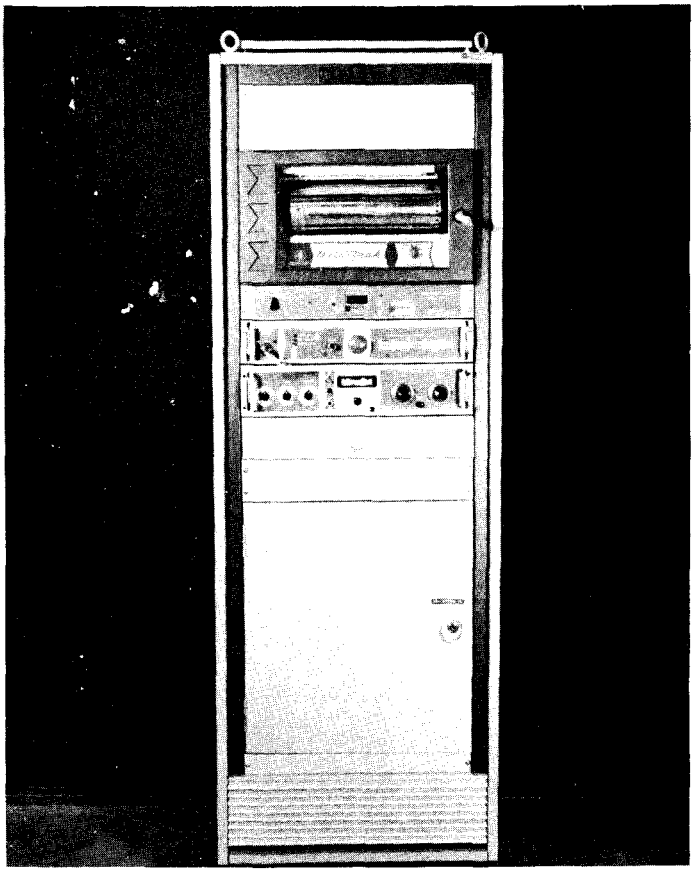


Fig 6. Research, Incorporated, control console.

A complete set of load frames (Fig 7) has been constructed to provide a wide variety of possible test setups, including one frame which can be rolled into the controlled temperature chambers. The actuators are designed to be placed in a load frame for material testing or secured directly to the floor, or other base, for structural loading.

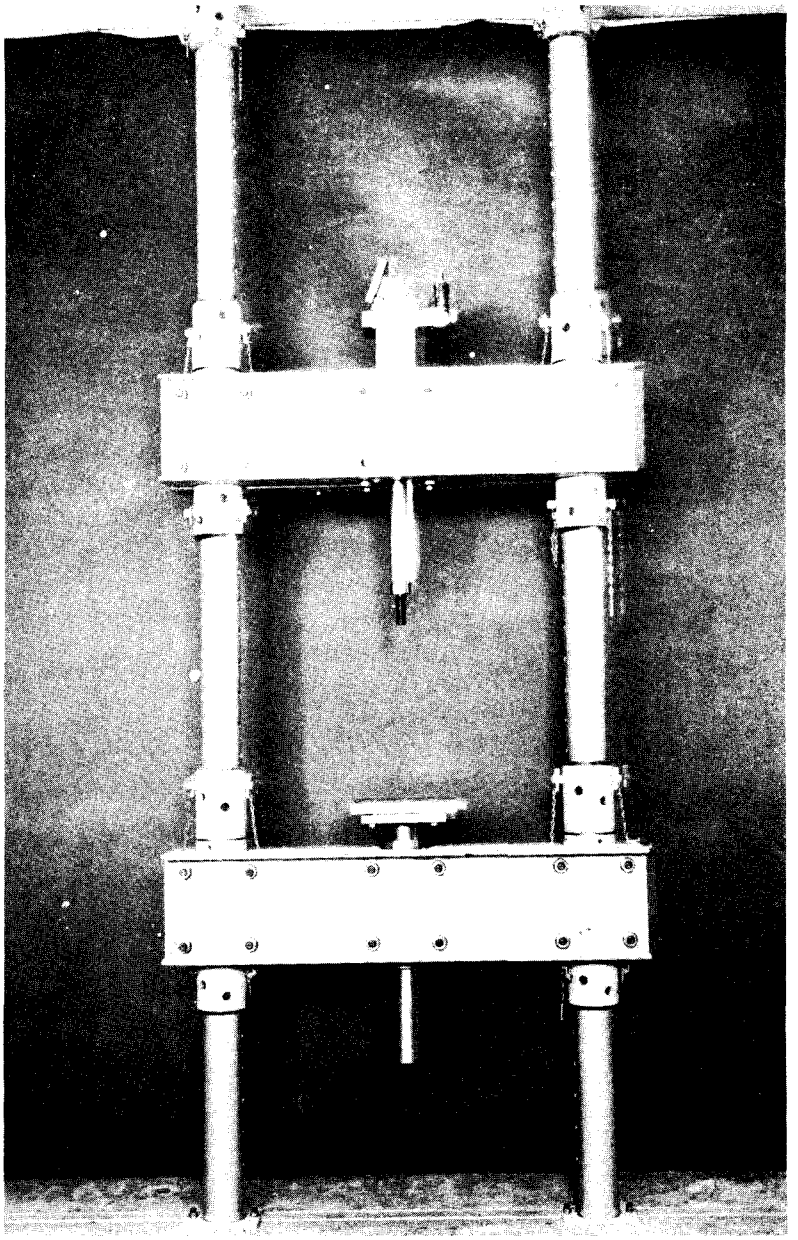


Fig 7. Floor-to-ceiling load frame.

SOIL MECHANICS AND FOUNDATION ENGINEERING LABORATORY

Facilities for soil mechanics and foundation engineering research include all types of standard equipment for tests for index properties of soils, for determination of consolidation characteristics, and for shear testing. A variety of triaxial cells of various diameters are available, along with equipment for measuring pore pressure (Fig 8). A special triaxial cell with three seperate loading axes is being investigated.

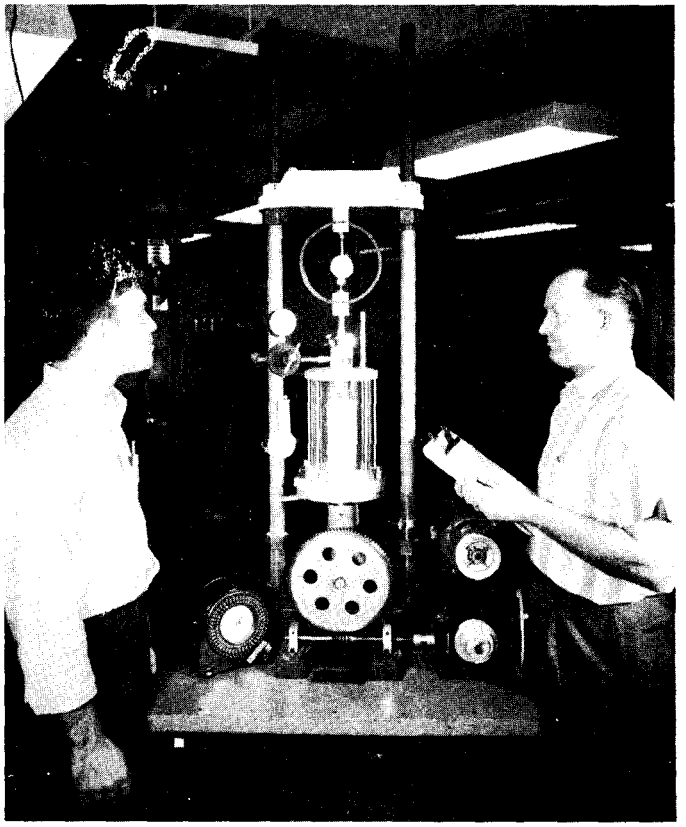


Fig 8. Triaxial test in progress.

There are moist rooms for sample storage, preparation, and testing, and three additional environmental rooms for testing under controlled conditions of temperature and humidity. A materials preparation room is equipped for

receiving, handling, and preparing large quantities of soils or base materials for laboratory testing. A test bed, hydraulic cylinders, load cells, and appropriate instrumentation are available for special setups involving studies of the interaction of soils and structures.

CONCRETE LABORATORY

The concrete laboratory has equipment for casting, curing, and testing concrete specimens. Small as well as relatively large quantities of concrete can be handled with mixers with capacities of 2 1/2 cubic feet to 11 cubic feet. In addition equipment is available for testing cement, aggregates, and fresh and hardened concrete according to ASTM recommend test procedures.

The environmental rooms described in another section of this statement are available for subjecting concrete to many curing conditions. Universal testing machines are available with capacities up to 400,000 pounds.

SECTION C

RELATED PUBLICATIONS

RELATED PUBLICATIONS

Pavement Systems Modeling

1. Hudson, W. R., F. N. Finn, B. F. McCullough, K. Nair, and B. A. Vallerga, "Systems Approach to Pavement Design," Interim Report, NCHRP Project 1-10, Materials Research and Development, Inc., March 1968.

2. Hudson, W. Ronald, B. F. McCullough, and Fred N. Finn, "Factors Affecting Performance of Pavement Systems," Transportation Engineering Journal of ASCE, Vol 95, No. TE3, Proceedings of the American Society of Civil Engineers, August 1969.

3. Committee on Structural Design of Pavements and Roadways, "Problems of Designing Roadway Structures," Transportation Engineering Journal of ASCE, Vol 95, No. TE2, Proceedings of the American Society of Civil Engineers, May 1969.

4. Hudson, W. Ronald, B. Frank McCullough, F. H. Scrivner, and James L. Brown, "A Systems Approach Applied to Pavement Design and Research," Research Report 123-1, published jointly by Texas Highway Department; Texas Transportation Institute, Texas A&M University; and Center for Highway Research, The University of Texas at Austin, December 1969.

5. Hudson, W. Ronald, "A Discussion of Pavement Systems Analysis and Design," presented at Specialty Session 18B, VII International Conference on Soil Mechanics and Foundation Engineering, Mexico City, Mexico, August 24-30, 1969.

Pavement Roughness Measurement and Evaluation

6. Hudson, W. Ronald, "High-Speed Road Profile Equipment Evaluation," Research Report No. 73-1, Center for Highway Research, The University of Texas, Austin, January 1966.

7. Hudson, W. Ronald, "High-Speed Road Profile Equipment Evaluation," Highway Research Record No. 189, Highway Research Board, 1967, pp 150-164.

8. Hudson, W. Ronald, and Freddy L. Roberts, "The 'How' of Pavement Performance Evaluation," Proceedings of the Association of Asphalt Paving Technologists, Vol 38, 1969.

9. Walker, Roger S., Freddy L. Roberts, and W. Ronald Hudson, "A Profile Measuring, Recording, and Processing System," Research Report No. 73-2, Center for Highway Research, The University of Texas at Austin, May 1969.

10. Hudson, W. Ronald, and Roger S. Walker, "A Road Profile Data Gathering and Analysis System," a paper presented at the 49th Annual Meeting of the Highway Research Board, January 1970 (accepted for publication).

11. Roberts, Freddy L., and W. Ronald Hudson, "The Development of Pavement Serviceability Equations Using Data from the Surface Dynamics Profilometer," Research Report No. 73-3, Center for Highway Research, The University of Texas at Austin, April 1969.

Analytical Methods for Pavement Slabs

12. Hudson, W. Ronald, and Hudson Matlock, "Discontinuous Orthotropic Plates and Pavement Slabs," Research Report No. 56-6, Center for Highway Research, The University of Texas, Austin, May 1966.

13. Hudson, W. Ronald, and Hudson Matlock, "A Finite-Element Analysis of Discontinuous Orthotropic Plates," Proceedings of the Fifth U. S. National Congress of Applied Mechanics, June 1966.

14. Hudson, W. Ronald, and C. Fred Stelzer, "A Direct Computer Solution for Slabs-on-Foundation," Journal of the American Concrete Institute, No. 3, March 1968.

15. Hudson, W. Ronald, and Hudson Matlock, "Discrete-Element Analysis for Discontinuous Plates," Journal of the Structural Division, Vol 94, No. ST10, Proceedings of the American Society of Civil Engineers, October 1968.

16. Pearre, Charles M., III, and W. Ronald Hudson, "A Discrete-Element Solution of Plates and Pavement Slabs Using a Variable-Increment-Length Model," Research Report No. 56-11, Center for Highway Research, The University of Texas at Austin, April 1969.

Evaluation of Expansive Soils

17. Lytton, Robert L., "Theory of Moisture Movement in Expansive Clays," Research Report No. 118-1, Center for Highway Research, The University of Texas at Austin, September 1969.

18. Nachlinger, R. Ray, and Robert L. Lytton, "Continuum Theory of Moisture Movements and Swell in Expansive Clays," Research Report No. 118-2, Center for Highway Research, The University of Texas at Austin, September 1969.

19. Lytton, Robert L., and Ramesh K. Kher, "Prediction of Moisture Movement in Expansive Clays," Research Report No. 118-3, Center for Highway Research, The University of Texas at Austin, June 1969.

Dynamic Loading of Highway Structures

20. Lee, Clyde E., and Nasser I. Al-Rashid, "A Portable Electronic Scale for Weighing Vehicles in Motion," Research Report No. 54-1F, Center for Highway Research, The University of Texas at Austin, April 1968.

21. Lee, Clyde E., "A Portable Electronic Scale for Weighing Vehicles in Motion," Highway Research Record No. 127, Highway Research Board, January 1966.

22. Lee, Clyde E., "A Portable Scale for Weighing on the Move," Instrumentation Technology, January 1966, pp 41-44.

23. Kelly, Allen E., and Hudson Matlock," Dynamic Analysis of Discrete-Element Plates for Nonlinear Foundations," Research Report 56-17, Center for Highway Research, The University of Texas at Austin, January 1970.

Finite-Element Analysis Capabilities

24. Johnson, C. P., "The Analysis of Thin Shells by a Finite Element Procedure," Structural Engineering Laboratory Report No. 67-22, University of California, Berkeley, California, 1967.

25. Clough, R. W., and C. P. Johnson, "A Finite Element Approximation for the Analysis of Thin Shells," International Journal of Solids Structures, Vol 4, Pergamon Press, Great Britain, 1968.

26. Johnson, C. P., and P. G. Smith, "A Computer Program for the Analysis of Thin Shells," Structural Engineering Laboratory Report No. 69-5, University of California, Berkeley, California, 1969.

27. Johnson, C. P., "Lateral Buckling of Compression Flanges in Rigid Frame Structures by a Finite Element Method," report to University of Arkansas and Varco-Prudin, May 1969.

28. Clough, R. W., and C. P. Johnson, "Finite Element Analysis of Arbitrary Thin Shells," American Concrete Institute Symposium on Concrete Thin Shells, April 1970.

29. Reese, Lymon C., and C. V. Girijavallabhan, "Finite Element Method for Problems in Soil Mechanics," Journal of the Soil Mechanics and Foundation Division, Vol 94, No. SM 2, Proc. Paper 5864, Proceedings of the American Society of Civil Engineers, March 1968, pp. 473-496.

30. Reese, Lymon C., and C. V. Girijavallabhan, "Application of the Finite Element Method to Problems in Soil and Rock Mechanics," a report to the American Petroleum Institute, Division of Production, Project 67H, January 1967, 165 pages.

31. Reese, Lymon C., and C. V. Girijavallabhan, "Finite Element Method Applied to Problems in Stresses and Deformations of Soil," a report to National Aeronautics and Space Administration prepared by the Department of Civil Engineering, The University of Texas, Austin, January 1967, 165 pages.

32. Reese, Lymon C., "Interaction of Soils and Structures: Finite Element Analysis of Soils and Rocks," Third Annual Industrial Associates Conference, College of Engineering, The University of Texas, presented in Dallas, Texas, January 27, 1965 and Houston, Texas, January 29, 1965.

33. Reese, Lymon C., "Application of the Finite Element Method to Problems in Soil Mechanics and Foundation Engineering," a paper presented to the Texas Section, American Society of Civil Engineers, Austin, Texas, October 1, 1966.

34. Reese, Lymon C., "Soil Parameters in Finite Element Analysis," keynote address to Session IV, Symposium on Application of Finite Element Methods in Civil Engineering, Vanderbilt University, Nashville, Tennessee, November 14, 1969.

Tensile Properties of Highway Materials

35. Hudson, W. Ronald, and Thomas W. Kennedy, "An Indirect Tensile Test for Stabilized Materials," Research Report No. 98-1, Center for Highway Research, The University of Texas at Austin, January 1968.

36. Kennedy, Thomas W., and W. Ronald Hudson, "Application of the Indirect Tensile Test to Stabilized Materials," Highway Research Record No. 235, Highway Research Board, January 1968.

37. Hadley, William O., W. Ronald Hudson, and Thomas W. Kennedy, "An Evaluation of Factors Affecting the Tensile Properties of Asphalt-Treated Materials," Research Report No. 98-2, Center for Highway Research, The University of Texas at Austin, August 1968.

38. Pendola, Humberto J., Thomas W. Kennedy, W. Ronald Hudson, "Evaluation of Factors Affecting the Tensile Properties of Cement-Treated Materials," Research Report 98-3, Center for Highway Research, The University of Texas at Austin, September 1969.

39. Tulloch, Walter S., II, W. Ronald Hudson, and Thomas W. Kennedy, "Evaluation and Prediction of the Tensile Properties of Lime-Treated Materials," Research Report No. 98-5, Center for Highway Research, The University of Texas at Austin, July 1970.

40. Hadley, William O., W. Ronald Hudson, Thomas W. Kennedy, and Virgil L. Anderson, "A Statistical Experiment to Evaluate Tensile Properties of Asphalt-Treated Materials," a paper presented at the Annual Meeting of the Association of Asphalt Paving Technologists, January 1969.

41. Hadley, William O., W. Ronald Hudson, and Thomas W. Kennedy, "Correlation of Indirect Tensile Test Results with Stability and Cohesiometer Values for Asphalt-Treated Materials," a paper presented at the Annual Meeting of the Association of Asphalt Paving Technologists, February 1970.

42. Moore, Raymond K., Thomas W. Kennedy, and W. Ronald Hudson, "Factors Affecting the Tensile Properties of Cement-Treated Materials," a paper presented at the 49th Annual Meeting of the Highway Research Board, January 1970 (accepted for publication).

43. Miller, Paul S., Thomas W. Kennedy, W. Ronald Hudson, "Evaluation of Tensile Properties of Subbases for Use in New Rigid Pavement Design," Research Report No. 98-4, Center for Highway Research, The University of Texas at Austin, March 1970.

44. Hadley, William O., W. Ronald Hudson, and Thomas W. Kennedy, "Correlation of Tensile Properties with Stability and Cohesiometer Values for Asphalt-Treated Materials", Research Report No. 98-6, Center for Highway Research, The University of Texas at Austin, March 1970.

45. Hadley, William O., W. Ronald Hudson, and Thomas W. Kennedy, "A Method of Estimating Tensile Properties of Materials Tested in Indirect Tension," Research Report No. 98-7, Center for Highway Research, March 1970

Pavement Rehabilitation

46. McCullough, B. F., "A Pavement Overlay Design System Considering Wheel Loads, Temperature Changes, and Performance," Ph.D. Dissertation, University of California, Berkeley, July 1969.

47. McCullough, B. F., and C. L. Monismith, "Application of a Pavement Design Overlay System," Special Report No. 123-1, Center for Highway Research, The University of Texas at Austin, October 1969.

48. McCullough, B. F., and C. L. Monismith, "A Pavement Overlay Design System Considering Wheel Loads, Temperature Changes, and Performance," a paper presented at the 49th Annual Meeting of the Highway Research Board, January 1970.

Road Surface Friction - Skid Resistance

49. McCullough, B. F., and K. D. Hankins, "Development of a Skid Test Trailer," Research Report 45-1, Texas Highway Department, April 1965.

50. Evans, Arlie, N., "A Method of Evaluating Pavement Skid Resistance," unpublished Thesis, Master of Science in Civil Engineering, The University of Texas at Austin, (Supervised by Clyde E. Lee), June 1967.

51. Hankins, Kenneth D., "Pavement Surface Texture as Related to Skid Resistance," unpublished Thesis, Master of Science in Civil Engineering, The University of Texas at Austin, (Supervised by Clyde E. Lee), June 1967.

52. Dean, Elmore H., "Relationship of the Tire-Pavement Interface to Traffic Accidents Occurring Under Wet Conditions," unpublished Thesis, Master of Science in Civil Engineering, The University of Texas at Austin, (Supervised by Thomas W. Kennedy), August 1969.

SECTION D

PERSONNEL

ANAGNOS, JAMES N.
Research Engineer Associate III

Degree

B.B.A. in Economics, University of Houston, 1958

Industrial Experience

Texas Highway Department, Houston - 13-1/2 years in the laboratory with the last 9 years as the lab supervisor

Lane Wells Company, Houston - 6 months as Applications Engineer for nuclear moisture density equipment

Texas Crushed Stone Company, Austin - 6 months as Plant Quality Control Engineer

Research Activities

Mr. Anagnos is in charge of the soils and materials laboratories. His current research activities involve asphalt, lime and cement stabilization, compaction studies, tensile testing of asphaltic concrete, and load transfer characteristics of drilled shafts and piles.

Publication

"The Nuclear Method of Soil-Moisture Determination at Depth," Research Report No. 89-4, Center for Highway Research, The University of Texas at Austin, June 1969 (with C. J. Ehlers and L. C. Reese)

March 1970

DALRYMPLE, HAROLD N.
Research Engineer Associate IV

Degree

B.S. in Electrical Engineering
University of Illinois, 1965

Experience

U.S. Air Force, Structural Research Instrumentation under Atomic Field Tests, 1951-55

University of Illinois, Civil Engineering Department, Structural Research Instrumentation, 1955-65

Mr. Dalrymple is currently involved in Soils and Structural Research Instrumentation at the Unviersity of Texas

Professional Societies

Instrument Society of America

Publications

"Instrumentation for Measurements of Lateral Earth Pressure in Drilled Shafts, " Research Report No. 89-2, Center for Highway Research, The University of Texas at Austin, September 1968 (with Lymon C. Reese and James Crozier Brown)

June 1969

HADLEY, William O.
Research Associate

Degrees

B.S. in Civil Engineering,
University of Tennessee, 1961

M.S. in Civil Engineering,
University of Texas, 1968

Industrial Experience

Highway Design Engineer, 1 year,
Clark, Dietz, Painter & Associates,
Memphis, Tennessee

Field Engineer, 6 months, C.H. Leavell & Co., Cape Kennedy, Florida,
Missile complex construction

Research Experience

2 years - University of Texas in evaluating the use of asphalt-treated subbases in rigid pavement construction

Professional Societies

Institute of Traffic Engineers, University of Texas, Student Chapter

Honors

Chi Epsilon
Sigma Xi
Scabbard and Blade
Distinguished Military Graduate

Publications

"A Statistical Experiment to Evaluate Tensile Properties of Asphalt-Treated Materials," a paper presented at the Annual Meeting of the Association of Asphalt Paving Technologists, Feb 1969 (with W. Ronald Hudson, Thomas W. Kennedy, and Virgil L. Anderson)

"Factors Affecting the Tensile Properties of Asphaltic Materials," A paper presented for publication by the American Society of Civil Engineers, Feb 1969 (with W. Ronald Hudson and Thomas W. Kennedy)

"An Evaluation of Factors Affecting the Tensile Properties of Asphalt-treated Materials," Research Report 98-2, Center for Highway Research, The University of Texas at Austin, August 1968 (with W. Ronald Hudson and Thomas W. Kennedy)

"An Evaluation of Factors Affecting the Tensile Properties of Asphalt treated Materials", Master's Thesis, The University of Texas at Austin, August 1968

August 1969

JAMES T. HOUSTON
Assistant Professor of Civil Engineering

Education

B.S. in C.E., The University of Texas, 1963
M.S. in C.E., The University of Texas, 1965
Ph.D., Texas A & M University, January 1969

Teaching Experience

2 years - The University of Texas at Austin

Industrial Experience

Texas Highway Department, Belton - Summer 1961
Austin - Summer 1962
Research Associate, Structural Mechanics Research Lab, The University of Texas, 1964-65
Engineering Research Associate, Structural Research Department, Texas Transportation Institute, Texas A & M University, 1965-1968.
Research for HUD - Low-cost housing materials studies
Consultant to lightweight aggregate producers

Professional and Honorary Societies

American Concrete Institute
American Society for Testing and Materials
Chi Epsilon
Tau Beta Pi
Sigma Xi

Publications

"Critical Mechanical Properites of Structural Lightweight Concrete and the Effects of These Properties Upon the Design of Pavement Structures," Highway Research Record No. 112, January 1966.

"Volume Changes in Unrestrained Structural Lightweight Concrete," Research Report No. 55-2, Center for Highway Research, The University of Texas, August 1964 (with J. N. Thompson).

"Development of a Rotary Kiln for Synthetic Aggregate Research," Pit & Quarry, Vol. 60, No. 5, November 1967 (with W. B. Ledbetter).

"Pilot-Sized Rotary Kiln Facility for East Pakistan," Texas Transportation Institute, Texas A & M University, November 1968, 62 pp (with W. B. Ledbetter).

"A Sandblast Abrasion Test for Synthetic Aggregate Evaluation," Texas Transportation Institute, Texas A & M University, 1969 (with W. B. Ledbetter).

"Effect of Synthetic Aggregate Thermal Transformation on Performance of Concrete," Texas Transportation Institute, Texas A & M University, 1969 (with W. B. Ledbetter).

"A Sandblast Abrasion Test for Synthetic Aggregate Evaluation," American Society for Testing and Materials, accepted for publication in Materials Research and Standards, 1970.

"Studies of the Thermal Transformation of Synthetic Aggregates Produced in a Rotary Kiln," Texas Transportation Institute, Texas A & M University, November 1969, 20 pp (with H. R. Blank and G. W. Kunze).

July 1970

HUDSON, W. RONALD
Assistant Dean of Engineering
Research Engineer, Center for Highway Research
Associate Professor of Civil Engineering

Degrees

B.S. in CE, Texas A&M, 1954
M.S. in CE, Texas A&M, 1955
Ph.D. in CE, The University of Texas, 1965

Current Research and Teaching Activities

Dr. Hudson presently serves as Assistant Dean of Engineering for The University of Texas. He is also conducting research in the following areas: (1) analysis and design of pavement management systems, (2) measurement of pavement roughness performance, (3) slab analysis and design, (4) tensile strength of stabilized subbase materials.

Industrial and Field Experience

Assistant Project Engineer, National Cooperative Highway Research Program Project I-1, "Preparation of Guidelines for Satellite Studies of Pavement Performance."
Supervising Designing Research Engineer, Highway Design Division of the Texas Highway Department, Austin, Texas
Assistant Chief, Rigid Pavement Research Branch AASHO Road Test, National Academy of Sciences, Ottawa, Illlnois
Civil Engineer, S. J. Buchanan and Associates, Consulting Engineers, Bryan, Texas

Professional Activities, Honors, and Awards

Registered Professional Engineer, Texas and Illlinois
Recipient of the James R. Croes Medal American Society of Civil Engineers, 1968, and the Annual Highway Research Board Award, 1964
Member: Phi Kappa Phi, Tau Beta Pi, Sigma Xi, and Chi Epsilon
Member of 9 technical societies including American Society of Civil Engineers, National Society of Professional Engineers, and Highway Research Board

Committee Activities

Chairman Committee A2-B6, Theory of Pavement Design, Highway Research Board of the National Academy of Sciences, October 1965 - present
Secretary Committee D-B1, Rigid Pavement Design, Highway Research Board of the National Academy of Sciences, 1964 - 1970
Committee A2-B5, Pavement Conditions Evaluation, Highway Research Board of the National Academy of Sciences, October 1963 - present
Committee A2-K01, Strength and Deformation Characteristics of Pavement Sections, Highway Research Board of the National Academy of Sciences, 1964 - present
Highway Research Board Award Committee of the National Academy of Sciences, 1965
Chairman, Committee on Structural Design of Pavements and Roadways,

American Society of Civil Engineers, 1965 - present
Task Committee on Continuing Education in Civil Engineering, American Society of Civil Engineers, 1965 - 1967
Committee, Concrete - Year 2000, American Concrete Institute, 1969 - present
Fees and Salaries Committee, Texas Society of Professional Engineers 1970 - present

Consulting Activities

U. S. Corps of Engineers, Waterways Experiment Station, C5A Pavement Test. Vicksburg, Mississippi and Construction Engineering Research Laboratory, Champaign, Illinois
Materials Research and Development Corporation, NCHRP Project 1-10 entitled "Systems Approach to Pavement Design."
Shell Oil Company laterally loaded pile and pile group studies
Eric H. Wang, U. S. Air Force, Civil Engineering Research Facility Advisory Panel, University of New Mexico, New Mexico, 1969 - 1970

Selected Recent Publications

"Airfield Pavement Systems and Their Parameters," presented to The Conference of Airfield Pavement Systems, Construction Engineering Research Laboratory, Urbana, Illinois, March 1970
"Factors Affecting Performance of Pavement Systems," Transportation Engineering Journal, Vol 95, No. TE3, Proceedings of the American Society of Civil Engineers, August 1969 (with McCullough and Finn)
"Problems of Designing Roadway Structures," Transportation Engineering Journal, Vol 95, No. TE2, Proceedings of the American Society of Civil Engineers, May 1969 (with Committee on Structural Design of Roadways)
"A Statistical Experiment to Evaluate Tensile Properties of Asphalt-Treated Materials," The Association of Asphalt Paving Technologists Proceedings, Vol 38, February 1969 (with William O. Hadley, Thomas W. Kennedy, and Virgil L. Anderson)
"Discrete-Element Analysis for Discontinuous Plates," Journal of the Structural Division, Vol 94, No. ST10, Proceedings of the American Society of Civil Engineers, October 1968 (with Hudson Matlock)
"A Direct Computer Solution for Slabs on Foundation," Journal of the American Concrete Institute, No. 3, March 1968 (with C. Fred Stelzer, Jr.)
"Systems Approach to Pavement Design," System Formulation, Performance Definition, and Material Characterization, Interim Report NCHRP Project 1-10, March 1968 (with F. N. Finn, et al)
"Application of the Indirect Tensile Test for Stabilized Materials," Highway Research Record, No. 235, Highway Research Board, National Academy of Sciences, Washington, D. C., September 1968 (with Thomas W. Kennedy)
"Cracked Pavement Slabs with Nonuniform Load and Support," Journal of the Highway Division, Vol 93, No. HW1, Proceedings of the American Society of Civil Engineers, April 1967 (with Hudson Matlock)(Winner of the ASCE J. James Croes Medal, 1967)
"High-Speed Road Profile Equipment Evaluation," Highway Research Record, No. 189, Highway Research Board, January 1967

In addition to these listed, Dr. Hudson has published over 48 other technical reports and articles and has given more than 38 oral presentations of a technical nature.

March 1970

JOHNSON, C. PHILIP
Associate Professor of Civil Engineering

Degrees

B. S. - Civil Engineering, Mississippi State University, 1957
M. S. - Civil Engineering, University of Arkansas, 1961
Ph.D. - Structural Engineering and Structural Mechanics, University of California, 1968

Teaching Experience

Associate Professor of Civil Engineering, The University of Texas, 1969 - present.
Associate Professor of Civil Engineering, The University of Arkansas, 1967 - 1969.
Assistant Professor of Civil Engineering, The University of Arkansas, 1960 - 1963.

Industrial Experience

Consultant to University of California, T. Y. Lin & Associates, 1968 - 1969.
Junior Engineer, Mississippi Highway Department, 1958 - 1959.
Assistant Structural Designer, Michael Baker Jr., 1957 - 1958.

Recent Publications

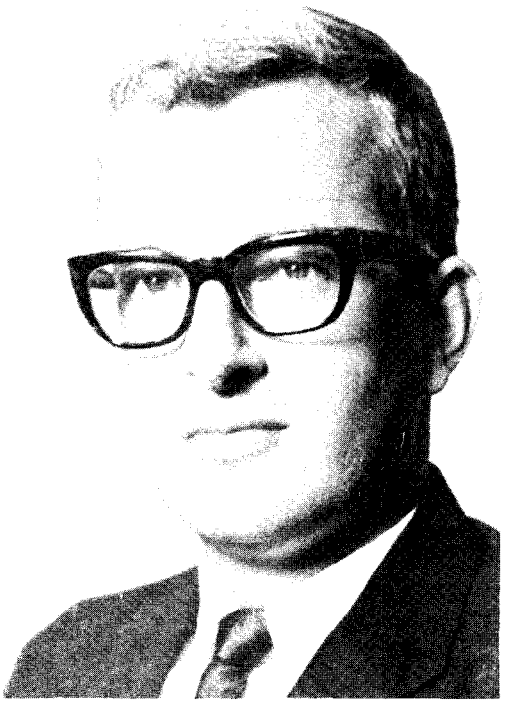
Johnson, C. P. and Smith, P. G., "A Computer Program for the Analysis of Thin Shells," SEL Report No. 69-5, University of California, Berkeley, California, 1969.
Clough, R. W. and Johnson, C. P., "A Finite Element Approximation for the Analysis of Thin Shells," International Journal of Solids Structures, Vol. 4, Pergamon Press, Great Britain, 1968.
Johnson, C. P., "The Analysis of Thin Shells by a Finite Element Procedure," SEL Report No. 67-22, University of California, Berkeley, California, 1967.

Field of Specialization

Computer Methods of Structural Analysis

October 1969

KENNEDY, THOMAS W.
Research Engineer and Associate Professor
of Civil Engineering



Degrees

B. S. in Civil Engineering, University of Illinois, 1960
M. S. in Civil Engineering, University of Illinois, 1962
Ph.D. in Civil Engineering, University of Illinois, 1965

Teaching Experience

4 years - The University of Texas at Austin
3 years - University of Illinois

Research and Industrial Experience

Research in the areas of stabilized materials and the time-dependent deformation of concrete, The University of Texas, 1965-69
Research in the areas of highway geometrics, concrete durability, University of Illinois, 1960-65
Illinois Division of Highways, 1958-59

Current Research

Dr. Kennedy is currently involved in research involving (1) the evaluation of tensile properties of subbases for use in new rigid pavement design and (2) an investigation of the time-dependent deformation of concrete under triaxial-stress conditions in prestressed reactor vessels

Professional Societies

American Society of Civil Engineers
American Concrete Institute Committee: Creep and Shrinkage in Concrete (Committee 209)
Highway Research Board Committees:
Traffic and Operations (TO-3)
Subcommittee on Medians
Subcommittee on Channelized Intersections
Lime and Lime Fly-Ash Stabilization (SGF-A4)

Honors

Tau Beta Pi
Chi Epsilon
Phi Kappa Phi
Kappa Mu Epsilon
Sigma Xi

June 1969

KENNEDY, THOMAS W.

Publications

"Medians of Divided Highways -- Current Status of Knowledge and Annotated Bibliography," Bibliography 34, Highway Research Board, 1963 (with J. W. Hutchinson and W. A. Scott)

"Use of Accident Records in Highway Research," Highway Research News, No. 13, Highway Research Board, June 1964 (with J. W. Hutchinson)

"History of Median Development in Illinois," Highway Research Record No. 105, Highway Research Board, 1966 (with J. W. Hutchinson and H. E. Surman)

"Medians of Divided Highways -- Frequency and Nature of Vehicle Encroachment," Bulletin 487, Engineering Experiment Station, University of Illinois, 1966 (with J. W. Hutchinson)

"Safety Considerations in Median Design," Highway Research Record No. 162, Highway Research Board, 1967 (with J. W. Hutchinson)

"Mechanisms of Concrete Scaling," Thesis, Doctor of Philosophy, University of Illinois, 1965

"Physical Factors Influencing Resistance of Concrete to De-icing Agents," Report 27, National Cooperative Highway Research Program, Highway Research Board, 1966 (with Malisch, Raecke, Fischer, Lott, and Kesler).

"An Indirect Tensile Test for Stabilized Materials," Research Report 98-1, Center for Highway Research, The University of Texas at Austin, January 1968, 88 pp (with W. R. Hudson)

"Application of the Indirect Tensile Test to Stabilized Materials," Highway Research Record No. 235, Highway Research Board, 1968, pp 36-48 (with W. R. Hudson)

"The Evaluation of Factors Affecting the Tensile Properties of Bituminous Stabilized Materials," Research Report 98-2, Center for Highway Research, University of Texas at Austin, March 1969 (with W. O. Hadley and W. R. Hudson)

"A Statistical Experiment to Evaluate Tensile Properties of Asphalt-Treated Materials," submitted to and accepted for publication by Association of Asphalt Paving Technologists, January 1969 (with W. O. Hadley, W. R. Hudson, and V. L. Anderson)

"Evaluation of Factors Affecting the Tensile Properties of Cement-Treated Materials," Research Report 98-3, Center for Highway Research, University of Texas at Austin, January 1969 (with H. J. Pendola and W. R. Hudson)

"Evaluation of Factors Affecting the Tensile Properties of Lime-Treated Materials," Research Report 98-4, Center for Highway Research, University of Texas at Austin, July 1969 (with S. P. Miller and W. R. Hudson)

"Tensile Properties of Asphalt-Treated Materials," submitted to the American Society of Civil Engineers for publication, May 1969 (with W. O. Hadley and W. R. Hudson)

KOZUH, JOSEPH A.
Statistician and Operations Engineer

Degrees

B. A. in Mathematics, University of Dayton, 1965
M. A. in Mathematics, University of Texas at Austin, 1967
Ph. D. in Operations Research, University of Texas at Austin, in progress

Teaching Experience

3 years - Teaching Assistant in Mathematics, The University of Texas at Austin

Research Experience

1 year - Electrical Engineering Department, The University of Texas at Austin; resolution, discrimination, and classification of mixture data and mixture distributions by the method of moments.
2 years - Statistician. Center for Highway Research, The University of Texas at Austin.

Publications

"Practical Applications of Static Tensile Tests for Lime-Treated Materials," Research Report No. 98-9, Center for Highway Research, The University of Texas at Austin, August 1970 (with Raymond K. Moore, Thomas W. Kennedy, and W. Ronald Hudson).

Current Research

(1) Sensitivity analysis for flexible pavement systems
(2) Regression analysis when errors are present in the independent variables, and
(3) Measuring pavement performance by means of spectral analysis.

Consulting Activities

Texas Highway Department, stepwise regression analysis of wet weather accident data
Texas Highway Department, experiment for quality control over cement contractors

Professional Societies

American Statistical Association
Operations Research Society of America
Institute of Management Science

July 1970

MATLOCK, HUDSON
Research Engineer and Professor
of Civil Engineering

Degrees

B. S. in Civil Engineering, The University of Texas, 1947
M. S. in Civil Engineering, The University of Texas, 1950

Principal Consulting Work

Preliminary instrumentation design to test dynamic effects of ice on offshore test platform for the State of Alaska Department of Highways, 1968
Development of a computer system for lateral and axial solutions of beam columns for Shell Development Company, 1968
Analysis of a flexible two-way footing on elastic foundation for Humble Oil and Refining Company, 1967
Study of lateral load behavior of model skirt plate structures in soft clay for Shell Development Company, 1966
Study with field tests of lateral load behavior of groups of closely placed piling for offshore structures for Shell Development Company, 1966
Study of structural characteristics of a mobile drilling rig for Penrod Drilling Company, 1966
Study of structural characteristics of mobile drilling rig for Esso Production Research Company, 1965

Scientific and Professional Society Memberships

American Concrete Institute
American Society of Civil Engineers
American Society for Engineering Education
Society for Experimental Stress Analysis
Registered Professional Engineer, Texas
Texas Society of Professional Engineers
Tau Beta Pi (Fellow, 1947-48)
Sigma Xi
Chi Epsilon

Honors and Awards

J. James R. Croes Medal, American Society of Civil Engineers, September 1968, Pittsburgh, Pennsylvania, for paper entitled "Cracked Pavement Slabs with Nonuniform Support," with W. R. Hudson
Technical Paper Award, Texas Section, American Society of Civil Engineers, Fall 1965, Fort Worth, Texas, for paper entitled "Generalized Solutions for Pavement-Slabs on Foundations," with W. R. Hudson
Fellow, Tau Beta Pi, 1947-48
Sigma Xi
Chi Epsilon

MATLOCK, HUDSON

Publications

"Structural Damage from Tsunami at Hilo, Hawaii, Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 94, No. HY4, Proceedings Paper No. 6037, July 1968 (with Lymon C. Reese)

"Cracked Pavement Slabs with Nonuniform Support," Journal of the Highway Division, American Society of Civil Engineers, Vol. 93, No. HW1, Proceedings Paper No. 5191, April 1967 (with W. R. Hudson)

"Behavior of a Two-Dimensional Pile Group under Inclined and Eccentric Loading," Proceedings, Offshore Exploration Conference, Long Beach, California, February 1966 (with Lymon C. Reese)

"Analysis of Discontinuous Orthotropic Pavement Slabs Subjected to Combined Loads," Highway Research Record, No. 131, 1966 (with W. R. Hudson)

"Inelastic Bending and Buckling of Piles," Session I, Proceedings, Conference of Deep Foundations, Mexican Society of Soil Mechanics, Mexico City, Vol. I, December 1964 (with T. Allan Haliburton)

"Bending and Buckling of Soil-Supported Structural Elements," Paper No. 32, Proceedings, Second Pan-American Conference on Soil Mechanics and Foundation Engineering, Brazil, July 1963 (with Wayne B. Ingram)

"Applications of Numerical Methods to Some Structural Problems in Offshore Operations," Proceedings, First Conference on Drilling and Rock Mechanics, The University of Texas, Austin, Texas, January 1963 Also, Journal of Petroleum Technology, Vol. XV, No. 9, September 1963.

"Generalized Solutions for Laterally Loaded Piles," Transactions, American Society of Civil Engineers, Paper No. 3370, Vol. 127, Part I, 1962 (with Lymon C. Reese)

"A Graphical Solution for Strain Rosettes," Strain Gage Readings, Vol. IV, No. 5, December 1961 - January 1962 (with Richard L. Tucker)

"Foundation Analysis of Offshore Pile-Supported Structures," Proceedings, Fifth International Conference, International Society of Soil Mechanics and Foundation Engineering, 3B/14, Paris, July 1961 (with Lymon C. Reese)

"Welding of Reinforcing Steel Between Precast Concrete Units," Journal of American Concrete Institute, Proceedings, Vol. 58, No. 6, Part I, December 1961 (with J. Neils Thompson and A. A. Toprac)

"Numerical Analysis of Laterally Loaded Piles," Proceedings, Second Structural Division Conference on Electronic Computation, American Society of Civil Engineers, Pittsburgh, September 1960 (with Lymon C. Reese)

In addition to these listed Mr. Matlock has published 39 other technical papers and articles and submitted 25 consulting research reports.

MCCULLOUGH, B. FRANKLIN
Assistant Professor of Civil Engineering

Degrees

B. S. - Civil Engineering, The University of Texas, 1957

M. S. - Civil Engineering, The University of Texas, 1962

Doctor of Engineering - Transportation Engineering, University of California, 1969

Teaching Experience

Assistant Professor of Civil Engineering, The University of Texas, 1969 - present

Industrial Experience

Senior Engineer, Materials Research & Development Inc., Oakland, California, 1966-1968

Supervising Design-Research Engineer, Texas Highway Department, Austin, Texas, 1958-1966

Engineering Assistant, Texas Highway Department, Austin, Texas, 1957-1958

Testing Engineer, Testing Laboratories, Convair Aircraft Co., Fort Worth, Texas, 1957

Engineering Assistant, Bureau of Reclamation, Austin and Cuero, Texas, 1956

Professional Societies

American Society of Civil Engineers
Highway Research Board
American Society of Testing Materials
American Concrete Institute
Registered Professional Engineer in Texas

Recent Publications

Vallerga, B. A. and B. F. McCullough, "New Pavement Evaluation and Design Techniques for Jumbo Jet Loadings," to be published in ASCE Journal, 1969

McCullough, B. F. and H. J. Treybig, "A Statewide Deflection Study of Continuously Reinforced Concrete Pavement in Texas," Highway Research Record, No. 239, 1968

McCullough, B. F. and H. J. Treybig, "Determining the Relationship of Variables in Deflection of Continuously Reinforced Concrete Pavement," Highway Research Record, No. 331, 1966

McCullough, B. F. and K. D. Hankins, "Skid Resistance Guidelines for Surface Improvements on Texas Highways," Highway Research Record, No. 131, 1966

Hudson, W. R. and B. F. McCullough, "An Extension of Rigid Pavement Design Methods," Highway Research Record, No. 60, 1964

"Slick When Wet - Field Evaluations of Saw Cut Method," Texas Highways, January, 1963

Shelby, M. D. and B. F. McCullough, "Determining and Evaluating Stresses of an In-Service Continuously Reinforced Concrete Pavement," Highway Research Record, No. 5, 1963

Committee Activities

Committee DB-1, Rigid Pavement Design, Highway Research Board of the National Academy of Sciences

Committee DB-4, Skid Testing with an Automobile, Highway Research Board of the National Academy of Sciences

ASCE, Committee on Structural Design of Roadways, American Society of Civil Engineers

ASTM E-17, Committee on Skid Resistance, American Society for Testing and Materials

AASHO Committee on NCHRP, Satellite Studies on Pavement Performance, American Association of State Highway Officials

Field of Specialization

Transportation Engineering

April 1969

MOORE, RAYMOND K.
Research Engineer Assistant III

Degrees

B. S. in Civil Engineering, Oklahoma State University, 1966

M. S. in Civil Engineering, Oklahoma State University, 1968

Teaching Experience

1 year - Technical Institute, Extension Division, Oklahoma State University

Research and Industrial Experience

Research in the area of stabilized materials, The University of Texas at Austin, 1968-70

Research in the areas of in-situ soil moisture and soil density measurement with nuclear depth probe, nuclear depth probe calibration procedures with soil, and subgrade moisture variations under in-place pavements, Oklahoma State University, 1966-68

Current Research

Mr. Moore is currently involved in research involving the evaluation of tensile properties of subbases for use in new rigid pavement design

Professional Societies

American Society of Civil Engineers
International Society of Soil Mechanics

Honors

Phi Kappa Phi
Phi Eta Sigma
Chi Epsilon
Sigma Xi

Publications

"Suggested Nuclear Depth Gage Calibration Procedures," Interim Report IV, Subgrade Moisture Variation Study, School of Civil Engineering, Oklahoma State University, 1968 (with T. Allan Haliburton)

"A Calibration Procedure for Nuclear Depth Probes with Oklahoma Soils," Thesis, Master of Science, Oklahoma State University, 1968

"Freeze-Thaw Study of Abilene Base Material," Research Note 98-A to Texas Highway Department, 1968 (with T. W. Kennedy and W. R. Hudson)

"Factors Affecting the Indirect Tensile Strength of Cement-treated Materials," to be published in Highway Research Record, Highway Research Board, 1970 (with T. W. Kennedy and W. R. Hudson)

February 1970

PANAK, JOHN J.
Research Associate in Civil Engineering

Degrees

B. S. in Civil Engineering, University of Colorado, 1958
M. S. in Civil Engineering, The University of Texas, 1968

Industrial Experience

Texas Highway Department, Bridge Division, Austin, Texas (Highway Bridge Design)
California Division of Highways, Bishop, California (Highway Design, Highway Construction, Material Testing)

Professional Societies

Registered Professional Engineeer in Texas
American Society of Civil Engineers
Texas Society of Professional Engineers

Honorary Societies

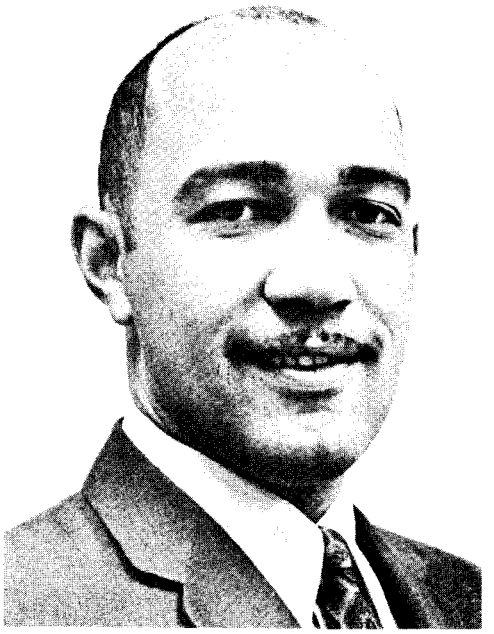
Chi Epsilon
Sigma Xi

Current Research

Mr. Panak is currently involved in research on Computer Simulation of Bridge Floor Systems. He has responsible charge of six to ten people working on a large research program. His other research activities involve photo stress investigations and structural analysis for a large portable drilling rig

June 1969

PERRY, ERVIN S.
Research Engineer and Assistant Professor
of Civil Engineering



Degrees

B. S. in Civil Engineering, Prairie View A&M College, 1956
M. S. in Civil Engineering, The University of Texas, 1961
Ph.D. in Civil Engineering, The University of Texas, 1964

Teaching Experience

5 years - The University of Texas
1 year - Prairie View A&M College (Chairman of Civil Engineering Department)
1 year - Southern University, Baton Rouge, Louisiana

Research

7 years - The University of Texas

Current Research

Dr. Perry is currently involved in research of creep of concrete under triaxial-stress conditions for use in prestressed concrete reactor vessels

Professional Societies

American Society of Civil Engineers
American Concrete Institute
American Society for Testing and Materials
American Society for Engineering Education
Texas Society of Professional Engineers
National Society of Professional Engineers

Honors

Chi Epsilon
Tau Beta Pi
Sigma Xi
Phi Kappa Phi
Fellow in Ford Foundation Academic Administration Internship Program 1967-68
Listed in "American Men of Science" and "Who's Who in the South and Southwest"

Publications

"Pullout Bond Stress Distribution Under Static and Dynamic Repeated Loadings," ACI Journal , Vol. 66, No. 5, May 1969 (with Nabil Jundi)
"Shear and Bond Strength of High-Strength Reinforced Concrete Beams Under Impact Loads - First Phase," Technical Report No. AF WL-TR-67-113, Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico, May 1968 (with R. W. Furlong, N. H. Burns, and J. N. Thompson)

June 1969

PERRY, ERVIN S.

"Behavior of Concrete Beams Reinforced with Steel Plates Subjected to Dynamic Loads," ACI Journal, Vol. 64, No. 10, October 1967 (with Ned H. Burns and J. N. Thompson)

"A Study of the Response of Backpacking Material Encasing a Tunnel Liner Subjected to a Dynamic Disturbance," Structural Mechanics Research Laboratory, The University of Texas, December 1966 (with Salah Nosseir and J. N. Thompson)

"Bond Stress Distribution on Reinforcing Steel in Beams and Pullout Specimens," ACI Journal, Vol 63, pp 365-375, August 1966 (with J. N. Thompson)

"Simple Setup for Applying Impact Loads," Materials Research and Standards, Vol 5, No 10, October 1965 (with Ned H. Burns)

"The Effects of Shape of Load Pulse on Shock-Mitigating Characteristics of a Styrofoam Plastic," Structural Mechanics Research Laboratory, The University of Texas, July 1965 (with Carr, Ripperger, and Thompson)

"Critical Mechanical Properties of Structural Lightweight Concrete and the Effects of These Properties on the Design of the Pavement Structure," Center for Highway Research, The University of Texas, January 1965 (with Ledbetter, Houston, and Thompson)

"A Study of Dynamically Loaded Composite Members," Technical Documentary Report No. AFWL TDR-64-35, July 1964 (with N. H. Burns and J. N. Thompson)

"Effects of Shape of Load Pulse on Shock-Mitigating Characteristics of Vermiculite Concrete and Foamed Plastics," Shock Vibration, and Associated Environments, Protective Construction, Bul No 32, December 1963 (with Ripperger, Smith, and Thompson)

"Transverse Strength of 8-Inch Cavity Walls," Report to Clay Products Association of the Southwest, February 1963

"Preliminary Studies of Aggregates for Shock Isolating Lightweight Concrete," Structural Mechanics Research Laboratory, The University of Texas, DASA 1319, August 1962 (with E. F. Smith and J. N. Thompson)

"Effects of Shape of Load Pulse on Shock-Mitigating Characteristics of Vermiculite Concrete and a Polyurethane Plastic," Structural Mechanics Research Laboratory, The University of Texas, DASA 1299, July 1962 (with Smith, Burns, and Thompson)

"Shock-Mitigation with Lightweight Vermiculite Concrete," Structural Mechanics Research Laboratory, The University of Texas, DASA 1263, February 1962 (with R. Shield, Ripperger, and Thompson)

REESE, LYMON C.
Research Engineer and Professor of Civil Engineering

Degrees

B. S. in Civil Engineering, The University of Texas, 1949
M. S. in Civil Engineering, The University of Texas, 1950
Ph.D. in Civil Engineering, University of California, 1955

Teaching Experience

17 years - The University of Texas
3 years - Mississippi State College

Industrial Experience

E. I. duPont
International Boundary Commission
U. S. Naval Construction Battalion
Associated Contractors and Engineers, Houston, Texas
Shell Development Company, Houston, Texas

Consulting Work

Socony-Mobil Oil Company
The California Company
The Texaco Company
Humble Oil and Refining Company
Brown and Root, Inc.
McClelland Engineers
Northumberland Consultants, Limited
Dow Chemical Company

Professional Societies

Registered Professional Engineer in Texas
American Society for Engineering Education
American Society of Civil Engineers
American Society for Testing and Materials

Honors and Awards

The Middlebrooks Award of the American Society of Civil Engineers
Fellow of the General Education Board
Fellow of the National Science Foundation

Fields of Specialization

Soil Mechanics and Foundation Engineering
Interaction of Soils and Structures

Publications

"Pipe Soil Interaction for Buried Offshore Pipeline," (Preprint), Paper No. SPE 2343, 43rd Annual Fall Meeting of the Society of Petroleum Engineers of AIME, Houston, Texas, September 29-October 2, 1968 (with A. O. P. Casberian)

"Finite-Element Method for Problems in Soil Mechanics," Proceedings, American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, Vol. 94, No. SM2, Proc. Paper 5864, March 1968, pp. 473 - 496. (with C. V. Girijavallabhan)

Publications (continued)

"Structural Damage from Tsunami at Hilo, Hawaii," Proceedings, American Society of Civil Engineers, Journal of the Hydraulics Division, Vol. 94, No. HY4, Proc. Paper 6037, July 1968, pp. 961-982. (with Hudson Matlock) (Also published as Preprint No. 552, 1967 ASCE National Meeting on Water Resources Engineering, New York, New York, October 16-20, 1967.)

"Analysis of Three-Dimensional Pile-Supported Space Frames Subjected to Inclined and Eccentric Loads," Proceedings, American Society of Civil Engineers, Symposium on Civil Engineering in the Oceans, September 1967, pp. 245-276. (with Michael W. O'Neill)

"The Analysis of Three-Dimensional Pile-Supported Space Frames Subjected to Inclined and Eccentric Loads," Abstracts of Papers from Conference on Civil Engineering in the Oceans, American Society of Civil Engineers, San Francisco, September 6-8, 1967, pp. 33-36 (with Mike W. O'Neill)

"Deep Water Platform Design Considerations," Supplement to Proceedings, Offshore Exploration Conference, Long Beach, 1967, pp. 43-55. (Report of a panel discussion. Other panelists: F. Ames Smith, Robert H. Anderson, F. Richard Hauber, Manley St. Denis, and John H. Wiggins)

"Analysis of a Bridge Foundation Supported by Batter Piles," Proceedings, Fourth Annual Symposium on Engineering Geology and Soils Engineering, Moscow, Idaho, April 1966, pp. 61-73

"Load Transfer for Axially Loaded Piles in Clay," Proceedings, American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, Vol. 92, No. SM 2, March 1966, pp. 1-26 (with Harry M. Coyle)

"Behavior of a Two-Dimensional Pile Group Under Inclined and Eccentric Loading," Proceedings, OECON (Offshore Exploration Conference, Long Beach, California, 1966, pp. 123-139 (with Hudson Matlock)

Discussion of "Influence Functions for Beams on Elastic Foundations," by Alexander Dodge, Proceedings, American Society of Civil Engineers, Journal of the Structural Division, Vol. 91, No. ST 3, June 1965, p. 277

"Criteria for Acceptability of Papers," Report of the Committee on Publications of the Soil Mechanics and Foundations Division, Proceedings, American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, Vol. 91, No. SM 3, May 1965, pp. 51-62 (with Robert V. Whitman, et. al.)

"Predicting the Performance of Friction Piles in Saturated Clays," Proceedings, Conference on Deep Foundations, Vol. I, Mexico City, December 1967, pp. 127-140 (with H. B. Seed). Also, Discussions in Vol. II: A discussion of a pile group subjected to eccentric and inclined loads, pp. 495-496; "Suggestions for Future Use of Models," pp. 538-539; and a discussion of types of inelastic models which are appropriate for real soils, p 570

"Experimental Studies of the Influence of Soil Properties on the Landing Characteristics of a Manual Spacecraft," Proceedings, Parachute Technology and Evaluation Symposium, El Centro, California, April 8, 1964 (with William E. Baker)

"Load Versus Settlement for an Axially Loaded Pile," Proceedings, Symposium on Bearing Capacity of Piles, Part 2, Central Building Research Institute Roorkee, February 1964, pp. 18-38

REESE, LYMON C.

Discussion of "Towers and Foundations for Project EHV," by Philip A. Wild and Emerson F. Haslam, Jr., (ASCE Proceedings Paper 3652), Proceedings, American Society of Civil Engineers, Journal of the Power Division, Vol. 89, No. PO 1, September 1963, pp. 125-132 (with Wayne B. Ingram)

Discussion of "Dynamic Response and Stability of Piers on Piles," by James Michalos, (ASCE Proceedings Paper 3321), Proceedings, American Society of Civil Engineers, Journal of the Waterways and Harbors Division, Vol. 89, No. WW 2, May 1963, pp. 85-91 (with T. Alan Halibruton)

Discussion of "Friction Pile Groups in Cohesive Soil," by Robert L. Kondner, (ASCE Proceedings Paper 3175), Proceedings, American Society of Civil Engineers, Vol. 89, No. SM 1, February 1963, pp. 285-290 (with Harry M. Coyle)

"Criteria for the Design of Offshore Structures," Paper SPE-403, Proceedings, First Conference on Drilling and Rock Mechanics, The University of Texas, Austin, Texas, January 23-24, 1963 (with Lowell Johnston)

"Ultimate Resistance Against a Rigid Cylinder Moving Laterally in a Cohesionless Soil," Paper SPE-372, The Society of Petroleum Engineers of AIME, Production Research Symposium, Tulsa, Oklahoma, April 12 and 13, 1962, pp. 240-245. Also, Society of Petroleum Engineers Journal, December 1962, pp. 355-359

"Factors Affecting the Stability of Offshore Drilling Platforms," Paper 926-7-H, Division of Production, American Petroleum Institute, March 1, 1962 (published as Preprint)

"Foundation Analysis of Offshore Pile-Supported Structures," Proceedings, Fifth International Conference, International Society of Soil Mechanics and Foundation Engineering, Paris, July 1961, Vol 2, pp. 91-97 (with Hudson Matlock)

"Generalized Solutions for Laterally Loaded Piles," Proceedings, American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, Paper 2626, Vol. 86, No. SM 5, October 1960, pp. 63-91 (with Hudson Matlock). Also, Transactions, American Society of Civil Engineers, Paper 3370, Vol. 127, 1962, Part I, pp. 1220-1248

"Numerical Analysis of Laterally Loaded Piles," Proceedings, Second Structural Division Conference on Electronic Computation, American Society of Civil Engineers, Pittsburgh, September 8 and 9, 1960, pp. 657-668

Discussion of "Model Study of a Dynamically Laterally Loaded Pile," by Roy D. Gaul, (ASCE Proceedings Paper 1535), Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, Vol. 85, No. SM 4, October 1958, pp. 1828-13 to 1828-17 (with Hudson Matlock)

Discussion of "Numerical Solutions for Beams on Elastic Foundations," by Henry Malter, (ASCE Proceedings Paper 1562), Proceedings, American Society of Civil Engineers, Paper 1787, Vol. 84, No. ST 5, September 1958, pp. 57-61

The Digital Computer in Engineering Education," Transactions of Short Course and Conference on Automation and Computers, The University of Texas, Vol. 1, June 1958, pp. 16-24

Discussion of "Soil Modulus for Laterally Loaded Piles," by Bramlette McClelland and John A. Focht, Jr., (ASCE Proceedings Paper 1081) Transactions, American Society of Civil Engineers, Vol. 123, 1958, pp. 1071-1074

THOMPSON, J. NEILS
Professor of Civil Engineering
Director, Balcones Research Center
Director, Structural Mechanics Research Laboratory
Coordinator, Surplus Property Acquisitions

Degrees

B. S. Civil Engineering, University of Texas at Austin 1935
M. S. Civil Engineering, University of Texas at Austin 1944

Teaching Experience

29 years - The University of Texas at Austin

Industrial Experience

Texas Highway Department
Consultant to over 40 engineering firms and industries since 1945

Professional Societies

Registered Professional Engineer in Texas
Texas Society of Professional Engineers (President)
National Society of Professional Engineers (President)
American Concrete Institute (Director)
American Society for Testing and Materials
American Association for the Advancement of Science
National Academy of Science
Society for Experimental Stress Analysis
American Society of Civil Engineers
American Society for Engineering Education
Precast Concrete Institute

Honors and Awards

Tau Beta Pi, Chi Epsilon, Sigma Xi
Engineer of the Year Award, 1960 Travis Chapter, Texas Society of Professional Engineers.
Recipient of American Concrete Institute's Wason Medal for Noteworthy Research in 1953 (with Phil M. Ferguson).
Received Silver Certificate from the Society for Experimental Stress Analysis, May 15, 1969.
Honorary Member Bricklayers International Union
Blue Book of Awards for 1970
Repeated listing in Who's Who in America, Who's Who in American Education, Who's Who in the South and Southwest, American Men of Science.

July 1970

THOMPSON, J. NEILS

Publications

Critical Mechanical Properties of Structural Lightweight Concrete and the Effects of These Properties on the Design of the Pavement Structure, (with William B. Ledbetter, Ervin S. Perry and James T. Houston), Center for Highway Research, The University of Texas at Austin, January 1965.

The Effects of Shape of Load Pulse on Shock-Mitigating Characteristics of a Styrofoam Plastic, (with E. A. Ripperger, Ervin S. Perry and R. I. Carr), Structural Mechanics Research Laboratory, The University of Texas at Austin, July 1965.

A Study of the Interaction of Cushioning Materials and Structural Elements, Report prepared for the U. S. Army Engineer Waterways Experiment Station, (with Ned H. Burns and Mansour Nikkhah), July 1965.

Transverse Strength of Masonry Bonded Hollow Walls, (with Franklin B. Johnson and L. A. Wheeless), Report prepared for the Structural Clay Products Research Foundation, Geneva, Ill., August 15, 1965.

"Development Length for Large High Strength Reinforcing Bars," Journal of American Concrete Institute, Proceedings of, (with Phil M. Ferguson), Vol 62, No. 1, January 1965.

"Pullout Tests on No. 7, No. 14S and No. 18S High Strength Reinforcing Bars," (with Phil M. Ferguson and John E. Breen), Journal of American Concrete Institute, Part I, Proceedings, Vol 62, No. 8, August 1965.

"A Technique for Evaluation of Tensile and Volume Change Characteristics of Structural Lightweight Concrete," (with William B. Ledbetter), Proceedings of American Society for Testing and Materials, Vol 65, 1965.

"Development Length for Large High Strength Reinforcing Bars," (with Phil M. Ferguson), Discussion in Journal of American Concrete Institute, September 1965.

"Bond Stress Distribution on Reinforcing Steel in Beams and Pullout Specimens," (with Ervin S. Perry), Journal of American Concrete Institute, August 1966, pp 865-875.

"Critical Mechanical Properties of Structural Lightweight Concrete and Their Effects on Pavement Design," (with William B. Ledbetter, Ervin S. Perry, and James T. Houston), Highway Research Record, No. 112, Highway Research Board, National Academy of Sciences, National Research Council, Publication 1334, 1966.

A Study of the Response of Backpacking Material Encasing a Tunnel Liner Subjected to a Dynamic Disturbance, (with Ervin S. Perry and Salah Nosseir), Structural Mechanics Research Laboratory, The University of Texas at Austin, December 1966, 64 pp.

"Engineering," 1967 Yearbook, Living History of the World, Stravon Educational Press, New York, N. Y., pp 270-272.

"Guide for Structural Lightweight Aggregate Concrete," Report of the American Concrete Institute, Committee 213, (with others), Journal of the American Concrete Institute, August 1967, No. 8, Proceedings, Vol 64.

THOMPSON, J. NEILS

"Behavior of Concrete Beams Reinforced with Steel Plates Subjected to Dynamic Loads," (with Ervin S. Perry and Ned H. Burns), Journal of the American Concrete Institute, No. 10, Proceedings Vol 64, October 1967, 7 pp.

Shear and Bond Strength of High-Strength Reinforced Concrete Beams Under Impact Loads--First Phase, (with Richard W. Furlong, Ned H. Burns, Ervin S. Perry), Report prepared for the Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico, May 1968.

"Engineering," Living History of the World, 1968 Yearbook, Stravon Educational Press, New York, N. Y., pp 259-262.

"Engineering," 1969 Yearbook, Living History of the World, Stravon Educational Press, New York, N. Y., pp 270-272.

"Correlation of Tests of Masonry Assemblages with Strength Characteristics of Reinforced Masonry Beams," Proceedings of the International Conference on Masonry Structural Systems, Gulf Publishing Company, Houston, Texas, 1969, pp 150-160 (with Franklin B. Johnson).

"Development of Diametral Testing Procedures to Provide a Measure of Strength Characteristics of Masonry Assemblages," Proceedings of the International Conference on Masonry Structural Systems, Gulf Publishing Company, Houston, Texas, 1969, pp 51-57, (with Franklin B. Johnson).

"Engineering," Living History of the World, 1970 Yearbook, Stravon Educational Press, New York, N. Y., 1970, pp 264-266.

In addition to these listed, Professor Thompson has published over 100 other reports, articles, and books of a technical nature.

TREYBIG, HARVEY J.
Research Engineer

Degrees

B. S. in Civil Engineering, University of Texas, 1965
M. S. in Civil Engineering, University of Texas, 1969

Industrial Experience

Associate Design Engineer, Highway Design Division of the Texas Highway Department, Austin, Texas, 1965-1969

Professional Activities and Honors

Registered Professional Engineer, Texas
Texas Society of Professional Engineers
Chi Epsilon

Recent Publications

"Determining the Relationship of Variables in Deflection of Continuously Reinforced Concrete Pavement," Highway Research Record 131, Highway Research Board, National Academy of Sciences, Washington, D. C., 1966 (with B. F. McCullough)

"A Statewide Deflection Study of Continuously Reinforced Concrete Pavement in Texas," Highway Research Record 239, Highway Research Board, National Academy of Sciences, Washington, D. C., 1968 (with B. F. McCullough)

"Observation and Analysis of Continuously Reinforced Concrete Pavement," Research Report 46-7, Texas Highway Department, Austin, Texas, 1968

"Analysis of Steel Stress and Concrete Movement on an Experimental Continuously Reinforced Concrete Pavement," Research Report 46-2, Texas Highway Department, Austin, Texas, 1968 (with B. F. McCullough).

"Performance of Continuously Reinforced Concrete Pavement in Texas," Research Report 46-8F, Texas Highway Department, Austin, Texas, 1969

Current Research

Mr. Treybig is currently involved in research on the development of a feasible approach to systematic pavement design and research. He is also involved with the application of research on computer simulation of slabs to real, practical problems

September 1969

WAGNER, GERALD R.
Assistant Professor of Mechanical Engineering

Degrees

B. S. in Agriculture, University of Nebraska, 1958

Ph.D. in Biochemistry and Statistics, Iowa State University, 1964

Teaching Experience

Iowa State University

University of Texas

Research and Industrial Experience

Head of Experimental Statistics, Chief Corporate Statistics and Manager of Operations Research at the Corporate Headquarters of Swift and Company

Vice-President and principal in Management Research International, Inc., Austin, Texas

Current Research

Dr. Wagner's research interests are in the area of applied statistics and operations research. He is particularly interested in (1) experimental design, (2) regression analysis, (3) combining decision theory with time-share computing for use by management in decision making, (4) pedagogical use of time-share computing for training in statistical data analysis, (5) adoptive forecasting models which combine Bayesian statistics with time series forecasting techniques, (6) use of OR methods in selection of experimental designs, and (7) statistical methods for process optimization.

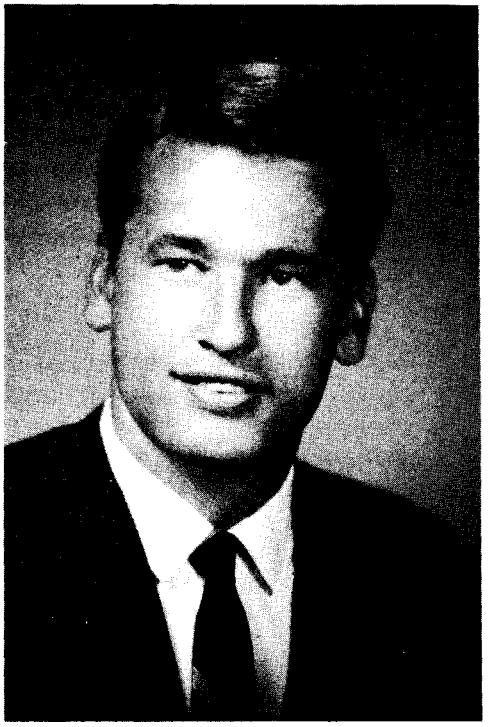
Publications

Numerous proprietary reports on a wide range of projects in statistics and operations research

Textbooks in progress on (a) Methods in Applied Statistics and (b) Statistical Techniques in Consumer Research

March 1970

WALKER, ROGER S.
Research Engineer



Degrees

B. S., Electrical Engineering, The University of Texas, 1963

M. S. E. E., Information Systems, The University of Texas at Austin, 1970

Industrial Experience

Research Engineer, The University of Texas at Austin

Systems Engineer, Radio Corporation of America, White Sands, New Mexico

Electrical Engineer, Control Data Corporation, Minneapolis, Minnesota; Applications Analyst, Houston, Texas

Honors

Sigma Xi

Field of Specialization

Systems Engineering

Publications

"Real-Time Control Program Coding Specifications," ES113526B, Real-Time Control Program Manual for the Eastern Test Range Real-Time Computer System, Control Data Corporation, Minneapolis, Minnesota, October 1964.

"Engineering Task Report for ARTRAC Display and Control," Volumes 1 and 2, RCA Systems Engineering, White Sands Missile Range, New Mexico, October 1966 (with M. P. Falls, G. G. Zeigler, and Anthony Petry).

"Simplified Methods for Determining Display Screen Characteristics," Information Display, January-February 1968.

"A Profile Measuring, Recording, and Processing System," Research Report 73-2, Center for Highway Research, The University of Texas at Austin, May 1969 (with Freddy L. Roberts and W. Ronald Hudson).

"A Road Profile Data Gathering and Analysis System," A paper prepared for presentation and publication at the 49th Annual Meeting of the Highway Research Board, January 1970 (with W. Ronald Hudson).

"A Model for Traffic Simulation and Control," Information Systems Research Laboratory, Electronic Research Center, The University of Texas at Austin, January 1970 (with B. F. Womack).

"Traffic Network Simulation and Control with Driver Response Criteria," to appear in the Proceedings of the Houston Conference on Circuits, Systems, and Computers, April 1970 (with B. F. Womack and C. E. Lee).

WALKER, ROGER S.

Publications (Continued)

"Analog-to-Digital System," Research Report 73-4, Center for Highway Research, The University of Texas at Austin, April 1970 (with W. Ronald Hudson).

"A Model for Traffic Simulation and a Simulation Language for the General Transportation Problem," to be presented at and published in the proceedings of the 1970 Fall Joint Computer Conference at Houston, Texas (with B. F. Womack and C. E. Lee).

WRIGHT, STEPHEN G.
Assistant Professor of Civil Engineering

Degrees

B. S. in Civil Engineering, The University of California, 1966
M. S. in Civil Engineering, The University of California, 1967
Doctor of Philosophy, Civil Engineering, The University of California, 1969

Teaching Experience

Assistant Professor of Civil Engineering, The University of Texas at Austin, 1969 - present.

Professional Societies

American Society of Civil Engineers

Recent Publications

Wright, S. G., and J. M. Duncan, "Anisotropy of Clay Shales," 7th International Conference on Soil Mechanics and Foundation Engineering, Specialty Session, August 1969

Field of Specialization

Soil Mechanics and Foundation Engineering

October 1969