Putting Research Into Practice

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Some time ago a speaker at a national convention of professional engineers made a point which is pertinent to this conference—the 48th Annual Purdue Road School. His point was that today experienced engineers must spend at least 10 per cent of their time in keeping up with new developments. I agree with his point, and I believe that Purdue University and other engineering educational institutions across the nation which are sponsoring annual road schools are making a very important contribution to the success of the highway program. During conferences such as the one here this week all of us have an excellent opportunity to update our knowledge and to update our thinking.

The prime source of current knowledge of highway engineering and administration has been highway research. Research down through the years has pointed the way toward further improvements in carrying out highway programs. When we develop applications for the findings of research so that they are actually put to use, then the benefits to the highway program in greater efficiency, economy, and quality become a reality.

Recently we have reorganized our Bureau of Public Roads headquarters organization. The functions of highway planning and highway research, formerly managed in a single office, have now been established as separate major offices. This is simply recognition of the fact that there is need both to expand and to concentrate serious attention on each of these vital functions. In the new Office of Research have been included the Physical, Economic, Traffic Operations, Hydraulic, and Equipment and Methods Divisions.

We believe that this new Office of Research set-up will enable us to give added emphasis to the essentiality of research and development activities. We intend to step up these activities within the Bureau. We want to encourage the state highway departments to avail themselves more extensively of funds provided by the Federal-Aid Highway Acts for research projects. And we want to accelerate the development of applications for research performed by other government agencies, by universities, and by industry.

The Bureau is not alone in recognizing the essentiality and the benefits from research and development activities. A pooled fund plan has been adopted by the American Association of State Highway Officials for the purpose of carrying out needed research. This fund was developed by contributions from each state of one-twentieth of the federal-aid highway funds allocated to it annually for research and planning. The association plans to put about $1.6 million of federal-aid funds into the first year's projects. When fully implemented, it is anticipated that about $2.5 million will be available annually to carry out this research program.

These research activities have been discussed because they have significance to all of you. Each of you is a member of the highway team. Some of you are state, county, or local highway officials. Others are contractors and material suppliers. Some of you design and build the equipment for constructing and maintaining our roads. Long ago we learned to pull together as a team. When the expanded highway program was undertaken in 1956, the need for mutual understanding and cooperation was brought home more forcibly than ever before.

Each segment of our highway team faces certain difficult problems in carrying out its particular responsibilities. Research and development activities frequently provide the solution to these problems. Sometimes, however, before a problem can be solved, acceptance of a research finding or a new development is necessary by other members of the highway team, too. Let's take an example.

Equipment manufacturers are striving continuously to improve their construction machinery. And down through the years they have succeeded. This did not come about by chance. A survey just completed by the Construction Industry Manufacturers Association reveals that its members are spending $100 million annually on research and development to further improve construction equipment.

But before the highway program can benefit from these expenditures for research and development, two additional requirements must be met. First, the highway contractor must be encouraged to buy and use the improved equipment. He wants these machines because they help improve his competitive position. But he will buy them only if he has assurance that when he takes them on a highway construction project he will be free to develop the full productive capacity and the greater efficiency of the improved machines.

This brings us to the second requirement. That requirement is that highway specifications must be kept in tune with the times. Let me explain a little more fully by an example. The 34-E dual drum

paver is widely used in the construction of portland cement concrete pavements and has been for some time. We in the Bureau of Public Roads have accomplished considerable research to determine the effect of mixing time upon the quality, as measured by the compressive and flexural strength, of the concrete produced by these pavers. The results are conclusive. A 60-second mixing cycle is the optimum.

Next, we examined bid prices for concrete pavements on federal-aid highway construction projects a few years ago. We found that where the required mixing time ranged between 60 and 69 seconds. the average bid was $17.02 per cubic yard; where the required mixing time was 70 seconds or over, the average bid price was $19.83 per cubic yard.

Here, then, is an instance where, by putting to work the findings of research and by taking advantage of new developments, far-reaching benefits are obtained for the highway program. The highway department benefits from assurance of quality, economy, and efficiency in completing contracts. The contractor benefits from his improved competitive position and lower unit costs from more productive and efficient machines. The manufacturer is encouraged to further improve his equipment by the knowledge that it will be accepted and used once it proves its merit. The material supplier benefits too, when his products are used properly and economically.

Bear in mind that this is just one instance where research and new developments can help the highway team do a better job. There are hundreds of other areas covering practically all of our major activities where further improvements can be made and the solution to problems found by applying the findings of research and utilizing new developments.

Many of you are involved in the complex problems which exist in our urban areas. The solutions to urban transportation problems must be custom tailored to the particular needs of each area. In each case, however, improving the capacity of existing roads and streets is an important part of the overall solution. And this can be done. A year or so ago a study was made of ways and means of increasing the capacity of Wisconsin Avenue—an arterial street in Washington D. C. The study was pursued in three steps or phases. The first, entailing no, or very little, expense and no construction, considered use of such techniques as parking regulation, turning movement control, and lane marking. The second phase, requiring moderate expenditure and some construction, encompassed widening narrow sections, resurfacing, channelization, a flexible progressive signal system, and so on. The third

and final phase, calling for major expenditures, envisioned construction of two grade separations at critical intersections and further street widening but still within the existing right-of-way.

While we could only calculate the effects of the projected Wisconsin Avenue improvements, it appears that completion of the planned operations would have permitted peak-hour traffic-volume increases, measured from existing flow, of 50 to 70 per cent in the first phase, 90 to almost 130 per cent in the second phase, and 100 to over 200 per cent in the third. Concurrently, averaged traffic speed would have jumped from the existing 14 to 20 miles per hour to 18 to 25 in the first phase and to 25 to 30 in the second and third phases.

New developments are helping to increase the capacity of existing streets, too. The Toronto Metropolitan Area, for example, is starting to install a centralized system for the control of the timing of its 500 key traffic signals by radio. While the cost of the new system will be $3 million, they estimate that the increased capacity of the streets involved will be at least equal to that which could be obtained by building $20 million worth of new highways.

Los Angeles is planning to install a more sophisticated, electronic-computer-controlled central system for timing traffic signals. Here again, the increased capacity of existing streets is expected to equal the construction of many millions of dollars of new highways.

The urban transportation problem is a matter of much concern to all of us who have responsibilities for successfully carrying out the current highway program. In no other area is there as great a need for so many to work and study together with a willingness to cooperate and with mutual understanding in an effort to solve these difficult problems. State, county, local, and federal officials, as well as special groups, frequently have joint responsibilities in such areas and each of these responsibilities must receive due consideration. Fortunately, research and new developments today are aiding tremendously in preparing long- and short-range transportation plans which will foster the orderly growth of our urban communities.

Electronic computers, line plotters, and other relatively new equipment developments have become almost indispensable for automatically processing the masses of data involved in urban transportation planning studies. Second generation equipment with far greater capacity is now enabling us to do the job even more thoroughly and more precisely because the impact of the many variables can be evaluated more closely.

Practically all state highway departments now have these new tools. Their benefits are being extended through the development of equip-

ment and techniques for the rapid transmission of large masses of data between field offices and computer centers. The benefits of these new tools frequently can be realized in the development of urban transportation plans for even the smaller cities through the facilities of state highway departments or those of universities or consulting engineers.

More research is needed to provide answers to the urban transportation problem. Actions have been taken in this direction. One of the first areas in which projects will be undertaken in the new cooperative AASHO research program is to develop techniques for improving the capacity and safety of existing roads and streets.

In addition, the Highway Research Board has organized a 70-man committee to study the problem of urban transportation. Already this committee has made recommendations for specific needed research. The recommendations include studies of economic, land-use, social, organizational, and other factors as they affect urban transportation.

These joint efforts will produce research findings and new developments which can help us come closer to solving our urban transportation problems. Highway officials, however, must keep themselves informed so that they can put to work those research findings and new developments which are applicable. Here at the 48th Purdue Road School you will find at least one product of research or a new development which you can take home and put to work.

This is the principal purpose and principal value of such a conference as this. I don't think that any of us today can afford to remain wedded to a method or procedure merely because it is traditional. But all too often we find provisions in highway specifications which are outmoded by the findings of research or by new developments. For example, the American Association of State Highway Officials publishes certain standard specifications, policies, and manuals as guides to highway departments. These guides are developed by committees of experienced highway officials and must be approved by a majority of the state highway departments before they are published. They are updated periodically on the basis of research and new developments so that they constitute current standards of good practice. In spite of this background, we frequently find considerable variation from these guides. I am aware that conditions warrant changes in design criteria for highways and bridges, in construction specifications, or in methods of test in many instances. But is it necessary, for example, to have in current highway specifications 215 different gradations for coarse aggregates when the approved AASHO standard recommends only 19?

Why should a contractor be refused permission to use a nine-wheeled pneumatic-tired roller in one state, where an eight-wheeled roller was required, when the roller he has performed satisfactorily on similar work in an adjacent state? Was it reasonable to require a contractor to provide three different curb forms because his project extended through three different jurisdictions? Steel fabricators advise that nonstandard designs for bridge components frequently add to the cost because special shop drawings must be prepared.

We know that it is unreasonable and undesirable to have rigid conformance to recommended standards of good practice. We do think, however, that if your requirements are at substantial variance from recommended standards, you would do well in the interest of economy and quality to take a new look at them.

We in the Bureau are concerned about the lack of uniformity, particularly in construction standards. This concern stems from the Federal-Aid Highway Act of 1956. In that act, the Congress provided as follows: "The geometric and construction standards to be adopted for the Interstate System shall be those approved by the Secretary of Commerce in cooperation with the state highway departments." The act provides further that, "The Secretary shall apply such standards uniformly throughout the States."

The Bureau of Public Roads and the American Association of State Highway Officials moved pretty fast in developing and adopting geometric standards for the Interstate System. But not very much has been done about developing and applying construction standards for the Interstate System uniformly throughout the states.

Early this year, however, the new AASHO president, Jasper Womack, took a constructive step. He asked the AASHO Construction Committee to undertake two jobs. The first job is to review all state construction specifications to determine if there are any that might be so unduly restrictive as to affect economical and satisfactory production or to preclude the use of modern equipment and methods. The second job is far more extensive and more difficult, but in the end will be even more valuable. It is to prepare basic guide standard specifications for consideration and adoption by the AASHO member state highway departments and approval by the Secretary of Commerce through the Bureau of Public Roads.

You can be sure that any AASHO-developed construction specifications will be broad enough and basic enough so that individual states

can insert special provisions or refinements or requirements that are really needed in specific areas.

I hope that when those construction specifications are developed and approved, each one of you will make it a point to get a copy. I hope that you will compare them with the specifications under which you are operating. I hope that when you do so that you will bear in mind that these construction specifications have the following background:

1. They were prepared by experienced highway engineers
2. They have been approved by a majority of state highway officials
3. They were based upon the findings of research
4. They take into consideration new developments in highway construction.

When you find major variation between your own specifications and the AASHO recommended practice, ask yourself if a change would be desirable. Greater uniformity in the acceptance and use of sound standards for highway construction would have many advantages. It would foster uniform high quality in the roads we build. It would reduce contractors' operating costs and would promote competition because contractors would move more freely between different jurisdictions. Materials would be more standardized thereby reducing suppliers' overhead costs. Also, importantly, the taxpayer would benefit.

I see no valid reason why such standards should not be the basis for the construction of all roads, regardless of whether they are on or off the federal-aid systems. The same benefits from greater uniformity would be realized and these are worth serious study and consideration by all of us.

I mentioned earlier that all of us are members of the highway team. Together we have made considerable progress since July 1956 in carrying out this great highway program. Almost 12,300 miles of the Interstate System were open to traffic by the end of 1961. An additional 4,245 miles were under construction and preliminary engineering or right-of-way acquisition was underway on over 10,600 more miles.

Construction contracts for the improvement of 131,400 miles of federal-aid primary and secondary roads including their urban extensions have been completed. Work is underway for improving over

22,200 more miles of these roads and streets. Substantial progress is also being made toward improving roads off the federal-aid systems.

We have a big job ahead. We can best do that job by keeping ourselves informed. This requires a considerable effort on the part of all of us. This annual Purdue Road School is a means whereby we can help bring each other up-to-date. We need such conferences to learn of research findings and new developments which will enable us to put greater efficiency, economy, and quality into the highway program.