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Long-Term Pavement Performance Division

SPECIFIC PAVEMENT STUDIES
CONSTRUCTION GUIDELINES FOR EXPERIMENT SPS-2
STRATEGIC STUDY OF STRUCTURAL FACTORS FOR RIGID PAVEMENTS

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INTRODUCTION

This report describes the guidelines for the construction of test sections for the Specific Pavement Studies' SPS-2 experiment, Strategic Study of Structural Factors for Rigid Pavements. These guidelines were originally developed by the Strategic Highway Research Program (SHRP) in cooperation with state and provincial highway agency personnel participating in various meetings, including a construction guidelines review meeting held in Atlanta, Georgia, September 10-12, 1990. The recommendations of the participants and comments by other highway agency personnel were incorporated in the guidelines. These guidelines will help participating highway agencies develop acceptable construction plans for test sections for this experiment. This revised report is a product of several years experience of the RCOC staffs and participating agencies in developing contract documents for constructing SPS experiment sites. The revisions incorporate the recommendations of the SPS-1 and SPS-2 Construction Guidelines Workshop held in St. Paul Minnesota, April 1993.

The SPS-2 experiment, Strategic Study of Structural Factors for Rigid Pavements, requires the construction of multiple test sections with similar details and materials at each of sixteen sites distributed in the four climatic regions. The primary SPS-2 experiment requires the construction of twelve test sections at each of the test sites. However, in addition to the primary experiment, supplementary SPS-2 experiments (designated SPS-2A and SPS-2B) require the construction of additional test sections at each of the test sites. SPS-2A requires six test sections and SPS-2B requires eight test sections at each site. The experimental design and construction considerations for this experiment are described in the SHRP document, "Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS-2, Strategic Study of Structural Factors for Rigid Pavements," April 1990. The experiment has been developed as a coordinated national experiment to address the needs of the highway community at large and not only the participating highway agencies. 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 outlined in this report 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-2 test sections with the intent to maximize uniformity of these procedures across all projects. More specifically, the objectives are:

- To review the major construction features of the SPS-2 experiment test sections.
- To describe the details of the different experimental levels of test section construction.
- To provide specifications for construction materials (subgrade, base course, filter fabric) and the portland cement concrete (PCC) mix design.
- To provide specifications on typical cross section design, details of pavement layers, drainage system, joint load transfer devices, and shoulders.
- To describe the general construction operations and as-built requirements.

It is strongly recommended that direct discussions between the RCOC, the participating agency, and contractor(s) be held periodically throughout the preconstruction and construction phases of the project. This interaction is critically important for developing the necessary understanding, by the participants, of the objectives of the experiment and the need for cooperation in adhering as much as possible to the requirements outlined in this report. It is suggested that RCOC attendance and limited participation is needed in the pre-bid conference, pre-construction conferences and such other coordination activities as are scheduled by the agency.

EXPERIMENTAL DESIGN

The experiment is designed as a primary experiment with two planned supplementary experiments. The primary experiment, designated SPS-2, addresses doweled jointed plain concrete pavements and must be built for participation in this study. The supplemental experiments, designated SPS-2A and SPS-2B, address undoweled jointed plain concrete pavements with skewed joints and jointed reinforced concrete pavements, respectively. Neither of the supplemental experiments may be constructed unless a primary experiment is also constructed at a site. Table 1 presents the experimental design for the primary experiment SPS-2. Tables 2 and 3 present the experimental designs for the supplemental experiments SPS-2A and SPS-2B, respectively. The study factors are grouped into structural factors that relate to the base and concrete materials and site factors that relate to the climate and subgrade. Table 1 shows the 192 test sections included in the primary experiment SPS-2 as indicated by a cell containing a letter-number code. The letter denotes one of 16 test sites (J through Y) where a test section is to be constructed, while the number designates one of twelve test sections that are to be constructed at each site.

As shown in Table 1, 48 test sections representing all structural factor and subgrade type combinations in the primary experiment are to be constructed in each of the four climatic regions, with 24 test sections to be constructed on fine-grained subgrade and 24 test sections on coarse-grained soil. For each climate-soil combination, one-half of the 24 test sections (numbers 1 through 12) are to be constructed at one test site and the other complementary one-half (numbers 13 through 24) are to be constructed at another site. Ideally, these two sites should be located in different states and/or provinces. However, it is acceptable that these two sites, i.e. all 24 test sections, may be built within the same project.

Similarly, as shown in Table 2 for the supplemental experiment on undoweled jointed plain concrete pavements with skewed joints (SPS-2A), one half of the 12 test sections are to be constructed at each site, as indicated by the cells containing a letter-number code. Test sections in the supplemental experiment SPS-2A are numbered consecutively following the 24 test sections in the primary experiment, i.e. 25 through 36. Sections 25 through 30 will be constructed at one site while sections 31 through 36 will be constructed at another site.

Also, as shown in Table 3 for the supplemental experiment on jointed reinforced concrete pavements (SPS-2B), one-half of the 16 test sections are to be constructed at each site, as indicated by the cells containing a letter-number code. Test sections in the supplemental experiment SPS-2B are numbered consecutively following the 36 test sections in the basic experiment and the supplemental experiment SPS-2A, i.e. sections 37 through 52. Sections 37 through 44 are constructed at one site while sections 45 through 52 are constructed at another.

TEST SECTIONS

The combinations of base layer, concrete pavement thickness, concrete strength, and lane width are shown in Figures 1, 2, and 3 for SPS-2, SPS-2A, and SPS-2B test sections, respectively. Each test section must be constructed as uniformly as practical over a minimum length of 183 m (600 feet) to allow 152.5 m (500 feet) for monitoring and at least 15.25 m (50 feet) at each end for post construction material sampling. However, uniform construction is desired for a length of 220 m (720 feet), corresponding to a whole number of pavement slabs. Cross sections of the pavements for the undrained and drainable sections

Table 1. Basic Experiment Doweled Jointed Plain Concrete Pavements (SPS-2)

PAVEMENT STRUCTURE					CLIMATE ZONES, SUBGRADE SITE															
Drain	Base Type	PCC		Lane Width	WET								DRY							
					Freeze				No Freeze				Freeze				No Freeze			
		Thick In	Strength psi		Fine		Coarse		Fine		Coarse		Fine		Coarse		Fine		Coarse	
					J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
NO	DGAB	8	550	12	J1		L1		N1		P1		R1		T1		V1		X1	
				14		K13		M13		O13		Q13		S13		U13		W13		Y13
			900	12		K14		M14		O14		Q14		S14		U14		W14		Y14
				14	J2		L2		N2		P2		R2		T2		V2		X2	
		11	550	12		K15		M15		O15		Q15		S15		U15		W15		Y15
				14	J3		L3		N3		P3		R3		T3		V3		X3	
			900	12	J4		L4		N4		P4		R4		T4		V4		X4	Y16
				14		K16		M16		O16		Q16		S16		U16		W16		Y16
NO	LCB	8	550	12	J5		L5		N5		P5		R5		T5		V5		X5	
				14		K17		M17		O17		Q17		S17		U17		W17		Y17
			900	12		K18		M18		O18		Q18		S18		U18		W18		Y18
				14	J6		L6		N6		P6		R6		T6		V6		X6	
		11	550	12		K19		M19		O19		Q19		S19		U19		W19		Y19
				14	J7		L7		N7		P7		R7		T7		V7		X7	
			900	12	J8		L8		N8		P8		R8		T8		V8		X8	
				14		K20		M20		O20		Q20		S20		U20		W20		Y20
YES	PATB DGAB	8	550	12	J9		L9		N9		P9		R9		T9		V9		X9	
				14		K21		M21		O21		Q21		S21		U21		W21		Y21
			900	12		K22		M22		O22		Q22		S22		U22		W22		Y22
				14	J10		L10		N10		P10		R10		T10		V10		X10	
		11	550	12		K23		M23		O23		Q23		S23		U23		W23		Y23
				14	J11		L11		N11		P11		R11		T11		V11		X11	
			900	12	J12		L12		N12		P12		R12		T12		V12		X12	
				14		K24		M24		O24		Q24		S24		U24		W24		Y24

DGAB = Dense-graded untreated aggregate base LCB = Lean concrete base
PATB = 4-inch Permeable asphalt treated base on 4 inch Dense Graded Aggregate Base
All perpendicular doweled joints at 15-feet spacing

SI Conversion: 8" = 203 mm; 11" = 279 mm; 550 psi = 3.8 MPa; 900 psi = 6.2 MPa; 12 ft = 3.66 m; 14 ft = 4.27 m

Table 2. Supplementary Experiment on Undoweled Plain Concrete Pavements with Skewed Joints (SPS-2A)

DRAIN	BASE TYPE	PCC THICKNESS in.	LANE WIDTH ft.	SITE "a" Section No.	SITE "b" Section No.
NO	DGAB	8	12	25	
			14		31
		11	12		32
			14	26	
NO	LCB	8	12		33
			14	27	
		11	12	28	
			14		34
YES	PATB / DGAB	8	12	29	
			14		35
		11	12		36
			14	30	

DGAB = Dense-graded untreated aggregate base

LCB = Lean concrete base

PATB / DGAB = 102 mm (4 inch) permeable asphalt treated base on 102 mm (4 inch) untreated dense graded aggregate base

All skewed joints, variable spacing: 3.66-4.57-3.96-4.27 m (12-15-13-14 feet)

Concrete flexural strength: 3.8 MPa (550 psi) @ 14 days

Site "a" supplements Site J, L, N, P, R, T, V, or X in the basic experiment
Site "b" supplements Site K, M, O, Q, S, U, W, or Y in the basic experiment

SI Conversion: 8" = 203 mm; 11" = 279 mm; 12 ft = 3.66 m; 14 ft = 4.27 m

Table 3. Supplementary Experiment on Jointed Reinforced Concrete Pavements (SPS-2B)

DRAIN	BASE TYPE	PCC		LANE WIDTH ft	SITE "a" Section No.	SITE "b" Section No.
		THICK in.	STRENGTH psi			
NO	DGAB	8	550	12		45
				14	37	
			900	12	38	
				14		46
		11	550	12	39	
				14		47
			900	12		48
				14	40	
YES	PATB/DGAB	8	550	12		49
				14	41	
			900	12	42	
				14		50
		11	550	12	43	
				14		51
			900	12		52
				14	44	

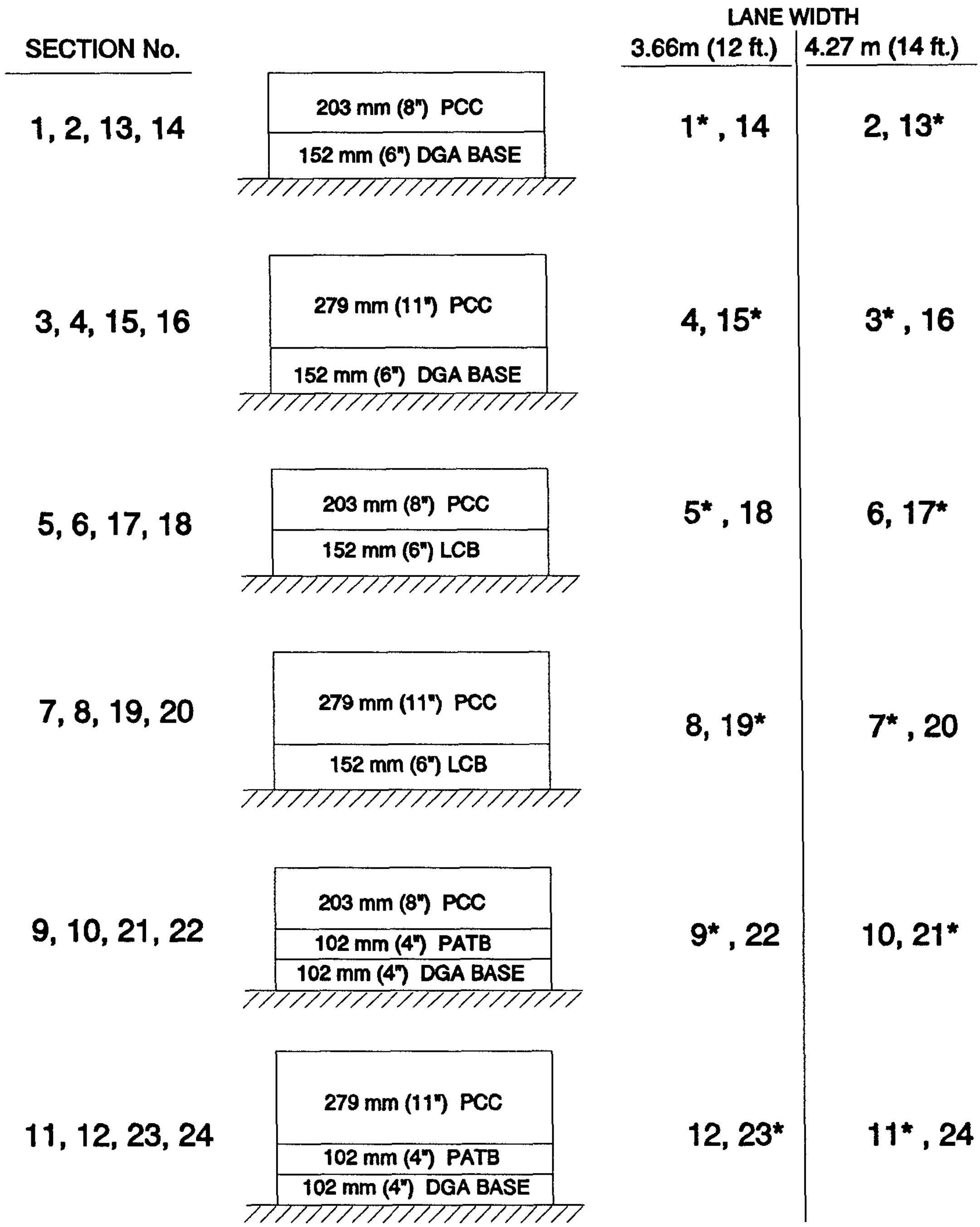
DGAB = Dense-graded untreated aggregate base

PATB/DGAB = 102 mm (4 inch) permeable asphalt treated base on 102 mm (4 inch) untreated dense graded aggregate base

Site "a" supplements Site J, L, N, P, R, T, V, or X in the basic experiment

Site "b" supplements Site K, M, O, Q, S, U, W, or Y in the basic experiment

SI Conversion: 8" = 203 mm; 11" = 279 mm; 550 psi = 3.8 MPa; 900 psi = 6.2 MPa; 12 ft = 3.66 m; 14 ft = 4.27 m



*Denotes sections using 3.8 MPa (550 psi) PCC.

Remaining sections use 6.2 MPa (900 psi) PCC.

Figure 1. Test Section Details for Primary SPS-2 Experiment

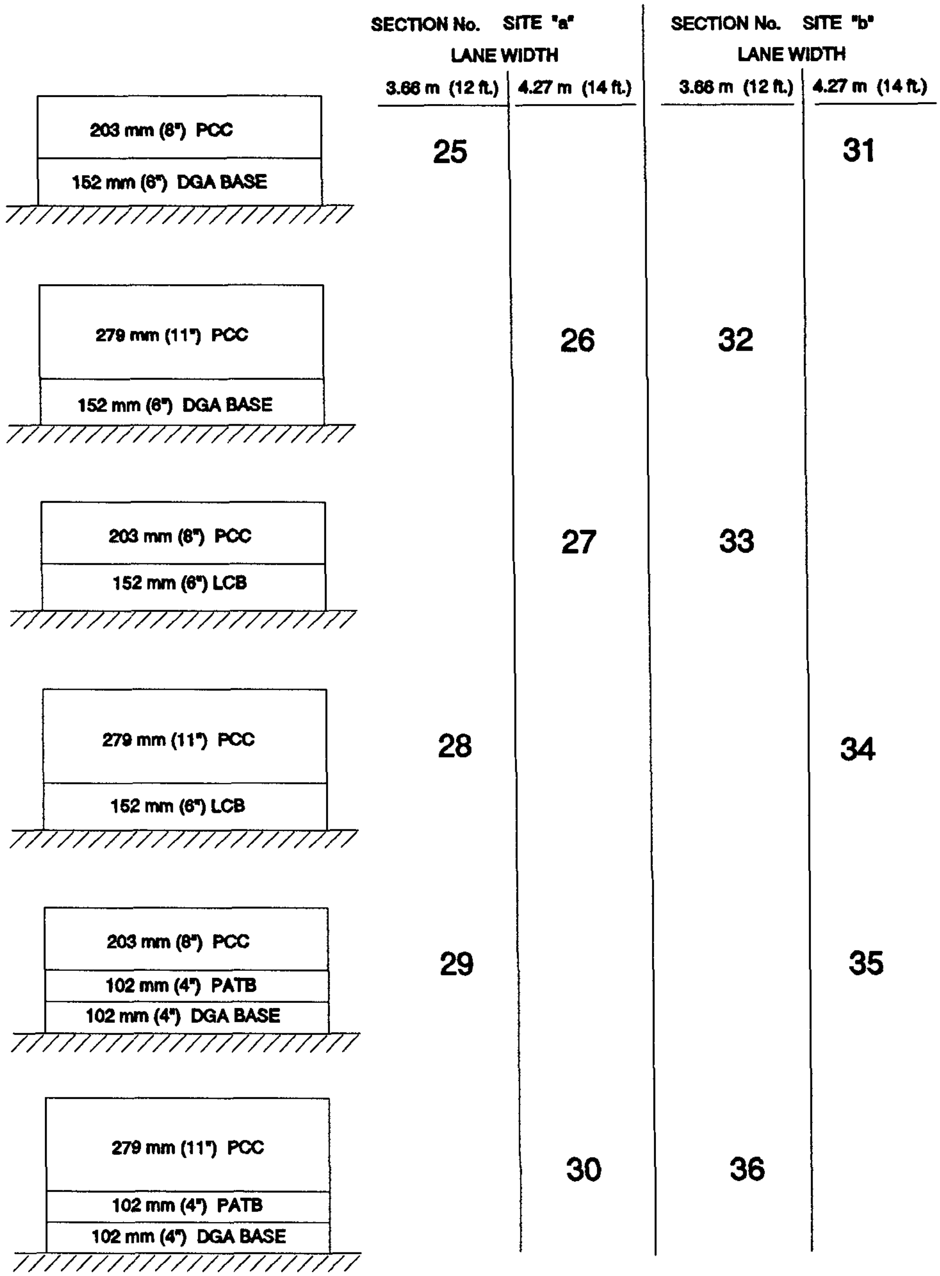


Figure 2. Test Section Details for Supplementary SPS-2A Experiment

	SECTION No. SITE "a" LANE WIDTH 3.66 m (12 ft.)	SECTION No. SITE "a" LANE WIDTH 4.27 m (14 ft.)	SECTION No. SITE "b" LANE WIDTH 3.66 m (12 ft.)	SECTION No. SITE "b" LANE WIDTH 4.27 m (14 ft.)
203 mm (8") PCC 152 mm (6") DGA BASE	38	37*	45*	46
279 mm (11") PCC 152 mm (6") DGA BASE	39*	40	48	47*
203 mm (8") PCC 102 mm (4") PATB 102 mm (4") DGA BASE	42	41*	49*	50
279 mm (11") PCC 102 mm (4") PATB 102 mm (4") DGA BASE	43*	44	52	51*

* Denotes sections using 3.8 MPa (550 psi) PCC.

Remaining sections use 6.2 MPa (900 psi) PCC.

Figure 3. Test Section Details for Supplementary SPS-2B Experiment

are shown in Figures 4 and 5, respectively.

Participating agencies must arrange the sequence of the test sections to accommodate site specific conditions and allow construction expediency. Items that should be considered in selecting a particular sequence for the test section construction include the following:

- Future rehabilitation needs - Placement of test sections with similar life expectancies adjacent to each other to facilitate future rehabilitation activities.
- Base material - Placement of test sections with similar base material adjacent to each other to minimize haul distances and to optimize plant runs of processed material.
- Drainage provisions - Placement of test sections with in-pavement drainage layers adjacent to each other to minimize transitions between drained and undrained pavement sections.
- Transitions - Placement of test sections with similar thicknesses, concrete strength, lane width, or base materials adjacent to each other to minimize the distance needed between sections to accommodate changes in thicknesses, lane widths and material type.
- Grouping of sections with similar concrete strength adjacent to each other.

PREPARATION AND COMPACTION OF SUBGRADE

Ideally, the test sections shall be located in shallow fills. However, if the test section cannot be placed in a fill, the entire length of the section shall be located completely in a cut section. Cut-fill transitions or side hill fills should not be located within a test section. In addition, rock cut sections should be avoided unless all test sections are located within the cut.

Subgrade soils shall be prepared according to the following requirements:

- The subgrade soil shall be tested according to AASHTO T99, Method D to determine the moisture-density relationship.
- Fill material shall be compacted to a minimum of 95% of AASHTO T99 density for the top 305 mm (12 inches). Expansive soils shall be compacted to a minimum of 90% of AASHTO T99 for the top 305 mm (12 inches).
- Moisture content of the compacted subgrade soil should be in the range of 85% to 120% of the optimum moisture content.

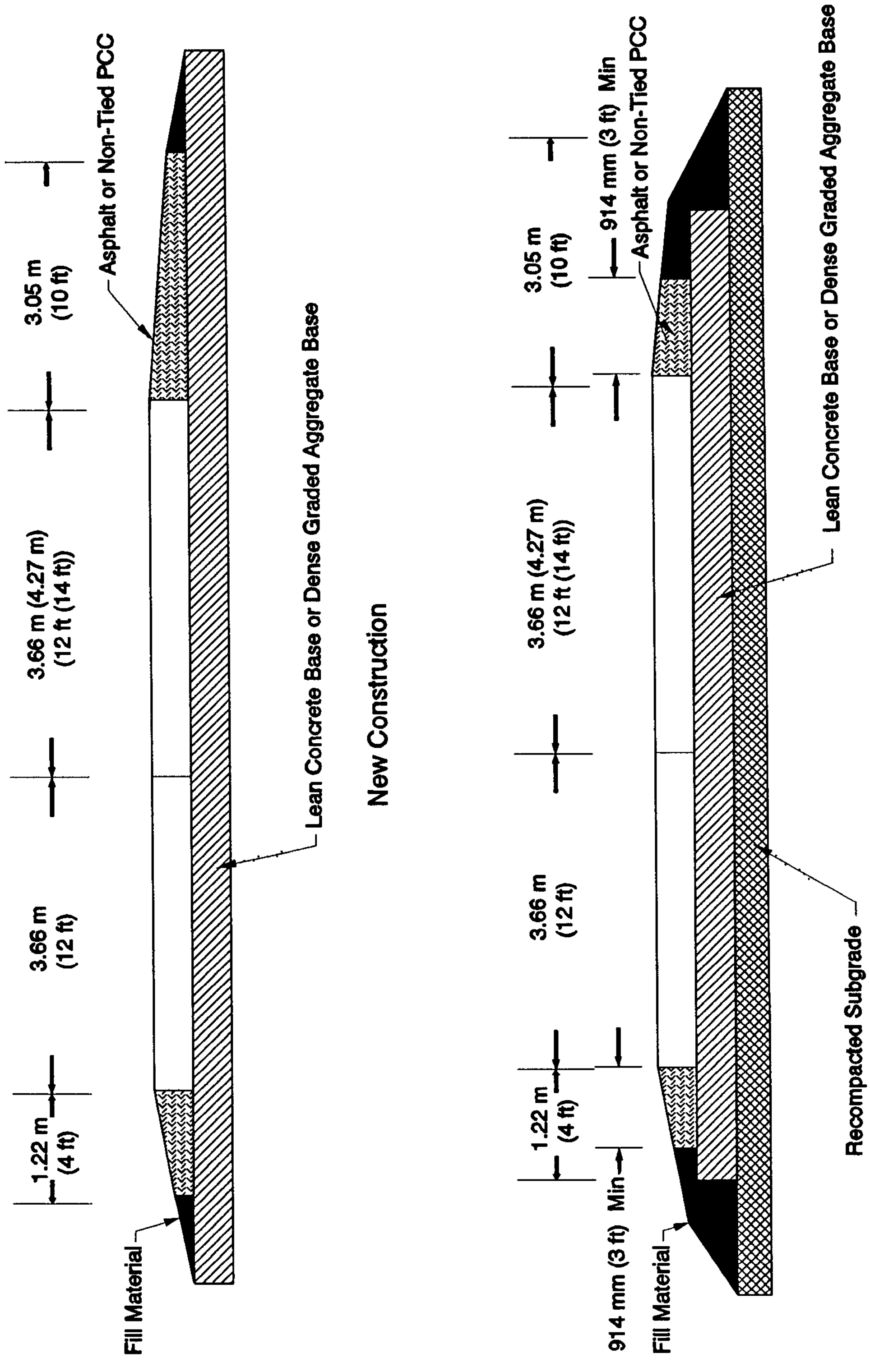


Figure 4. Typical Section for Test Sections with Non-Drainable Base

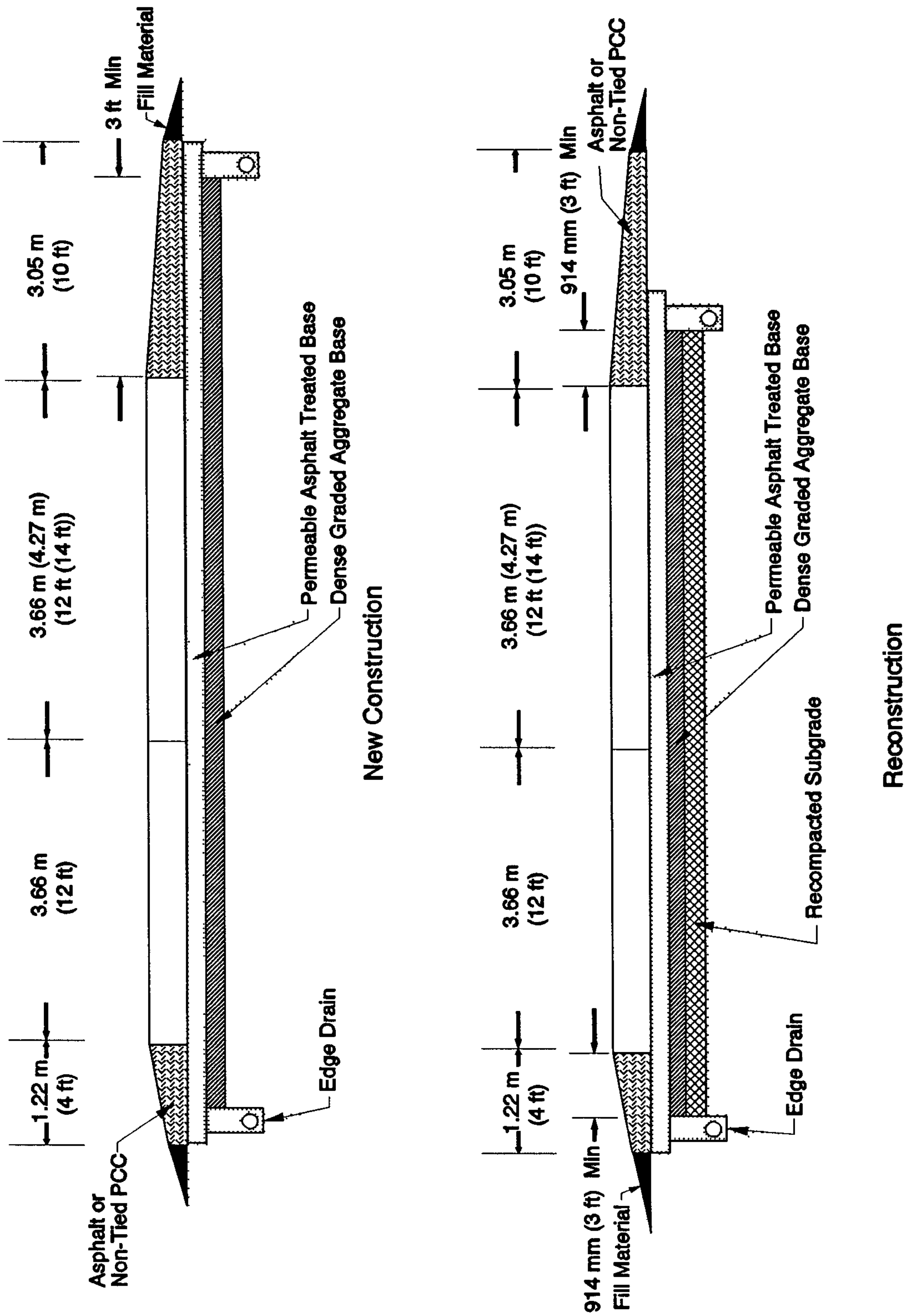


Figure 5. Typical Section for Test Sections with Drainable Base Layer

- Sections built as part of a reconstruction project shall have the upper 305 mm (12 inches) of subgrade compacted to the appropriate specification.
- Subgrade shall be compacted for the width of the travel lanes plus the width of the inside and outside shoulders except where sections are built as part of reconstruction of an existing pavement. In this case, reconstruction must extend a minimum of 914 mm (3 feet) 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. Geotextile reinforcement shall not be used to stabilize the subgrade.
- 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 6 mm (1/4 inch) between two points longitudinally or transversely using a 3.05 m (10 foot) straightedge.
- Final subgrade elevations shall not vary from design more than 12 mm (0.04 feet) based on rod and level survey readings taken 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 15.25 m (50 feet). Locations for survey measurements are illustrated in Figure 6.
- Modifiers, lime, portland cement etc., can be added to provide a stable working platform to facilitate construction. The use of modifiers shall be limited to materials and quantities which will alter the index properties of the subgrade (e.g. reduce the plasticity index) without unduly increasing the strength of the subgrade in the pavement structure. Working platforms consisting of thin asphalt concrete layers placed directly on subgrade are not permitted.

Note: The working platform is considered a pavement layer, therefore, sampling and testing, in addition to that required for the subgrade, must be planned and performed.

BASE LAYERS

The discussion of construction guidelines for base materials are divided into two categories: undrained and drained base structures. The drained and undrained designations do not refer to external pavement drainage features such as cross-slope and ditches. Undrained base structures refer to relatively impermeable dense graded base layers consisting of dense graded aggregate base and/or lean concrete base. The drained base structures refer

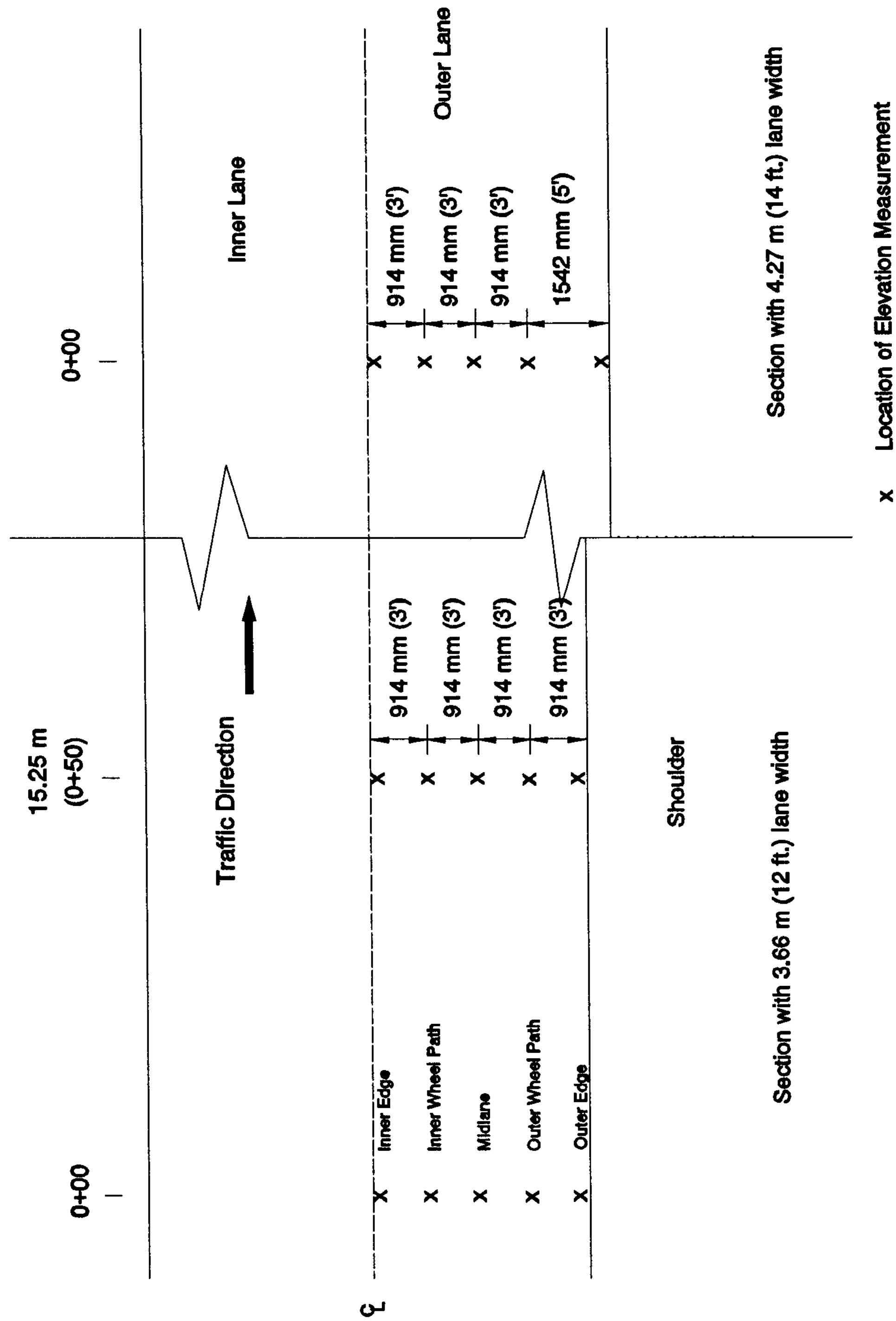


Figure 6. Elevation Measurement Locations

to a system which consists of a permeable asphalt treated base drainage layer and edge drains.

Undrained Base Layers

Test Sections 1 through 8 and 13 through 20 of the primary experiment (25 through 28, 31 through 34, 37 through 40 and 45 through 48 of the supplemental experiments) are constructed with undrained base layers that incorporate the dense graded untreated aggregate bases or lean concrete bases. Drainage layers and longitudinal edge drains shall not be used on these sections.

Dense Graded Aggregate Base

The dense graded aggregate base (DGAB) is an untreated, crushed material. Requirements and construction guidelines for this material are presented in the following sections.

Aggregate Requirements. The quality and gradation criteria for selection of the aggregate required in the construction in the dense graded aggregate base (DGAB) shall be as follows:

- The base material must consist of a high quality crushed stone, crushed gravel or crushed slag.
- The base aggregate shall consist of a minimum of 50% of material retained on the No. 4 sieve. Of the particles retained on the 8 mm (3/8 inch) sieve at least 75% shall have 2 or more fracture faces.
- A 38 mm (1.5 inch) top size aggregate is preferred, however, the maximum top size normally specified by the state agency, if less than 38 mm (1.5 inch), may be used.
- The final aggregate mixture must be dense graded.
- The fraction passing No.200 sieve shall be less than 60% of the fraction passing the No. 30 sieve and not more than 10% of the total sample.
- The fraction passing No. 40 sieve shall have a liquid limit not greater than 25 and plasticity index not greater than 4.
- Aggregate tested with L.A. Abrasion which shows loss of more than 50% at 500 revolutions shall not be used.
- No additives, other than water, are allowed in the dense graded aggregate base.

<u>Construction Requirements</u>. The base course shall be prepared to grade according to the participating agency's practice and the following requirements:

- No segregation or degradation of materials should occur during laydown and compaction. Areas of excessive segregation shall be removed and replaced with proper aggregate.
- Maximum lift thickness shall be 152 mm (6 inches) compacted.
- Maximum dry density and optimum moisture content shall be determined by AASHTO T180 method D.
- DGAB course must be compacted to an average of not less than 95% of AASHTO T180 density.
- The DGAB shall be compacted for 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. In this case, reconstruction must extend a minimum of 914 mm (3 feet) outside the edge of the travel lanes to allow proper preparation of the subgrade and base course.
- For those sections incorporating a PATB layer, a DGAB base course will be constructed over the subgrade prior to placement of the PATB. For these sections a low viscosity asphalt shall be used to prime the surface of the DGAB prior to placement of the PATB. Application and curing will be according participating agency practice.
- In place-density for purposes of construction quality control shall be measured and recorded prior to application of an asphalt cement prime coat (in drained sections), if used.
- Prior to the placement of the PCC surface layer, the DGAB shall be maintained uniformly moist; however, the method of moistening shall not be such as to form mud or pools of water.
- Surface irregularities shall not exceed 6 mm (1/4 inch) between two points longitudinally or transversely using a 3.05 m (10 foot) straightedge.
- Final DGAB elevations shall not vary from design more than 12 mm (0.04 feet) 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 15.25 m (50 feet). Locations for survey measurements are illustrated in Figure 6.

Lean Concrete Base

A lean concrete base (LCB) shall consist of a mixture of aggregate, hydraulic cement, water, and admixtures. The variability in specifications used by the different highway agencies makes it impractical to specify the same materials or mix design for all test locations. Therefore, the participating agency's procedures and specifications shall be used to produce and place a lean concrete base with a target average compressive strength, slump, and air content as follows:

- Compressive Strength - 3.4 MPa (500 psi) (5.2 MPa (750 psi) maximum) at 7 days
- Slump (slip-formed paving) - 25 mm to 76 mm (1 to 3 inches)
- Air Content - 4 to 9%

Material Properties. Cement and aggregate used in producing the LCB shall meet the following requirements:

- Only Type I or Type II portland cement shall be used. Type III portland cement shall not be used. The cement used shall meet the requirements of AASHTO Specification M85.
- Coarse aggregate (retained on the No. 8 sieve) shall consist of crushed gravel or crushed stone particles meeting the requirements of AASHTO M80. It is recommended that the coarse aggregate meet the gradation requirements of AASHTO 57 gradation. The following specific requirements shall be met by the coarse aggregate:

		Value
1.	Abrasion Loss, Maximum %	50
2.	Magnesium Sulfate Soundness, Maximum %	12
3.	Crushed particles, Minimum %	55

It is important that the coarse aggregate meet the highest standard of durability specified by the agency. Coarse aggregate must be reasonably free from deleterious substances such as chert, gypsum, iron sulfide, amorphous silica and hydrated iron oxide and must be obtained from a source approved by the agency. Coarse aggregate for use in LCB that will be subject to wetting or extended exposure to moist ground shall not contain any materials that are deleteriously reactive with alkalies in the cement in an amount sufficient to cause excessive expansion of mortar or concrete. The potential reactivity should be determined in accordance with the procedure given in AASHTO M80.

Construction Requirements. Construction requirements for the LCB include:

- LCB shall be 152 mm (6 inches thick).
- For new construction, the LCB layer will be constructed the full width of the travel lanes plus the width of the inside and outside shoulders. For sections built as part of reconstruction (inlay), the LCB will be placed to a width not less than 914 mm (3 feet) outside the edges of the travel lanes.
- Wax-base curing compound (AASHTO Description: M 148, Type 2) shall be used at a rate of 4 liters per 10 square meters (one gallon per 100 square feet). A second coat of curing compound shall be applied within 24 hours prior to concrete placement at a rate of 4 liters per 15 square meters (one gallon per 150 square feet).
- LCB surface shall not be textured and shall be finished to a smooth surface, free from mortar ridges and other projections before curing compound is applied.
- Final LCB elevations shall not vary from design more than 12 mm (0.04 feet) based on a rod and level survey. Readings shall be taken 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 15.25 m (50 feet). Locations for survey measurements are illustrated in Figure 6.
- Surface irregularities shall not exceed 6 mm (1/4 inch) between two points longitudinally or transversely using a 3.05 m (10 foot) straightedge.
- LCB constructed in widths greater than 7.92 m (26 feet) shall be constructed with a longitudinal joint offset not more than 914 mm (3 feet) from the centerline of the width being constructed.
- Longitudinal joint in the LCB shall not be within one foot of the planned longitudinal joint in the concrete pavement.
- Procedures normally used for placing concrete pavements shall be used for placing LCB. The use of slip-form paving is recommended.
- Traffic will not be allowed on the LCB surface before a period of 7 days or until the compressive strength of the LCB has reached a minimum of 3.4 MPa (500 psi). No traffic should be allowed onto the LCB after the second application of curing compound.

Drained Base Structures

Test Sections 9 through 12 and 21 through 24 of the primary experiment (and sections 29, 30, 35, 36, 41 through 44 and 49 through 52 of the supplementary experiments) are constructed with drained base structures that incorporate a permeable asphalt treated base (PATB) and edge drains that permit water to drain out of the pavement structure. The PATB is constructed in combination with the DGAB materials previously described.

Permeable Asphalt Treated Base

The Permeable Asphalt Treated Base (PATB) serves as a drainage layer in the pavement structure. Material and construction requirements for the PATB are presented in the following.

Material Requirements. The PATB material shall meet the following requirements:

- PATB shall be an open graded, hot laid, central plant mixed, asphalt base material.
- The use of asphalt cement emulsion in the mix is prohibited.
- An AASHTO No. 57 size stone, or such other gradation used by an agency as a highly permeable drainage material in pavement structures, shall be used. It is required that this gradation have no more than 2 percent passing the No. 200 sieve, as shown in the gradation guidelines in Table 4. The aggregate shall consist of crushed material having more than 90% with at least one fracture face.
- The mix shall be designed with a target asphalt cement content of 2 to 2.5 percent.
- Additives or modifiers may be used to reduce stripping of asphalt if such use represents the participating agency's practice. Experimental additives or modifiers shall not be used in the test sections.
- Asphalt grade and type may vary according to agency practice. Experience on early SPS-2 projects indicated good placement experience when using AC-30 for the PATB mix.
- No recycled asphalt concrete shall be permitted in the PATB.

Table 4. Recommended Gradation for PATB

Sieve	Percent Passing
38 mm (1 1/2 inch)	100
25 mm (1 inch)	95-100
13 mm (1/2 inch)	25-60
No. 4	0-10
No. 8	0-5
No. 200	0-2

Construction Requirements. Construction requirements for the PATB include the following:

- A static steel wheel roller shall be used to compact the permeable base applying 14.6 kN to 29.1 kN per meter (0.5 to 1.0 tons per foot) of roller width.
- No portion of the PATB layer shall be day-lighted.
- Appreciable amounts of distortion shall be avoided on the permeable base.
- A roller may be used immediately in front of the paver to dress up the permeable base if required.
- A track mounted paver is strongly recommended for operation on the permeable base. It has been the experience on early projects in this experiment that the PATB may be sufficiently stable, after cooling or with the use of stiffer asphalt grades or modifiers, to allow wheeled pavers and construction trucks to operate on the PATB surface. However, sharp turning movements do cause significant distortion and should be avoided.
- Other than the paver and roller, no other equipment or vehicles should be allowed to operate or park on the travel lane or outside shoulder portion of the permeable base. Limited operation of equipment on the inside lane may be permitted. The use of side-dump delivery for layers constructed on the PATB should be encouraged to minimize damage to the PATB layer. However, limited construction traffic (with reduced loads) may be allowed provided the contractor is cautioned that excessive shoving and tearing of the PATB surface will be cause for prohibiting traffic. This requirement is intended to prevent damage to the PATB layer which would affect layer thicknesses in subsequent layers and also to prevent damage to the drainage properties of the finished PATB layer.
- Transverse interceptor drains, as illustrated in Figure 7, shall be installed on the down slope end of the permeable base layers. They shall be placed in the transition zone between drained and undrained base structure test sections. They should be placed at least 30.5 m (100 feet) past the end of the 152.5 m (500 feet) monitoring section, or in the center of transitions which are shorter than 30.5 m (100 feet). The interceptor drains shall be placed along the mid-length of a slab panel and will not be placed along a transverse joint.

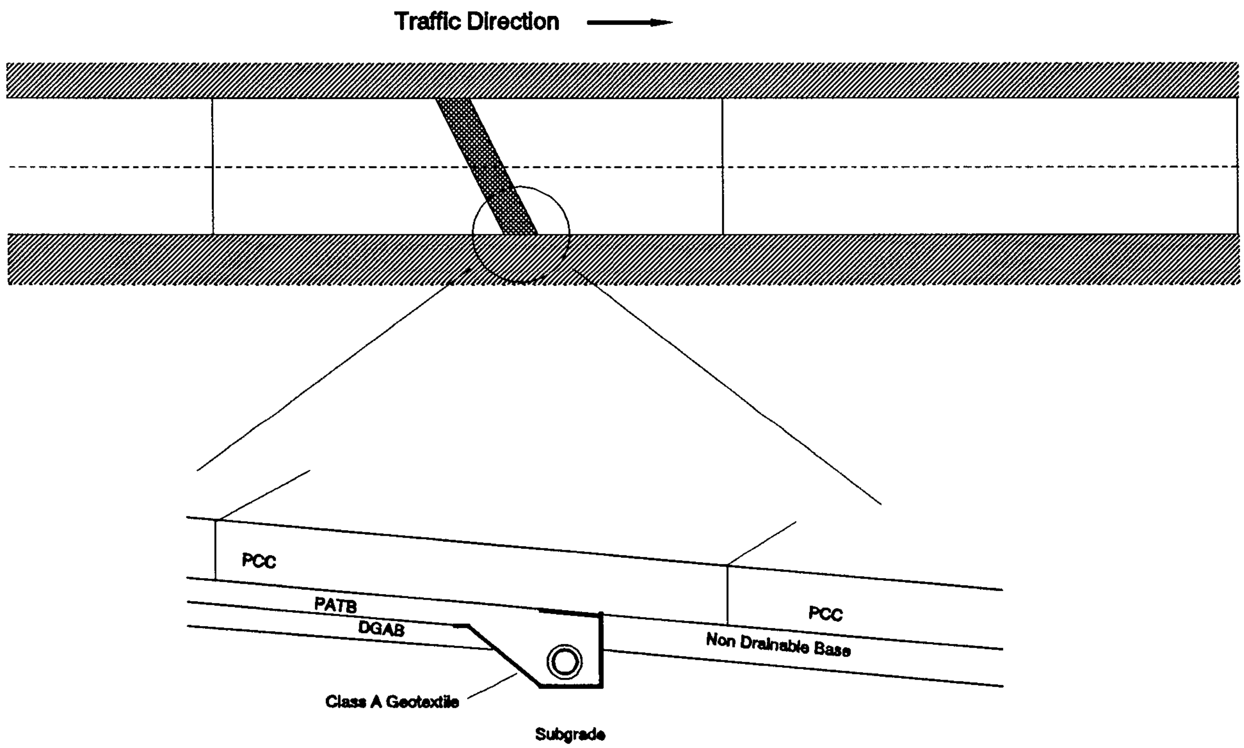


Figure 7. Transverse Interceptor Drain

Filter Fabrics

Filter fabric (or geotextiles) shall be used to prevent the clogging of the permeable material in the edge drains and transverse interceptor drains due to the migration of fine aggregates from untreated layers, the shoulder and the subgrade. The requirements for the filter fabrics used in the edge drains are:

Material Requirements

- Nonwoven or woven geotextile materials which conform to recommendations for Class B drainage applications where installation stresses are low will be used in edge drains. Fabric for the transverse interceptor drains shall meet Class A requirements. The following physical requirements on an average per roll basis sampled in accordance with ASTM D4354 shall be met:

Property	Minimum Value		Test Method
	Class A	Class B	
Grab Strength, N (lbs)	800 (180)	355 (80)	ASTM D 4632
Puncture Strength, N (lbs)	355 (80)	111 (25)	ASTM D 3787
Trapezoid Tear, N (lbs)	222 (50)	111 (25)	ASTM D 4533
Burst Strength, kPa (lb/in^2)	2000 (290)	896 (130)	ASTM D 3786
Permeability	$k_{fabric} > k_{soil}$		ASTM D 4491
Apparent Opening Size			ASTM D 4751
1. Soil with ≤50% passing No. 200 sieve.	AOS < 0.6mm > #30 US std. sieve		
2. Soil with >50% passing No. 200 sieve.	AOS < 0.3mm > #50 US std. sieve		

Construction Requirements

- Filter fabrics shall extend around each of the edge drain trenches as shown in Figure 8. The filter fabric must extend around each edge drain and wrap around the outer edge of the PATB layer, but does not need to extend under the full width of the pavement. The fabric must wrap around the edges of the PATB layer extending over the top of the PATB and extending under the pavement a minimum of 610 mm (2 feet) beyond the shoulder joint.
- Filter fabrics must be installed according to manufacturers specifications and as shown in the typical drawings.

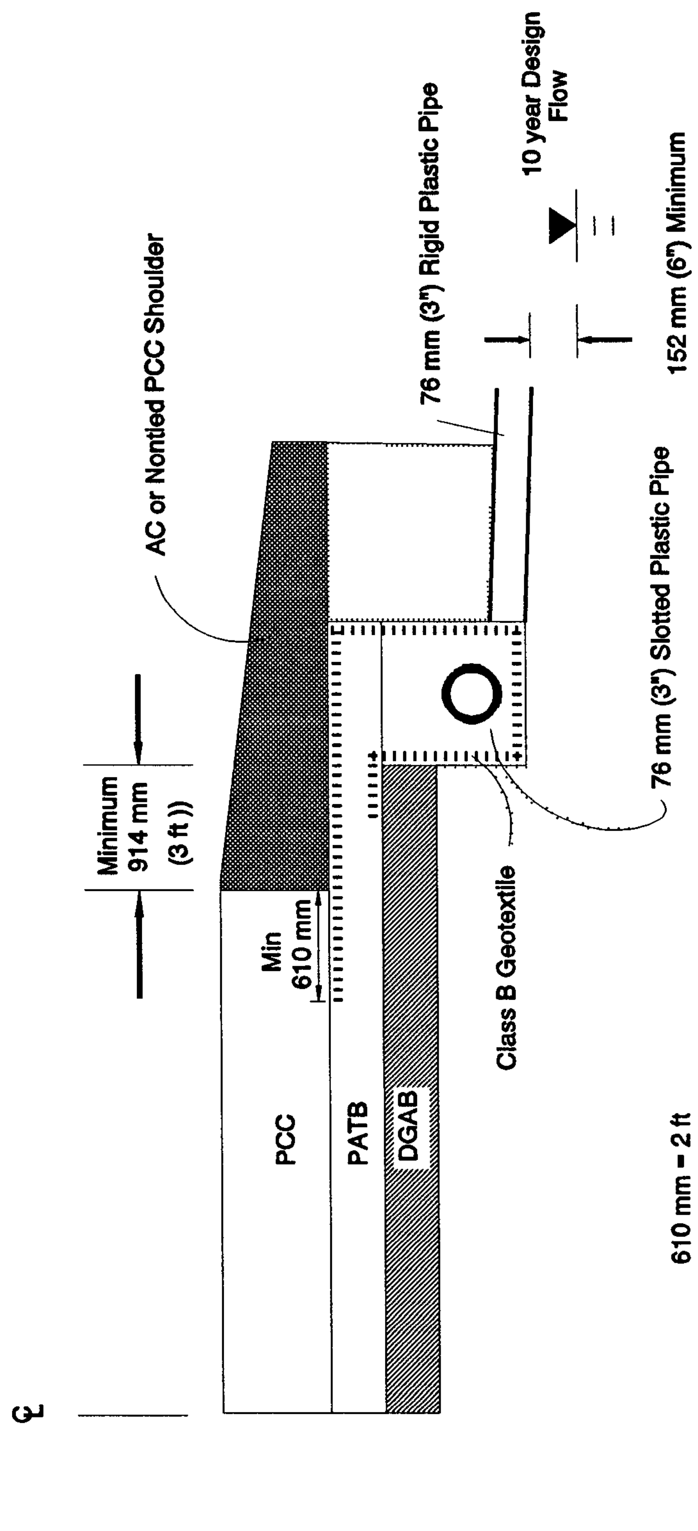


Figure 8. Edge Drain Detail

- Exposure of geotextiles to the elements between laydown and cover shall not exceed 14 days or manufacturer's specifications, whichever is less.
- Any filter fabric which is ripped or torn during the construction process shall be replace or repaired with a patch which extends 914 mm (3 feet) beyond the perimeter of the tear or damage.
- Geotextile shall be overlapped a minimum of 610 mm (2 feet) at all longitudinal and transverse geotextile joints. Joints may be sewn if required by agency practice.

Edge Drains

Edge drains shall be used in the shoulders of the pavement sections with PATB to collect the water from the permeable base.

- Both inside and outside edge drains shall be constructed for crowned pavement cross-sections. For pavements with cross-slope, only one edge drain will be required.
- The edge drains should be located a minimum of 914 mm (three feet) outside the edge of the mainline pavement, as illustrated in Figure 8.
- The edge drains shall run continuous throughout each of the 183 m (600 foot) minimum length permeable base test sections.
- The PATB is recommended as backfill in the edge drain trench, however, other approved open graded material may be used.
- Collector pipes shall be a minimum 76 mm (3-inch) diameter slotted plastic pipe and outlet pipes shall be a minimum 76 mm (3-inch) diameter unslotted rigid plastic pipe. Pipes must be capable of withstanding the temperature of the PATB without damage if PATB is used as backfill.
- Transverse collector subdrains shall be located in transition zones between drained and undrained sections where a longitudinal slope exists. The drain should be installed at an acute angle relative to the downslope direction, as shown in Figure 7.
- Drainage pipes should be sized for the expected flows determined as part of design. Discharge outlet pipes should be located at maximum intervals of 76.2 m (250 feet) and rodent protected. Outlets must be at least 152 mm (6 inches) above the expected 10 year flow elevation of the collector ditches to prevent backflow into the drainage system.

Shoulders

For the SPS-2, SPS-2A, and SPS-2B experiments, participating agency practice shall be used to provide asphalt concrete or PCC shoulders. Portland cement concrete shoulders shall not be tied to the mainline pavement. Also, if the concrete shoulder is placed monolithically with the traffic lanes, then the shoulder joint shall be sawed full depth. Tied PCC shoulders may be constructed in additional supplemental test sections, although not in the SPS-2A or SPS-2B experiments. The longitudinal joint between the mainline concrete pavement and the shoulder shall be sealed.

PORTLAND CEMENT CONCRETE MIX DESIGN

The quality of concrete as delivered and as placed and the subsequent strength development in concrete are critical factors in concrete pavement performance. Although only the strength property (flexural strength) is normally considered in evaluating the structural behavior of concrete pavements, durability related properties (entrained air content, aggregate type, degree of consolidation) are also important in evaluating the long term performance of concrete.

The test sections in the primary experiment SPS-2 and the supplemental experiment, will be constructed for two levels of flexural strength. These strength levels are 3.8 MPa and 6.2 MPa (550 and 900 psi) as determined from third point loading tests at 14 days. The test sections for the supplemental experiment SPS-2A will be constructed with concrete designed for a 14-day nominal flexural strength of 3.8 MPa (550 psi). The concrete mixture should be designed according to the procedures and specifications followed by the participating agency. It is recommended that a slip-form method be used for placement of the concrete. In such a case, slump of the as-delivered concrete shall not exceed 64 mm (2 1/2 in).

Concrete with an average 14-day flexural strength of 3.8 MPa (550 psi) is considered standard and readily available. However, some agencies have reported difficulty in achieving this strength level while maintaining sufficient cement content for acceptable durability. In such cases, an average strength level of 4.1 MPa (600 psi) is considered acceptable for the lower strength level criterion. For the higher strength concrete, well-planned laboratory testing may be required to design a mixture capable of achieving an average flexural strength of 6.2 MPa (900 psi) at 14 days. The higher strength in most cases should be achievable by using a higher cement content (cement factor). Laboratory mix design will be in accordance with participating agency practice except that determination of the strength level for trial mixes shall be in accordance with the procedures contained in Appendix A.

The following is a summary of the requirements for the portland cement concrete:

- Flexural Strength - 3.8 MPa or 6.2 MPa (550 or 900 psi) average at 14 days
- Slump (Slip-form paving) - 25 mm to 64 mm (1 to 2 1/2 in)
- Air Content - 6 1/2 ± 1 1/2% for freeze-thaw areas

Materials

Material requirements for the concrete should be based on the normal practice of the participating highway agency. Many agencies have specific requirements for coarse and fine aggregates based on durability concerns as well as local availability of quality aggregates. However, it is necessary to maintain a high degree of uniformity and consistency in the construction of the test sections to achieve the objectives of a coordinated national experiment. Therefore, concrete materials must conform to certain minimum requirements to insure consistency in the concrete quality at the different sites.

Portland Cement - Only Type I or Type II portland cement shall be used. Type III portland cement shall not be used. The cement used shall meet the requirements of AASHTO Specification M85.

Fly Ash - Fly ash may be used as substitute for a portion of the portland cement. The amount of substitution shall not exceed 15% by weight of cement. The fly ash replacement amount shall be determined through laboratory trial mix investigations using the specific materials proposed for the project. Use of Class F fly ash meeting the specific requirements of the agency is permitted. The use of Class C fly ash is not permitted. Participating agency practice concerning the use of fly ash in concrete in certain months of the year should be observed.

Fine Aggregate - Fine aggregate (passing the No. 8 sieve) shall consist of natural sand, manufactured sand, stone screenings, slag screenings, or a combination thereof, and meet the quality requirement of AASHTO M6. The fineness modulus of the fine aggregate shall not be less than 2.3 and shall not be greater than 3.1.

Coarse Aggregate - Coarse aggregate (retained on the No. 8 sieve) shall consist of crushed gravel or crushed stone particles meeting the requirements of AASHTO M80. It is recommended that the coarse aggregate conform to AASHTO 57 gradation as follows:

Sieve Size	Percent Passing
38 mm (1 1/2 in)	100
25 mm (1 in)	95-100
13 mm (1/2 in)	25-60
No. 4	0-10
No. 8	0-5

Coarse aggregate with a 25 mm (1-inch) maximum size aggregate may be used if such use represents the common practice of the participating agency.

The coarse aggregate shall conform to the following specific requirements:

		Value
1.	Abrasion Loss, Maximum %	50
2.	Magnesium Sulfate Soundness, Maximum %	12
3.	Thin and Elongated Pieces, Maximum %	15
4.	Crushed particles, Minimum %	55
5.	Total of deleterious materials including chert, shale and friable particles, Maximum %	3

It is important that the coarse aggregate meet the highest standard of durability specified by the participating agency. Coarse aggregate must be obtained from a source approved by the agency and must be reasonably free from deleterious substances such as chert, gypsum, iron sulfide, amorphous silica and hydrated iron oxide.

Coarse aggregate for use in concrete that will be subject to wetting, extended exposure to humid conditions, or contact with moist ground shall not contain any materials that are deleteriously reactive with alkalies in the cement in an amount sufficient to cause excessive expansion of mortar or concrete. However, if such materials are present in injurious amounts, the coarse aggregate may be used with a cement containing less than 0.6 percent alkalies calculated as sodium oxide equivalent or with the addition of a material that has been shown to prevent harmful expansion due to the alkali-aggregate reaction. The potential reactivity should be determined in accordance with the procedure given in AASHTO M80.

Other Items - Other items used in the production of concrete such as water and admixtures shall conform to the requirements normally specified by the agency for interstate concrete pavement construction. Use of micro-silica (silica fume) as an additive is not permitted. Also, the use of additives to accelerate the strength gain of the concrete is not permitted for the SPS-2 experiment.

CONCRETE PAVEMENT REQUIREMENTS

Concrete pavement requirements for the primary experiment SPS-2 and for the two supplementary experiments SPS-2A and SPS-2B are summarized in the following sections:

Primary Experiment SPS-2

The primary experiment SPS-2 addresses doweled jointed plain concrete pavements. The concrete pavement design for this experiment stipulates the following details:

1. Slab thickness - 203 mm and 279 mm (8 and 11 inches)
2. Joint spacing - 4.57 m (15 foot) uniform spacing
3. Lane width - 3.66 m and 4.27 m (12 foot and 14 foot) A solid white line shall be painted to delineate the 3.66 m (12 foot) wide travel portion of the widened lane.
4. Joint load transfer - Doweled perpendicular transverse joints, with 32 mm (1-1/4 inch) dowel bars for the 203 mm (8 inch) thick pavement and 38 mm (1-1/2 inch) dowel bars for the 279 mm (11 inch) thick pavement. Dowels are to be epoxy coated, 457 mm (18 inches) long, spaced at 305 mm (12 inches) and conforming to the requirements of AASHTO M254. Dowels are to be placed mid-depth using basket assemblies or dowel bar inserters with each bar aligned

parallel to the longitudinal direction (with a tolerance of 1 mm per 50 mm of length (1/4 inch per foot)) and located such that the bars will be centrally located (longitudinally) at the joint. Dowels shall be placed no closer than 152 mm (6 inches) from the longitudinal joints.

5. Longitudinal joints - between lanes should be sawcut, preferably using up to a 8 mm (3/8 inch) wide blade, to a depth of D/3 (where D = slab thickness). The sealant reservoir may be formed later using a second sawcut to provide for a 8 mm (3/8 inch) wide by 25 mm (1 inch) deep cut. The use of plastic inserts to form longitudinal joints is not permitted. The longitudinal joint between lanes will be tied using epoxy coated deformed steel bars, No. 5 grade 40 steel, spaced at 762 mm (30 inches) center to center and 762 (30 inches) long. The tie bars shall be placed perpendicular to the longitudinal joint at a target depth of D/2.

A plan view of the test section slab panels is shown in Figure 9.

Supplementary Experiment SPS-2A

The supplementary experiment SPS-2A addresses undoweled concrete pavement with skewed joints. The concrete pavement design for this experiment stipulates the following details:

1. Slab thickness - 203 mm and 279 mm (8 and 11 inches)
2. Joint spacing - variable @ 3.66 m, 4.57 m, 3.96 m, and 4.27 m (12, 15, 13, and 14 feet)
3. Lane width - 3.66 m and 4.27 m (12 and 14 feet). A solid white line shall be painted to delineate the 3.66 m (12 foot) wide travel portion of the widened lane.
4. Joint load transfer - aggregate interlock only, no load transfer devices are permitted.
5. Joint type - skewed, 1 m in 6 m (2 feet in 12 feet), right hand forward.
6. Longitudinal joints - between lanes should be sawcut, preferably using up to a 8 mm (3/8 inch) wide blade, to a depth of D/3. The sealant reservoir may be formed later using a second sawcut to provide for a 8 mm (3/8 inch) wide by 25 mm (1 inch) deep cut. The use of plastic inserts to form longitudinal joints is not permitted. The longitudinal joint between lanes will be tied using epoxy coated deformed steel bars, No. 5 grade 40 steel, spaced at 762 mm (30

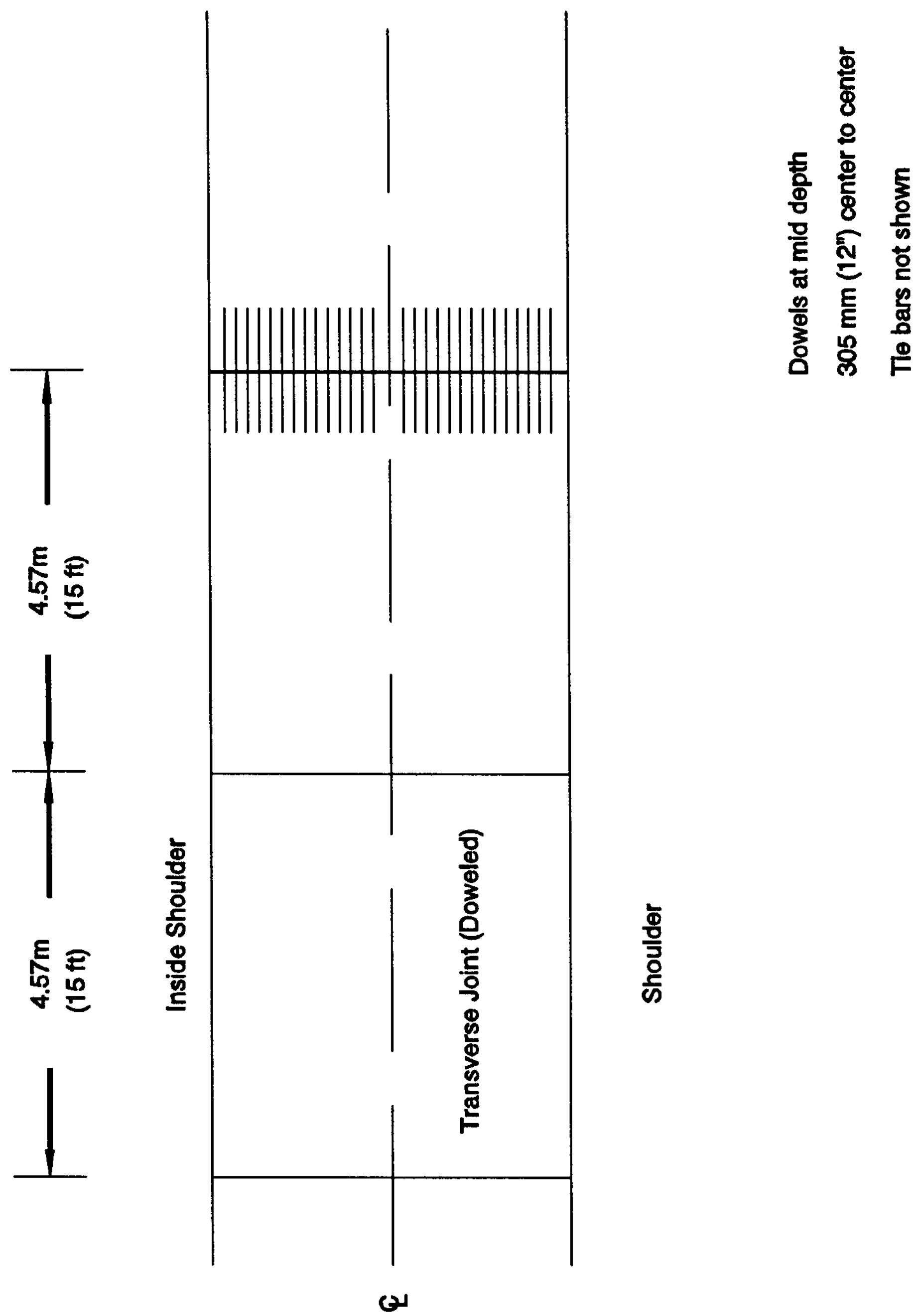


Figure 9. Plan View - Main Experiment

inches) center to center and 762 mm (30 inches) long. The tie bars shall be placed perpendicular to the longitudinal joint at a target depth of D/2.

A plan view of the SPS-2A test section slab panels is shown in Figure 10.

Supplementary Experiment SPS-2B

The supplementary experiment SPS-2B addresses reinforced concrete pavements. The concrete pavement design for this experiment stipulates the following details:

1. Slab thickness - 203 mm and 279 mm (8 and 11 inches)
2. Joint spacing - 9.14 m (30 feet)
3. Lane width - 3.66 m and 4.27 m (12 and 14 feet). A solid white line shall be painted to delineate the 3.66 m (12 foot) wide travel portion of the widened lane.
4. Joint load transfer - Doweled perpendicular transverse joints, with 32 mm (1-1/4 inch) dowel bars for the 203 mm (8 inch) thick pavement and 38 mm (1-1/2 inch) dowel bars for the 279 mm (11 inch) thick pavement. Dowels are to be epoxy coated, 457 mm (18 inches) long, spaced at 305 mm (12 inches) and conforming to the requirements of AASHTO M254. Dowels are to be placed mid-depth using basket assemblies or dowel bar inserters with each bar aligned parallel to the longitudinal direction (with a tolerance of 6 mm (1/4 inch) per 305 mm (1 foot) of length) and located such that the bars will be centrally located (longitudinally) at the joint. Dowels shall be placed no closer than 152 mm (6 inches) from the longitudinal joints.
5. Reinforcement - Normal "temperature" reinforcement consisting of welded wire fabric. All reinforcement shall be epoxy-coated.
6. Longitudinal joints - between lanes should be sawcut, preferably using up to a 8 mm (3/8 inch) wide blade, to a depth of D/3. The sealant reservoir may be formed later using a second sawcut to provide for a 8 mm (3/8 inch) wide by 25 mm (1 inch) deep cut. The use of plastic inserts to form longitudinal joints is not permitted. The longitudinal joint between lanes will be tied using epoxy coated deformed steel bars, No. 5 grade 40 steel, spaced at 762 mm (30 inches) center to center and 762 mm (30-inches) long. The tie bars shall be placed perpendicular to the longitudinal joint at a target depth of D/2.

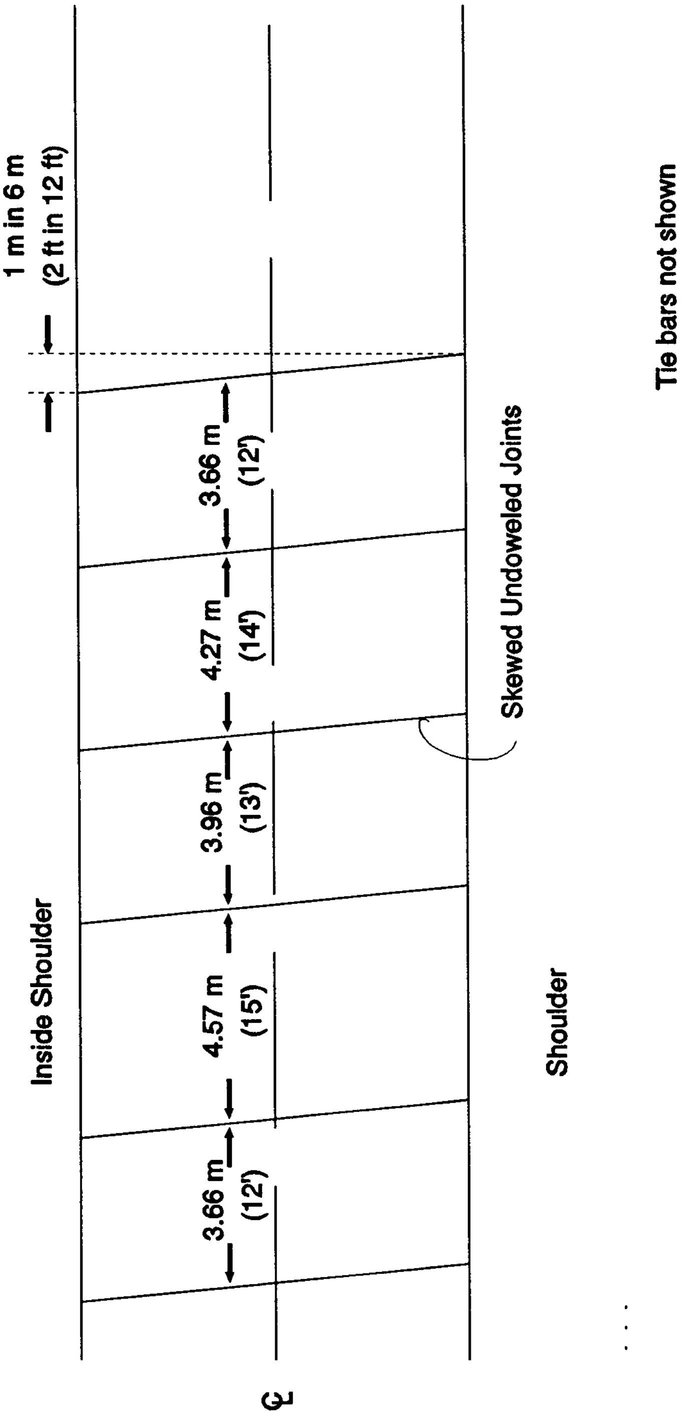


Figure 10. Plan View - SPS-2A

The steel reinforcement shall be provided over the length of each slab panel up to 610 mm (2 feet) from each transverse joint and the centerline longitudinal joint. Laps should be a minimum of 305 mm (12 inches) but not less than 30 times the diameter of the longitudinal wire or bar. Reinforcing steel shall be placed at slab mid-depth. Reinforcing steel shall conform to the requirements of ASTM A185 for welded steel wire fabric or ASTM A497 for welded deformed steel fabric. The following steel reinforcement is recommended:

Slab Thickness	Fabric Type	Percent Steel	Area, mm^2/m (in^2/ft)
203 mm (8")	6x12-W7xW7	0.15	290 (0.14)
279 mm (11")	6x12-W10xW10	0.15	423 (0.20)

A plan view of the test section slab panels is shown in Figure 11.

CONCRETE PAVEMENT CONSTRUCTION OPERATIONS

The concrete pavement for the SPS-2 test sections shall be constructed in accordance with the practices and specifications which have proven to be successful for the participating highway agencies. It is strongly recommended that slip-form paving procedure be used for concrete placement, and that test lane and adjacent lane be slip-formed in one operation. The key items related to construction are outlined in the following sections.

Concrete Placement and Finishing

The test sections at each site incorporate several variables pertaining to the concrete slabs including pavement thickness, concrete strength, and lane width. Therefore, it is recommended that special consideration be given to arranging the test sections at the site in a manner that will facilitate construction operations. Concrete placement for each test section should be done in a single continuous operation.

When dowel baskets are used at transverse joints concrete placement using side-dump procedures will facilitate placement of dowel bars ahead of concrete placement. Therefore, this procedure shall be used for placement of concrete.

Use of slip-form equipment is recommended. The equipment shall spread, consolidate, screed and float-finish the concrete so that a minimum of hand finishing will be necessary and a well consolidated and homogeneous pavement is produced. The machine shall vibrate the concrete for the full-width and depth of the concrete. Internal spud-type vibrators shall be used at a spacing of no more than 610 mm (24 inches).

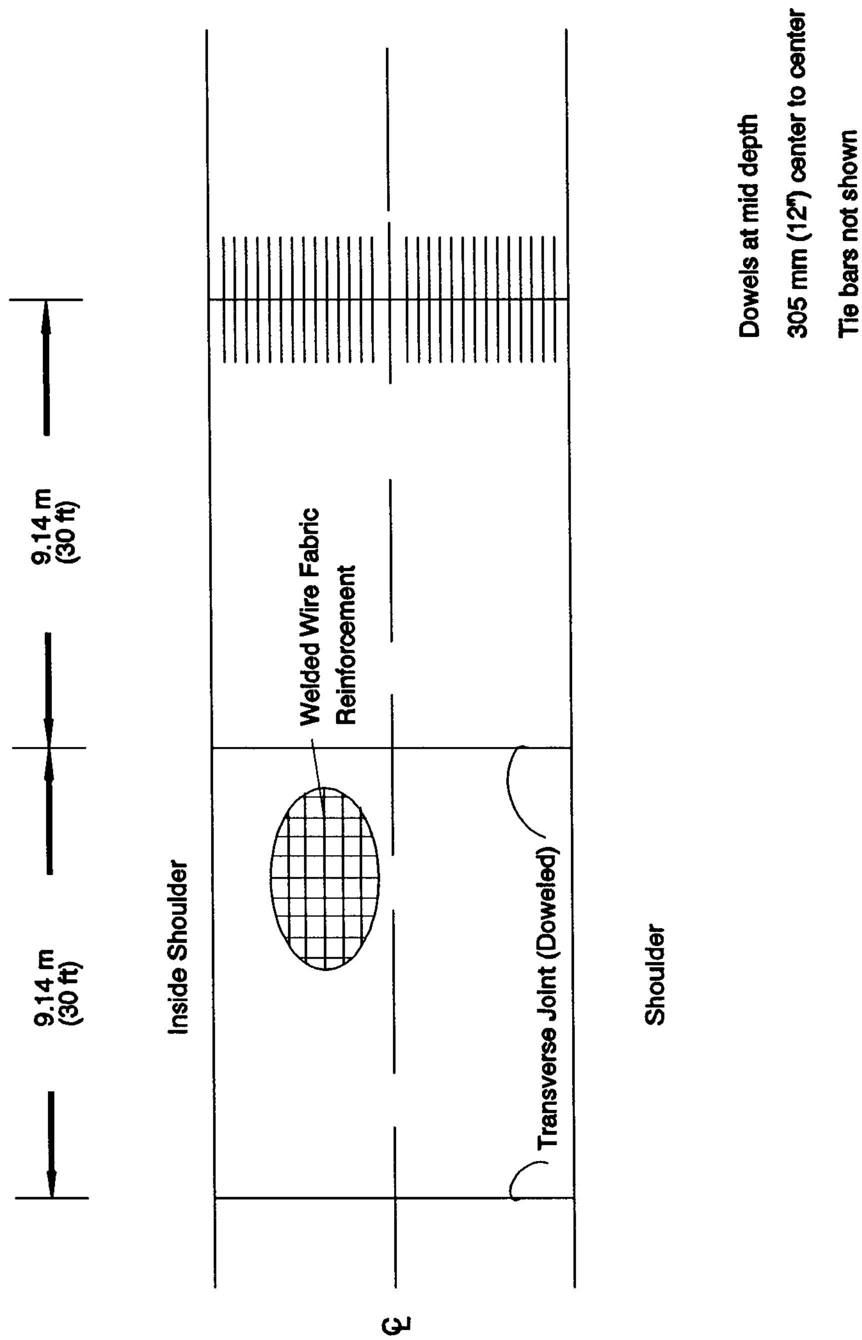


Figure 11. Plan View - SPS-2B

Jointing

For the primary SPS-2 and supplementary SPS-2B experiments, transverse contraction joints with dowel bars shall be provided at a spacing of 4.57 m (15 feet) and 9.14 m (30 feet), respectively. These joints shall be sawed perpendicular to the longitudinal direction of the pavement. At these joints, dowel bars shall be provided using basket assemblies or dowel bar inserters. Dowels should be properly aligned and the dowel baskets, if used, should be securely anchored to the base layer and placed at pavement mid-depth. Dowels should be lightly coated with grease or other suitable lubricant over their entire length to prevent bonding of the dowel to the concrete.

For the supplementary SPS-2A experiment, skewed joints shall be provided at a random spacing 3.66 m, 4.57 m, 3.96 m, and 4.27 m (12, 15, 13, and 14 feet). The skew shall be 1 m in 6 m (2 feet in 12 feet), right hand forward in the travel direction.

All joints for the primary experiment SPS-2, and the supplementary experiments SPS-2A and SPS-2B shall be sawed. For transverse contraction joints, an initial sawcut of D/3 is required, preferably made using up to a 8 mm (3/8 inch) wide blade. A second sawcut should be made later, if necessary, to provide the required shape factor for the sealant material. Longitudinal joints between lanes should be sawed initially, preferably using up to a 8 mm (3/8 inch) wide blade, to a depth of D/3. A second sawcut should be made later to provide for a 8 mm (3/8 inch) wide by 25 mm (1 inch) deep sealant reservoir.

The use of plastic inserts to form longitudinal joints is not permitted. The longitudinal joint will be tied using epoxy coated deformed steel bars, No. 5 grade 40 steel, spaced at 762 mm (30 inches) center to center and 762 mm (30 inches) long. The tie bars shall be placed perpendicular to the longitudinal joint at a target depth of D/2.

NOTE: If a concrete shoulder is used along the test sections, then the longitudinal joint between the outside shoulder and the travel lanes shall not be tied. The joint will be formed by placing the shoulder separately or by sawcutting full depth if the concrete is placed at the same time as the travel lanes.

Timing of initial sawing of both transverse and longitudinal joints is critical. Therefore, sawing should begin as soon as the concrete is strong enough to both support the sawing equipment and to prevent excessive ravelling of the concrete surface. Longitudinal sawing shall be initiated at the same time as the transverse sawing. All sawing shall be completed within 24 hours of placement.

Curing

Only liquid curing compound is permitted for curing the concrete pavement. Curing compound shall be applied to the concrete surface within 15 minutes after surface texturing operation and no later than 45 minutes after concrete placement. Participating agency practice shall be followed for surface texturing and in specification of the type of curing compound and application rate.

Joint Sealing

Joint sealing shall be accomplished using only silicone sealants. The sealant shall be either self-leveling or a tooled, no-slump material proven by the agency to work satisfactorily. Neither new or experimental sealants nor field poured liquid sealants shall be used for test sections. All pavement joints shall be sealed before opening to traffic.

Thickness Tolerance

It is necessary that every effort be made to obtain slab thickness as close to the target values of 203 mm and 279 mm (8 and 11 inches) as possible. Neither a deficiency nor an excess in thickness is desired. Final pavement thickness should be within 6 mm (1/4 inch) of the target values as determined from cores and rod and level survey elevation changes. Figure 6 illustrates the locations for elevation measurements to be taken at intervals of 15.25 m (50 feet) or less within the test sections, both before and after concrete placement.

Pavement Smoothness

The surface of the finished pavement shall be tested with a California type Profilograph. Profiles shall be made in both wheel paths parallel to each edge of the pavement. The pavement shall have a pro-rated profile index of less than 158 mm per 1000 m (10 inches per mile) as evaluated using California Test 526. The contractor shall remove high pavement areas with vertical deviations greater than 11 mm in 8 m (0.4 inches in 25 feet) by diamond grinding devices or multiple-saw devices as approved by the agency. Only localized grinding is permitted, wholesale grinding of the finished pavement surface is not permitted.

Opening to Traffic

The test section pavements shall be opened to traffic not before 7 days after concrete placement and concrete flexural strength has reached 3.8 MPa (550 psi). Joint sealing must be completed prior to opening to traffic. No construction traffic will be allowed on the test section until that time.

Repair of Defective Slabs

Pavement slab panels exhibiting cracking before the test sections are opened to traffic shall not be repaired. In cases where slab panels are damaged to the extent where structural repairs are necessary, FHWA LTPP Division shall be consulted prior to performing any repair activity.

Construction Operations

Construction operations shall be performed in compliance with the guidelines and specifications established by the participating agency for "Road and Bridge." The agency's high quality construction practice should be enforced for the experiment. Adequate attention shall be given to details and control of the mix plant, hauling, placement, and consolidation operations to prevent construction practices which are known to result in poor pavement performance. In addition, care should be taken to ensure that the construction of the test sections is performed in a manner consistent with normal highway construction.

TRANSITIONS

The 183 m (600 foot) overall length of each test section includes 152.5 m (500 foot) for monitoring and 15.25 m (50 feet) before and after the section for materials sampling. The distance between these 183 m (600 foot) sections must be sufficient to allow changes in materials and thicknesses during construction. This distance is required to accommodate changes in concrete mix and slab thickness in a manner that will reduce the effect on the properties of the finished pavement. A minimum transition length of 36.6 m (120 feet) is recommended between the test sections to provide sufficient production in order to develop consistency after changes in materials, thicknesses, or lane widths.

SECTION STATIONING

The test site shall be surveyed to the extent that limits of each test section location will be known to an accuracy of one foot. The first test section occurring in the direction of traffic at a site will have the project station 0+00 at the beginning of the monitoring section. Subsequent test sections will have a test section station 0+00 at the beginning of each monitoring section. Site and individual test section beginning stations for SPS-2 and SPS-2B sections will be located 3.05 m (10 feet) before the first joint of the monitoring section. The ending stations for SPS-2 and SPS-2B monitoring sections (station 152.5 (5+00)) will be 3.05 m (10 feet) beyond the last joint in the monitoring section. SPS-2A has variable joint spacing of 3.66 m, 4.57 m, 3.96 m, and 4.27 m (12, 15, 13, and 14 feet). The beginning station will be located within a 4.57 m (15 foot) slab, 3.05 m (10 feet) before the first joint in the section and the ending station will occur in a 3.96 m (13 foot) slab 1.07 m (3.5 feet) beyond the last joint in the section. Figure 12 illustrates the layout expected for the beginning and ending stations for the SPS-2, SPS-2A, and SPS-2B sections.

DEVIATIONS FROM GUIDELINES

An agency that desires to participate in the SPS-2 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. LTPP Division 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.

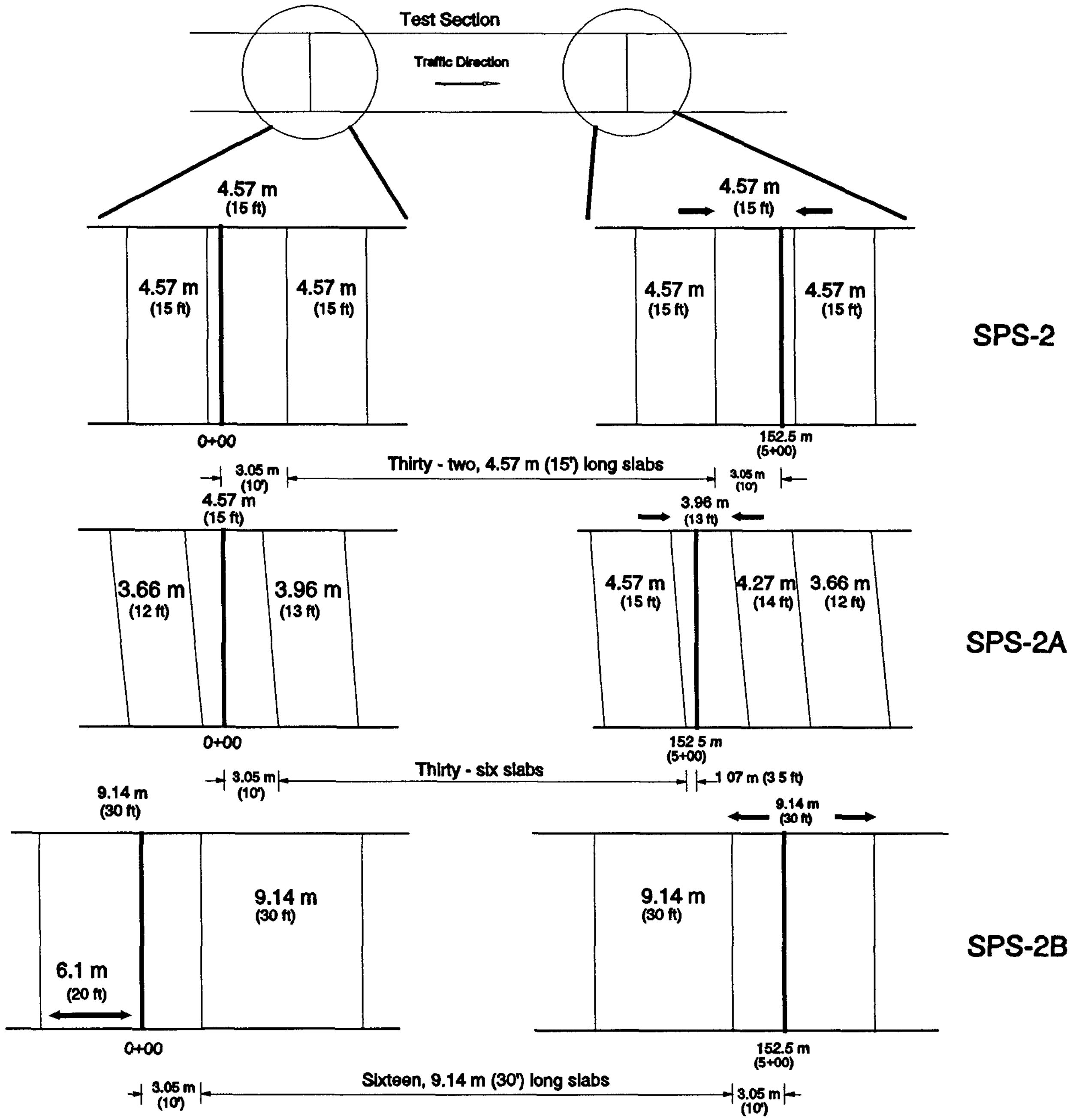


Figure 12. Location of Transverse Joints Relative to Test Section Stationing

APPENDIX A
STRENGTH LEVEL DETERMINATION FOR CONCRETE MIX DESIGNS

STRENGTH LEVEL DETERMINATION FOR CONCRETE MIX DESIGNS

The following procedures shall be used in determining concrete strength levels during mix design to ensure that the 550 psi and 900 psi concrete mixtures are uniquely obtained at the test sites.

1. Perform trial batches using several cement contents to cover the strength range of about 500 to about 900 psi flexural strength (at 14 days).

2. At least 3 flexural strength specimens should be tested per batch to obtain average strength per batch. Select mixture representative of 14-day flexural strengths of 550 and 900 psi, respectively.

3. Perform 3 or more trial batches for each mixture and test for 14-day flexural strength using 3 specimens.

4. The mixtures are acceptable if the following conditions are met:

   a. 550 psi Concrete

      i. The average of the average strength for each batch should be within 525 to 575 psi.

      ii. The range of average batch strength should not exceed the following:

No. of Batches	Maximum Range, psi
3	3.31(s) = 165
4	3.63(s) = 180
5	3.86(s) = 195
6	4.03(s) = 200

      s = batch to batch standard deviation = 50 psi (normal)

      iii. If the above two conditions are not met, then re-evaluate mix design and quality control procedures.

   b. 900 psi Concrete

      i. The average of the average strength for each batch should be within 860 to 940 psi.

ii. The range of average batch strength should not exceed the following:

No. of Batches	Maximum Range, psi
3	3.31(s) = 250
4	3.63(s) = 270
5	3.86(s) = 290
6	4.03(s) = 300

s = batch to batch standard deviation = 75 psi (assumed)

iii. If the above two conditions are not met, then re-evaluate mix design and quality control procedures.

The maximum range values are based on 95% probability that the batches are from the same population.

5. The acceptable mix designs should be used for construction and normal construction specification for concrete strength should be used to ensure that the contractor produces concrete as specified/designed.