INTRODUCTION

The days of the family "flivver", the nickel loaf of bread, and gravel highways are long past. As the demand for improved transportation grew, the Indiana State Highway Commission tried to keep pace. Indiana made the investment and pushed for early completion of the interstate system. Today, we find transportation needs are changing and new demands are being made of the commission. To meet these different needs, there must be changes in what we expect from our people, materials, and money.

The Research and Training Center is a prime mover in providing data to highway management so that the best decisions about what to change can be made. Our research deals with changes or modifications in construction materials and methods. Our training is geared to changing people, so that they can understand, implement, and use these advancements. There have been some recent changes at the center, and this is what the next few minutes is all about.

PERSONNEL OF THE RESEARCH AND TRAINING CENTER

The center has been described from time to time as the commission's "orphaned child." It is, in reality, a detached and specialized organization of the central office. Within the commission, we are placed under the administration of the Research and Engineering Services, headed by Robert L. Eskew. In 1966, the center was built on ten acres in the Purdue Industrial Park in West Lafayette. West Lafayette was chosen because of its proximity to the resources of Purdue University and its civil engineering department. The number of our staff is quite small for the work we do, so each one usually has more than
one project or major area of responsibility. The Center's administrative staff consists of the director and an assistant. They are responsible for the work of the other 23 people. The research function is controlled by a coordinator and his staff of five research engineers. Our systems engineer and his two technicians provide the electronic instrumentation required. Eight highway engineering assistants provide the manpower needed to keep the projects moving. The training function is administered by the training officers. One is in charge of scheduling and student services and the other is responsible for program development and audiovisual materials production. He is assisted by a combined photo and audio-visual technician. Classroom instruction is completed by our own training and engineering staff, in addition to qualified district and central office personnel. That takes care of who we are. Now I will tell you what we do.

FUNCTIONS

Originally our primary research function was to coordinate, monitor, and supervise any and all construction research projects for the commission. Because the needs of the highway system are changing, the direction of research is also changing to include work concerning maintenance, traffic, and the like. From the completed research, we make recommendations that meet or answer the ever-changing technological needs in these areas.

Our research can be divided into three major areas. One group of projects is initiated by the commission, managed by the research and training center, and conducted with the help and cooperation of other departments and divisions within the highway commission. There are currently 25 projects under way listed as "Category II—Experimental Features of Construction." There are also 22 major, long-term studies funded by FWHA and investigated in cooperation with members of the Purdue Civil Engineering Department, through the Joint Highway Research Project. The research and training center is the state's agent for these combined studies. Also there are about eight major in-house projects we are completing. Several projects are concerned with traffic safety. One measure of safety is a skid test. This is a controlled simulation of a passenger car skidding on a wet pavement.

Skid Test Measurements

These skid test measurements have caused the center to develop very specialized skid research equipment, (Figure 1). This skid test system is one of the most highly developed research vehicles of its type in the United States. The center has developed and now maintains
two such systems. Indiana is a leader in the area of skid testing due to the extensive knowledge and experience of our staff. Few other states have designed and constructed a computer which reduces test measurements on board the testing system.

One skid test vehicle is used for the study, “Optimizing Indiana Pavement Surfaces.” This project has two objectives. The first is to identify how seasonal changes effect the measured skid resistance values. This is a necessary step in deriving a mathematical formula that gives a true or uniform skid resistance number for any time of the year for a particular pavement. This uniform testing procedure then allows us to achieve the second objective. That objective is to determine which surfaces will offer the best skid resistance over a long period of time, regardless of the traffic load or climatic conditions.

The second skid system provides a statewide inventory of road surface conditions. This program is being used to develop a skid accident reduction program. This study takes into account the surface materials, design, construction, maintenance practices, and any action taken to correct locations with high numbers of skid-related accidents. The testing schedule is set so that 100 percent of interstate, federal and state highways are tested every two years. Special roads or high accident locations receive more frequent testing. Last year, approximately 11,500 tests were performed for inventory purposes. This covered about 8,000 miles of highway. It is extremely important that the districts and the center exchange timely data about work completed and work planned. This will help provide the safest, most durable pavements available with the monies allowed.

Upon request, special testing is also conducted. One special test was made in the city of Hammond on this open-graded, slag surface.
Initial testing indicated a safe, stable, and highly skid-resistant surface. Skid testing is often combined with other pavement studies. Along with the skid resistance this same open-graded slag was tested for surface water infiltration. The surface quickly carried water to the side gutter. This slag surface material shows great potential for the use at special locations.

**Pavement Smoothness Measurements**

Pavement smoothness is determined with this P.C.A. roadmeter, (Figure 2). About 4,500 miles of pavement were measured last year. This meter provides about the smoothness of roads and the data can be correlated to both the construction techniques used and the contractors' work quality.

**Pavement Structural Measurements**

The Dynaflect system (Figure 3), provides a dynamic and non-destructive method to quickly gather information about the strength of the surface, the base, and the subgrade of pavements. These are some of the factors used to determine a pavement's total structural adequacy.
This system uses geophone sensors to record the pavement deflections produced by a thousand-pound load applied at eight cycles per second. This testing provides data for two extensive research projects. One is an in-house study, “Evaluation of Various Factors Influencing the Dynaflect,” and the other is a Joint Highway Project called “Development of a System for the Evaluation of Indiana Pavements.” Dynaflect testing has become a useful aid in analyzing and comparing differently designed pavements and their strengths. The data from dynaflect testing can be a great help in planning resurfacing, recycling, or undersealing projects.

**Bridge Deck Deterioration Investigations**

Another high priority study is an investigation of bridge deck deterioration due to the penetration of salt into the bridge deck rusting the reinforcing steel. The premature deterioration of bridge decks is a common problem to other states as well as to Indiana. Evaluation of current methods of post-construction protection systems such as waterproof membranes, special latex modified concretes, and high density, low slump, conventional concretes is being conducted. As a part of this study, 31 bridge decks were cored and the concentration of chloride ions were compared to the previous year’s findings. It is expected that the movement of chloride ions toward the steel can be predicted for the various means of protection on particular types of bridges. This will offer some help in determining when a particular type of bridge deck needs to be restored or reconstructed.

**Laboratory Testing**

Other physical and chemical studies are conducted in the center’s laboratory, such as the study on special concretes to be used for patching. Also several pavement types, designs, and their construction techniques are being evaluated for the resultant micro and macro properties. These properties include viscosity and penetration testing of recovered asphalt from certain bituminous surfaces. The aggregates are examined. The polishing characteristics are described and a detailed petrographic profile is made. Other on-going lab work includes the testing and classification of soil types taken from all counties in Indiana. This service is provided for the Soil Conservation Service, U.S.D.A., for use in soils mapping and land use planning.

**Corrosion and Pothole Patching Studies**

There are two new studies that I would like to mention. The first involves the corrosion rate of selected, coated drainage pipes when
subjected to changes in the pH levels of surface drainage. This should be of help in solving recurrent problems in areas having corrosive surface drainage, such as the coal and peat areas. Work has also started that should give definite answers regarding pothole patching materials and methods of compaction. There are a lot of people who need this information. I could go on about other projects, but I also want to tell you about developments in our training program.

Employee Training

Employee training is an inherent part of any job. Training and the learning processes are going on all the time. Successful industrial and business leaders recognize that a formal training system is a tool that good management uses to stay in business. The Indiana State Highway Commission has recognized this need also. In 1963, the first formal construction training program was developed with the help of Purdue University. This training emphasized the performance of specific quality control tests, proper documentation and use of forms, and specialized knowledge of methods, materials, and specifications that the general inspector needed to know in order to do his job. In 1966, the training center was established to continue this formal training program. By 1968, all training development and teaching was controlled by commission members. Today, as back then, the need for qualified, accurate and knowledgeable inspectors is still with us. We will continue to train construction inspectors as long as the need exists.

Other training needs have been identified by the division of construction. These needs are discussed at the training meeting held in Indianapolis early each fall. The training center, in cooperation with construction personnel, develops and implements the new training requested. After employees receive training, they return to their assigned jobs in the district. The cycle is completed when the district evaluates the individual's field performance, and then looks at the district's future job requirements for which training is needed.

At present, we are providing training in fifteen specific construction areas. Some of this training is done in the classrooms and in the teaching laboratory at the center. For several courses, we have made it less costly and more convenient by taking the training to the districts. One such class is on the care, operation, and application of the nuclear gauge for density testing.

Repair of Nuclear Gauges

The Nuclear Regulatory Commission has authorized and licensed the center to repair and maintain the gauges, and to train and certify the
operators. This training and greater field use of the nuclear testing is a direct result of a research project conducted by the research and training center several years ago.

Other Areas of Training

The other current training topics include work in many areas such as specific skills for concrete and soils density testing. Our training includes highway survey procedures, mathematics and trigonometry, bituminous paving procedures, and we offer help in developing procedures and skills needed by the field office manager and project supervisor.

QUALIFICATIONS OF TRAINEES

Any qualified state employee may attend these sessions. We do not train for the sake of training so we ask that only those that are presently assigned to, or those who soon will be assigned to the job requiring training be sent to the center. That is why we ask that students have the recommendation and approval of their immediate supervisor, the construction engineer, and the district engineer. For some courses the employees must meet prerequisites such as prior field experience or previous training. This training is also available to employees of cities and counties or their consultants. The city or county must be involved with a FHWA project before their consultants can attend. Cities and counties can receive this training at no experience, a fee is charged.

Figure 4. Annual Attendance Summaries for Training Administered by the Research & Training Center
for any training given to consultants. Over the years, we have trained a great number of people in many areas of construction (Figure 4). Please keep in mind that the data shown are summaries for all training sessions in a given year. There are some people who attended more than one course in one year and therefore are counted as one registrant for each session. The center has not neglected the other divisions. All highway divisions and departments are invited to the training meeting each fall. And as the center’s staff and capabilities expand, we are able to provide more help to these other divisions.

SPECIAL TRAINING COURSES FOR MAINTENANCE DIVISION

Our staff is quite involved with the maintenance division in designing and providing audio-visual training packages to meet their particular training needs. In the two years since maintenance has established a formal training program, we have developed seventeen different work-methods training courses. Each training session uses a specialized film projector and self-contained sound and 16mm film cassettes that describe and demonstrate approved work methods and standards of maintenance work performance. A printed training guide is provided for the supervisor who manages the training session. Maintenance has placed a projector and film library in each subdistrict and district office. Uniform training is now conveniently available to all maintenance workers in a subdistrict. The topics include a wide range such as: work planning and on-the-job management; bituminous surface maintenance; patching procedures; equipment preventive maintenance; snow and ice policies, procedures and materials usage, and many other important subjects. Some of this training can be used by contractors, especially the program used to train flagmen. These training cassettes are getting good use. Reports indicate that for the first seven programs released between October 1977 and October 1978, the total number of trainees is well over 5,000 individuals. Again, this number reflects that many employees were trained in more than one area.

TRAINING PROGRAMS FOR SAFETY AND PUBLIC INFORMATION

Our training and A-V center has maintained a close working relationship and has provided materials for groups such as Safety, Public Information and Purdue. We are justifiably proud that Indiana is one of the few states that is set up so that the results of research can be quickly implemented into the training program. As more divisions and departments are becoming aware of the center’s added dimensions,
we are receiving more requests and are fulfilling some of the needs of these organizations.

PHONE AND ADDRESS OF ISHC R & T CENTER
Feel free to contact us by phone 317-463-1521 or on the Centrex line 4816; by letter, P. O. Box 2279, West Lafayette, Indiana 47906, or visit us at the center, 1205 Montgomery Street, West Lafayette, Indiana.

CONCLUSION
Just remember that training and research are tools good managers use to help get work accomplished. Training and research are work. They both must be scheduled, budgeted, controlled and evaluated just as any other job. Jobs involve people and people can make an organization successful. Our people at the center are successful in many areas related to the changing nature of the highway system. We are limited in our success only by our number, budgets, the "system," and the desire to produce. By attracting, developing, and retaining qualified personnel, we can continue to expand our success and thereby help assure the safe, well-built, and maintained highway system that Indiana taxpayers deserve.