

Highlights of the Indiana Department of Transportation Research Program

Barry K. Partridge, P.E.

Chief, Research Division

Indiana Department of Transportation

I would like to make a few comments on the INDOT research program and mention some resources available to local transportation officials through the program. I would also like to highlight some specific projects of interest to this group.

First a word about transportation research would be in order. As managers, engineers, accountants, and city officials, you know that research can be a powerful tool for your business or organization. The potential for a significant payback in research is quite large. It is not uncommon in research to have benefit/cost ratios of five to one, ten to one, twenty to one, or higher.

In the deliberations aimed at the upcoming Federal Surface Transportation Legislation, AASHTO, the U.S. DOT, and many other national organizations have issued statements strongly supporting the need for research. Some are also endorsing significantly expanded research programs with adequate budgets and stable funding. AASHTO has stated that commitments to research will lead to increased productivity, international competitiveness, and efficient use of financial resources. It will provide additional access and mobility, and protect public safety and the environment. AASHTO has even chosen "Enhanced Transportation Research" as one of its emphasis areas for 1991.

Funding for research, however, has not kept pace with the growing needs and opportunities for technological innovation in the transportation industry. Highway research spending as a share of total highway program expenditures is currently about 0.2 percent. This amount is far less than even "Low-Tech" industries, which spend eight times more on research and developing new technology than the transportation industry does.

Highway planning and research funding has declined under the 1987 surface transportation act to the extent that, when adjusted for inflation, HP&R funding in 1991 is about 30 percent below the 1986 level, with approximately one-half of the purchasing power of the 1986 level. Furthermore, hi-tech industry spends thirty to fifty times more of its gross sales revenue on research than does the transportation industry.

This lack of funding for research and careless attitude about tomorrow's technology is shocking when we see that the United States spends \$60 billion annually on transportation or \$225 for every man, woman, and child in the U.S. AASHTO believes that rather than considering research spending to be an expense, it should be viewed as an essential investment that pays off by making other expenditures more effective.

AASHTO has also recommended an increase in funding for the rural technical assistance program (RTAP), which uses many of the products of research to assist local cities, counties, and towns. In Indiana, the RTAP program is largely handled through the Highway Extension and Research Program for Indiana Counties and Cities (HERPICC), which is directed by Dr. Charles F. Scholer.

Now, let me briefly discuss the INDOT Research Program and mention some resources that are available. The purpose of the INDOT Research Program is to engage in research and development of new ideas and technology that will ultimately lead to an efficient and effective method of accomplishing its mission. Also, new products or materials offered by vendors for usage shall be given due consideration. Results and findings of the research program benefits Indiana and other states, as well as the cities, counties, and towns in Indiana.

The INDOT Research Program has been described by the National Transportation Research Board (TRB) and FHWA as one of the best in the country. I am quite certain this praise and this program is a direct result of the outstanding cooperation and relationship we share with FHWA, industry, and their associations in Indiana such as the Indiana Mineral Aggregate Association, Asphalt Pavement Association of Indiana, and the Indiana Concrete Council. Members of these organizations voluntarily serve on study advisory committees and often donate materials and time toward the successful completion of research projects of mutual concern.

This unique relationship is further enhanced by the Joint Highway Research Project (JHRP), which combines academia and expertise with INDOT practitioners in performing research. Currently, Purdue University's School of Civil Engineering is in this joint program and the IU Transportation Research Center was added in 1989. Other Indiana universities and colleges will follow.

RESOURCES AVAILABLE TO LOCAL OFFICIALS

Described below are some of the resources in the INDOT Research Program that are available to local transportation officials. To utilize any of these services, contact the Division of Research.

The Division of Research has the ability to perform information searches through the International Transportation Research Information Service (TRIS) and its subset the Highway Research Information Service (HRIS). Typically, there is no charge for this service and a printout is provided showing sources of published findings in the area of interest along with an abstract of each report.

INDOT also publishes annually, a research and implementation summary of all INDOT sponsored research. It includes information on each study, along with a contact person. In the back of the report is a listing of all completed research reports since 1980. The 1990 Research Summary is now available.

Lastly, the conduct of research and specialized testing are also resources and products of the INDOT Research Program. INDOT personnel, academia, Indiana industry associations, and FHWA are all consulted in preparing annual research programs. Furthermore, we are interested in solving problems of mutual concern to Indiana cities, counties, and towns. We would suggest local agencies submit their suggestions through the INDOT Division of Local Assistance and MPOs through the Division of Program Development.

RESEARCH PROJECTS

Let me present a cross section of some specific research projects. First, in the area of new technology, a study is being conducted into the cost-effectiveness of new technologies in INDOT. This study is being undertaken to systematically identify those new and emerging technologies that have potential current and future applications in INDOT, including an assessment of their costs and effectiveness. Furthermore, Indiana was one of nine states, in a survey, that did not have a program of new technology development. Indiana was judged to be one of the states lagging behind in introducing new technologies. This study is changing that prognosis. Most of the current applications and future programs identified in the survey involved the use of computer technology.

This initial project is scheduled to complete in August 1992. Projects being examined in the study are grouped into five broad categories including:

Data Base Management and Information Systems. This includes geographic information systems (GIS), pavement management, traffic inventories, personnel records, material records, and planning and preconstruction record keeping.

Traffic Operations and Management. This category contains new technology that can be used to improve the capacity and safety of freeways and arterial systems. Specific applications include traffic surveillance and control, variable speed and other message signs, incident detection, weigh-in-motion systems for truck monitoring, and so forth.

Highway Information Systems and User Communications. This includes driver information technology encompassing electronic route planning, radio broadcasting of traffic information, on-board navigation systems, freeway and corridor controls, automatic vehicle identification (AVI), etc.

Computer Aided Design and Drafting. This includes investigation into such things as interactive graphics and computer aided design and drafting systems (CADD).

Laboratory and Field Data Collection and Analysis and Construction Management and Quality Control. The principle use of this technology includes construction project management, inventory control, bidding estimating, and partial payment schedules.

Another research study was recently completed with the office of Highway Development entitled, "An Electronic Surveillance and Control System for the Management of Traffic on the Borman Expressway." The Borman Expressway, I-80/94, in Northwest Indiana has the highest average daily traffic of any roadway in the state with an ADT of approximately 140,000 vehicles per day with 30 percent trucks or heavy vehicles.

Specifically, the study was to make recommendations towards the design and installation of an automated surveillance and control system. Such a system will significantly reduce incident-induced traffic flow problems which now occur regularly on the expressway. The initial study recommended that the proposed freeway management system consist of three components, which would include:

- Traffic Surveillance, including inductive loop detectors, closed circuit television and service patrols;
- Motorist Information, including changeable message signs, highway advisory radio, and traffic bulletins; and

- **Traffic Management**, to minimize traffic congestion resulting from incidents by establishing communication links with other agencies such as local DOT's, police and fire agencies.

In the future, ramp metering may be implemented to maintain acceptable expressway traffic flow when incidents do occur. This original study's recommendations are currently under review, and a follow-up study has been proposed to develop design criteria for the proposed Borman Expressway Surveillance and Control System.

In 1990, INDOT, working with Purdue University, the Indiana Mineral Aggregate Association, the Asphalt Pavement Association of Indiana, and FHWA approved a research project to construct an accelerated pavement testing facility at the INDOT Research Division. The accelerated pavement tester in the facility will be able to provide relatively quick answers to materials and overlay performance by compressing 10 years of interstate traffic into less than one year of operation. Rutting damage and structural damage can be accelerated by reducing the speed of the loading and controlling pavement temperature.

This facility will first be used to determine the minimum crushed aggregate content necessary in bituminous mixes to prevent rutting of Indiana pavements, yet still be economical and practical for suppliers to produce. This equipment has now been installed in the accelerated pavement testing facility.

Another research project in the new technology area is developing an automated construction data management system. An informal survey in Indiana showed construction supervision personnel spend a considerable amount of time processing construction data. The survey showed five hours a day is spent by the project engineer or project supervisor and the inspector on this processing of construction information. Furthermore, trends show increased construction activity in the future without parallel increases in personnel. Data management will, therefore, continue to expand, making more demands on their time.

Though we cannot reduce the amount of construction needed, this project will develop an innovative, automated, data management system to greatly assist project personnel in reducing the amount of time they have to spend on paperwork. States such as Connecticut and New Jersey that have such a system in-place spend approximately 1/2 to 1/11 the amount of time on similar paperwork. Expected total time savings, in dollars, from this study is estimated at \$1.8 million annually, with the system paying for itself in one year.

INDOT and Purdue have also recently completed a synthesis study on the use of waste materials in highway construction. Senate Bill No. 209, proposed in the last legislative session and similar legislation now being proposed will mandate the use of reclaimed, waste, and demolition materials in highway construction projects. This synthesis study is examining the use of these materials nationwide and their performance and acceptance.

INDOT currently is using many reclaimed materials such as flyash, bottom ash, recycled materials, and ground rubber. Other materials are also being proposed. This study will be able to provide a comprehensive and common sense response to proposed legislation, suggest which materials should be field tested and what specifications need to be developed for their proper use. The Indiana Department of Environmental Management is working with INDOT in implementing the use of waste and reclaimed materials in Indiana.

In conjunction with this study the research program has a study on I-465 that is looking at numerous asphalt additives to control pavement rutting. This study is a special FHWA Experimental Project with 100 percent Federal funding. It is investigating seven asphalt additives in base, binder, and surface courses. Generic additive types include asphalt rubber, latex, polyethylene, polyester fibers, styrelf and multigrade asphalt cements.

We are also concerned with the control of hazardous materials, and the research program currently has a study developing strategies for compliance with EPA and OSHA regulations applicable to INDOT facilities. Many of these strategies will be of interest and of use to local agencies as well.

As a state agency we are a major user of hazardous materials and a major generator of what are considered by regulations to be hazardous wastes. This study will provide technical assistance to aid the Department in complying with employee and environmental protection regulations. Besides assisting in compliance with existing regulations, this study aims to develop a management framework in which compliance can be achieved efficiently.

Among the many areas the study will address include:

- Hazardous Communication Standards, which are the Foundation for an Employee's Right-to-Know;
- Community's Right-to-Know;
- Underground Storage Tanks;
- The Federal Insecticide and Rodenticide Act Administered by EPA;
- Pollution Prevention/Waste Minimization;
- Superfund Regulations; and
- The Clean Air Act and the Clean Water Act.

The research program is also addressing development of guidelines for permitting overloads and the economic impact of heavier truck weights. Besides developing quick guidelines for permitting overloads on a case-by-case basis, the study will provide information for transporters of heavy loads on hauling unit configurations that will not impose damage to our bridges and pavements. Information and guidance will be available on number of axles, axle spacing and number of tires required for various loads.

Another research study is developing guidelines for traffic impact analysis of developments along state highways. There is a long-standing conflict regarding access between private property and the adjacent public road. This is complicated by the need for economic development and the need for the roadway improvements required by the new development.

This study is developing clear, comprehensive, and realistic procedures for analyzing the impacts of any significant development proposed along or near a state highway. These procedures will protect the taxpaying and travelling public's interest while giving the developer the benefit of established guidelines and a streamlined approval process.

In conjunction with the transportation planning office, the IU Transportation Research Center is conducting a study to eventually develop a database of commodity flows into and out of Indiana counties, and to allocate this commodity traffic flow to the transportation network of the state. Commodities will include coal, agriculture products (corn, wheat and soybeans), and twenty different

manufacturing sectors. This database will be of considerable value to state policy makers and planners to determine which corridors are important in the movement of Indiana inbound and outbound commodities. It will also help determine the impacts of rail abandonments, evaluate traffic diversion from road to rail, identify the need for new highway construction, and make short term commodity traffic flow projections.

In the safety area, one of the projects the research program has been evaluating is the performance of new energy absorbing guardrail systems, such as the centre guardrail, vehicle attenuating terminal (VAT) and Crash Attenuating Terminal (CAT). These new end treatments are designed to bring about gradual deceleration of the impacting vehicle by absorbing the energy of the hit without spearing, vaulting, overturning the vehicle, or returning the vehicle into traffic. INDOT has placed over 320 of these units around the state. Though the units are more costly — approximately seven times more expensive — than turned down terminals, and about equal to the cost of barrel arrays, these costs are coming down.

With twenty-four units hit we can say with reasonable confidence that up to eight fatalities were avoided — or eight lives saved — and personal property damage has been significantly reduced. Other systems such as the brakemaster and Attenuating-2000 systems are being considered by the department.

In the construction and maintenance areas, research is currently being performed to develop functional and structural overlay design procedures for Indiana that will allow us to design an overlay for specific site conditions. We are also performing a comprehensive evaluation of cracking and seating of pavements, which looks at:

- Techniques and Equipment for Cracking and the Subsequent Seating Process;
- Performance of Crack and Seat Overlays;
- Overlay Material Options;
- Performance and Thickness Requirements; and
- The Effect of Adding Fibers to the Asphalt Overlay Mixture.

We are also investigating rubblizing of pavements, big rock mixes, and developing a comprehensive drainage design process.

One study is evaluating new crack sealing materials. Crack sealing of Indiana roads is a very labor intensive and costly process. INDOT spends over \$2 million annually just for transverse crack sealing alone. Furthermore, some of the emulsion sealants last less than one year, while the current program attempts to seal cracks only on a three to five year cycle. Consequently, if a sealant fails, the pavement can be exposed to the intrusion of water leading to premature pavement failure.

Over thirteen state-of-the-art crack sealing materials are being evaluated, including the generic categories of latex, polymers, crum rubber, and fiber additives to determine which materials perform, last, and are cost effective. It's very possible different types of roads and different types of cracks will require different sealing materials and methods.

Currently, a task force is being set up with district maintenance engineers and operations support personnel to select crack sealing materials and equipment,

recommend an implementation plan, and develop guidelines for the use of these new materials and processes. This study has a huge potential in saving money and in saving our pavements.

I unfortunately can't describe all the important needs the INDOT research program is addressing. Let me, however, mention some of the titles in closing. Study titles include:

- Quality Assurance Specification for Bridge Painting;
- Implementation of an Indiana Bridge Management System;
- Developing, In-house, a Profile/Rut Measuring System; and
- Participation in the Strategic Highway Research Program general pavement studies and special pavement studies.

Often highway and transportation agencies are considered as users as opposed to generators of tax revenues. Furthermore, highway and transportation agencies are perceived by the public as not very innovative — doing the same things today they did twenty years ago. You may also recall the very small applause President Bush received in his State of the Union Address when he proposed additional transportation funding.

However, many research programs nationwide in private industry, at universities, and in state DOT's, such as the INDOT Research Program, show that these research programs are very innovative, giving the taxpayers large returns on their investments and providing their agencies and department with technology for tomorrow. Research and practice cannot advance separately, they build on each other. Meetings like Road School are a key to getting better ideas that work.