Final

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Good morning Mr. Chairman, members of the committee, I am E. Dean Carlson, Executive Director of the Federal Highway Administration (FHWA). I am here to offer testimony in response to your letter of invitation dated February 5, 1992, relative to the Department of Transportation and FHWA's efforts to provide the States with the means to build better quality highways. Accompanying me today is Charles L. Miller, the FHWA's Associate Administrator for Research and Development.

Permit me to begin my comments by noting that the delivery of a quality, durable highway construction project involves a series of actions by a number of partners. First, the delivery of a quality highway project begins with the conceptual planning stages and evolves through design, selection of appropriate alternatives, utilization of high quality materials, implementation of sound construction techniques, exercise of adequate quality control, acceptance activities on the part of the owner to ensure that the desired quality and quantity of construction was delivered and the timely and efficient placing of the facility into operation. Further, it is important to note that each of these activities requires the appropriate level of research and technology exchange and the FHWA's activities are involved with each. The FHWA is just one of the partners involved with these activities in terms of both expertise and resources. Other active participants are State and local governments, together with the private sector. I should also note that the ability to deliver technically advanced construction, by all parties, will be enhanced by the recent passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) (P.L. 102-240). Accordingly, in the following

testimony, it is my intent to describe to you how the FHWA interacts with those partners and in concert with them provides added value to the product being delivered through research, development, and technology transfer activities. Additionally, the issue of coordination and communication between the partners will also be addressed.

LEVELS OF EXPENDITURE

Current levels of expenditure for highway Research and Development (R&D) must be viewed in the context of those levels existing over the past 10 years. Further, expenditures of Federal funds for highway research and development must be viewed with a basic understanding of the integrated relationship of the State highway and transportation departments and the FHWA through such programs as Highway Planning and Research (HP&R), the National Cooperative Highway Research Program (NCHRP), and the FHWA contract and staff research programs. In addition, these program expenditures involve the FHWA Technology Transfer program through the Office of Technology Applications and the National Highway Institute. Coincident with these activities, both the States and the FHWA are involved with the Strategic Highway Research Program (SHRP).

The history of highway research expenditure levels during the 1970's and 1980's and its relation to the total highway expenditures has been well documented. The American Association of State Highway and Transportation Officials (AASHTO) in their report "Innovation" (October, 1989) noted that, based upon Transportation Research Board (TRB) estimates, the U.S. research and development expenditure in 1984 constituted only approximately 0.15 percent of national expenditures for highway construction.

It was against this background that the Strategic Highway Research Program was conceived and initiated during the 1980's. It was a program funded at a level of $150 million over 5 years, with a very focused program of applied research. This program

has been successful with specific products starting to appear during 1992. Accordingly, a major effort of the FHWA during this and future years will be the further evaluation, development, and implementation of these results. Specific resources are devoted to this activity and and I will address the details of these efforts later.

Levels of expenditures together with current authorization and appropriations have demonstrated a significant increase since 1990 and portend uniform trends in the future. The new ISTEA provides significant levels of support for research, development, and technology transfer. This support is demonstrated by the data in Table 1 (attached).

To this point, our comments have been focused on the levels of Federal expenditure for highway research and technology. It must be noted that a considerable level of effort has been, and will continue to be, made by the States. The AASHTO report "Innovation" estimates that for 1988 the 100 percent State-funded research program was approximately 16 percent of the total publicly-funded national program.

The levels of expenditure by the private sector in research leading to new products and processes for the highway construction industry are difficult to assess. However, it is recognized that many barriers exist in the institutional relationships between the public and private sector that inhibit the incentive for private sector investment. The FHWA is actively engaged with the TRB and other interested parties to find solutions to these barriers.

TECHNOLOGY TRANSFER

Technology transfer has always been an integral part of the FHWA's mission. Over the past few years, the consensus in the highway community was that an expanded technology transfer effort was necessary to respond to the demands that are being placed on the highway infrastructure.

The FHWA's technology transfer mission includes the timely identification and assessment of innovative research results, technology, and products, and the application of those that are determined to be of potential benefit to the highway community. These technologies and products are developed, implemented, and promoted with State and local agencies, private industry, universities, and others in the national and international highway communities. In addition, alliances are being expanded with State and local highway agencies, private industry, universities, and others to broaden the network through which technology can reach its intended users.

New technology, such as new asphalt and concrete mixes and construction techniques, pavement construction testing equipment, traffic operations and management equipment, and geographic information systems, is transported in mobile field laboratories. Other methods used for reaching the users of the technology are publications, videotapes, computer programs (CD-ROM), technical summaries, demonstration projects, site visits, equipment loans, exhibits, workshops, symposia, interactive video discs, and training.

The FHWA recognizes the importance of marketing principles and will communicate the high priority it places on incorporating these principles throughout the agency. We have initiated a proactive role in involving our partners and customers in the identification of research needs, as well as product development, promotion, and delivery. The FHWA has restructured its internal operation to reflect our heightened emphasis on technology transfer, including the establishment of an Office of Technology Applications and a greater role for the agency's program and field offices. The FHWA is augmenting its current technical expertise, formalizing its technology assessment and transfer process, and providing broad-based training on basic marketing principles.

Examples of formalized technology transfer programs in the FHWA

include the following:

- Test and Evaluation Projects--Efforts to evaluate innovative or emerging technologies that have been identified as having a great potential for use nationwide.

- Demonstration Projects--Efforts to promote nationwide a proven material, process, method, equipment item, or other feature that the FHWA has targeted for adoption by the highway community.

- Application Products--Individual efforts to assess, refine, or disseminate an emerging technology. Such efforts may include contracts, regional or national seminars or workshops, specifications, notebooks or pamphlets, instructional/how-to guides, open houses, and focused clearing houses that are not part of demonstration or test and evaluation projects.

- Special Projects--Evaluation efforts of industry and the FHWA in conjunction with interested States to evaluate a material, process, method, or other feature. An effort begins with a technology sharing meeting, progresses through a work plan and several control experiments (or operational tests) to a closeout evaluation. The special project can lead to a demonstration, special experimental, or combination project.

- Short Courses--Nearly 100 technical courses are offered nationally through the FHWA's National Highway Institute (NHI), primarily to the States. These courses carry on a program that has existed for more than 20 years.

- Extended Courses--The FHWA sponsors three extended technical courses within the National Highway Institute's program:

  - Highway Pavements--This is a 4-week course held at

Michigan State University under NHI's sponsorship. The course covers the broad range of topics related to highway pavements, including design, maintenance, and other areas as well as pavement management systems to aid States in managing their pavements. Since 1989, five sessions of 30 to 35 students each have been held. In spring 1992, a sixth session will be conducted for international participants (selected through the World Bank). As many as three additional sessions may be held for international participants in winter 1992-1993.

- Highway Materials Engineering--This is a 6-week course held at Purdue University under NHI's sponsorship. It provides applied knowledge in highway engineering materials and quality control. Coverage includes materials control and acceptance-quality assurance; soil and foundations; steels, welding, and coatings; aggregates and unbound bases; asphalt materials and paving mixtures; and portland cement concrete. Two sessions with approximately 30 students each were held in 1990 and 1991 with a third session planned for winter 1992.

- Environmental Training Center--This is a 3-week course held in the Washington, D.C., area. The course is intensive hands-on training, covering all of the considerations related to the preparation of appropriate environmental documentation with emphasis on gathering and analyzing data and project management. Two previous sessions have included 30 to 35 students each, and a third session is planned for fall 1992.

PARTNERSHIPS

The FHWA's technology applications mission strongly emphasizes continuing partnerships in the highway community. The FHWA works within the highway community through technical advisory committees, national and international conferences, various

committees and task forces, and other direct and indirect interactions.

The highway community identifies needs so the national research and development of technology products and operational tests and evaluations can be focused. Input for the projects to be assessed, developed, and promoted comes from the public and private sector, from universities, and from others in the highway community. Proposed projects are screened and evaluated by Research and Technology Coordinating Groups (representatives from FHWA, other Federal agencies, and private sector experts) in pavements; structures; intelligent vehicle-highway systems; safety; motor carriers; and policy, planning, environment, and right-of-way, who provide guidance and direction during the development of test and evaluation, demonstration, application, and special projects. The FHWA assists in product evaluation and recommends further courses of action in technology transfer. Effective promotion of the products relies heavily on the strength of the partnership.

RURAL TECHNICAL ASSISTANCE PROGRAM

As noted earlier, a significant number of users in the highway community are represented by local highway agencies. The FHWA interacts with them through its Rural Technical Assistance Program (RTAP), which provides a way for local governments and agencies with limited resources to have access to new technologies to help them operate their transportation programs more efficiently and economically. The RTAP provides funds for the development of national technical projects, for the operation of local technology transfer (T^2) Centers, and for the operation of a national T^2 clearinghouse.

Since the start of the RTAP, a cooperative spirit of networking has developed among the local highway agencies, the States, universities, and the Federal Government. This cooperative spirit has helped to make the RTAP a very successful program.

Under RTAP projects, instructional manuals have been developed and technical guidance designed to meet the needs of rural transportation agencies. The RTAP has over 150,000 publications and over 9,000 videotapes which have been provided to local agencies. The RTAP also held more than 1,500 training sessions in 1990, drawing a total attendance of over 46,400, and conducted nearly 1,700 roadshows with a total attendance of over 9,700.

Technical Projects--The FHWA's Headquarters and field offices, States, and members of a national RTAP network work to adapt new highway technology to better meet the needs of the local highway agency. These projects are solicited from the Centers and FHWA personnel and include instructional manuals, courses, videotapes, and reports in technical and management areas.

Technology Transfer Centers--A key element in reaching local highway agencies is the 50 T^2 Centers. All 50 States are served by these centers as well as the Commonwealth of Puerto Rico. These centers provide technical assistance to rural transportation agency personnel through quarterly technical newsletters, training courses, instructor's guides, users manuals, and workshops. Training is offered in both management and technical areas.

RTAP National T^2 Clearinghouse--The American Public Works Association (APWA) is currently under contract to the FHWA to operate a National Clearinghouse for Technical Information that serves as the focal point for collecting and exchanging new information and technical assistance for the T^2 Centers. Among the services provided by the Clearinghouse are a national newsletter, a catalog of training and technology transfer resources, information services, a videotape library and catalog, and a compendium of profiles of each Center, highlighting their particular accomplishments during the preceding year.

STRATEGIC HIGHWAY RESEARCH PROGRAM

The FHWA's technology transfer program also includes Strategic

Highway Research Program (SHRP) implementation. As the 5-year SHRP approaches its end, the FHWA is taking a central role in the implementation of the program's products. From the mid-1980's, the FHWA has worked with the SHRP as the program's staff developed the program and conducted research.

The need for new or improved pavement materials and design procedures was one of the driving forces behind the SHRP's development, and much of the work is directed toward these procedures.

SHRP product specifications and test methods strive to improve the performance of asphalt concrete materials, protection of reinforced concrete structures, highway maintenance, and durability of pavements. The results of the SHRP's efforts for both the transportation industry and State highway agencies will help to improve the durability and longevity of the Nation's highways.

The SHRP's efforts have resulted in useful products ready for implementation. The FHWA is preparing to ensure that the nearly 100 products that are resulting from the SHRP will receive full consideration. The SHRP has estimated the potential savings to the highway program from full implementation of these products to be hundreds of millions of dollars annually.

Over the past year and a half, the FHWA has worked closely with the SHRP in developing an implementation program. Our initial implementation efforts have concentrated in the asphalt area. One current example is a cooperative effort between the FHWA and the AASHTO Task Force on SHRP Implementation to develop a pooled-fund project to help States purchase SHRP developed asphalt binder and mix test equipment now ready for field evaluation. We anticipate a strong participation level from the States as reflected by 41 responses from the States to date with 39 indicating a positive willingness to participate.

The expanded technology applications program will pick up more implementation projects as the SHRP winds down and as more products become available. Major technology transfer emphasis will begin in 1993 at the completion of the SHRP.

INTERNATIONAL

The FHWA is working to expand its program of interaction internationally. The agency is formalizing its scanning process for finding transportation technology that can aid the United States in improving the durability of its infrastructure and the safety and operation of its facilities. As the international network expands, the agency will increase the number of focused technical trips abroad to facilitate the exchange of technology in various fields. The FHWA will continue strong participation in committees and task forces of the Organisation for Economic Co-operation and Development and of the Permanent International Association of Road Congresses.

The FHWA has already begun to draw on other countries for asphalt pavement technology. In late 1990, a 21-member study group representing the FHWA, the AASHTO, the National Asphalt Pavement Association, the Asphalt Institute, the SHRP, and the TRB toured six European countries.

One of the technologies that was brought back to the United States from the study tour was Stone Matrix Asphalt (SMA). It is an asphalt mixture developed in Germany to provide a rut resistant pavement surface layer. During 1991, SMA projects were constructed in Georgia (I-85), Michigan (M-52), Missouri (I-70), and Wisconsin (I-94). The FHWA has initiated an SMA demonstration project to further evaluate this asphalt mix.

Other international activities have included Integrated Highway Information System seminars in 10 European countries, including Eastern Europe and a presentation at the 1991 Conference and Exhibition of the Transportation Association of Canada (held in Winnipeg, Manitoba) about portland cement concrete technology,

including demonstrations in the FHWA's Concrete Technology Mobile Laboratory. The FHWA also has continued to support and participate in the planning of a major Pacific Rim Conference scheduled for 1993.

OTHER TECHNOLOGY COMMUNICATION

In addition to the technology transfer actions noted above, the FHWA continues to disseminate information through a number of technical publications and initiatives. As examples of the type of technical publication, permit me to use pavement design to illustrate some of our activities:

- Technical Paper 90-01, Technical Guide Paper on Subsurface Pavement Drainage was issued in October 1990.

- Demonstration Project 87, Drainable Pavement Systems, is being developed to promote improved drainage of portland cement concrete pavements.

- Technical Advisory 5040.30, Concrete Pavement Joints, was issued November 30, 1990. This advisory presented the state of the art in concrete joint design details. It was developed based on recently completed research with input from the States and industry.

- Technical Paper 89-04, Preformed Compression Seals, was issued September 11, 1989. This paper was developed in cooperation with the seal manufacturers, States, and contractors to describe the proper procedures for designing and constructing preformed joint seals. Preformed joint seals give outstanding performance when properly designed and installed. However, many seals were providing poor performance because of design and construction deficiencies caused by the lack of good instructions on proper procedures. This paper filled that void.

- The ride quality of portland cement concrete pavement has

been improved through the issuance of Technical Paper 88-03, A Selection of Measuring Equipment Used to Monitor and Enforce Rideability Specifications. Also, a workshop on the use of the profilograph to measure ride quality has been developed and is being presented.

- The Pavement Division has developed the FHWA Pavement Rehabilitation Manual. The manual provides the latest pavement rehabilitation techniques to the highway agencies. This manual is continually updated to reflect the current experience and research results.

- Pavement Design and Rehabilitation Teams provide technical assistance to the States. Teams are dispatched on request to provide advice on difficult or unusual pavement design and rehabilitation problems.

- Technical Advisory T5040.29. Paved Shoulders, was issued in February 1990. The technical advisory outlines recommended practices for the design of paved shoulders.

- Reviews have been made of new materials or techniques which have the potential for improving pavement performance. Reports have been distributed describing those techniques which appear to have promise. These have included: asphalt pavements with crumb rubber additives, new equipment for inserting dowel bars in concrete pavements, large stone asphalt mixtures, and silicone joint sealants.

- Technical Advisory 5040.27, Asphalt Concrete Mix Design and Field Control, was issued in 1988. The technical advisory sets forth guidance and recommendations relating to asphalt concrete paving. It covers the areas of materials selection, mixture design, mixture production, and mixture placement.

- By a February 16, 1988, memorandum, I directed each Division

office to initiate an effort to compare State practices to the Technical Advisory on Asphalt Concrete Mix Design and Field Control.

- Technical Paper 88-02, Prevention of Premature Distress in Asphalt Concrete Pavements, was also issued in 1988. This paper provided additional background information on some of the key points in Technical Advisory 5040.27.

- The revised regulation on pavement design policy, issued in 1989, required each State highway agency to implement a pavement management system within 4 years.

- Sponsored workshops on pavement management for the State and local highway agencies.

- Provided technical assistance to the State highway agencies in the development of pavement management systems.

CONSTRUCTION QUALITY EFFORTS

Development of new technology and its transfer to practitioners is only one part of the entire spectrum of actions required to build a quality product through the existing highway transportation delivery mechanism. Implementation of the collective technical expertise of all partners--Federal, State, local, and private sector--is required on a daily basis. The role of the FHWA in this relationship has been referred to as "stewardship," and that role has been changing.

- The FHWA's construction program stewardship is changing from primarily project level oversight toward a mix of project and process level oversight, thus placing the responsibility for assuring quality construction on a given project with the State highway agencies (SHA's). On November 12, 1991, the FHWA issued a memorandum to all its offices advising them of the "Statement of Operational Philosophy." The Statement reinforced the use of process review/product

evaluation procedures as the primary mode of operation but it also made it clear that other factors such as the level of Federal interest, technical complexity, local circumstances, risk management, etc., should be considered in determining the appropriate monitoring technique for an office.

- The FHWA has been discussing cooperative program oversight functions with the SHA's. The SHA's, however, are faced with the loss of highly experienced staff. They are looking for ways to extend funds for construction, and are carefully examining ways to utilize their staff and resources more effectively while maintaining a high level of quality. In the construction area, a major focus is on improved and more efficient inspection, sampling, and testing procedures.

- In response to these concerns, the FHWA has been actively promoting construction quality assurance programs consisting of involving contractors in formal quality control (inspection, sampling, and testing) programs, performance specifications utilizing statistical tools where appropriate, and effective State agency acceptance procedures. This concept has been around since the early 1960's, and the FHWA has had numerous training and technology transfer activities in this area. Emphasis by the FHWA in construction quality management has increased in the past several years.

- An effective quality assurance program should increase the quality of the constructed product by increasing the involvement of the industry in obtaining a quality effort, promoting innovation, and allowing the contractor to have more control over the construction procedure and schedule. In addition, the State's staff should be used more effectively by concentrating on quality assurance and acceptance efforts rather than process control. The overall program to place responsibility for providing quality

products with the contractor and putting responsibility for quality monitoring and acceptance with the owner is known as quality management (formerly referred to as quality control/quality assurance).

- Construction Quality Management (QM) is a broad term for the overall process of ensuring construction of quality products. It encompasses subjects of contractor process control, owner acceptance issues, personnel qualifications and training, information management systems, performance-related specifications, innovative contracting practices to achieve quality, incentive/disincentive provisions, performance recognition, improved materials/tests/equipment, and quality improvement techniques.

As an example of a National Quality Initiative, permit me to note the following:

- The FHWA Demonstration Project 89 (DP-89), "Quality Management Workshop," was held on December 12-13, 1990, to develop recommendations for future QM activities. Approximately 30 leaders in the QM field from State highway departments, academia, consultants, contractors, and industry associations were brought together to discuss this issue. The group recommended development of a national initiative on quality including an industry-wide national policy statement. The results of the workshop indicated an overwhelming support for a national focus on quality. The results and recommendations from the workshop were presented to both FHWA management and AASHTO. A steering committee has been formed to develop both a policy and associated training programs on this issue.

- Innovative Contracting Practices

  - In January 1988, a Transportation Research Board (TRB) task force was formed to explore innovative contracting practices

used by State highway agencies (SHA's), consultants, and construction contractors. The task force, identified as Task Force A2T51, Innovative Contracting Practices, is comprised of 23 representatives from all segments of the highway industry including contractors, consultants, trade associations, surety and bonding agents, academia, SHA's, and the FHWA.

- The task force subsequently requested that FHWA establish an experimental project on Innovative Contracting Practices, which could be used to evaluate and validate the task force findings. The FHWA in response, has initiated Special Experimental Project No. 14 (SEP 14), Innovative Contracting Practices.

- The objective of Special Experimental Project No. 14 (SEP 14) is to identify for trial evaluation and documentation, innovative contracting practices which have the potential to reduce life cycle costs to SHA's while maintaining product quality and an acceptable level of contractor profitability.

- Another initiative relative to innovative contracting practices has evolved as a result of the previously mentioned asphalt pavement study group tour to Europe in September 1990. The study group reviewed and evaluated foreign asphalt pavement practices. They were very impressed by what they saw, and in June 1991, published a report summarizing their observations. In the area of contract administration, the report proposes that three innovative practices observed in Europe be pursued through SEP 14. These include:

  - Functional contracts (design/build)
  - Warranties of riding surfaces; and
  - Lane rental

- All three of these innovative contracting practices are

eligible for trial evaluation under SEP 14. Both the use of design/build contracts and the use of warranties have already been proposed by several States and their work plans approved by the FHWA.

- The lane rental method (charges for lane closures), successfully applied in the United Kingdom (U.K.), is relatively new in the United States. By memorandum of April 2, 1991, Region and Division Administrators were provided general information on the several different forms of lane rental which have been developed and applied in the U.K. A number of States have indicated an interest. The FHWA has developed lane rental sample special provisions. They were distributed by memorandum of November 18, 1991, to all Regional Administrators.

- From the contractor's perspective, we think innovative contracting concepts can allow firms to enhance their management practices and thus better utilize their personnel, equipment, and expertise. This, in turn, will result in increased efficiency, contractor profitability, and improved quality of construction.

- The competitive bid process has served the highway industry well through the years. Therefore, in all innovative initiatives the FHWA will assure the competitive bidding process is maintained.

- Partnering

- The concept of "Partnering" is generating a lot of interest. Several articles have been published in national magazines and the AGC has recently distributed a publication on the subject. The intent of this concept is to create a cooperative team spirit, trust between team members, and a step-by-step joint issue identification and resolution process so that the number and contentiousness of disputes

are minimized and a quality product is produced.

- Partnering is a way of doing business with both the contracting agency and the contractor recognizing that they have common goals which can be achieved through cooperation and open communication.

- Partnering benefits the construction industry in four areas: quality, cost, time, and profit. Partnering charters/agreements have been initiated by State highway agencies and contractors on a number of Federal-aid highway projects.

- The partnering concept places an emphasis on cooperation rather than confrontation. The foundation of partnering is teamwork. Both the owner and the contractor's organizations have a common vision and responsibility to build the highest quality product on schedule, safely and within budget.

- Because partnering has the potential to be an effective tool for improving communications between the parties involved in constructing a Federal-aid project, the FHWA endorses the concept.

COORDINATION OF RESEARCH AND DEVELOPMENT

As the demand for new technology expands, and the resultant emphasis placed in research grows, it gives rise to the concern that the programs be coordinated and non-duplicative. To address this potential problem, the FHWA has taken a number of steps together with a variety of partners. As an example of recent efforts, our contract with TRB to assist in communication and coordination has resulted in the establishment of a high level committee which TRB has named the Research and Technology Coordinating Committee. This committee is composed of nationally recognized leaders that represent the State departments of transportation, academia, local government, the private sector,

and other special backgrounds and interests. It is anticipated that as they become knowledgeable of existing programs and needs their reports will focus on gaps as well as redundancies in research programs.

There are additionally a number of mechanisms both formal and informal which provide for interchange of information about existing and planned research activities. Examples include the FHWA's Nationally Coordinated Program (NCP), an annual compilation of all FHWA-funded activity, and the TRB TRIS computer file of completed and current research. Within the Department of Transportation a group known as the Research and Development (R&D) Coordinating Council provides a means of review of ongoing activities among the several modal administrations.

The recent passage and signing into law of the ISTEA addresses, in a comprehensive way, the issue of coordination through establishment of the National Council on Surface Transportation Research and the follow-on Research Advisory Committee.

In addition to the more formal councils, committees, and computer indexes are a number of forums in which those involved in highway research meet and exchange information. These range from large general meetings, such as the TRB Annual Meeting, to individual organization exchanges such as those between the FHWA staff, the Corps of Engineers, the Civil Engineering Research Foundation, and the national laboratories.

Mr. Chairman that concludes my testimony. Mr. Miller and I will be pleased to answer any questions you may have.