Traffic Engineering Activities at Purdue University

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Highway transportation has become one of the largest and most critical domestic problems of the present age. The need, the demand, and the desire to supply adequate highway facilities indicate that an enormous effort will be expended in the next decade to provide facilities that will satisfy the requirements of highway transportation. The planning and operation of this vast system of highways, to say nothing of the construction, will be a tremendous job. Increased funds and an increasing number of well trained and competent engineers will be required to provide these needed facilities. Current proposals indicate that some rational method of finance will be developed but the manpower shortage is expected to continue for some time.

The traffic engineer, although engaged in a relatively young profession, will be expected to carry much of the burden of planning and operation. This responsibility cannot be taken lightly by either the traffic engineers or those charged with the responsibility of training highway engineers. The engineering colleges must provide facilities for the development of competent men in highway and traffic engineering. In this paper the activities of Purdue University in these areas will be briefly outlined so that one may see how Purdue is meeting that challenge.

THE UNDERGRADUATE CURRICULUM

The development of an engineer, of course, begins at the undergraduate level and at Purdue, as in other engineering schools, this phase of development is primarily devoted to a coverage of basic engineering elements. Among the areas of instruction are the civil engineering aspects of surveying, geology, soils, structures, hydraulics, highways, and railroads. The undergraduate highway subjects consist of two courses covering highway construction, location, earthwork, drainage, design, contract procedure, maintenance, materials, construction practices, subgrade stabilization, administration, finance, and operation.
During the senior year the undergraduate often selects at least four credits of technical electives. He may select any two of the following courses that are directly related to traffic engineering:

Highway Traffic Engineering (2 credits)—Study of the elements of highway traffic-accident records, signs, markings, and signals, roadway and intersection design and control, research, traffic administration, and public relations.

Traffic Planning (2 credits)—Study of the conduct, analysis, and reporting of the comprehensive traffic survey necessary for street and highway planning in city and areal highway systems.

Comparative Analysis of Transportation (3 credits)—A comparative analysis of the phenomena affecting the engineering economy of our transportation systems.

Highway Motor Transportation (3 credits)—A study of the engineering requirements of the highway and the performance of the vehicle and driver as they relate to safety, regulation, industry, commerce, and public need.

City Planning (2 credits)—A study of the principles of planning; street systems, transportation, recreational facilities, housing, and landscape engineering.

Municipal Engineering (2 credits)—A study of the engineering and legal problems of the city engineer, city government, city surveys, sub-division design, building codes, and legal procedures for making public improvements.

THE JOINT HIGHWAY RESEARCH PROJECT

It is the graduate student, however, who may obtain an optimum amount of training in the highway engineering field. It should be noted that the graduate program in highway engineering at Purdue is directly associated with the research activities of the Joint Highway Research Project.

This Project was established in 1936 as a cooperative research organization of the State Highway Commission of Indiana and Purdue University. It operated during the first year as an agreement between the Director of the Engineering Experiment Station of Purdue University and the Chairman of the State Highway Commission. In 1937 it was established by an act of the State Legislature which permitted the State Highway Commission to allocate $50,000 annually to Purdue for highway research. The University provides the laboratory and office space and administers the Project through the Engineering Experiment Station. The Project is guided by an Advisory Board consisting
of members of the Staff of the School of Civil Engineering and Engineers of the State Highway Department of Indiana. This board approves, and often suggests, the research projects which it believes to be of greatest value to the citizens of Indiana.

The Project has been expanded in recent years as the result of the critical need for additional research and the acknowledgment of that need by an act of the State Legislature in 1949 which increased the permitted maximum funds to be used by the Project from $50,000 to $150,000. Although this increase was substantial, this allotment for research in highways, even when added to that performed solely by the State Highway Department as planning and development, is far less than that which would be deemed advisable by a progressive and successful private industry of equal size.

With the available funds, a great deal, however, has been accomplished. The basic objectives of the Project are to:

1. Make basic studies of highway materials.
2. Facilitate economical design, construction, and maintenance of highways.
3. Investigate traffic and safety.
4. Provide advanced instruction in fundamentals of highway engineering.
5. Provide practical experience in construction and maintenance procedures.

To carry out these objectives a staff has been organized and divided into eight separate sections:

1. Soils
2. Concrete Materials and Rigid Pavements
3. Bituminous Materials and Flexible Pavements
4. Airphoto Interpretation
5. Chemistry of Materials
6. Economics, Administration, and Finance
7. Traffic and Safety
8. Structures

Each of these operate from a Laboratory in the School of Civil Engineering and use the highway facilities of the state, a private test road, and laboratory data as the source of research material.

The staff at the present time (April 1955) consists of 44 full and part-time personnel—engineers, a chemist, a statistician, an engineering geologist, an economist and 25 graduate assistants studying for
an advanced degree—and a clerical and service staff of nine. As an example of the advanced study underway in the Project, the work in the Traffic and Economics Sections will be cited. At the present time 3 men are studying for the Ph.D. degree and 6 are studying for a master's degree in these areas. Each of these candidates performs research as part of his requirement for the degree and in the field of traffic and economics. Experience in the other sections of the Project is similar.

THE GRADUATE CURRICULUM

In discussing traffic engineering activities in particular, the available graduate courses in this area as well as the research activities which have recently been completed or that are underway are of particular interest.

The graduate student may obtain a master's and a Ph.D. degree in Civil Engineering with a major in Transportation. In Transportation he may specialize in some aspect of transportation, such as traffic engineering, or he may take a general course. In either event, the student is generally able to complete the requirements for a master's degree in eighteen months and a Ph.D. degree in three years. Assistantships that pay $110 per month and that require the student to work half-time on a research project which he may use for his thesis material are available to outstanding students. Occasionally full-time employment on research and/or teaching while working towards a degree is available. The requirements for a master's program are 24 hours of course work and an acceptable thesis or 36 hours of course work. For the Ph.D. degree the requirements include 48 hours of course work (includes the 24 hours used for the master's), a reading knowledge of two foreign languages or one language and six course hours in some scientific area, and an acceptable thesis.

Students specializing in traffic engineering are urged to include a statistics minor and an economics minor in their graduate program (6 credits of each for master's and 12 of each for Ph.D.). A minor in some other area, such as soils, structures, or surveying, may, however, replace the economics minor.

The student selects the courses in Transportation according to his special interest and in Traffic and Economics they usually consist of the following courses that have already been discussed:

- Highway Traffic Engineering (2 credits)
- Traffic Planning (2 credits)
- Comparative Analysis of Transportation (3 credits)
- Highway Motor Transportation (3 credits)
These courses are supplemented by the following:

Highway and Airport Materials (3-4 credits) Selection, testing, specifications, and utilization of materials; embankments, subgrade, treatment, stabilization, foundation problems, soil profiles, and drainage; use of geology and pedology.

Airphoto Interpretation (3-6 credits) Principles, techniques, uses, applications and limitations of airphoto interpretation, including the identification of soils and rocks with airphotos, site selection, identification of materials of construction, a study of landforms, and the preparation of engineering soil maps.

Pavement Design (2-3 credits) Rigid and flexible pavement slabs; transverse and longitudinal joints, temperature and warping stresses, and thickness of concrete pavements; base courses and thickness of flexible pavements.

Airport Design (2-4 credits) Site selection and runway layout and design, application of airphotos, soil and geological maps, and topographic sheets for location and layout.

Courses are also offered in Bituminous and Portland Cement Concrete materials and in chemistry of materials and may be taken if desired. Special courses in geometric highway design, traffic survey technique, and special traffic engineering projects may also be included in the plan of study. Each student selects a major professor and is assigned to a faculty committee to guide him in his program of study and advise him on the development of his academic and research studies.

Almost all of these graduate courses offered in the Transportation area are conducted by members of the staff of the Joint Highway Research Project, and they also supervise the research activities.

RESEARCH ACTIVITIES

In the area of research, Purdue University is particularly active in traffic engineering and highway economics. During the past few years many projects in this area have been completed and several have been reported in the literature.

A complete resume was made in 1939 of the literature, related to the psychological aspects of highway safety, and in 1953 a member of the Project received the Institute of Traffic Engineers annual award for the most outstanding traffic paper of the year; the paper reported a study of public opinion concerning various traffic engineering devices. Other research has been completed and reported on the effect of a narrow bridge on lateral placement of the vehicle. A study of accidents in the state was also performed several years ago and contributed valuable information on driver behavior and causes of accidents.
A study of the effect of by-passes, which was reported last year, indicated that for maximum safety increased planning and provisions for limited access were necessary. As a result of this study the State Highway Department of Indiana has adopted a limited access policy for future by-passes—a sure way to reduce accidents on them. The recent legislature made the policy mandatory for urban areas.

The Project has also assisted the Metropolitan Area Traffic Survey Unit of the State Highway Department of Indiana in comprehensive traffic surveys for seven Indiana cities—Kokomo, Lebanon, Logansport, Richmond, Huntington, Vincennes, and Princeton—and conducted the surveys and prepared the report for the first five listed. Many of the techniques for these surveys were developed from these studies and impetus to a comprehensive planning program has resulted.

Sampling techniques for origin-destination surveys, allocation of traffic to new facilities, the economic benefits of by-passes, a technique for analyzing origin-destination data obtained from uni-directional interviewing, a comparison of the results obtained from the home interview and the post card method of origin-destination surveys, and a study of traffic paints are some of the more recent researches that have been completed.

Projects presently underway include studies of the skidding characteristics of pavements, factors affecting the roughness of pavements, the classification of county roads, the naming and numbering of county roads and rural residences, and the lateral placement of vehicles as affected by pavement types and condition of the center stripe.

The Project has also obtained rural traffic speeds for almost 18 years and has recently reported a study that considered the effect of the current Indiana speed law on average speeds. Characteristics of travel on Indiana highways was the subject of a recent study and reported information on volumes, type of vehicle, speeds, persons per car, purpose of trip, and other basic information required for the planning, design, construction, maintenance and operation of a safe and efficient highway system. Each year speeds are correlated with the weight of trucks to determine the trend in truck speeds and weights so that the design of our highways will meet the demands of the vehicle of tomorrow.

Another project, now underway, is a study of the effects of the "scramble" system traffic light for pedestrian control. This light stops all traffic for a portion of the cycle while only pedestrians cross, thus minimizing pedestrian and vehicular conflicts.

Research projects which are presently being planned include an attempt to evaluate desired traffic movement data from some source other than interview, such as from land use, driver characteristics, and
population habits. Another includes a study of the factors affecting the obedience of drivers to stop and slow signs.

A very important study presently underway is a Needs Study of Indiana State Highways. This project is being performed in cooperation with the State Highway Department and will include an inventory of all state highways; an historical and economic study of highway development; and road use, operational, classification, financial, and administrative studies of the state highway system and development of a program of improvements for the State Highway system. This study is intended to enlist public understanding of the highway problem and to provide state highway authorities with a scientifically-determined plan of attack that will guide the construction, maintenance and operation of an adequate, efficient and economical highway system.

Research projects have also been discussed in crash-injury research in cooperation with the Indiana State Police and the Office of Traffic Safety. This cooperation has resulted in the production of a movie on this subject and which is available to the public. It is entitled "For Whom the Traffic Toll", 13 minutes long in black and white. Other projects in this area include safety belt research, design of vehicles to minimize injury in auto crashes, and a study of the causes of accidents.

Other projects in the discussion stage in the traffic area include studies of the effects of highway lighting, the effects of the Yield sign, and the best form for accident record summarization and reporting. Any of these are fruitful areas for interested personnel to apply themselves.

OTHER ACTIVITIES

In addition to these formal academic and research activities, Purdue also engages in extension activities in the area of traffic engineering. The Purdue Road School is the best known of these activities and aids road and street men in carrying on their official duties in the most efficient and economical manner possible.

A Traffic Control Conference has also been held for the past few years and offers good advice to personnel from cities and counties about their traffic problems. The one for 1955 is devoted to a study of the parking problem. To further assist the local cities and counties with their traffic problems, a unit known as Traffic Engineering Services has been organized within the Joint Highway Research Project to advise and assist cities and counties in the planning and conduct of an orderly traffic program. Advice and counsel are provided on an extension basis while actual surveys and studies are performed on a fee basis if no private concern is available to perform the studies. Although this
unit was only established in April of last year, we have already assisted Allen County to formulate a county road program, Kokomo prepare a model traffic ordinance, and have begun discussions on a traffic program with the cities of Goshen, Monticello, Columbus, Brazil, and Crawfordsville. We also assisted in the formation of a Calumet area committee to consider the formation of a Calumet Area Planning Board and to prepare legislation to establish a desirable transportation authority.

Recently the Civil Engineering School organized a Cooperative Training Program, and the first agency to enter into the program was the State Highway Department of Indiana. Under this five-year program a student may alternate semesters with the highway department and in school. One of the areas to which each such student will be assigned will be to the Traffic Engineering group. A limited number of undergraduate students (50 to 75 per year) are also hired to work during the school year in our Joint Highway Research Project laboratories and some of them obtain some traffic engineering knowledge in this manner.

**SUMMARY**

It is apparent from all this discussion that Purdue University is actively engaged in traffic engineering education and research and that it is meeting the challenge to develop competent engineers in this area. It is planned that the conduct of research on traffic engineering problems and the cooperation with individuals or organizations that desire to have such research conducted as well as academic work in this area will continue.

Activities similar to those detailed for traffic engineering and economics are also present at Purdue in the Civil Engineering School in the fields of soils, structures, and sanitary and in the Transportation areas of airphoto interpretation, highway materials, and engineering geology. Research projects are generally available for assignment in bituminous materials, concrete materials, soils, airphotos, structures, and many other Highway and Civil Engineering areas. In short, if education is desired in any of these areas, including traffic engineering, come to Purdue.

**BIBLIOGRAPHY**

*Publications in Traffic and Economics*

The following publications are reports of research studies conducted at Purdue University in the areas of Traffic and Highway Economics. Copies of the publications, except for theses, are generally available from the Joint Highway Research Project, Purdue University.
Highway Research Bulletins


Highway Research Reprints


Other Publications


5. "Classification and Evaluation of Indiana County Roads," by John E. Baerwald, Presented at the 41st Annual Road School, Purdue University, Lafayette, Indiana, April 12, 1955.


UNPUBLISHED THESIS


