X: Superpave Implementation Activities

Even before the SHRP research began, it was recognized that a “program designed without taking into account obstacles on implementation of research will fail,” in TRB Report 202, which proposed the development of the Strategic Highway Research Program. Eventually, more money will be spent on the implementation of the SHRP products than on the research itself.

This section will discuss some of the activities surrounding the implementation of Superpave. Many of the Superpave implementation programs and activities are interrelated, and this text may reference some activities before they are fully explained. By the end of the section, the activities will be fully described, and the reader should know where any necessary help could be obtained.

FUNDING AND PLANS

Although the 5-year, $150 million SHRP program did not end until March 1993, planning for implementation had started well before that date. Funding and leadership for SHRP implementation was officially established on December 18, 1991, with the signing of the Intermodel Surface Transportation Efficiency Act (ISTEA). ISTEA allocated a total of $108 million to FHWA to implement the products of SHRP and to continue the Long Term Pavement Performance (LTPP) Program.

The strategic plan for implementation of all of the SHRP products is described in “Implementation Plan - SHRP Products”, June 1993, FHWA-SA-93-054. The SHRP implementation plan describes the internal and external organizational structure, partners and partnerships, purpose, roles, implementation mechanisms, and support functions that are used to accomplish the FHWA Implementation Program. It also details the framework under which the various entities function in carrying out this mission.

The development and execution of national implementation plans for specific products or groups of products is accomplished through four Technical Working Groups (TWGs):

Asphalt
Concrete and Structures
Highway Operations
Long Term Pavement Performance

The initial meetings of these TWGs were held in the summer of 1993.

The implementation plan for the asphalt program is described in “Strategic Highway Research Program Asphalt Research Output and Implementation Program”, September 1993, FHWA-SA-94-025. For more recent information and the current status of the Superpave Asphalt Implementation Program, contact:

<u>Asphalt TWG</u>

Chairman	Don Steinke	Highway Operations	202-366-0392
Secretary	John D’Angelo	Engineering Applications	202-366-0121

The complete Superpave System incorporates over 25 individual SHRP asphalt research products. It includes performance-based asphalt binder specifications, tests, and testing equipment; performance-based asphalt-aggregate mixture specifications, design, analysis, tests, and testing equipment; protocols for the use and handling of modified asphalt binders; and software that incorporates all elements into an asphalt pavement mix design and analysis system. Superpave was officially turned over to the FHWA for implementation in the spring of 1993.

FHWA IMPLEMENTATION ACTIVITIES

To provide a forum for the SHRP researchers to present the research and development results and to review the decision-making processes that took place, FHWA sponsored a SHRP Asphalt Technology Conference in Reno, Nevada. This technical forum, held October 24-28, 1994, served as a foundation for the many future implementation efforts. Since that initial forum, several additional conferences have been held across the US to continue providing a means of implementing Superpave technology.

FHWA has a series of initiatives underway that will provide assistance to State Highway Agencies and the asphalt industry in the implementation of the Superpave System. The FHWA implementation activities for asphalt actually began in 1992 and are projected to continue until the end of the decade. The program includes six major initiatives and numerous related projects:

Technical Assistance Program
Superpave Pooled-Fund Equipment Purchase
National Asphalt Training Center
Superpave Regional Centers
Mobile Laboratory Program
Research Activities

Superpave Technology Delivery Team

To serve as a focal point for all Superpave implementation activities, FHWA formed the Superpave Technology Delivery Team (TDT) using representatives from various offices. This team will provide leadership, coordination, and support for the many initiatives and staff involved in Superpave implementation. For more information, contact:

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Technical Assistance Program

To implement a new technology, the industry must be familiar with it and comfortable with all of its many aspects. In 1993 and 1994, FHWA purchased five sets of the Superpave binder test equipment and loaned the equipment to the five newly-formed regional asphalt user-producer groups. This early trial period served to introduce the equipment to the asphalt industry and provide preliminary training for the tests. The user-producer groups typically placed this equipment in their associated Superpave Regional Center. During this period, equipment refinement continued, resulting in the final specifications of the Superpave binder equipment. There was significant redesign of all of the protocols, especially for the PAV, DTT, and SGC.

The asphalt user-producer groups consist of representatives from state, federal and local agencies (users) and material producers and suppliers (producers). By having a forum where each group can present their views on very complex issues, the points of view of all sides can be understood, and resolutions can be more easily reached by balancing the needs of all parties.

Under TE Project 39, *Superpave Asphalt Support Services*, engineers and technicians are available through several sources to assist the states and industry in setting up equipment and conducting preliminary training. This assistance includes workshops and mini-classes; equipment installation assistance, operation, and data collection; field tests (SPS-9); data analysis; and a variety of other activities.

FHWA support staff have visited several states to provide training and technical support:

Missouri	Rhode Island	Massachusetts	District of Columbia
Delaware	Maine	Arizona	Arkansas
Indiana	Kentucky	Michigan	North Carolina
Washington	Montana	Minnesota	South Dakota

Several states have had difficulty setting up and operating some of their binder equipment. The same FHWA support staff have worked with many of the DOTs and manufacturers to try to resolve these problems and ensure that each state has properly operating equipment.

Technicians were also involved in conducting the ruggedness testing of the binder equipment. Several engineers and technicians from private laboratories have also been trained at the FHWA Office of Technology Binder Lab at the Turner-Fairbank Highway Research Center (TFHRC).

Pooled-Fund Equipment

In February 1992, SHRP accepted the research recommendations for the accelerated performance tests (APT). In March 1992, FHWA, working with Draft Number 6 of the asphalt binder specifications, initiated the planning of the Highway Planning and Research (HPR) pooled-fund Superpave equipment purchase, after a joint meeting with the State Materials Engineers. The states had agreed to pool a portion of their Federal-Aid research money to purchase sets of testing equipment for the Superpave binder and mixture procedures. The original plan included these eight pieces of laboratory equipment:

Binder Equipment :
- Pressure Aging Vessel (PAV)
- Rotational Viscometer (RV)
- Bending Beam Rheometer (BBR)
- Dynamic Shear Rheometer (DSR)
- Direct Tension Tester (DTT)

Mix Equipment :
- Superpave Gyratory Compactor (SGC)
- Superpave Shear Tester (SST)
- Indirect Tensile Tester (IDT)

The original estimate for the pooled fund project was $335,000:

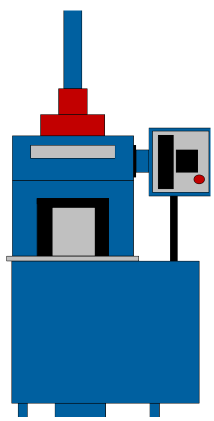
$98,000 for binder equipment
$227,000 for mix equipment
$10,000 for training

All of the pooled-fund asphalt binder equipment, except the DTT, has been delivered to the 52 participating highway agencies. Based on this purchase of equipment, the expected cost for a laboratory to buy a complete set of binder equipment is approximately $85,000:

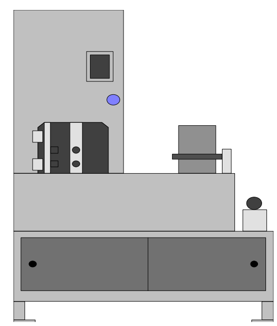
PAV	$10,000
RV	$5,000
DSR	$25,000
BBR	$20,000
DTT	$25,000

These costs are estimated based on individual purchases of each piece of equipment. The possibility exists for savings in a multiple purchase agreement. Any additional options desired to accompany the equipment would obviously increase the cost.

The pooled-fund buy for the DTT is on hold until new equipment, test procedures, and specifications are developed. A new prototype for the DTT was delivered in January 1996 and a preliminary evaluation has been completed. The new equipment can perform all the required functions and it has proven that repeatable results can be achieved. Five more units are being purchased prior to executing a general pooled-fund buy and these units will be used for ruggedness testing and resolving any questions about the accuracy of the test procedures.



The pooled-fund purchase of the SGC is complete; all 52 participating highway agencies have taken delivery of their first device. At the time, there were two manufacturers of the SGC. Several other manufacturers are now producing suitable SGCs. The typical cost of a SGC is about $25,000.



Due to the complexity, cost, and technical uncertainty of the SST and IDT and the need to use the Superpave software to analyze the output of the test equipment, the initial buy was restricted to one first article of each along with an additional five units each. The first article testing was completed in 1995 at the FHWA TFHRC. The remaining units were loaned to the five states with the Superpave Regional Centers and installed in their laboratories.

Since January 1996, the devices have been delivered and set-up and preliminary testing and evaluation of the equipment, procedures, and test output data has been conducted at TFHRC and the Superpave Regional Centers. The procedural ruggedness testing of all twelve units (six SST and six IDT) and the test methods has been underway since November 1996.

There is continued interest in developing a less sophisticated shear tester that would have less capability (confinement pressure) along with a smaller purchase price. However, the current SST will be fully evaluated prior to the final development of a simplified version for the states.

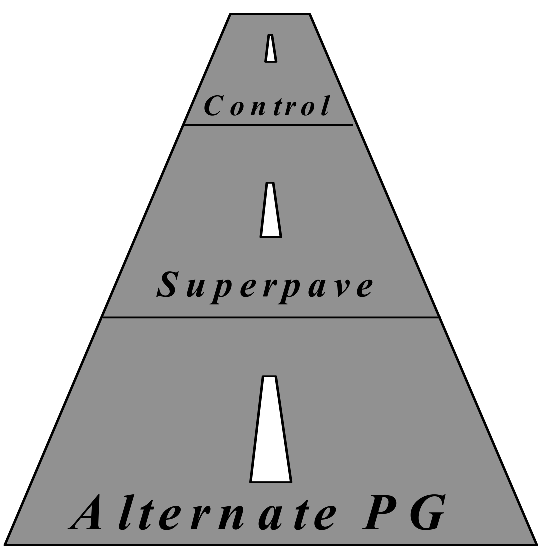
Long-Term Pavement Performance

Part of the SHRP research included the Long-Term Pavement Performance (LTPP) program. The LTPP program involved developing pavement monitoring and management tools for testing and evaluating the performance of in-place pavements. A major portion of the LTPP program was the selection and testing of hundreds of General Pavement Study (GPS) sites across North America. These GPS sites represented all types of pavements, climates and soil conditions, in an effort to analyze the hows and whys of long term pavement performance.

In 1993, the FHWA assumed the management of the LTPP. The experimental project selection and development, data collection and analysis, and information sharing will continue into the next century. The design and construction of Specific Pavement Study sections (SPS-9) will be used to validate the Superpave binder selection criteria, mix design requirements, and the mix analysis predictions.

The original SPS-9 experiment has been split into two separate, yet related studies :

SPS-9A, Superpave Binder Specification and Mix Design
SPS-9B, Pavement Structural Factors and Reliability of Performance Prediction



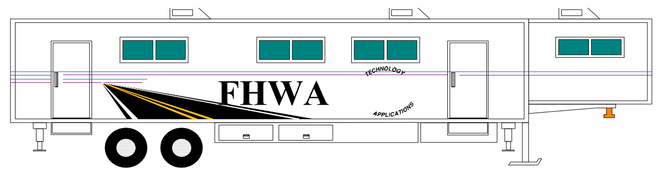
By dividing up the experiment, it allowed the first part to begin while the second part was still being formulated. The data collection can also be more easily managed. For the complete SPS-9A experiment, it is hoped to have 32 test sites with three test sections at each site. Each test section is a minimum of 305 m long; half of that will be for monitoring performance, the other half will be for drilling and sampling. A 31-m transition section will be constructed between each test section. The three test sections are intended to represent these conditions:

Control: designed and built using State's conventional specifications
Superpave: designed using Superpave PG binder and mix design
Alternate PG: designed using Superpave PG (one grade shift) binder and mix design

The SPS-9B experiment is being developed as the FHWA Superpave Support and Performance Models Management contract progresses.

Mobile Lab Program

Since 1987, the FHWA has had a mobile asphalt laboratory program, which has provided assistance in volumetric mix design and quality control of mixes at the plant site. This program was expanded in 1992, and two new mobile laboratories have been equipped to bring the principles of the Superpave volumetric mix design to the construction site. This effort was the first introduction of the concept of field management with volumetric mix design. At each project, there are two objectives:



1. Current mix is tested to Superpave standards.
2. A full independent Superpave mix design and analysis is performed.

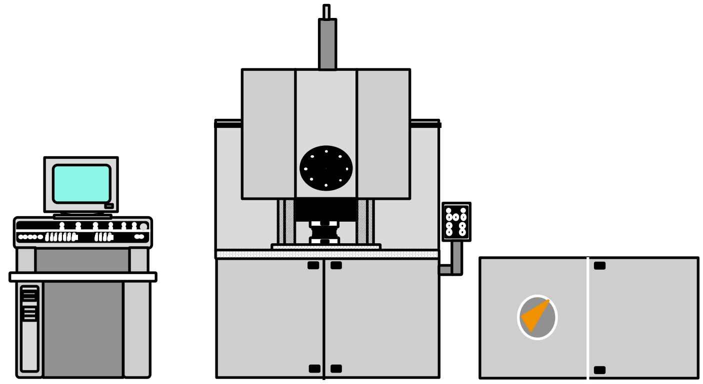
At each site, the mobile lab personnel offer to hold a one- or two-day workshop. The workshop covers an introduction to the Superpave specifications and procedures for volumetric mix design. The two demonstration trailers are equipped with a Superpave Gyratory Compactor. The first priority of the mobile labs are supporting the mix design activities involved with the SPS-9 studies. One of the trailers supported the construction of WesTrack, the test track for the Performance Related Asphalt Specification near Reno, Nevada. The trailer developed the Superpave mix designs and also assisted in the construction quality control testing for the track. These personnel have also been used to compare the results of different SGCs and operators with the same mixes.

A third trailer is equipped with a full set of the Superpave binder equipment and is available to provide states with technical support.

NATC

In September 1992, FHWA established the National Asphalt Training Center at the Asphalt Institute in Lexington, Kentucky. The primary activities of the NATC were to develop training materials for hands-on laboratory courses in Superpave asphalt binder testing and volumetric mix design. Hundreds of participants, representing State DOT, industry, university, and FHWA, received training in one-week Superpave Binder and Superpave Mix Design courses. As an additional part of the NATC activities, the Superpave Gyratory Compactor ruggedness experiment was conducted to establish sources of test procedure variability. These test data were later used to revise a few of the tolerances of the AASHTO provisional method, TP4, *Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the SHRP Gyratory Compactor.*

A second contract (NATC II) was established in September 1995 with the Asphalt Institute (AI) to continue the Superpave training and to provide on-site technical assistance and laboratory testing for the next five years. This contract included the development of additional training materials and courses for Superpave Mix Analysis, as well as coordinating with the Superpave Regional Centers in performing the ruggedness experiment(s) on the various test procedures of the Superpave Shear Tester (SST) and the Indirect Tensile Tester (IDT).

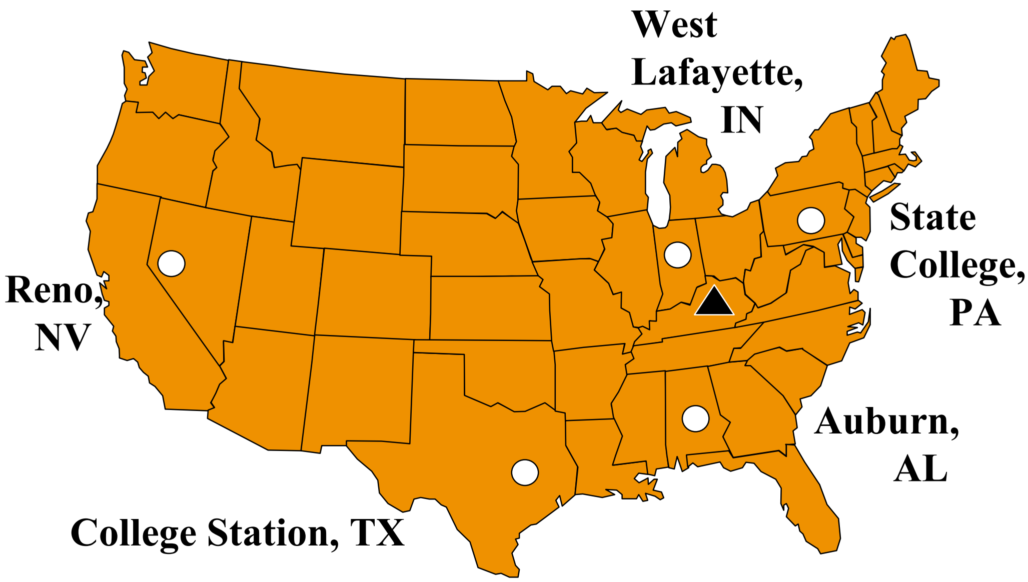


AI has also conducted numerous specialized implementation activities, under this contract including:

- Reevaluation of the N_{design} Compaction Levels
- Comparison of Superpave Gyratory Compactors
- SST and IDT Evaluation of Various PG 76-22 Binders
- Comparison of Bending Beam Rheometers
- RAP Extraction Comparisons
- Examination of PG Blending Charts for RAP
- Measurement of Moisture Content and the Effect on Tenderness in Superpave Mixes

Superpave Regional Centers

Five Superpave Regional Centers were established in 1995 to provide technical leadership and assistance on a more-localized, regional basis for the implementation of Superpave. The Centers are tasked to evaluate Superpave equipment and procedures and help the State highway agencies put the technology into practice. They provide another source of hands-on training and experience for engineers and technicians in the area. The Superpave Regional Centers, shown below, have a working relationship with a local university and have established a detailed operations plan with them and the surrounding states. All of the Centers have strategic plans and advisory boards to implement Superpave in the U.S.



Superpave Models

During 1992, FHWA recognized the need to complete development of Superpave performance prediction models and revise the initial version of the Superpave software. In 1995, the Superpave Support and Performance Models Management contract was awarded to the University of Maryland. A long-term program is being planned to eventually develop the final performance models based on the revised system framework to be established under this contract.

WesTrack

To accelerate the validation of the Superpave Mix Design method and to develop performance parameters for Performance Related Specifications (PRS) for asphalt pavements, FHWA awarded a contract to the Nevada Automotive Test Center in September 1994. An accelerated test track facility, "WesTrack," was completed in November 1995 about 100-km southeast of Reno, Nevada.

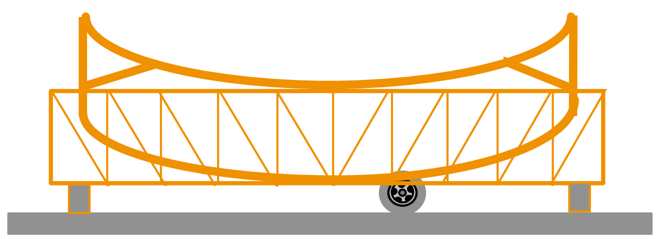
The 2.9-km track includes 26 test sections to evaluate the effect of variations in binder content, gradation, and density on the Superpave Mix Design System. Four sections were designed by strictly following all of the Superpave recommendations. Both a coarse gradation, made from crushed gravel and local natural sands, and a fine gradation, made from all crushed material, were used on the track. Another fine mix included three percent additional dust (minus 0.075 mm) material. Three levels of binder content (optimum, optimum -0.7 percent, optimum + 0.7 percent) and three levels of in-place air voids (4, 8, and 12 percent) were evaluated.

An automated vehicle guidance system was designed and installed in March 1996, and four heavily loaded triple-trailer driverless trucks began trafficking at 65 kph for 15 hours each day. As planned, the track will be subjected to ten million equivalent single axle loads (ESAL) in two years. The initial traffic on the track was applied with very little lateral wander, which is unrealistic compared to actual highway conditions. This "wheel tracking" was later modified. By September 1996, approximately one million ESAL had been applied and several test sections were experiencing various degrees of rutting. As expected, the sections placed with the highest binder content exhibited the most severe deformation. These distressed sections were rehabilitated, and some of the replacement sections also failed.

A number of cores were obtained and various tests have been conducted to examine the causes of the premature rutting. Early findings indicate that the size of the aggregate is not as critical as the angularity, shape, and texture quality of the particles, when the pavement is being asked to endure heavy traffic. The findings of the investigation are reported in *Performance of Coarse-Graded Mixes at WesTrack – Premature Rutting.*

Accelerated Loading Facility (ALF)

An Accelerated Loading Facility (ALF) is a mobile testing device that applies truck traffic loadings to pavement test sections. Much like the automated trafficking at WesTrack, an ALF can apply a concentrated number of loadings in a short period of time. The FHWA has an ALF at the Turner-Fairbank Highway Research Center.



The pavement sections for the ALF at TFHRC were reconstructed to isolate and evaluate Superpave binder effects on specific types of mixtures. A second ALF has also been delivered to further expedite the testing. Five different PG binders (52-34, 58-28, 64-28, 82-34, and 70-22) and two different gradations (19 mm and 38 mm maximum aggregate size) are included in this experiment.

The initial testing for the rutting and fatigue experiment is now completed. Future testing will be conducted on sections at differing temperatures to explore this effect.

NCHRP Studies

The National Cooperative Highway Research Program is a program administered by the National Academy of Sciences and funded by the individual states to investigate research needs identified by the state highway and transportation departments. NCHRP has several projects related to Superpave implementation and validation. The results of these studies are reported elsewhere.

Expert Task Groups (ETG)

Expert Task Groups (ETGs) have been formed to provide technical guidance for the activities of the Technical Working Groups (TWGs). Three ETGs support the Asphalt TWG: the Binder ETG, the Mixtures ETG, and the Models/Software ETG.

The Binder ETG reviews issues related to the AASHTO provisional binder specifications and test methods. A number of issues are being considered, including:

Alternative binder fatigue criteria
New Direct Tension Tester and modification of criteria
Revisions necessary for testing modified binders
Revision of the low pavement temperature calculation
PG asphalt binder supplier certification system

The Mixtures ETG reviews issues related to the AASHTO provisional specifications, test methods, and practices related to mix and aggregate. A number of issues are being discussed, including:

Objectives of the gradation restricted zone
Refinements to gradation control points
Fine aggregate angularity test and level of criteria
Gyratory Compaction Levels (N_{design})
Short-term oven aging duration
Incorporation of Reclaimed Asphalt Pavement (RAP)

The Software/Models ETG reviews issues related to the AASHTO provisional test methods related to mix analysis; the various material, structural, and performance models; and the framework for the Superpave software. Ideas being discussed include:

Modeling of rutting
Modeling of fatigue
Characterization of material properties
Modeling the lower layers of the pavement structure
Need of a reflective cracking model
Form of traffic load input
Data necessary for field verification
Content of Superpave software

Lead States Pool of Expertise

With the goal of shortening the learning period for others, a “Lead State” initiative was advanced in 1996. The objective of AASHTO and the FHWA was to form teams of people from states that had lots of experience using a particular SHRP product or technology. A team of lead states with Superpave experience agreed to share what they had learned from implementing the Superpave technology. Engineers and technicians from the six Superpave Lead States (Florida, Indiana, Maryland, New York, Texas, and Utah) are available to provide technical support and assistance, by telephone, regarding binder testing, mix design and analysis, and construction. This program will end in 2000.