U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
Pavement Performance Division
Long-Term Pavement Performance

SPECIFIC PAVEMENT STUDIES
CONSTRUCTION GUIDELINES FOR EXPERIMENT SPS-9A
SUPERPAVE™ ASPHALT BINDER STUDY

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SPECIFIC PAVEMENT STUDIES
CONSTRUCTION GUIDELINES FOR EXPERIMENT SPS-9A
SUPERPAVE™ ASPHALT BINDER STUDY

INTRODUCTION

This report describes the guidelines for the construction of test sections for the Specific Pavement Studies' SPS-9A experiment, SUPERPAVE™ Asphalt Binder Study. These guidelines have been developed by Federal Highway Administration Long Term Pavement Performance Division (LTPP) in cooperation with federal, state, and provincial highway agency personnel. The recommendations of the participants and comments by other highway agency personnel are incorporated in the guidelines outlined in this report. These guidelines will help participating highway agencies develop acceptable construction plans for test sections for this experiment.

The SPS-9A experiment, SUPERPAVE™ Asphalt Binder Study, requires the construction of multiple test sections with similar details and materials at each of 32 sites distributed throughout 32 geographical locations representing specific combinations of average temperatures, temperature extremes, and moisture conditions. The experimental design and construction considerations for this experiment are described in the document, "Specific Pavement Studies: Experimental Design and Research Plan for Experiment SPS-9A, SUPERPAVE™ Asphalt Binder Study," August 1994, revised January 1995. The experiment has been developed as a coordinated national experiment to address the needs of the highway community at large. Therefore, it is important to control construction uniformity at all test sites to reduce the influence of construction variability on test results. Consequently, the construction guidelines that have been developed must be followed by all participating highway agencies to accomplish the desired objectives of the experiment.

OBJECTIVE

The objective of this document is to provide guidelines for preparing and constructing SPS-9A test sections to maximize uniformity of these procedures across all projects. More specifically, the objectives are:

- To review the major construction features of the SPS-9A experiment test sections.
- To describe the details of the different experimental levels of the test sections.
- To provide guidelines for pre-overlay repair treatments for test sections built as part of rehabilitation of existing flexible or rigid pavements.
- To provide guidelines for asphalt concrete materials and mix design and quality control procedures.
- To describe the general construction operations and as-built requirements.

This is a materials related study requiring additional care and documentation of the materials aspects of construction. As such, the participating agency will be required to provide a written quality control/quality assurance plan to assure the materials used in construction meet experiment requirements and maintain consistent properties during construction.

EXPERIMENTAL DESIGN

The combinations of experimental factors are illustrated in the experimental design shown in Table 1. The experiment design calls for 3 test sections to be constructed at each project site. There will be a total of 32 projects in the experiment, indicated by the unshaded cells in the table. The test sections in each project must include a participating agency mix design (Test Section 01), SUPERPAVE™ mix design (Test Section 02), and alternate SUPERPAVE™ mixture utilizing a different asphalt binder having a performance grade chosen to provide early distress (Test Section 03). The mixtures being compared shall be used in the surface course and may also be used in the binder course. The mixes must be used in the same layers in each test section in a project. The assigned test section numbers are reserved, any supplemental test sections constructed at a project must use numbers 59 and higher for identification. This numbering scheme is intended to provide a unique number for each type of test section in the experiment, based on the particular attributes of that section. Future identification of the sections and data specific to those sections will rely on the uniform approach to numbering presented here.

Each participating agency must construct the conventional mix section, the SUPERPAVE mix section, and the SUPERPAVE alternate binder test section but may also construct additional supplemental test sections, at their discretion. It is recommended that a second group of sections be constructed at the same site as a replicate, to take advantage of the same moisture and temperature conditions and construction effort.

TEST SECTIONS

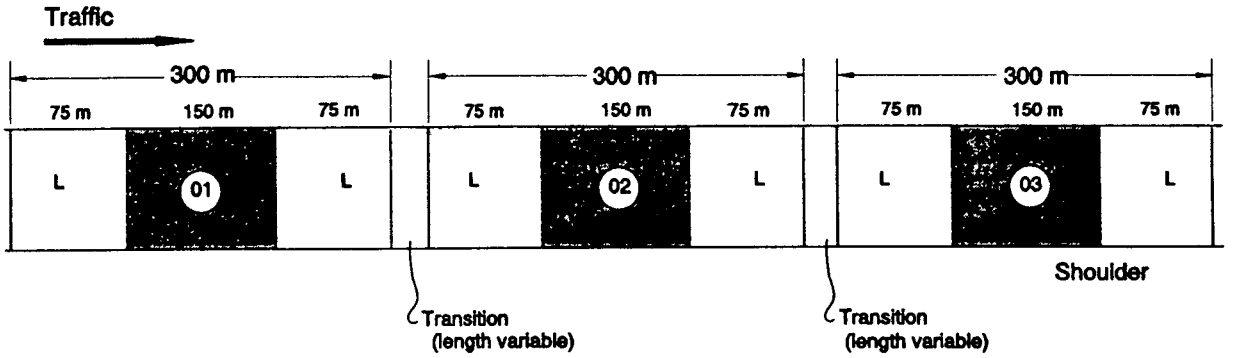
All projects in SPS-9A must conform to the criteria contained in the FHWA-LTPP "Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS-9A, SUPERPAVE™ Asphalt Binder Study," August 1994, revised August 1995.

The asphalt surface materials required for the different test sections are illustrated in Figure 1. Test Sections must be constructed as uniformly as practical over a minimum length of 300-m. A minimum length of 75-m is required on each end of the 150-m long monitoring portion of the test section to allow for pre-construction and post construction material sampling to support the materials characterization laboratory testing requirements including the long-term coring needs for evaluating the performance of the asphalt materials using the SUPERPAVE performance testing protocols. Quality control and quality assurance activities are of critical concern in this experiment. Sufficient plant production should be provided to ensure acceptable uniformity and consistency in asphalt concrete mixture delivered and placed. This requires a minimum of one asphalt tanker load (approximately 410 metric tons of mix). Test sites that use 9,000 metric tons of mix or more using the SHRP Binder grades will receive priority in coordinating the availability of FHWA SHRP Asphalt trailer and NCHRP 7-9 quality control assistance. Assistance in design of SUPERPAVE™ mixes will also be provided.

Table 1. Study Design - SPS-9A

Moisture		Wet > 635 mm/year of precipitation				Dry < 635 mm/year precipitation			
Average 7 Day Maximum Pavement Design Temperature		<52C	<58C	<64C	<70C	<52C	<58C	<64C	<70C
Minimum Pavement Design Temperature	>-46C								
	>-40C								
	>-34C								
	>-28C								
	>-22C								
	>-16C								
	>-10C								

NOTES: Traffic rate should exceed 50,000 ESAL/year in study lane.
Total traffic for design (design life) is Agency choice.
The Average 7-day maximum pavement design temperature is the average of the highest daily pavement temperatures for the seven hottest consecutive days.
The minimum pavement design temperature is the coldest pavement temperature of the year.



LEGEND

(01) Agency mix design test section

(02) SUPERPAVE mix design test section

(03) SUPERPAVE Alternate Binder test section

L - Sampling area

Figure 1. Test section layout

Agencies may arrange the sequence of the test sections to meet site specific construction expediency considerations. In deciding on the order of test sections, the distance between sections needed for transitioning due to material changes will be the primary constraint.

NEW CONSTRUCTION AND RECONSTRUCTION

General

Projects constructed as part of new construction or reconstruction of flexible pavements shall conform to the following general requirements.

Pavement Structure and Geometry

1. The structural number for new and reconstructed flexible pavements must be between 80 and 120 percent of the SN determined using the 1993 AASHTO Guide. The use of stabilized subgrade and treated subbase and base courses is permitted. The total thickness of high quality AC (including hot-laid plant mix asphalt treated base) must be greater than 100-mm. The use of Full Depth asphalt is permitted. Pavement cross sections and materials (except for the asphalt concrete materials being studied) must be consistent throughout the project.

2. Required lane width is 3.66-m.

3. The minimum compacted thickness of an AC lift is 65-mm in order to allow laboratory testing of recovered cores in strict accordance with the test protocols.

4. The use of edge drainage is at the discretion of the agency, but if used must be included in all test sections at the site. Drainage structures under the pavement, if used, should consist of a drainage blanket layer, such that the layer thickness and structural properties are consistent throughout all test sections at a site.

5. Shoulders for new and reconstructed sections should extend a minimum of 1.2-m outside the lane edge. The pavement structural cross section should extend a minimum of 1.2-m outside the lane edge. However, a bituminous surface treated aggregate shoulder is acceptable. Turf and untreated aggregate are not permitted as the surfacing of shoulders.

Subgrade/Subbase Preparation

1. Agency practice will govern the preparation of the subgrade and subbase.

2. Consistency of material type and layer thickness is mandatory for the site. Elevations of subgrade and subbase layers should not deviate more than 25-mm from design, when measured at intervals of 15-m longitudinally.

Base Course Construction

1. Agency practice will govern the construction of the base course.

2. Consistency of material type and layer thickness is mandatory for the site. Elevations of base layer should not deviate more than 10-mm from design, when measured at intervals of 15-m longitudinally. Correction of the grade deviation resulting from subgrade/subbase elevation variation may result in an allowable base course thickness variation up to 37-mm.

Surface Course Construction (Binder and Surface, Porous Friction Layer)

1. Agency practice will govern the construction of the surface course.

2. Consistency of material type and layer thickness is mandatory for the site. Elevations of the surface layer should not deviate more than 10-mm from design, when measured at intervals of 15-m longitudinally. Layer thickness should not vary more than 10-mm.

3. A porous friction course may be used if it is the agency's normal practice. (Note: This will obscure the observation of distress development.)

Preparation and Compaction of Subgrade

Ideally the test sections shall be located in shallow fills. The entire length of a test section, however, shall be located completely in a cut or fill section. Cut-fill transitions or side hill fills within a section shall not be used in the experiments. In general, rock cut sections should be avoided unless all test sections are located within the cut.

Subgrade soils shall be prepared according to participating agency practice with the following additional requirements:

- The compaction of the subgrade shall be the width of the travel lanes plus the width of the inside and outside shoulders except in cases where sections are built as part of reconstruction of an existing pavement. Reconstruction must extend a minimum of 0.9-m outside the edge of the travel lanes to allow proper preparation of the subgrade and base course.
- Where sections are constructed on newly placed fill material, the thickness of the fill should be as uniform as possible along the test section.

- Proof rolling should be performed to verify the uniformity of support and to identify unstable areas which might require remedial construction (undercutting and replacement).
- Surface irregularities shall not exceed 13 mm between two points longitudinally or transversely using a 3-m straightedge.
- Finished subgrade elevations shall not vary from design more than 25-mm based on a rod and level survey conducted taking readings at a minimum of 5 locations (edge, outer wheel path, midlane, inner wheel path, and inside edge of lane) at longitudinal intervals no greater than 15-m. Locations for survey measurements are illustrated in Figure 2.
- Modifiers, lime, etc., can be added to provide a stable working platform as part of the construction process and may be used as a additive to increase the strength of the subgrade in the pavement structure, but must be used in all test sections in a project.

Base Layer

The experiment uses a base layer constructed of either unbound dense graded aggregate or any treated granular aggregate. Requirements for the materials and construction of the base course for SPS-9A are those of the participating agency with the following additional requirements.

- Reconstruction must extend a minimum of 0.9-m outside the edge of the travel lanes to allow proper preparation of the subgrade and base course.
- In place-density should be measured and recorded.
- Surface irregularities shall not exceed 6-mm between two points longitudinally or transversely using a 3-m straightedge.
- Finished base course elevations shall not vary from design more than 0.01-m based on a rod and level survey conducted taking readings at a minimum of 5 locations (edge, outer wheel path, midlane, inner wheel path, and inside edge of lane) at longitudinal intervals no greater than 15-m. Locations for survey measurements are illustrated in Figure 2.

REHABILITATION OF EXISTING FLEXIBLE PAVEMENT

Projects constructed as part of the rehabilitation of existing flexible pavements, including all overlays, shall conform to agency practices and the following general requirements.

Pavement Structure and Geometry

1. Asphalt surface layer constructed on either an unbound or treated granular material.

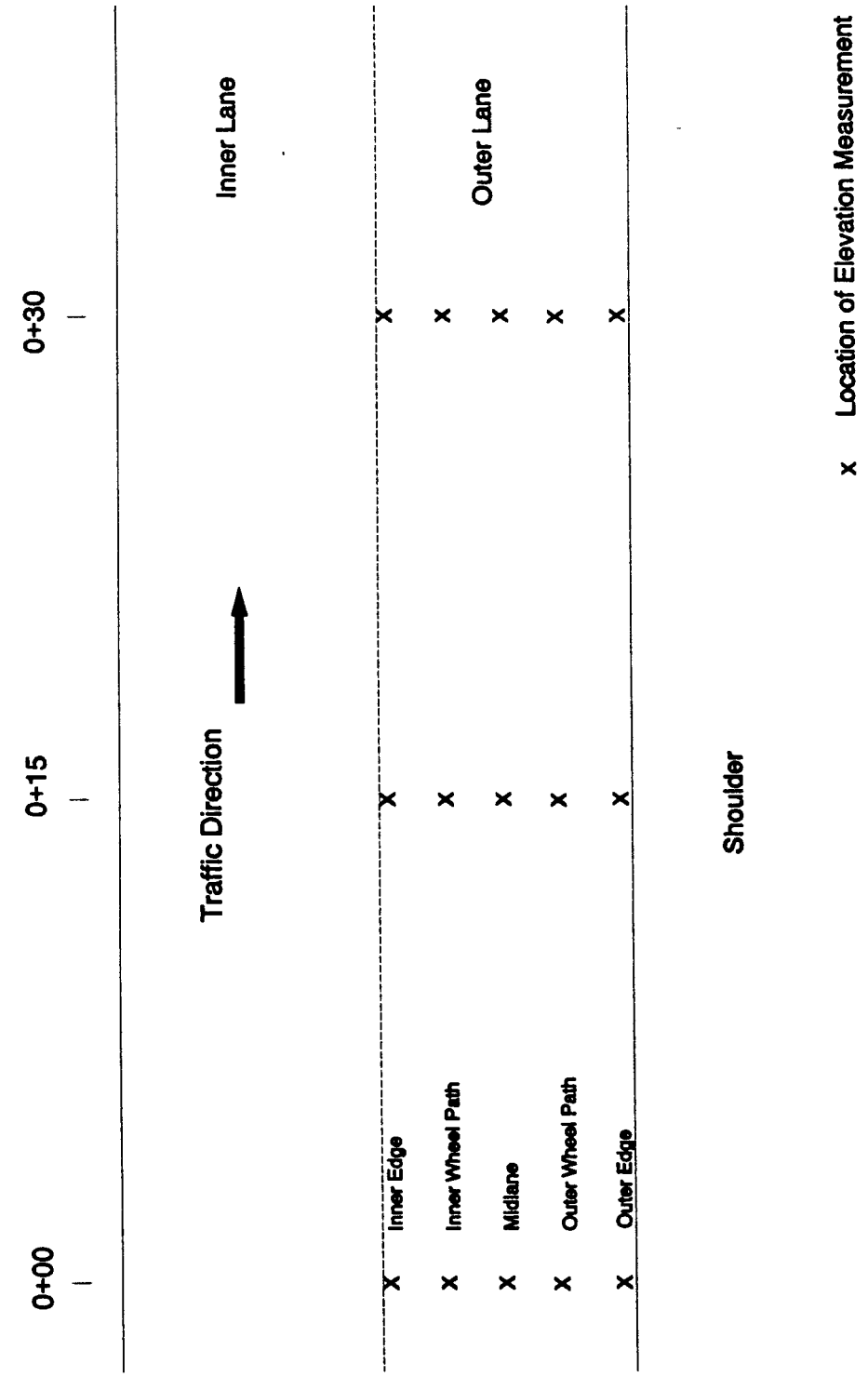


Figure 2. Location of elevation measurements

2. The minimum lane width is 3.66-m. Shoulders should extend a minimum 1.2-m outside the edge of the lane. Shoulder construction should consist of the main line pavement structure but may be a bituminous surface treated aggregate.

Condition

1. Uniform distress distribution throughout the site is required. Timely distress, deflection, and profile surveys are required before placement of the overlay.

2. The presence of moderate to high severity transverse cracks must be noted. Reflection of these cracks through the new asphalt layer will occur early in the performance cycle of the rehabilitation, reducing the reliability of data collected on the performance of the overlay.

Repair and Surface Preparation

1. Milling may be used to remove portions of the existing pavement at the agency's discretion. If milling is used it shall be used on all test sections at the site.

2. Milling or rut level-up must be performed on all sections as conditions warrant, in accordance with agency practice.

3. Patching of defects should be performed prior to overlay construction using AC. Full depth patches, those requiring the removal of base and subbase materials, should be avoided in the 150-m monitoring portion due to the differences (structure, material condition and type) between the patch and the existing pavement.

4. Crack repair (filling) should be performed in accordance with agency practice.

Overlay Placement

1. The maximum AC lift thickness is 100-mm, minimum AC lift thickness, compacted, is 65-mm.

2 A porous friction course may be used if it is the agency's normal practice. (Note: This will obscure the observation of distress development.)

REHABILITATION OF EXISTING RIGID PAVEMENT

Projects constructed as part of the rehabilitation of existing rigid pavements, including jointed concrete and continuously reinforced concrete pavements, shall conform to agency practices and the following general requirements.

Pavement Structure and Geometry

1. Jointed PCC pavement, either plain or reinforced, and continuously reinforced concrete pavement over unbound or treated base (including Lean Concrete, Econocrete) - with or without AC overlay.

2. The minimum lane width is 3.66-m. Shoulders may be PCC, asphalt, or bituminous surface treated aggregate.

3. Test sections may be constructed on rubblized PCC pavement. Crack/seat and break/seat techniques, where the elimination of slab action can be highly variable, are not permitted for this experiment.

Condition

1. Test sections must exhibit similar and uniform distress distribution throughout the site. Timely distress, deflection, and profile surveys are required before placement of the overlay.

2. Major surface defects (scaling, D-cracking) should be avoided for overlay projects. If rubblizing is specified these distresses are not significant.

3. The average load transfer efficiency throughout the test sections for jointed PCC pavements should be greater than 70 percent prior to overlay construction.

4. Maximum faulting should not exceed 6-mm for transverse joints and 12-mm for longitudinal joints.

Repair and Surface Preparation

1. Load transfer restoration methods (such as full depth repairs, undersealing, retrofitting dowels) must be used to restore the average load transfer efficiency to 70 percent or more.

2. Diamond grinding of the surface to reduce or eliminate faulting is permitted.

3. Partial depth patching may use either AC or PCC.

4. Full depth patches shall use PCC.

Overlay Placement

1. The maximum AC lift thickness, compacted, is 100-mm and the minimum lift thickness, compacted, shall be 65-mm.

2. Sawing and sealing of the new asphalt over the locations of joints in the jointed concrete pavement shall be permitted but must be performed in all test sections on the project.

3. A porous friction course may be used if it is normal agency practice. (Note: This will obscure the observation of distress development.)

ASPHALT CONCRETE MIX DESIGN

This experiment compares conventional agency asphalt mix designs to mixes conforming to the SUPERPAVE™ asphalt specifications and mix design procedures. It is not practical or feasible to specify either the same mix, mix design, or even mix design method for the individual agency conventional mixes on nationwide experimental pavement projects. However, it is recommended that design of the conventional asphalt concrete mixes be performed in compliance with the guidelines contained in the FHWA Technical Advisory T5040.27, "Asphalt Concrete Mix Design and Field Control", March 10, 1988 with the mix design criteria conforming to the Asphalt Institute Manual, MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types", 1988. SUPERPAVE™ mixes shall be designed using the materials specifications in SHRP-A-379, "The SUPERPAVE Mix Design System Manual of Specifications, Test Methods and Practices", as adopted by AASHTO, and mix design procedures contained in SHRP-A-407, "The SUPERPAVE Mix Design Manual for New Construction and Overlays."

The asphalt concrete shall employ all new materials which have not been used in previous construction. Recycled asphalt pavement materials are not permitted on SPS-9A test sections. Aggregates used in the mix shall be new aggregates of the highest quality available to the agency and must meet SHRP specifications for the SUPERPAVE™ test sections. Agency personnel involved in mix design of the SUPERPAVE™ mixtures must have attended and successfully completed the mixture and binder training courses at the National Asphalt Training Center (NATC).

Agency Mix

In accordance with the FHWA Technical Advisory and the Asphalt Institute Manual, the individual agency asphalt concrete surface mixtures are recommended to be designed to the following equivalent specifications:

Marshall	
Compaction blows	75
Stability (Minimum)	1,800
Flow	8 - 14
Hveem	
Stability (Minimum)	37
Swell (Maximum)	0.03 in.
Air Voids	3 - 5%

Agencies using non-standard Hveem or Marshall mix design procedures, should design mixes to achieve design indices equivalent to those obtained using these standard procedures. The asphalt grade and characteristics for the agency mixture should be selected based on normal practice.

SUPERPAVE™ Mix

SUPERPAVE™ mixtures used in SPS-9A test sections will be designed in accordance with the procedures for the SUPERPAVE™ Level I, regardless of the traffic level determined for the project site. Asphalt binder will be selected using the current Performance Grade criteria for the 98 percent reliability (mean value plus 2 standard deviations) weather data provided by the weather station nearest the project site. The use of modifiers is permitted but care must be taken to properly account for the type of modifier when performing the binder characterization tests. Aggregates must meet the requirements of the latest SHRP specification as adopted by AASHTO.

Mix design procedures as presented by the NATC in the training courses shall be used.

SUPERPAVE™ Mix with Alternate Binder

The design for the SUPERPAVE™ mix with alternate binder merely consists of selecting the appropriate alternate binder grade based on the agency choice of primary distress. Once the alternate binder is selected it will be substituted into the SUPERPAVE™ mixture in the exact proportion as that for the site specific "correct" binder. No alteration of the aggregate gradation or binder content is permitted.

The alternate SHRP binder selection will be based on the following:

1. The participating agency shall choose the distress type that the binder will be selected to minimize or prevent. If the agency desires to examine both distresses, then an additional test section will be constructed and included as a SPS-9A core test section.

2. If the agency selects:

   Thermal Cracking - Low temperature grade component is increased by two grade levels and the high grade remains the same. (e.g. PG 58-34 may be required for the site so the alternate binder would be a PG 58-22 to examine thermal cracking)

   Rutting - High temperature grade component decreases by one grade and low temperature grade remains the same. (e.g. PG 64-28 may be required for the site so the alternate binder would be PG 58-28 to examine rutting)

Weather data having a 98 percent reliability (mean plus 2 standard deviations) shall be used for selecting the appropriate performance grade from which to deviate according to the guidelines listed above.

CONSTRUCTION OPERATIONS

Construction operations shall be performed using guidelines and specifications presented in each participating agency's standard specifications for "Road and Bridge" construction, representative of high quality construction practice employed by the participating agency. Adequate attention shall be given to details and control of mix plant, hauling, placement and finishing/compaction operations must be maintained on the test sections to prevent construction practices which are known to result in limited performance. Careful documentation of the properties of the materials used in asphalt concrete mixtures as well as properties of the plant production mixes is critical to the successful evaluation of the performance of these test sections. In addition, care should be taken to ensure that construction of all test sections is performed in a manner consistent with normal highway practice.

Each participating agency will develop and submit a construction quality control and quality assurance plan for the asphalt concrete materials at each SPS-9A project for review by FHWA-LTPP and OTA prior to the start of construction. Again, because this is a materials dependent experiment, it is critical that the actual production mixtures are close to the design mix and that any deviations are measured and documented. As a minimum, the following QC type testing is required for each mix used in the test sections:

- For each test section, the production of each mixture shall be sampled at the paver a minimum of 6 times during laydown operations in the section. These six samples shall be compacted using the SUPERPAVE™ Gyratory compactor and the compacted specimens shall be tested to determine percent air voids, asphalt content, and aggregate gradation. Also monitor the compaction versus number of gyrations during the compaction process to note significant differences from the design mix curve.

- Agency mixtures will be tested as above and with additional testing performed on specimens compacted using the agency conventional methods.

The following construction related guidelines shall be followed for construction of the flexible test sections:

- The asphalt concrete mix shall be placed only after the contractor has satisfactorily demonstrated proper placement and compaction procedures on locations other than the test sections.
- Longitudinal paving joints shall be located within 0.3-m of the center of a lane or within 0.3-m of the center of two adjacent lanes.
- No transverse construction joints shall be placed within the monitoring portions of test sections.
- The as-compacted thickness of the asphalt concrete layer (surface plus binder course) in any test section shall be constructed to within ± 6 mm of the average value of the other test sections in the project.
- The finished surface of the overlay should be smooth and provide an excellent ride level. As a target, the as-constructed surface should have a pro-rated profile index of less than 160-mm per km as measured by a California type Profilograph and evaluated following California Test 526.
- The surface course shall be the same thickness on all test sections on projects which incorporate a separate binder and surface course HMAC mix.

TRANSITIONS

The 300-m overall length of Test Sections includes a 150-m monitoring section and 75-m long sampling areas before and after the section for sampling of the asphalt surface layers. The distance between these sections must be sufficient to allow changes in materials during construction. It is not possible to instantly change from one material to another without some short-term increase in variability of material quality which would influence the properties of the finished pavement. A minimum transition length of 30-m is recommended between different test sections to provide sufficient production in order to develop consistency after changes in material types.

SPECIAL CONSIDERATIONS

Some agencies require the use of surface friction courses on asphaltic concrete pavement surfaces. Their inclusion is therefore permitted on test sections within their jurisdiction. In these instances, the thickness of the friction course should be limited to 25 mm and should not be considered as part of the asphalt concrete thickness specified for the test section.

DEVIATIONS FROM GUIDELINES

An agency that desires to participate in the SPS-9A experiment but finds it necessary to deviate from some of the guidelines described in the report should review these deviations with the LTPP Regional Office or LTPP Division headquarters. LTPP will assess the implications of these deviations on the study objectives. If the implications of the non-compliance appear minimal, the deviations will be accepted, otherwise LTPP will suggest alternatives for consideration by the participating agency.