1995 RESEARCH AND TECHNOLOGY PROGRAM HIGHLIGHTS

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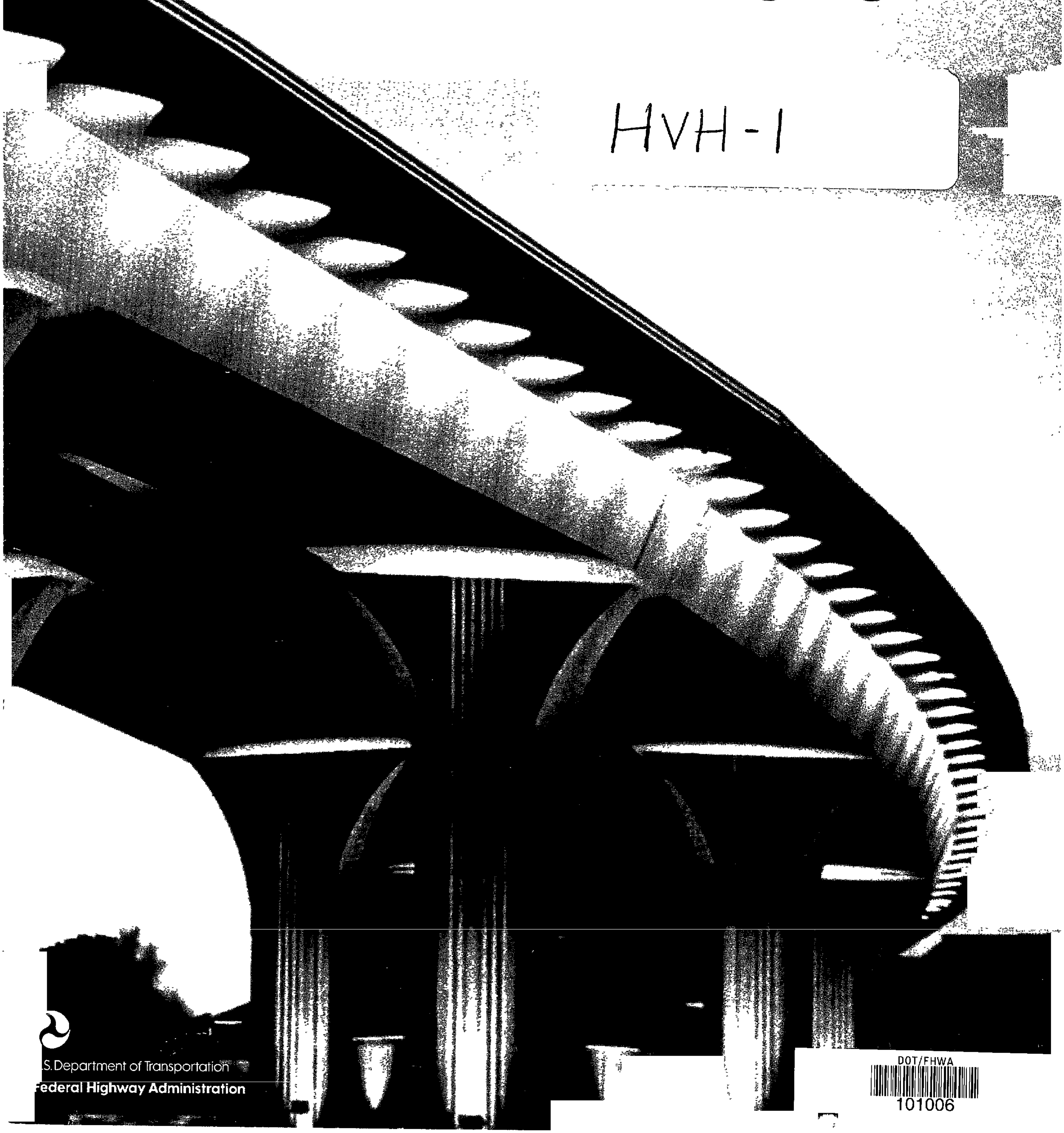
Federal Highway Administration

1995 Research & Technology Program Highlights

HVH-1



U.S. Department of Transportation
Federal Highway Administration

This report highlights the 1995 Research and Technology Program of the Federal Highway Administration. Information was gathered through interviews with key FHWA officials and staff. The quotes that appear in the text are their comments.

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Roads Better

There is a great

satisfaction in

building good tools

for other people

to use.

— Freeman Dyson , U.S. physicist

We opted for more practicality.

Tight budgets. Crumbling infrastructure. Downsizing. Against this backdrop, the Research and Technology (R&T) Program of the Federal Highway Administration (FHWA) made a choice.

We could look at the shortfalls, the needs, the problems. Or we could focus on the solutions — solutions that will both work today and position us for the long haul as well.

Was there really any choice to be made?

In fiscal year (FY) 1995, the R&T program opted for more practicality.

- We got much more selective about choosing our research areas. We looked for the high-payoff areas, the ones where we could really see results.
- We concentrated on technology application and technology transfer as areas for maximum payoffs.
- We sought to demonstrate that the technologies and priorities we selected were worthwhile and had intrinsic value — that we were spending taxpayer dollars on the right projects.

These three principles guided our FY 1995 work.

We adopted a "find it and fix it" approach.

There are 4.8 million kilometers of highways and 576,000 bridges out there. In the future, there still will be. Recognizing that fact, we tried to be more responsive this year to the need to find and fix the areas of premature deterioration so that we can prolong the system's life.

This "back to basics" approach aims to preserve and prolong existing infrastructure through nondestructive evaluation (one of the many tools that we have developed); the use of high-performance materials (like high-performance steel and concrete, and fiber-reinforced plastics); and the improvement of asphalt and concrete based on engineering properties.

We're also trying to make the right decisions now to carry us into the future. These decisions apply both in high-technology areas — such as getting metropolitan areas on board now for the Intelligent Transportation System (ITS) architecture of the future — and low-technology areas -buying tomorrow's rights of way at today's prices.

We deployed high-quality, useful products to our customers.

We're trying not to "sit on" our accomplishments, but to get them out there where people can test them, improve them, and — most importantly — use them. New technologies are being tested under the ITS program and the new Priority Technology Program, among others. In some cases, reliable old technologies are being replaced by new ones: Superpave, the asphalt pavement of the future, is one example. We're giving our customers greater opportunity to get a jump on tomorrow. Big changes are on the way: State and local transportation agencies will have a lot to do to keep up. And we're going to continue to help them and support them in their efforts.

Also, we established an outreach program and are visiting the States to determine their needs and to talk about what our program can offer. It's a way to show our customers that we're here to serve them.

We asked our customers to become our partners.

Some challenges are too big, too complex, or too removed for the Federal Government to be permitted blanket authority. So we have created and nurtured new partnerships with business, industry, academia, and other members of the private sector. Our ITS program reflects this commitment to partnership.

We reduced the number of our high-priority R&T areas. We didn't make this change in a vacuum, however, but called on our stakeholders to help us define our program.

We've also looked abroad for answers and partnerships. We've found both. Through scanning trips in Europe and Asia, we have seen unfamiliar technologies and practices in action and have tried to bring back the best of these for application in the United States.

We strove for quality.

We've done a lot of reassessments at all levels to make sure that everything we do in R&T — testing and evaluation, implementation, and deployment — is about making things better for our customers.

Recognizing that we spend too much time on administration and overhead activities, we've streamlined our contracting process — leaving our technical staff freer to do actual R&T work. We've come to rely on broad agency announcements that ask the potential contractors to give us their best thoughts on what we want and need.

We've done considerable work to try to get a handle on the effects of highway and infrastructure spending on employment.

Also, FHWA continues to be a major force behind the National Quality Initiative (NQI) effort. NQI is a partnership of the American Association of State Highway and Transportation Officials (AASHTO), industry, and FHWA to place a national emphasis — from all corners of the highway industry — on producing quality products.

Our year has been busy and successful; our strategies have paid off. We look forward to the challenges ahead.

Putting on the

Technology and research are ultimately good only if they're useful and used. This doesn't mean we should rush products out before their time or quit our forays into speculative research and development (R&D). What it does mean is that we have an end goal.

Our R&T program is dedicated to getting mature, usable products into our customers' hands. Moreover, we are committed to helping them see and exploit the full potential of these products, and we have created some intriguing deployment mechanisms to do this.

"Pure science and real-live problem solving form a continuum. On this continuum, our research program is closer to the problem-solving side."

If politics is the art of the possible,

research is surely the art of the soluble.

Both are immensely practical-minded affairs.

— SIR PETER MEDAWAR, British immunologist

Hot Technologies

"Our work is to help make roads better. So we have to get our technologies out the door, out to where people are needing them and using them."

An excellent example of this approach is the *LTPP* Roadmap. The Long-Term Pavement Performance (LTPP) program is essentially a data base.

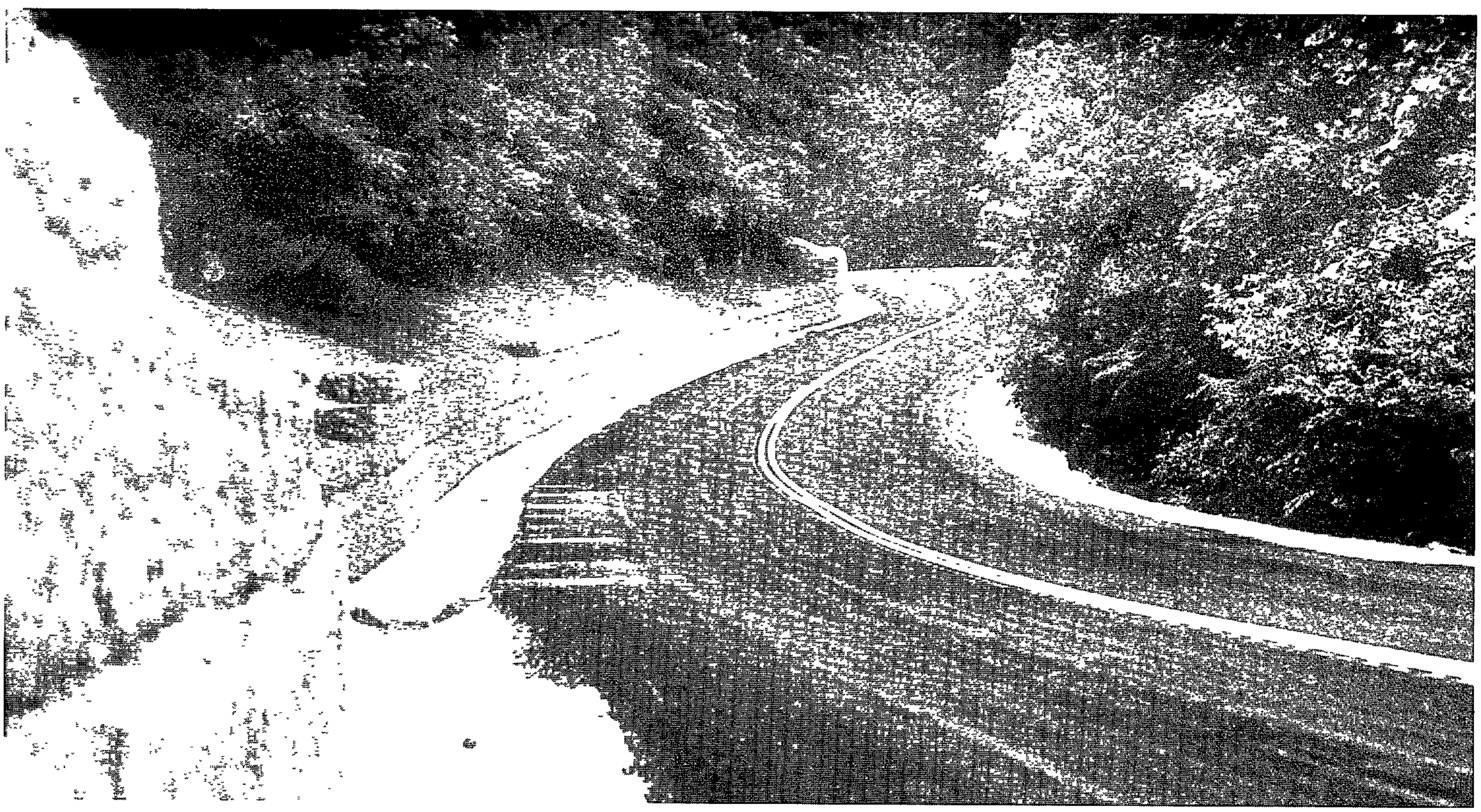
"If the LTPP data base were on disk and the disks were stacked up, you'd have eight and a half stories of data."

The LTPP data have been collected for 7 years from actual pavement sections around the country. They comprise countless observations about climate, loading, design, materials, construction, maintenance, and the environment.

"You can collect data forever, and it won't do any good. So we put together a roadmap of where we want to go with the data."

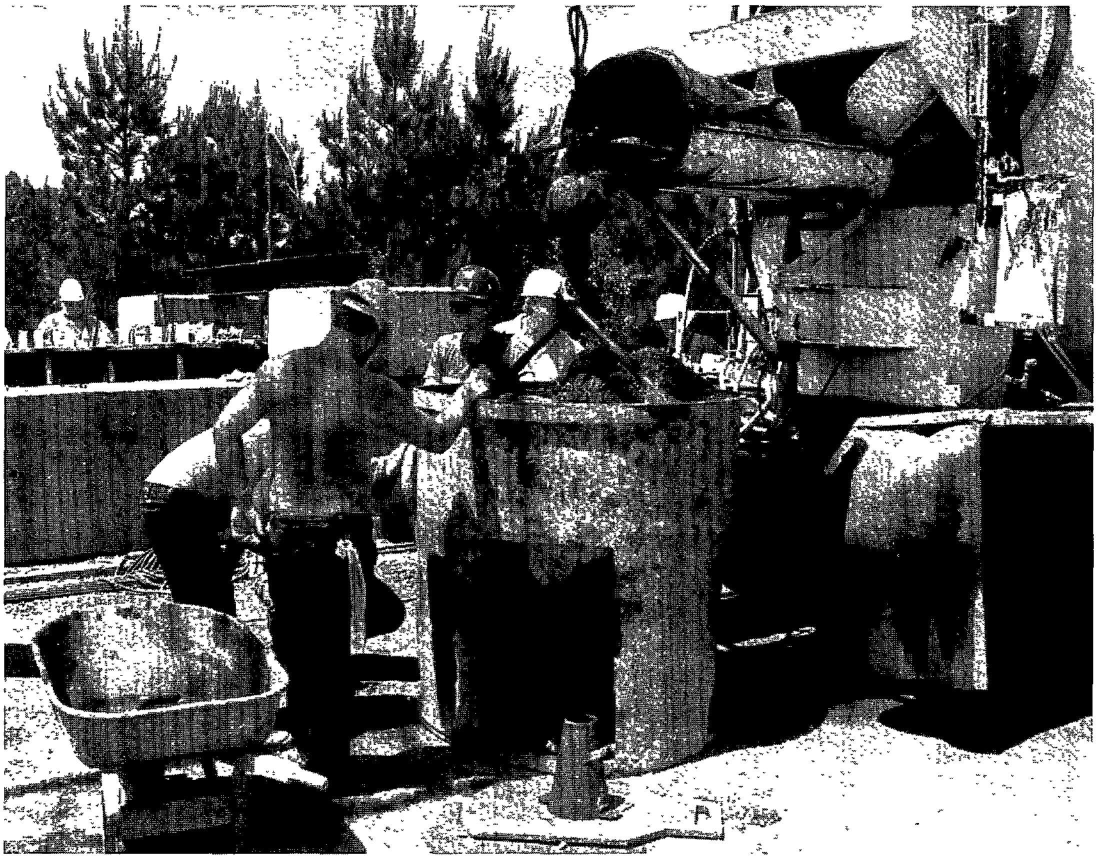
The LTPP *Roadmap* focused customers' attention on the potential locked in this program. And it gave them some keys to unlock this power. For instance, it gives them techniques for using the data base efficiently. It describes products that are available from the program. And it leads them to sophisticated analysis — all made possible by LTPP data — involving materi-

Taking pavement test data and using it.



als, loading, and environmental factors.

Complementing the Roadmap IS a new LTPP Products Catalog due out this winter. It describes the various software, models, testing procedures, guidelines, etc., available from the LTPP program. In addition, we have **10** active contracts producing still more LTPP products; these will be formally presented to the highway community at a national workshop next spring



Testing high-performance concrete for the Richlands Bridge project.

Superpave is another example of getting our research results literally "on the road." Superpave comes from the Strategic Highway Research Program (SHRP). Basically, it's a new design methodology for asphalt pavements, one that's based on both the conditions pavements are likely to face during their lifetimes as well as the performance of all the components that go into those pavements. Superpave lets the user design pavements that respond better to real-life conditions,

"You should get longer performance with Superpave, not because you're using some exotic new material — it's still just asphalt and aggregate -but because of a better understanding of pavement materials and tools. This understanding will let us optimize our materials, which should in turn lead to better performance."

Superpave technology and other research are moving toward making asphalt more predictive. For example, for 50 years, highway departments have used a Marshall hammer to compact the pavement mixes they use in mix design and to check samples. The Marshall hammer is a laboratory tool; it does not capture real-world compaction effects. Superpave, on the other hand, boasts a gyratory compactor that more closely simulates the action of a real pavement roller. It is also more consistent in its compactive effort than is the Marshall hammer. When your lab tools and methods more closely approximate what's happening in the field, you can predict performance more precisely. And, at a time when maintenance, repair, and rehabilitation dollars must be made to stretch even further over an aging infrastructure, prediction is the key to good management.

"Superpave is a collection of equipment, procedures, and specifications all tied together in a kind of cookbook."

Over the last 2 years, FHWA has been developing equipment specifications, buying Superpave equipment for the States, fine-tuning binder specifications, presenting hands-on training courses across the country for State and industry personnel, using the equipment on projects, visiting States in mobile labs, and establishing five Superpave regional centers. We are doing everything in our power to bring the States up to speed on Superpave technology. Also, we are taking steps to make Superpave be the method taught in universities.

"Eventually, SHIV's products will change the way the whole U.S. highway system is built. It's not a question of will it change; it's a question of when. Superpave is really the future of asphalt pavements."

And the future of long-lasting concrete pavements *is* **high-**performance concrete (HIT). Concrete strength and durability depend on the amount of water added to the mix. The more water, the lower the strength and the greater the permeability of the concrete. The more permeable the concrete, the more water and deicing salts can penetrate and cause damage. Two types of admixture are typically used in HPC to improve its strength and durability. The first is a "super plasticizer," which reduces the amount of water in the mix. The second is a mineral admixture such as fly ash or silica fume. These finely ground materials improve strength and reduce permeability through chemical reactions that fill pores in the concrete matrix.

We are working with the States and industry to introduce HPC into their new construction projects.

"*Engineers* are uncomfortable designing with something they're not familiar with, so this is an education process and a confidence-building exercise to show them that the product will work."

So far, there are five HPC projects under construction in four States. We are working closely with the State teams to help lead them to a new plateau of concrete strength and durability.

Sometimes, years of prolonged research culminate in a viable product. That's more or less the case with Superpave, SHRP, LTPP, and HPC. But sometimes, a technology just appears at the right time. That seems to be what's happening with the deep soil mixing technology being used in a section of the multibillion-dollar Boston Central Artery project.

Boston has some notoriously weak soils — clays, really. Usually, a soil stabilization technique like slurry wall construction would be used to help the clay support its own weight.

"But normal slurry construction would be extremely complicated here and therefore extremely expensive."

Instead, engineers are turning to a new technology — new to U.S. engineers, that is. Deep soil mixing is a method of stabilizing soft clay using augers and cementitious materials to ensure higher allowable shear strength. The technology is from Japan, where we have observed its effective use.

The bottom line is this: estimated cost savings from the use of deep soil mixing in this project are in the tens of millions of dollars.

Two computer-based products exemplify our commitment to creating useful products for our customers:

The Interactive Highway Safety Design Model (IHSDM) is a computer program that allows safety to be explicitly considered during the design process, rather than added later as an afterthought.

"That means that you can plan for safety from the start of the highway design process, rather than look at the plan later and say 'Now what do I need to do to make it safer?'"

This year, prototype vehicle dynamics and design consistency models for IHSDM were completed. The first model lets a designer "drive" different vehicles over a highway design and identify problem areas — for example, a design that might have a high potential for causing truck rollovers. With the second model, the designer can examine a design to identify areas where driver speeds are being affected in an inconsistent, and possibly dangerous, manner.

Highway Performance Monitoring System (HPMS) software, long available for use on a mainframe computer, is moving to a personal computing (PC) platform.

"HPMS will be accessible to a larger customer base, allowing many more people — especially at the State level — to use the data."

The HPMS program was written by dozens of people over more than a decade; it contains thousands of lines of code. We are not only "migrating" the code to a PC base, we are also looking at the way the program actually works to make sure that the new system can do what the old one did — and hopefully, do it better. The completed system should be finished during FY 1996.

Another high-tech effort we got on the roads this year was a set of four field tests in which police officers were equipped with various new technologies to collect accident data. The technologies used include global positioning systems, geographic system maps, and pen-based computer techniques.

"The project's objective is to see what happens in the real world when the officers try to collect data with these devices. How long does it take to collect data? How much time is saved by using these devices? How precise are the data? What institutional issues need to be addressed to get this technology on board?"

The effort began in the summer of 1995. The four State agencies involved are very enthusiastic about the tests; we all look forward to the findings due out next year.

Cool Mechanisms

A big responsibility for us is making sure that research and technology developed in the field are publicized and deployed.

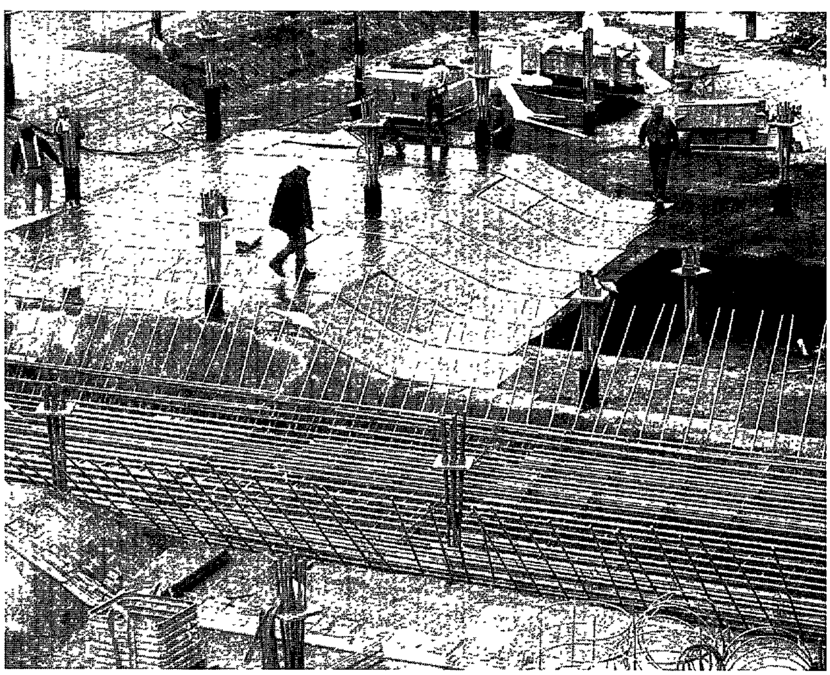
One highly successful mechanism for accelerating the development of market-ready new technologies from and in the field is our **Priority Technology Program (PTP).**

"The concept is great: FHWA gives seed money for a field-based technology transfer program."

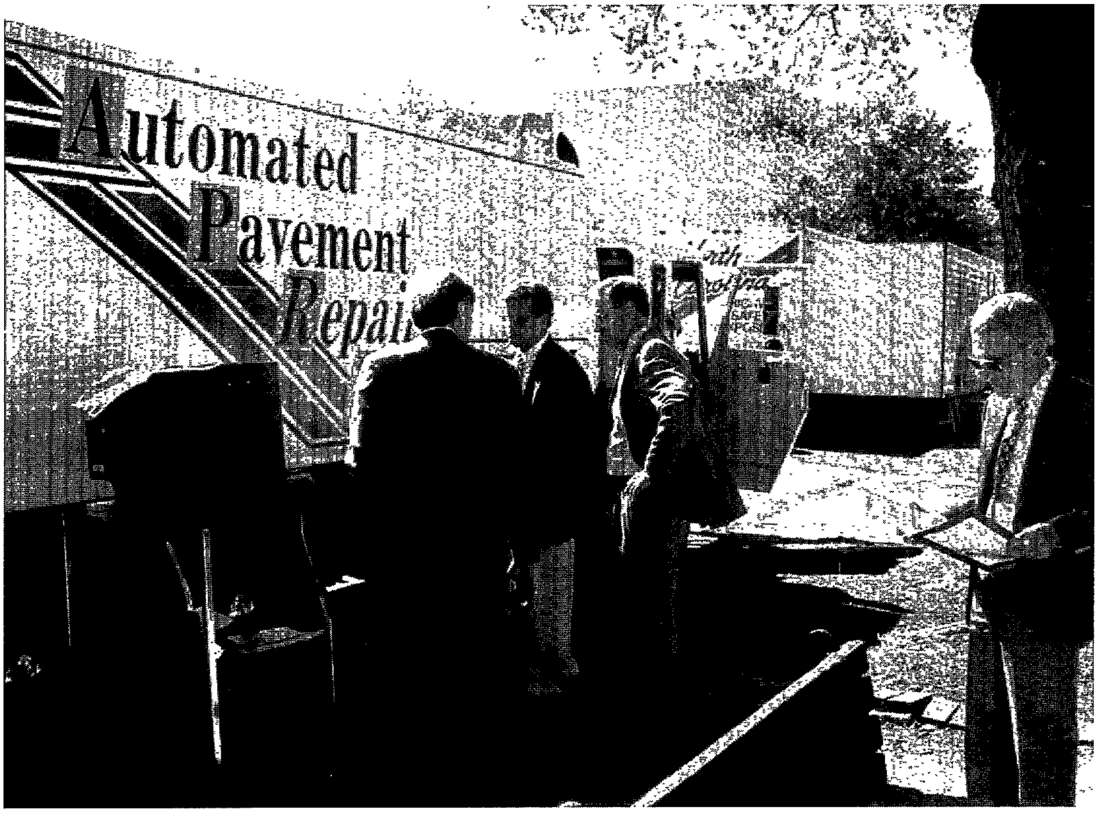
This unique new program, guided and developed by field staff, was funded in FY 1995 at $2 million. Our request for candidate technologies yielded over 100 project proposals, from which we selected 32. Project topics include the use of composite materials in structures, evaluating light-emitting diodes in traffic signals, and developing and deploying a new skid-resistant material now used only in the space program.

"The whole idea behind PTP is that we're getting out there and trying new things."

Technology won't be deployed if people don't know about it. We have devoted considerable time and resources to developing effec-



Constructing the Boston Central Artery.



Developing new ways to repair pavement using SHRP technologies.

tive ways to let people know about our latest research and technology efforts. In FY 1995, we initiated Technology Development Teams.

"We have people that take the products that are ready to be tested and evaluated and deliver them to the customers. Before, we had nice technologies that just sort of sat on the loading dock. Now, we're helping the customers take it off the dock and into their offices."

The teams demonstrate the products and technologies and work with field personnel to make sure that they "get it."

SHRP showcases are based on a similar "show-and-tell" concept. We had 12 such showcases around the country this year. They exhibited and explained such recent SHRP technologies as evaluating and improving on concrete performance, and formulating regional implementation plans for deploying and evaluating the technology. This coming year, showcases will feature preventive maintenance, winter maintenance, and snow and ice removal.

"The showcases let us go one-on-one with the State people. We can show them what we have and show them how to use it. Sometimes we give them a prototype to try out. For their part, they get to see and touch and use the product."

The SHRP showcases have been very successful. This year, we took showcases to England and Canada. We plan to take them to South America as well as to various U.S. States next year.

Training is another method we use to get our research and technology successfully deployed. Traditionally, our training has been developed and delivered by the National Highway Institute (NHI).

In FY 1995, NHI — on behalf of the FHWA and the 50 State departments of transportation (DOT's) — signed up as a lifetime member of the **National Technological University** (NTU) network. Plugging into this network expands our opportunities to disseminate our training materials and lets us participate in NTU's own educational offerings. These include master's degree programs in about 15 science and engineering fields, offered electronically through NTU affiliates, which are among the Nation's leading engineering schools (e.g., Georgia Tech, Michigan State, Purdue, Stanford, etc.).

In addition, NTU provides about 1,000 short courses per year intended to update knowledge within a specific technical discipline. The several transportation courses offered via the network represent a wonderful resource for our field and headquarters personnel. In time, we hope to broadcast our own courses — maybe about a dozen a year — over the NTU network.

Currently, we have NTU downlink sites at our Turner-Fairbank Highway Research Center and under development in six States; two more will be hooked up soon.

This year, we also stepped up our training on the new Load and Resistance Factor Design (LRFD) for bridges by using teleconferencing. Over a period of 2 months, about 1,500 students across the country were trained in the new design. The course was delivered by satellite and allowed instructors and students to interact (rather than being a "talking heads" type of delivery). If we'd done this training the old-fashioned way, it would have taken about 2 or 3 years to deliver the information to classes of 40 students each.

Besides our teleconferenced training and participation in the NTU network, we are involved in other alternative training mechanisms. We have just installed videoconferencing equipment at FHWA. Also, we are definitely moving toward a fair amount of computer-based training — interactive CD's, CD-ROM's, software, etc. We have an electronic bulletin board and are investigating how best to use the Internet, including news groups and the World Wide Web.