ORGANIZED RESEARCH UNIT SELF STUDY

CENTER FOR HIGHWAY RESEARCH

Dr. Clyde E. Lee, Director

Report Prepared for

Dr. H. Eldon Sutton

Vice-President for Research

The University of Texas at Austin

June 1976

I. OBJECTIVES AND GOAL SETTING

The basic purpose of the Center for Highway Research is to improve all aspects of highway transportation in Texas and across the nation through a coordinated program of research and education. The unique resources of faculty, students, staff, and facilities that are available at The University of Texas at Austin can best be brought to bear on solving the technical, economic, environmental, and societal problems of transportation if concentrated through one focal point. The mission of the Center is to serve this coordinating role.

Specific functions of the Center in accomplishing its mission include:

- Identifying research needs, both immediate and long-range.
- Maintaining communication with professionals in the transportation community at all levels.
- Evaluating the relative importance of identified research needs.
- Analyzing the relevant research potential at the University.
- Stimulating interest in university-conducted research - both at the University and among sponsors.
- Bringing together qualified, interested parties in a research agreement.
- Managing, coordinating, and controlling a multi-project program of research through an effective administrative organization.
- Employing student research assistants on a part-time basis to conduct research under faculty supervision.
- Encouraging faculty participation in current, high-quality, practical research.
- Providing a cadre of skilled technical and clerical support personnel to serve several, or all, projects in the program with optimum efficiency.
- Maintaining an inventory of specialized instruments and equipment needed for transportation research.
- Reporting research results in technical reports and professional journals.
- Assisting sponsors in implementing research results on a continuing basis.
- Sponsoring workshops and training sessions.

- Serving as an information and reference resource.
- Providing an easily identified entity at the University with which potential sponsors of transportation research, as well as prospective students, can relate.

Research conducted through the Center for Highway Research continues to make new techniques and technology available to the sponsor while also developing a highly-skilled and interested manpower force for possible future employment in the profession. Similarly, faculty and students involved in research at the University benefit from participation in developing new knowledge that can be used to solve practical transportation problems. The Center is dedicated to the concept that only research which involves faculty and students and relates directly to academic and professional interests should be undertaken. A goal of the Center is to maintain this posture and strive for a proper balance between academic pursuits and research activities.

II. ACTIVITY SUMMARY

A. History

The Center for Highway Research was established as an administrative unit in the College of Engineering to "represent the University of Texas in matters related to highway research." The primary impetus for the Center stemmed from the need for a single point of contact in the University through which highway research with the Texas Highway Department and the U.S. Bureau of Public Roads could be coordinated. The scope of research activities was not limited to these agencies, however.

President Norman Hackerman approved the statement of purpose and the organizational structure of the Center in 1963 and appointed Dr. Clyde E. Lee as Director. In the first year, a Cooperative Research Agreement was signed with the Texas Highway Department, and five projects were initiated under individual Interagency Contracts approved by the State Board of Control. Successful performance led to an expansion of the program in the following year, and the need for a continuing research relationship between these agencies became evident.

In 1965, legislation was introduced on behalf of the University, and Senate Bill 186, which was signed by the Governor on April 13, 1965, sanctioned the use of funds authorized to the Texas Highway Department to reimburse the University for research conducted under the Cooperative Research Agreement. Similar sanction was granted for Texas A&M University in 1948, but no other university has been so recognized by the State of Texas. The program has been in continual operation since 1963, and over seven million dollars have been invested in the University through the Center for Highway Research. Every project has been supervised by a faculty member, and the major part of all research has been performed by students. Even though most faculty and students are in civil engineering, many other colleges and departments have been represented in the cooperative research program. Contracts with other agencies such as the Highway Research Board and the Federal Highway Administration have also been administered through the Center upon approval by the Office of Sponsored Projects.

Close personal cooperation between University faculty, students, and administrators and their counterparts in the State Department of Highways and

Public Transportation as well as with cognizant personnel representing the Federal Highway Administration has made the Center's successful research program possible. Frequent on-site visits and strong mutual respect for the interests of the State have made the program functional extremely smoothly. The implementation of research findings which have resulted under this relationship is the envy of most other states. Continuity of the program year-after-year has immeasurably enhanced the ability to attract quality students and faculty to participate in highway research - a very important consideration.

Since 1966, the University has supported the Center with an operating budget. These funds provide the essential resources that make continuing research programs possible. In addition to sharing some of the administrative costs of the research program, the budget allows a small amount of out-of-state travel. This is particularly important since the Cooperative Research Agreement restricts travel to that performed in the State of Texas, and development of research proposals frequently involves out-of-state travel. Budgetary support by the University has been not only desirable, but essential.

B. Significant Accomplishments

During the past twelve years, the results of research conducted by the Center dealing with all phases of highway planning, design, construction, operation and maintenance have been implemented in Texas and in other states and nations as well. Some noteworthy projects are:

Design Criteria for Drilled Shaft Foundations

Extensive use is made of this type of foundation for many structures including highway bridges and other drainage control works. Mathematical, laboratory, and field studies of the interaction of drilled shafts with the surrounding soil have made possible the development of improved design criteria which result in significant money and material savings each year. The State of Texas has already recovered the cost of research several times over by implementing research findings, and other states are doing likewise. This research has been widely reported in the literature and at technical meetings.

Weighing Highway Vehicles in Motion

A system for weighing and dimensioning trucks as they move at normal road speeds has been developed at the Center and is now in operational use in six states and two foreign countries. Economic evaluations show that truck weight, axle spacing, and speed survey information can be obtained at about half the cost of conventional static weighing techniques. Additionally, the time and expense of stopping trucks is eliminated, and traffic safety is greatly enhanced by this new system. Other applications of the original research in law enforcement and in inventory control appear feasible and are awaiting further investigation.

Segmental Prestressed Concrete Bridge Construction

A research study conducted under the Cooperative Research Program led to the design and construction of the first prestressed concrete bridge of precast segmental construction erected in the United States. An accurate scale model that was built and tested at the University before the three-span highway structure was begun at Corpus Christi, Texas, in 1972 permitted engineers and contractors to study the new technique in advance and thereby achieve efficiency and economy in the actual structure. This bridge is now serving traffic, and more structures of this type are being considered as a result of the successful implementation of research.

Polymer-Impregnated Concrete in Highways

Practical techniques for introducing monomers into existing concrete highway structures and then inducing polymerization have been developed at the Center. The polymer-impregnated concrete is stronger, and the treatment makes the concrete virtually watertight. Deterioration of reinforcing steel in bridge decks due to the corrosive action of de-icing salts and water penetration is retarded or eliminated. Polymer-impregnation is also saving time and money in repair and maintenance operations on pavements and bridges.

Management of Pavement Systems

A strategy for optimal management of highway pavements to include design, construction, maintenance, and rehabilitation has been formulated through a cooperative research project involving the State Department of Highways and Public Transportation, Texas A&M University, and the Center. A battery of computer programs aids the decision maker in selecting the best alternative

solution to providing pavement structures which will service present and anticipated traffic economically, efficiently, and safely for any chosen period of time. Research on traffic materials, economics, environment, and optimization has been combined in this study. A number of agencies in America and around the world are now using this management technique.

Numerous other research studies conducted at the Center have yielded results that are already saving lives and dollars in Texas. As the role of the Texas Highway Department has changed to include public transportation and traffic safety, as indicated by its new name, State Department of Highways and Public Transportation, so has the nature of the Center's Cooperative Research Program. Research presently included in the program involves planning and evaluating public transit alternatives for small cities and providing personal transportation for certain individuals. The Center will continue to solve highway-related transportation problems in cities and rural areas of Texas through research and education. Attention will probably shift to emphasize maintenance up-grading, and rehabilitation of existing facilities rather than new construction in the coming years.

C. Current Activities

The Center's $588,500 research program for 1975-76 includes 18 studies and involves 18 faculty, 55 students, and 26 staff personnel. These studies fall into five major areas of highway research as follows:

- Area I - Geometric and Environmental Design, Safety, Traffic, Right-Of-Way, and Economics (4 studies)
- Area II - Materials, Construction and Maintenance (1 study)
- Area III - Pavement Design (5 studies)
- Area IV - Structural Design (7 studies)
- Area V - Administration and Management (1 study)

Titles of research studies, principal investigators, and funding levels are shown in the tabulation below. Each study is directed at solving a defined practical problem and will ultimately help provide better transportation for people and goods in Texas and across the nation.

CONTRACTS - COOPERATIVE HIGHWAY RESEARCH PROGRAM

Fiscal Year September 1, 1975, through August 31, 1976

Study No.	Title	Study Supervisors	Budget
3-8-76-16	DETERMINATION OF QUANTITIES OF CERTAIN FUELS, OILS, AND TARS IN STORM RUNOFF WATERS FROM HIGHWAYS	J. F. Malina, Jr.	$ 12,000
3-5-74-23	TEMPERATURE INDUCED STRESSES IN HIGHWAY BRIDGES BY FINITE ELEMENT ANALYSIS AND FIELD TESTS	C. P. Johnson H. Matlock	$ 19,400
3-5-74-29	STRENGTH AND BEHAVIOR OF ANCHOR BOLTS	J. O. Jirsa J. E. Breen	$ 16,600
3-10-67-109	REPRODUCTION OF FINAL REPORTS	C. E. Lee	$ 8,000
3-9-71-114	CONCRETE-POLYMER MATERIALS FOR HIGHWAY APPLICATIONS	D. W. Fowler D. R. Paul	$ 50,000
3-8-68-118	STUDY OF EXPANSIVE CLAYS IN ROADWAY STRUCTURAL SYSTEMS	H. Matlock	$ 2,000
3-5-75-172	MECHANICAL AND FATIGUE BEHAVIOR OF HIGH STRENGTH ANCHOR BOLTS	K. H. Frank	$ 30,000
3-5-72-176	THE BEHAVIOR OF DRILLED SHAFTS	L. C. Reese	$ 35,000
3-8-75-177	DEVELOPMENT AND IMPLEMENTATION OF THE DESIGN, CONSTRUCTION AND REHABILITATION OF RIGID PAVEMENTS	B. F. McCullough W. R. Hudson	$ 147,900
3-9-72-183	TENSILE CHARACTERIZATION OF HIGHWAY PAVEMENT MATERIALS	T. W. Kennedy	$ 84,200
3-18-72-184	SIMULATION OF TRAFFIC BY A STEP-THROUGH TECHNIQUE (APPLICATIONS)	C. E. Lee	$ 50,000
3-5-75-188	FAILURE CRITERIA FOR PRECAST ELEMENTS OF COMPOSITE INVERTED T-BEAMS	R. W. Furlong	$ 30,000

(continued)

(Fiscal Year 1975-76, continued)

Study No.	Title	Study Supervisors	Budget
3-5-76-196	OPTIMUM REINFORCEMENT FOR NOTCHED ENDS OF PRE-STRESSED CONCRETE GIRDERS	R. W. Furlong	$ 30,000
3-5-76-198	CRACK CONTROL ON THE SIDE FACES OF DEEP CONCRETE BEAMS	J. E. Breen J. O. Jirsa	$ 40,000
3-8-76-212	DESIGN CRITERIA FOR MEDIAN TURN LANES	C. M. Walton	$ 25,000
3-8-76-213	ROUGHNESS AT THE PAVEMENT-BRIDGE INTERFACE	C. E. Lee W. R. Hudson	$ 45,000

The Center for Highway Research is one of two research units in Texas that have been authorized by the state legislature and the governor to conduct a cooperative transportation research program with the State Department of Highways and Public Transportation. The Texas Transportation Institute at Texas A&M University is the other comparable unit. Each of these universities has special resources to contribute to the overall transportation research program of the State, and excellent coordination among the three state agencies involved has made it possible to realize maximum benefits from research without excessive competition.

Primary strengths of the Center lie in the availability of uniquely qualified personnel among faculty, students, and staff and in access to many specialized facilities at the University. Since much of the transportation research involves technology, engineering is heavily utilized, but the other disciplines are viewed as an equally important resource. Proximity to the State Department of Highways and Public Transportation significantly enhances the capability for cooperative research, also.

E. Organization

Each research study conducted through the Center is supervised by a faculty member; supported by technical, editorial, and clerical staff; and performed primarily by students (see Figs 1 and 2).

During 1974-75, fifty-seven graduate students received direct financial support, in the form of monthly payroll checks, through the Cooperative Highway Research Program with the State Department of Highways and Public Transportation and the Federal Highway Administration. During this period 3 Ph.D. degrees and 18 M.S. degrees were awarded to students who made use of the resources of the Center.

GRADUATE STUDENTS WHO MADE USE OF RESOURCES

Name of Student	Amount of Support	Supervising Professor
Marisol Abad-Castillo	$ 1,316	J. O. Jirsa
Adedare S. Adedimila	4,583	T. W. Kennedy
Ravi P. Aurora	5,365	L. C. Reese
Harish Bhatia	581	
Jesse D. Bogard	2,065	H. Matlock
Terrance L. Bowman	3,873	L. C. Reese
Ronald R. Bush	2,551	W. R. Hudson
Mark A. Campbell	372	R. W. Furlong
Robert F. Carmichael	1,360	B. F. McCullough
Edward R. Cervenka	975	D. W. Fowler
Anuchit Chareonsupkul	4,601	R. W. Furlong
Chy-Pin Chiang	3,236	B. F. McCullough
Tommy R. Chmores	3,375	B. F. McCullough
Robert L. Cooper	762	J. E. Breen
Charlie R. Copeland	2,157	C. E. Lee
John A. Crumley	2,442	T. W. Kennedy
Jatin A. Desai	1,700	R. W. Furlong
James S. Farr	112	L. C. Reese
Ivar H. C. Fett	831	C. E. Lee
James S. Ford	1,594	J. E. Breen
Gregory C. Frantz	2,830	J. E. Breen
Guillermo Gonzalez-Angarita	2,778	T. W. Kennedy

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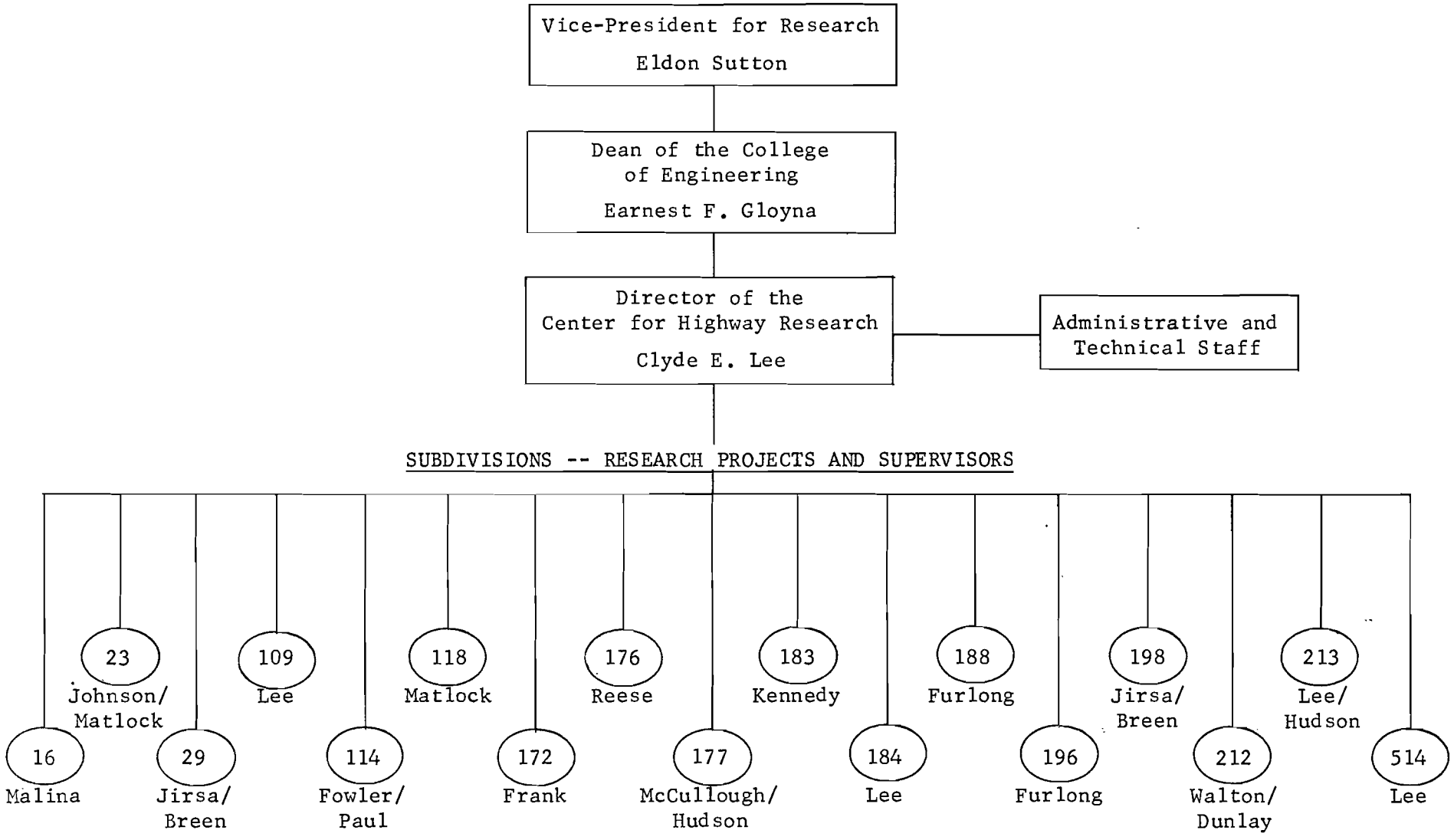

Fig 1. Administrative organization with subdivisions.

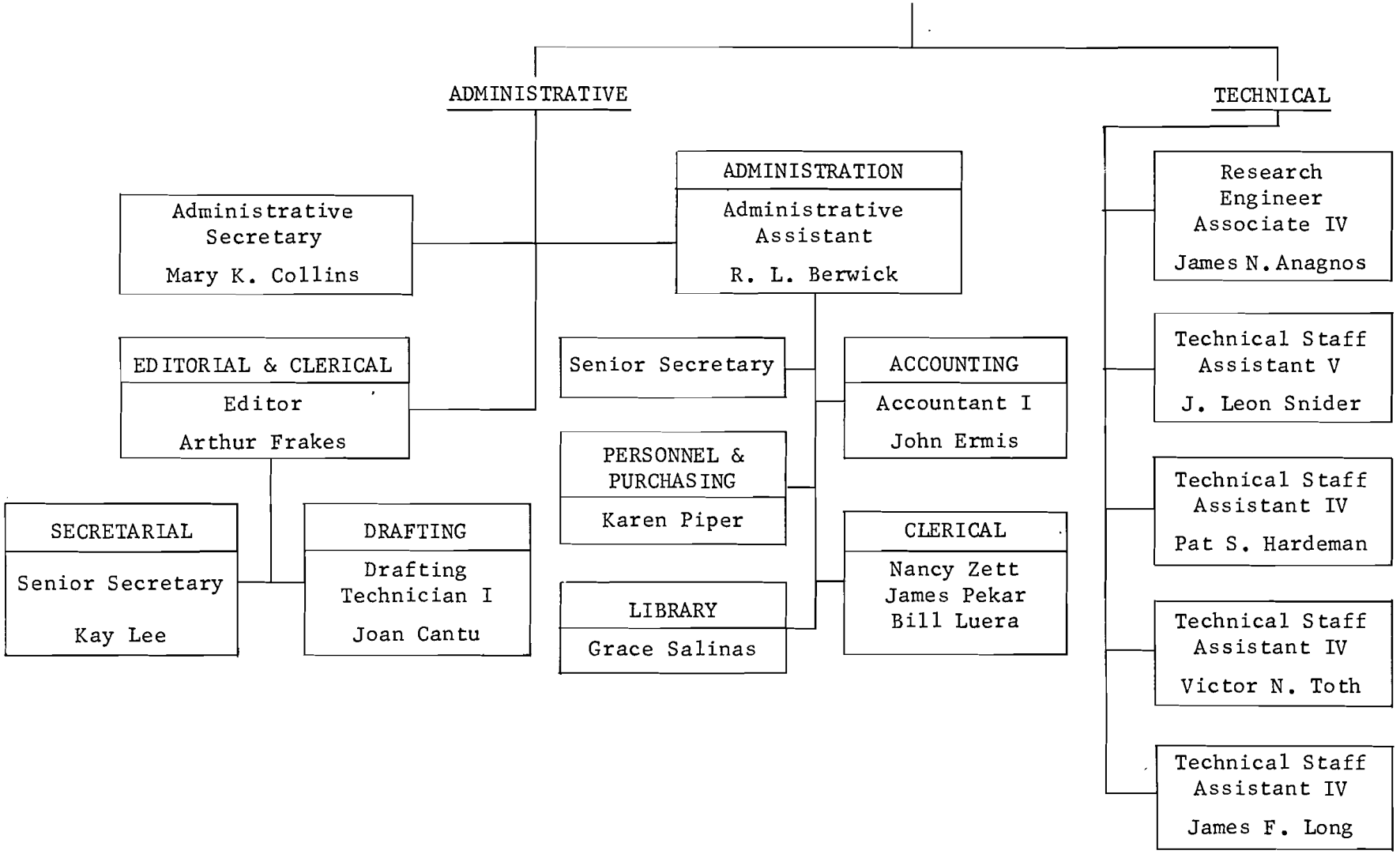

Fig 2. Administrative and technical staff.

(Graduate Students Who Made Use of Resources, continued)

Name of Student	Amount of Support	Supervising Professor
Glenn E. Grayson	$ 4,993	C. E. Lee
Don J. Green	1,470	R. W. Furlong
Thomas W. Hainze	4,388	
Gerard B. Hasselwander	4,388	J. O. Jirsa
William D. Henderson	812	R. W. Furlong
Yi-Chin Hu	4,249	W. R. Hudson
Enrique Jimenez	4,388	W. R. Hudson
Andrew M. Knysh	2,275	D. W. Fowler
David B. Law	2,605	W. R. Hudson
Ekasit Limsuwan	3,131	D. W. Fowler
Randy B. Machemehl	5,166	C. M. Walton
Viroj Mavichak	3,405	R. W. Furlong
Donald E. Meinheit	1,364	J. O. Jirsa
Arthur J. Meyer	1,156	
Domingo Navarro	890	T. W. Kennedy
David B. Peters	1,104	T. W. Kennedy
Prajya Phinyawat	4,537	D. W. Fowler
Robert L. Pinc	658	J. O. Jirsa
Byron W. Porter	1,521	T. W. Kennedy
Gerardo W. Quiros-Guillen	4,107	L. C. Reese
Thomas W. Rioux	8,618	C. E. Lee
Manuel Rodriguez	2,590	T. W. Kennedy
Daniel J. Ryan	1,622	C. E. Lee
Vivek S. Savur	6,159	C. E. Lee
John B. Stevens	1,472	H. Matlock
Pieter J. Strauss	5,868	B. F. McCullough
Thaksin Thepchatri	4,246	C. P. Johnson
Mark A. Thompson	762	J. O. Jirsa
Felipe A. Vallejo	4,004	B. F. McCullough
Joaquin Vallejo	3,643	T. W. Kennedy
Syed A. Wahidi	3,548	R. W. Furlong
Ronald P. Webster	488	D. W. Fowler
Kenneth M. Will	5,943	C. P. Johnson
Atalay Yargicoglu	3,065	H. Matlock
Piti Yimprasert	5,599	D. W. Fowler
	$163,753	

NUMBER OF CLASSIFIED POSITIONS BY TYPE

Research Engineer Associate V	3.0
Research Engineer Associate IV	1.0
Research Engineer Associate III	2.50
Research Engineer Associate I	1.0
Technical Staff Assistant V	1.1250
Technical Staff Assistant IV	5.20
Technical Staff Assistant III	2.0
Technical Staff Assistant II	1.50
Computer Programmer Assistant I	0.50
Research Engineer Assistant III	1.450
Research Engineer Assistant II	5.1250
Research Engineer Assistant I	9.50
Laboratory Research Assistant II	1.450
Drafting Technician I	1.0
Editor IV	1.0
Artist I	0.50
Administrative Assistant II	1.0
Administrative Assistant I	0.750
Administrative Secretary	3.50
Senior Secretary	5.8750
Secretary	3.0
Senior Clerk-Typist	1.0
Clerk-Typist	0.50
Clerk	1.0
Accountant I	1.0

TABLE I

	Name	Working Time in Unit	Percent of Working Time in Unit by Activity*				
			Research	Administration	Helping Others Do Research**	Public Service	Other
Faculty	Dr. John E. Breen Dr. William J. Dunlay, Jr. Dr. David W. Fowler Dr. Karl H. Frank Dr. Richard W. Furlong Dr. W. Ronald Hudson Dr. James O. Jirsa Dr. C. Philip Johnson Dr. Thomas W. Kennedy Dr. Clyde E. Lee Dr. Joseph F. Malina, Jr. Professor Hudson Matlock Dr. B. Frank McCullough Dr. Donald R. Paul Dr. Lymon C. Reese Dr. C. Michael Walton		One or more faculty members are principal investigators on each research study and supervise students and technical staff without direct compensation except for occasional brief appointments in the summer. Since much of the research involves thesis and dissertation work, faculty contributions are significant and generally account for about 1/4 to 1/3 time for most faculty members who are involved.			
Professional			The cooperative research program maximizes student and faculty participation supported by a cadre of technicians and other staff as needed. There are no full-time professional research supervisors. Technical, administrative, and editorial staff are shown in the annual report.				

*The total allocation of working time in various activities should be 100%.

**This column relates to time required to consult with or help others plan and conduct research employing specialized facilities or programs.

The Center works most closely with the Department of Civil Engineering; however, a number of other Colleges and Departments have been involved over the years. Notices of opportunities to participate in research through the Center are sent to all faculty members who have expressed interest in transportation research or who are known to have expertise related to a particular study. All research proposals and faculty appointments are approved in advance by the Chairman of the department in which the project supervisor or other faculty participant is under contract.

F. Outside Support

The major source of outside support to the Center has been through cost reimbursement contracts with the State Department of Highways and Public Transportation. The State, in turn, has been partially reimbursed by the Federal government through its Federal Highway Administration. Cooperation of the University in sharing these costs has been an essential feature in maintaining this support through the years.

The following tabulations show the source of funding, the subject, and the amount allocated to each research study for each year from 1972 through 1976. The proposed cooperative research program for 1976-77 is also shown; this reflects a twenty percent reduction as directed by the SDHPT, but approval is virtually certain at this time.

CONTRACTS - COOPERATIVE HIGHWAY RESEARCH PROGRAM

Fiscal Years 1972 - 1975

SDHPT Study No.	Title	Study Supervisors	1972-73	1973-74	1974-75
3-5-73-7	DESIGN PARAMETERS FOR COLUMNS IN BRIDGE BENTS	R. W. Furlong	$28,800	$36,850	$11,400
3-8-73-20	SPEED OF VEHICLES ON GRADES	C. M. Walton	$32,555	$32,200	
3-8-74-21	PRAGMATIC APPLICATIONS OF RIGID PAVEMENT RESEARCH	B. F. McCullough		$17,000	
3-5-74-23	TEMPERATURE INDUCED STRESSES IN HIGHWAY BRIDGES BY FINITE ELEMENT ANALYSIS AND FIELD TESTS	C. P. Johnson H. Matlock		$26,500	$30,300
3-5-74-29	STRENGTH AND BEHAVIOR OF ANCHOR BOLTS	J. O. Jirsa J. E. Breen		$32,000	$52,250
3-8-67-109	REPRODUCTION OF FINAL REPORTS	C. E. Lee	$13,490	$ 5,100	$10,000
3-9-71-114	POLYMER-IMPREGNATED CONCRETE FOR HIGHWAY APPLICATIONS	D. W. Fowler D. R. Paul	$48,000	$41,600	$41,000
3-8-68-118	STUDY OF EXPANSIVE CLAYS IN ROADWAY STRUCTURAL SYSTEMS	H. Matlock	$49,105	$41,850	$34,900
3-5-69-121	DESIGN PROCEDURES FOR LONG SPAN PRESTRESSED CONCRETE BRIDGES OF SEGMENTAL CONSTRUCTION	J. E. Breen N. H. Burns	$38,400	$34,800	
1-8-69-123	A SYSTEM ANALYSIS OF PAVEMENT DESIGN AND RESEARCH IMPLEMENTATION	W. R. Hudson B. F. McCullough	$77,500	$77,500	$73,150
3-5-71-153	STRENGTH AND SERVICEABILITY OF INVERTED T-BEAM BENT CAPS SUBJECT TO COMBINED FLEXURE, SHEAR, AND TORSION	R. W. Furlong	$10,000		
3-5-72-154	FACTORS AFFECTING SPLICE DEVELOPMENT LENGTH	J. E. Breen J. O. Jirsa	$41,000	$21,500	
3-5-71-155	STATIC AND BUCKLING ANALYSIS OF HIGHWAY BRIDGES BY FINITE-ELEMENT PROCEDURES	C. P. Johnson	$27,600		
3-8-71-156	SURFACE DYNAMICS ROAD PROFILOMETER APPLICATIONS	W. R. Hudson	$46,700	$44,700	$50,150

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Fiscal Years 1972 - 1975 (continued)

SDHPT Study No.	Title	Supervisors	1972-73	1973-74	1974-75
3-5-71-158	DIAPHRAGM REQUIREMENTS FOR PRESTRESSED CONCRETE BRIDGES	J. E. Breen	$13,200		
3-8-71-160	DYNAMIC TRAFFIC LOADING OF PAVEMENTS	C. E. Lee	$ 3,000		
3-8-71-161	STABILITY OF EARTH SLOPES	S. G. Wright	$22,160		
3-5-75-172	MECHANICAL AND FATIGUE BEHAVIOR OF HIGH STRENGTH ANCHOR BOLTS	K. H. Frank			$26,100
3-5-72-176	THE BEHAVIOR OF DRILLED SHAFTS	L. C. Reese	$41,400	$44,000	$43,300
3-8-75-177	DEVELOPMENT AND IMPLEMENTATION OF THE DESIGN, CONSTRUCTION AND REHABILITATION OF RIGID PAVEMENTS	B. F. McCullough W. R. Hudson			$53,400
3-10-74-181	APPLICATION OF IN-MOTION WEIGHING IN PLANNING AND DESIGN	C. E. Lee C. M. Walton		$25,000	$34,550
3-9-72-183	TENSILE CHARACTERIZATION OF HIGHWAY PAVEMENT MATERIALS	T. W. Kennedy	$62,200	$63,850	$68,550
3-18-72-184	SIMULATION OF TRAFFIC BY A STEP-THROUGH TECHNIQUE	C. E. Lee	$52,100	$46,600	$52,000
3-5-75-188	FAILURE CRITERIA FOR PRECAST ELEMENTS OF COMPOSITE INVERTED T-BEAMS	R. W. Furlong			$36,800
NCHRP Study No.					
1-15	DESIGN OF CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS FOR HIGHWAYS	B. F. McCullough W. R. Hudson	$72,000	$78,000	$ 1,885
		TOTAL	$679,210	$669,050	$619,735

Fiscal Year September 1, 1975, through August 31, 1976

Study No.	Title	Study Supervisors	Budget
3-8-76-16	DETERMINATION OF QUANTITIES OF CERTAIN FUELS, OILS, AND TARS IN STORM RUNOFF WATERS FROM HIGHWAYS	J. F. Malina, Jr.	$ 12,000
3-5-74-23	TEMPERATURE INDUCED STRESSES IN HIGHWAY BRIDGES BY FINITE ELEMENT ANALYSIS AND FIELD TESTS	C. P. Johnson H. Matlock	$ 19,400
3-5-74-29	STRENGTH AND BEHAVIOR OF ANCHOR BOLTS	J. O. Jirsa J. E. Breen	$ 16,600
3-10-67-109	REPRODUCTION OF FINAL REPORTS	C. E. Lee	$ 8,000
3-9-71-114	CONCRETE-POLYMER MATERIALS FOR HIGHWAY APPLICATIONS	D. W. Fowler D. R. Paul	$ 50,000
3-8-68-118	STUDY OF EXPANSIVE CLAYS IN ROADWAY STRUCTURAL SYSTEMS	H. Matlock	$ 2,000
3-5-75-172	MECHANICAL AND FATIGUE BEHAVIOR OF HIGH STRENGTH ANCHOR BOLTS	K. H. Frank	$ 30,000
3-5-72-176	THE BEHAVIOR OF DRILLED SHAFTS	L. C. Reese	$ 35,000
3-8-75-177	DEVELOPMENT AND IMPLEMENTATION OF THE DESIGN, CONSTRUCTION AND REHABILITATION OF RIGID PAVEMENTS	B. F. McCullough W. R. Hudson	$ 147,900
3-9-72-183	TENSILE CHARACTERIZATION OF HIGHWAY PAVEMENT MATERIALS	T. W. Kennedy	$ 84,200
3-18-72-184	SIMULATION OF TRAFFIC BY A STEP-THROUGH TECHNIQUE (APPLICATIONS)	C. E. Lee	$ 50,000
3-5-75-188	FAILURE CRITERIA FOR PRECAST ELEMENTS OF COMPOSITE INVERTED T-BEAMS	R. W. Furlong	$ 30,000

(continued)

Fiscal Year 1975-76 (continued)

Study No.	Title	Study Supervisors	Budget
3-5-76-196	OPTIMUM REINFORCEMENT FOR NOTCHED ENDS OF PRE-STRESSED CONCRETE GIRDERS	R. W. Furlong	$ 30,000
3-5-76-198	CRACK CONTROL ON THE SIDE FACES OF DEEP CONCRETE BEAMS	J. E. Breen J. O. Jirsa	$ 40,000
3-8-76-212	DESIGN CRITERIA FOR MEDIAN TURN LANES	C. M. Walton	$ 25,000
3-8-76-213	ROUGHNESS AT THE PAVEMENT-BRIDGE INTERFACE	C. E. Lee W. R. Hudson	$ 45,000
		TOTAL	$ 625,100

Fiscal Year September 1, 1976, through August 31, 1977

RENEWALS

Study No.	Title	Study Supervisors	Budget
3-10-67-109	REPRODUCTION OF FINAL REPORTS AND EQUIPMENT MANAGEMENT	C. E. Lee	$ 10,000
3-9-71-114	CONCRETE-POLYMER MATERIALS FOR HIGHWAY APPLICATIONS	D. W. Fowler D. R. Paul	$ 55,000
3-5-75-172	MECHANICAL AND FATIGUE BEHAVIOR OF HIGH STRENGTH ANCHOR BOLTS	K. H. Frank	$ 30,000
3-5-72-176	THE BEHAVIOR OF DRILLED SHAFTS	L. C. Reese	$ 10,000
3-8-75-177	DEVELOPMENT AND IMPLEMENTATION OF THE DESIGN, CONSTRUCTION AND REHABILITATION OF RIGID PAVEMENTS	B. F. McCullough W. R. Hudson	$ 122,000
3-9-72-183	TENSILE CHARACTERIZATION OF HIGHWAY PAVEMENT MATERIALS	T. W. Kennedy	$ 77,000
3-18-72-184	SIMULATION OF TRAFFIC BY A STEP-THROUGH TECHNIQUE (APPLICATIONS)	C. E. Lee	$ 20,000
3-5-76-198	CRACK CONTROL ON THE SIDE FACES OF DEEP CONCRETE BEAMS	J. E. Breen J. O. Jirsa	$ 35,000
3-8-76-212	DESIGN CRITERIA FOR MEDIAN TURN LANES	C. M. Walton	$ 26,000
3-8-76-213	ROUGHNESS AT THE PAVEMENT-BRIDGE INTERFACE	C. E. Lee	$ 10,000

(continued)

Fiscal Year September 1, 1976, through August 31, 1977 (continued)

PROPOSALS

Study No.	Title	Study Supervisors	Budget
3-5-77-201	STRUCTURAL EVALUATION OF EXISTING BRIDGES FOR LOAD RATING AND CARRYING CAPACITY	C. P. Johnson H. Matlock	$ 20,000
3-5-77-208	DESIGN CRITERIA FOR POST-TENSIONED ANCHORAGE ZONE BURSTING STRESSES	J. E. Breen	$ 35,000
3-5-77-209	FATIGUE LOADING IN SIGN BRIDGES	K. H. Frank	$ 20,000
		TOTAL PROGRAM	$ 470,000

III. IMPLEMENTATION PLANNING

A. Activities Planned for the Immediate Future

The need for highway-related research will continue to increase in the coming decade as economy, safety, and efficiency of transport in America becomes even more important than it has been in the past. Emphasis is shifting from design and construction of new streets and highways to maintenance and operation of existing facilities. Greater pressure for moving people and goods by highway is resulting from faltering railway service in many areas of the country, and materials and energy limitations are becoming evident. The role of the Center for Highway Research will continue to be one of leadership in coordinating all available resources of the University and applying them to productive research aimed at solving current and future highway transportation problems in Texas.

Maintenance and strengthening of the excellent relationship with the State Department of Highways and Public Transportation (SDHPT) through cooperative research will, of course, be the primary activity for the foreseeable future. The scope of the SDHPT has recently been enlarged to include not only highways, but public transport and traffic safety. The Center is now administering research studies in public transportation under its well established cooperative research program and expects to serve the other aspects of highway-related transport research in Texas as needs vary in the future.

From a strong base of twelve years of quality research experience related mostly to highways in Texas, the Center will selectively expand its activities in the coming years to include research studies that are local, regional, multi-state, and national in scope. This will involve additional federal contracts and perhaps contracts with other states in the region as well as with local governmental units in Texas. The same basic philosophy of maintaining a balance in academic pursuits with research commitments that has been practiced previously will continue as these additional activities are undertaken.

Research emphasis in coming years must continue to be placed on the fundamental aspects of engineering which involve the efficient use of manpower, materials, and energy to serve the transportation needs of Texas and of the nation. Prime types of research for the immediate future as far as

highway transport is concerned include techniques for rehabilitating existing roadway structures and optimizing operation of present street and highway facilities. Research on transportation planning; environmental, sociological, and economic impact of highway transportation; energy conservation; policy formulation; management; finance; and safety is urgently needed, also. The resources of the University will be brought to bear on these areas through the Center for Highway Research.

In order to support these activities adequately, additional staff are urgently needed. An associate director who can devote full time to planning, coordinating, and administering the details of research proposal preparation, reporting, and scheduling is of highest priority. A qualified research librarian to develop and maintain information resources on a current demand basis is next in importance, and one additional senior secretary position will give continuity to the report production requirements in the Center.

Current space allocations to the Center are adequate except for reference materials. An additional 800 square feet of space for this purpose can be used to great advantage.

Costs for services such as telephones and for supplies have increased significantly in recent months. An increase in the maintenance and operation budget is badly needed to cover these increases. Certain items of specialized laboratory equipment not available from other sources will significantly enhance the potential research capabilities of the Center; these should be budgeted and made part of the permanent inventory of equipment available to the Center and to other University users. Such items as traffic survey equipment and video recorders can be shared for instructional purposes and used for research, also.

B. Future Planning

Personal ground transportation is essential to life in Texas. People and goods will be moved on the streets and highways of this state in ever increasing numbers, and continuing research to improve the quality and efficiency of this movement is mandatory. The Center for Highway Research can best represent the interests of the University in highway-related research by maintaining a close cooperative relationship with the state agency that is responsible for planning, designing, constructing, operating, and maintaining ground transport facilities in Texas - the State Department of Highways and

Public Transportation. Adaptation to change, and impetus for change will be initiated in the Center as needed to maintain a current, vital posture in this cooperative role. No reduction in the need for research is envisioned; rather, an ever increasing need is more likely. Continuing support of the cooperative research program and at an increased level in coming years is anticipated.

As mentioned previously, highway-related research with local governments, regional agencies, and the federal government will be pursued with increased effort in coming years. The varied resources of the University offer excellent opportunities for this type of research.

C. Budget Options

In anticipation of an increase in state funding during the coming biennium the following options are offered.

10 percent increase - partially cover the normal inflationary costs of personnel and services.

50 percent increase - restore personnel cut from the budget in 1975, increase out-of-state travel slightly, and add a clerical position.

100 percent increase - add qualified assistant director; restore clerical personnel; increase maintenance and operation, travel, and equipment items.

In adjusting to a budget reduction in the next biennium, the following possibilities exist:

10 percent cut - reduce clerical or administrative personnel time, reduce maintenance and operating expense items. With inflation, this amounts to a significantly larger reduction in productive potential.

25 percent cut - reduce research management personnel appointments and cut travel; reduce administrative personnel and services; cut clerical support.

APPENDIX

Publications Issued Since the List Prepared for the January 19 Report

156-5F - "A Study of the Relationships Between Various Classes of Road-Surface Roughness and Human Ratings of Riding Quality," by Hugh J. Williamson, W. Ronald Hudson, and C. Dale Zinn, August 1975.

181-1F - "Truck Weight Surveys by In-Motion Weighing," by Randy B. Machemehl, Clyde E. Lee, and C. Michael Walton, September 1975.

514-1F - "Effects of Temperature Change on Plastic Crash Cushions," by Victor N. Toth and Clyde E. Lee, January 1976.