CA SPS-6

**NICHOLS
CONSULTING
ENGINEERS, Chtd**

April 30, 1996
File 800 12 3 9 10, 0606

Mr Joe Hannon
Department of Transportation
Division of New Technology
Materials and Research
5900 Folsom Blvd
Sacramento, CA 95819

RE: Final SPS-6 Construction Report

Dear Mr Hannon

Enclosed are two copies of the final version of the Construction Report for your SPS-6 project. We appreciated your input on the draft report

If you have any questions, or further comments, please call

Sincerely,
NICHOLS CONSULTING ENGINEERS, Chtd.

Douglas J Frith, P E
Principal Investigator

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FEDERAL HIGHWAY ADMINISTRATION

Long Term Pavement Performance Specific Pavement Studies

CALIFORNIA SPS-6

Construction Report on Section 060600
California Department of Transportation

Prepared by:

Western Region Contractor
Nichols Consulting Engineers, Chtd.

April 1996

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INTRODUCTION

The SHRP (Strategic Highway Research Program) SPS-6 (Specific Pavement Study) addresses the rehabilitation of jointed portland cement concrete pavements. This report discusses the rehabilitation of a section of Interstate 5 near Mt. Shasta City in Northern California.

A significant amount of the data, tables and figures for this report were obtained from a report written by Gordon K Wells of the California Department of Transportation entitled, "Rehabilitation of Jointed Portland Cement Concrete Pavements, SPS-6, Strategic Highway Research Program," Experimental Project No. CA93-15, November 30, 1993.

SPS-6 GENERAL CRITERIA

The SPS-6 experiment requires the construction of multiple test sections with similar details and materials at each of twenty-four sites distributed in the four climatic regions in the United States. A standard SPS-6 experiment consists of seven 500-ft long test sections. The combinations of experimental factors for the seven SPS-6 test sections, designated Section 2 through Section 8, are listed in Table 1 In addition, a control section designated Section 1, which receives only limited routine-type maintenance, is included in the experiment. The control section is designed to indicate the rate of change that could be expected for the test sections had they not been rehabilitated

In the experimental design, preparation and/or restoration of the existing pavement is classed into three levels: minimal, intensive, and crack and seat or break and seat. These preparation treatments and/or restoration levels are applied with and without HMAC overlays. In one test section, Section 4, the overlay is sawed and sealed over the existing pavement joints and working cracks. Table 2 presents a summary of the types of treatments and/or restoration that should be applied to each test section. Table 3 highlights the applicable rehabilitation treatments for each test section The states were encouraged to add any additional test sections they wished to study and SHRP agreed to monitor them just as they monitor the SHRP SPS-6 sections.

SPS-6 MONITORING REQUIREMENTS

Preconstruction

Table 4 lists the minimum number of material samples and sample types required for an SPS-6 site A code is assigned to each sample to designate sample type (core, test pit, or auger), core site, and location number. For each sample type, material samples are obtained from the different pavement layers The number of material samples listed in Table 4 are those required for each material layer. Different types of samples of the pavement structure are required at each site, as follows:

Table 1. SPS-6 test section numbering scheme.

SPS-6 Section No.	Preparation	Other Treatments	Overlay Thickness (in)
1	Routine Maintenance	--	0
2	Minimum Restoration	--	0
3	Minimum Restoration	--	4
4	Minimum Restoration	Saw & Seal Joints in AC Overlay	4
5	Intensive Restoration	--	0
6	Intensive Restoration	--	4
7	Crack/Break & Seat	--	4
8	Crack/Break & Seat	--	8

Table 2 Summary of rehabilitation treatments for SPS-6 test sections

Test Section Details and Treatment Options	Surface Preparation							
	Routine	Minimal			Intensive		Crack & Seat	
Section number	1	2	3	4	5	6	7	8
Section length (100 ft)	5	10	5	5	10	5	5	5
Overlay thickness (in)	0	0	4	4	0	4	4	8
Joint sealing	X	X	N	N	R&R	N	N	N
Crack sealing	X	X	N	N	R&R	N	N	N
Partial depth patch	N	X	X	X	R&R	R&R	N	N
Full depth patch/joint repair	N	X	X	X	R&R	R&R	N	N
Load transfer restoration	N	N	N	N	B	B	N	N
Full surface diamond grinding	N	X	N	N	A	N	N	N
Undersealing	N	N	N	N	X	X	N	N
Subdrainage	N	N	N	N	A	A	A	A
Crack/break and seat	N	N	N	N	N	N	A	A
Saw and seal	N	N	N	A	N	N	N	N

X - Apply treatment as warranted
R&R - Remove & replace existing and apply additional as warranted
N - Do not perform
B - Full depth dowelled patch or retrofit dowels in slots
A - Apply treatment regardless of condition or need

Table 3 Highlights of rehabilitation treatments for SPS-6 test sections

Section 1	Routine maintenance only as per agency practice 3-5 years of service desired
Section 2	Minimal surface preparation, no overlay • perform joint and crack sealing, if warranted • perform partial and full depth patching, if warranted • perform full surface diamond grinding, if warranted
Section 3	Minimal surface preparation with 4 inch overlay • perform partial and full depth patching, if warranted • place a 4 inch thick HMAC overlay
Section 4	Minimal surface preparation with saw and seal 4 inch overlay • perform partial and full depth patching, if warranted • place a 4 inch thick HMAC overlay • saw and seal overlay over existing PCC pavement joints and working cracks
Section 5	Intensive surface preparation, no overlay • remove and replace existing joint and crack sealing • perform additional joint and crack sealing, if warranted • remove and replace existing partial and full depth patches • perform additional partial and full depth patching, if warranted • correct poor load transfer at joints and/or working cracks by full depth patching or retrofitting dowels • perform full surface diamond grinding • retrofit subsurface edge drainage system • perform undersealing, if warranted
Section 6	Intensive surface preparation with 4 inch overlay • remove and replace existing partial and full depth patches • perform additional partial and full depth patching, if warranted • correct poor load transfer at joints and/or working cracks by full depth patching or retrofitting dowels • retrofit subsurface edge drainage system • perform undersealing, if warranted • place a 4 inch HMAC overlay
Section 7	Crack/break and seat section with 4 inch overlay • crack/break and seat • retrofit subsurface edge drainage system • total section length including transitions should be at least 1500 ft (500 ft transitions at each end) • place a 4 inch HMAC overlay
Section 8	Crack and seat section with 8 inch overlay • crack/break and seat • retrofit subsurface edge drainage system • place an 8 inch thick HMAC overlay

Table 4 Preconstruction materials sampling

Materials and Sample Description	Number of Material Samples	Sample Type Designation
PRE-CONSTRUCTION		
1. PCC (original layer)		
Coring - 4" diameter cores	20	C1-C20
Coring - 6" diameter cores	3	A1-A3
Coring - 12" diameter cores	3	BA1-BA3
2 Unbound Base/Subbase Layers (per layer)		
Augering 6" diameter holes	3	A1-A3
Bulk sampling in 12" diam. holes	3	BA1-BA3
Bulk sampling in test pit	2	TP1-TP2
In-situ density and moisture content (nuclear gauge)	2	TP1-TP2
Moisture content samples	7	TP1-TP2, BA1-BA3
3 Bound Base/Subbase Layers (per layer)		
Coring - 4" diameter cores	3	C5, C11, C19
Coring - 6" diameter cores	3	A1-A3
Coring - 12" diameter cores	3	BA1-BA3
4 Subgrade		
Splitspoon sampling	4*	A1-A2
Thin-walled tube sampling (* 2 tubes or 2 spoons or combination per hole)	4*	A1-A2
Bulk sampling in 12" diam holes	3	BA1-BA3
Bulk sampling in test pit	2	TP1-TP2
In-situ density and moisture content (nuclear gauge)	2	TP1-TP2
Moisture content samples	7	TP1-TP2, BA1-BA3
5 Shoulder Auger Probes	3	S1-S3

- 4-in. outer diameter cores of the pavement surface layer.
- 4-in outer diameter cores of portland cement concrete, bound base layers, and treated subbase layers.
- 6-in outer diameter cores of portland cement concrete, bound base layers, and treated subbase layers, auguring of unstabilized base and subbase layers; thin-walled tube and/or split spoon sampling of subgrade layers to 4-ft below the top of the untreated subgrade.
- 12-in. outer diameter cores of portland cement concrete, bound base layers, and treated subbase layers, auguring of unstabilized base, subbase, and subgrade to 12-in below the top of the untreated subgrade for bulk sample retrieval.
- 4 or 6-in. shoulder auger probes augured to a depth of 20-ft. through the shoulder to determine the location of the rigid layer.
- Bulk samples of the finished uncompacted AC mixtures used in the overlay.

The laboratory material testing program corresponding to the sampling plan outlined in Table 4 is shown in Table 5. This table shows the SHRP test designation, SHRP material testing protocol, the number of tests for each layer of material, and the material source/sample type designation which corresponds to the codes shown in Table 4.

During Construction

The bulk sampling requirements for the asphalt cement, aggregates, and uncompacted mixes to be collected during construction are shown in Table 6 Part A of this table lists material required for the test site evaluation and SPS purposes. Part B lists the material to be shipped to the SHRP Reference Materials Library for testing as part of the SHRP Asphalt Research Program The laboratory material testing program corresponding to the bulk sampling is shown in Table 7, the post-construction laboratory testing plan. The samples are labeled BV1, BV2, and BV3 for bulk virgin asphalt samples.

Post-Construction

The post-construction sampling requirements are shown in Table 8, as follows.

The details of the sampling plan for each SPS-6 site differs depending on the variability and constraints of each specific project Each sampling plan is tailored to account for the distance between test sections, project length, subgrade variability, and other conditions unique to the site Guidelines for before and after monitoring measurements are shown in Table 9, for deflection and profile measurements, distress surveys, and friction measurements

Table 5 Post-construction laboratory testing plans

Material Type and Properties	SHRP Designation	SHRP Protocol	Tests per Layer	Material Source/ Test Locations
I Portland Cement Concrete				
Compressive Strength	PC01	P61	10	C1 C3 C5 C7 C9 C11 C13 C15 C17 C19
Splitting Tensile Strength	PC02	P62	10	C2 C4 C6 C8 C10 C12 C14 C16 C18 C20
PCC Coefficient of Thermal Expansion	PC03	P63	3	A1 A2 A3
Static Modulus of Elasticity	PC04	P64	6	C3 C5 C7 C11 C15 C17
PCC Unit Weight	PC05	P65	10	C1 C3 C5 C7 C9 C11 C13 C15 C17 C19
Core Examination / Thickness	PC06	P66	23	C1-C20 A1 A2 A3
II Bound (Treated) Base and Subbase				
Type and Classification of Material and Treatment	TB01	P31	3	C5 C11 C19
Pozzolanic/Cementitious Compressive Strength	TB02	P32	3	C5 C11 C19
Asphalt Treated Dynamic Modulus (77F)	TB03	P33	3	C5 C11 C19
HMAC: Resilient Modulus	AC07	P07	3	C5 C11 C19

Table 5 Pre-construction laboratory testing plans (cont'd)

Material Type and Properties	SHRP Designation	SHRP Protocol	Tests per Layer	Material Source/ Test Locations
III Unbound Granular Base and Subbase				
Particle Size Analysis	UG01	P41	3	TP1 [BA1-3] TP2
Sieve Analysis (washed)	UG02	P41	3	TP1 [BA1-3] TP2
Atterberg Limits	UG04	P43	3	TP1 [BA1-3] TP2
Moisture-Density Relations	UG05	P44	3	TP1 [BA1-3] TP2
Resilient Modulus	UG07	P46	3	TP1 [BA1-3] TP2
Classification	UG08	P47	3	TP1 [BA1-3] TP2
Permeability	UG09	P48	3	TP1 [BA1-3] TP2
Natural Moisture Content	UG10	P49	3	TP1 [BA1-3] TP2
IV Subgrade				
Sieve Analysis	SS01	P51	3	TP1 [BA1-3] TP2
Hydrometer to 0 001mm	SS02	P42	3	TP1 [BA1-3] TP2
Atterberg Limits	SS03	P43	3	TP1 [BA1-3] TP2
Classification	SS04	P52	6	TP1 [BA1-3] TP2 A1 A2 A3
Moisture-Density Relations	SS05	P55	3	TP1 [BA1-3] TP2
Resilient Modulus	SS07	P46	3	A1 A2 A3
Unit Weight	SS08	P56	6	TP1 [BA1-3] TP2 A1 A2 A3
Natural Moisture Content	SS09	P49	3	TP1 [BA1-3] TP2
Depth to Rigid Layer			3	S1 S2 S3

NOTE 1 Samples within brackets are from the same sampling location

Table 6 Bulk material sampling during construction

A *Materials required for testing as part of SPS-6 experiment*

Materials and Sample Description	Number of Material Samples
1 Asphalt Concrete Mix	
100 lb bulk sample (total)	3

B Materials to be shipped to the SHRP asphalt reference library

Materials and Sample Description	Number of Material Samples
1 Asphalt Cement	
5 gallon containers	11
2 Aggregate	
55 gallon drums	1000 lbs
3 Finished Asphalt Concrete Mix	
5 gallon containers	200 lbs

Table 7 Pre-construction laboratory testing plans

Material Type and Properties	SHRP Designation	SHRP Protocol	Tests per Layer	Material Source/ Test Locations
A Asphalt Concrete				
Core Examination / Thickness	AC01	P01	20	All Cores
Bulk Specific Gravity	AC02	P02	20	All Cores
Maximum Specific Gravity	AC03	P03	3	BV1 BV2 BV3
Asphalt Content (Extraction)	AC04	P04	3	BV1 BV2 BV3
Moisture Susceptibility	AC05	P05	3	BV1 BV2 BV3
Creep Compliance	AC06	P06	3	C25 C34 C36
Resilient Modulus	AC07	P07	9	[C21,C22,C23] [C31,C32,C33] [C38,C39,C40]
Tensile Strength	AC07	P07	3	C24 C30 C37
B Extracted Aggregate				
Bulk Specific Gravity				
Coarse Aggregate	AG01	P11	3	From Uncompacted Mix
Fine Aggregate	AG02	P12	3	From Uncompacted Mix
Type and Classification:				
Coarse Aggregate	AG03	P13	3	From Uncompacted Mix
Fine Aggregate	AG03		3	From Uncompacted Mix
Gradation of Aggregate	AG04	P14	3	From Uncompacted Mix
Roundness Index of Coarse Aggregate	AG06	P14B	3	From Uncompacted Mix
NAA Test for Fine Aggregate Particle Shape	AG05	P14A	3	From Uncompacted Mix

Table 7. Post-construction laboratory testing plans (cont'd)

Material Type and Properties	SHRP Designation	SHRP Protocol	Tests per Layer	Material Source/ Test Locations
C Asphalt Cement (From Mix)				
Abson Recovery	AE01	P21	3	From Uncompacted Mix
Penetration at 50F, 77F, 90F	AE02	P22	3	From Uncompacted Mix
Specific Gravity (60F)	AE03	P23	3	From Uncompacted Mix
Viscosity at 77F	AE04	P24	3	From Uncompacted Mix
Viscosity at 140F, 275F	AE05	P25	3	From Uncompacted Mix

NOTE 1 Samples within brackets are from the same sampling location.

Table 8 Post-construction materials sampling

Material and Sample Description	Number of Material Samples	Sample Type Designation
Asphaltic Concrete (Overlay) Coring - 4" Diameter Cores	20	C21 - C40

The laboratory material testing program corresponding to these cores was shown in Table 7

Table 9 Guidelines on before and after monitoring measurements on SPS-6 test sites

MEASUREMENT	BEFORE CONSTRUCTION *	AFTER CONSTRUCTION
DEFLECTION MEASUREMENTS	< 3 Months	1 - 3 Months
PROFILE MEASUREMENTS	< 3 Months	< 2 Months
DISTRESS SURVEY	< 6 Months	< 6 Months
FRICTION MEASUREMENTS	< 12 Months	3 - 12 Months

* Deflection testing was performed on the crack and seat sections before cracking, immediately after cracking and again after seating

CALIFORNIA SPS-6 BACKGROUND

The California SPS-6 experiment was constructed in the northbound lanes of Interstate 5 near Mt Shasta City in Northern California It is located in Siskiyan County (Highway Agency District 2) between postmile 13 04 (station 698+50) and postmile 15 70, (station 839+00). Note that the state of California uses a distance designation of postmile, which is different than the milepost designation used by most states

The original PCC road was opened to traffic in 1973, with four divided lanes (two in each direction) The uphill portion of the northbound lanes (the area with test sections 060609, 060614, 060610, 060611, and 060612) has three lanes The test lane is always the outside lane (Note California designates the outside lane as either lane 2 or lane 3 depending on the number of lanes For all of the SHRP-LTPP studies, the outside lane is always considered lane 1) The road has an outside AC shoulder width of ten feet In 1983, subsurface edge drains were retrofitted into the roadway structure The original pavement type was a jointed plain portland cement concrete with skewed joints The joint spacing is 12, 13, 19, and 18 feet, or a 15 5-ft average The minimum PCC flexural strength was 550 psi at the time of construction The average PCC thickness was 8 4-in The base consisted of 5 4-in of a cement-aggregate mixture, and the subbase was a coarse grained poorly graded sand/gravel mixture

The annual average daily traffic in two directions for this section of road was 19,000 in 1988, with 31 5% heavy trucks and combinations The traffic growth rate since the project opened to traffic was 13 8%/yr in equivalent single axle loads (ESALs) In 1988, the estimated total 18k ESAL applications in the study lane was 1 $4x10^6$

At the time of rehabilitation, the predominate distresses were faulting and severe cracking The site is located in the dry-freeze, poor pavement condition category of the SPS-6 site selection factorial shown in Figure 1

The elevation of the project is near 4000 ft , the average annual rainfall is 37 in , and the average annual maximum, minimum, and mean temperatures are 62°F, 37°F, and 50°F, respectively Eight of the fourteen test sections were located entirely on fill sections while the remainder were in cuts

TEST SECTION LAYOUT

The California SPS-6 rehabilitation project includes

- 7 SHRP test sections
- 1 SHRP control section
- 6 state supplemental sections

	WET FREEZE		WET NO FREEZE		DRY FREEZE		DRY NO FREEZE
CONDITION	JRCP	JPCP	JRCP	JPCP	JRCP	JPCP	JPCP
FAIR	(2)*	(2)	(2)	(2)	(1)	(2)	(1)
POOR	(2)	(2)	(2)	(2)	(1)	California SPS-6 (2)	(1)

* Numbers in parentheses indicate the number of test sites nationwide

Figure 1 SPS-6 site selection factorial

These sections are shown in Figure 2 A detailed, as-built layout is shown in Figures 3a through 3c, and listed in Table 10 Section 14 is located between Sections 9 and 10 in Figure 2, and is the standard state rehabilitation for this roadway. It is not included in Figures 3a through 3c or in Table 10

MONITORING AND MATERIALS SAMPLING

Preconstruction

Figure 4 shows the location of samples taken on the California SPS-6 project before construction No test pits were taken on any of the sections The samples were tested as previously outlined in Table 5 Monitoring measurements, including deflection, profile, and distress were performed as previously outlined in Table 9

During Construction

Bulk samples taken during construction included

Plant Samples

- Eleven 5-gal pails of AR-4000 asphalt
- Two 55-gal barrels of aggregate

Field Samples

- Nine 5-gal buckets of AC mix (the AC mix samples were taken in the windrow ahead of the paver, at different locations throughout the project)
- Five buckets were taken for the SHRP A-001 Contractor at the University of Texas at Austin, and four taken for Caltrans

The bulk samples were tested as previously outlined in Table 7, the post construction laboratory testing plan

Post-Construction

Twenty post-construction cores were taken as shown in Figure 5, and tested according to Table 7, the post construction laboratory testing plan listed previously Monitoring measurements, including deflection, profile, and distress were performed as previously outlined in Table 9

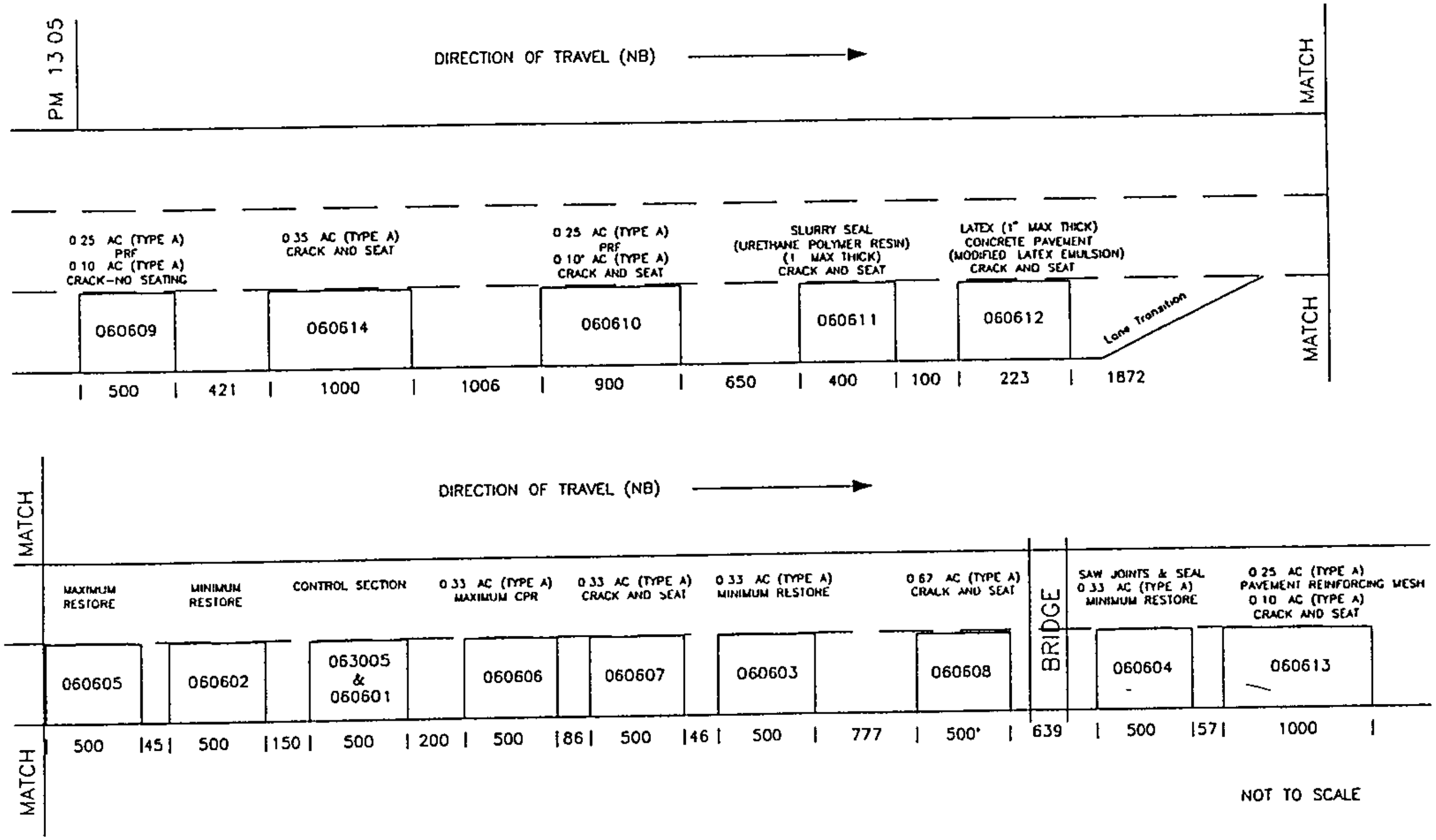

Figure 2. California SPS-6 test section layout.

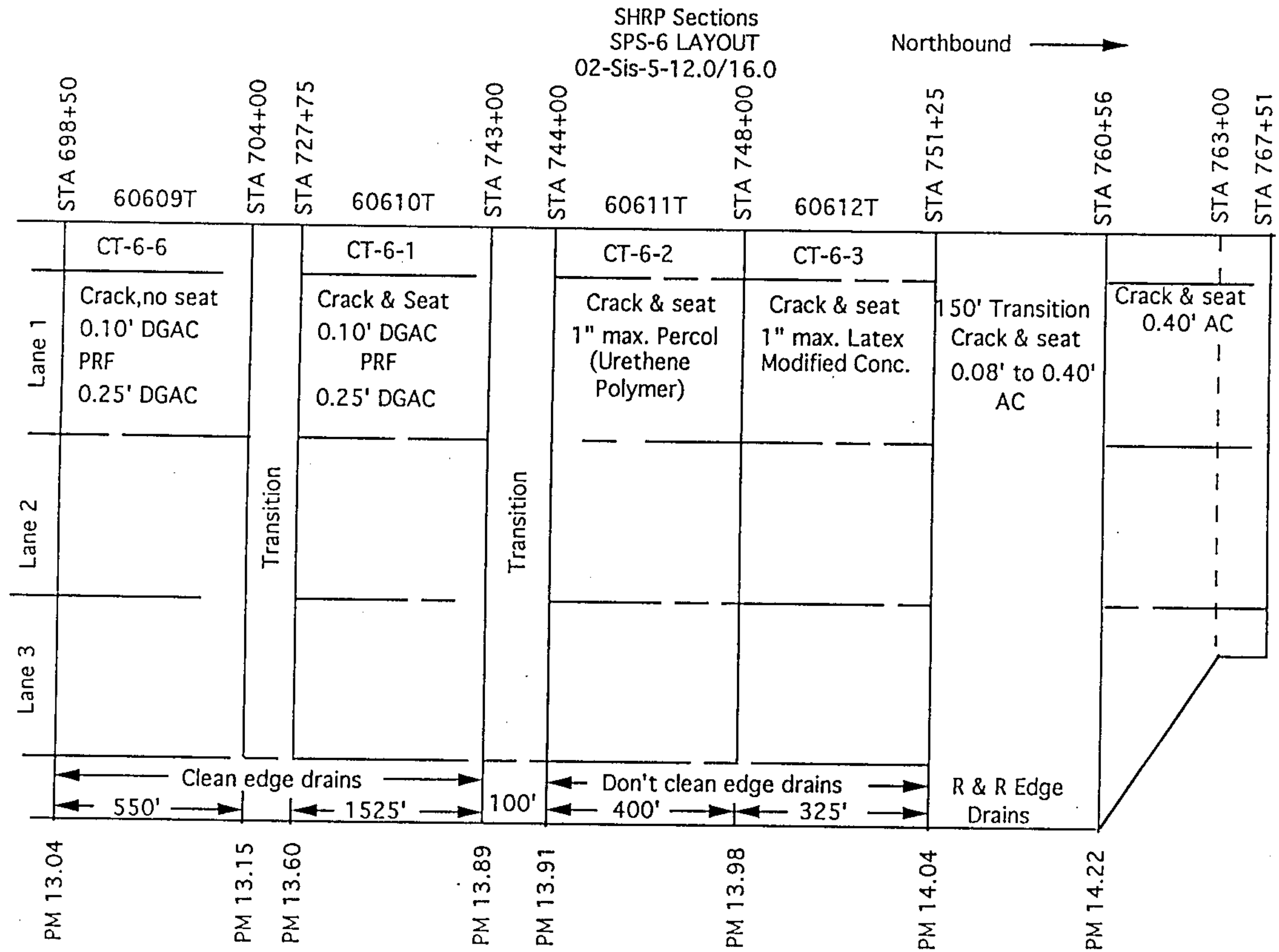

Figure 3a. California SPS-6 detailed as-built layout.

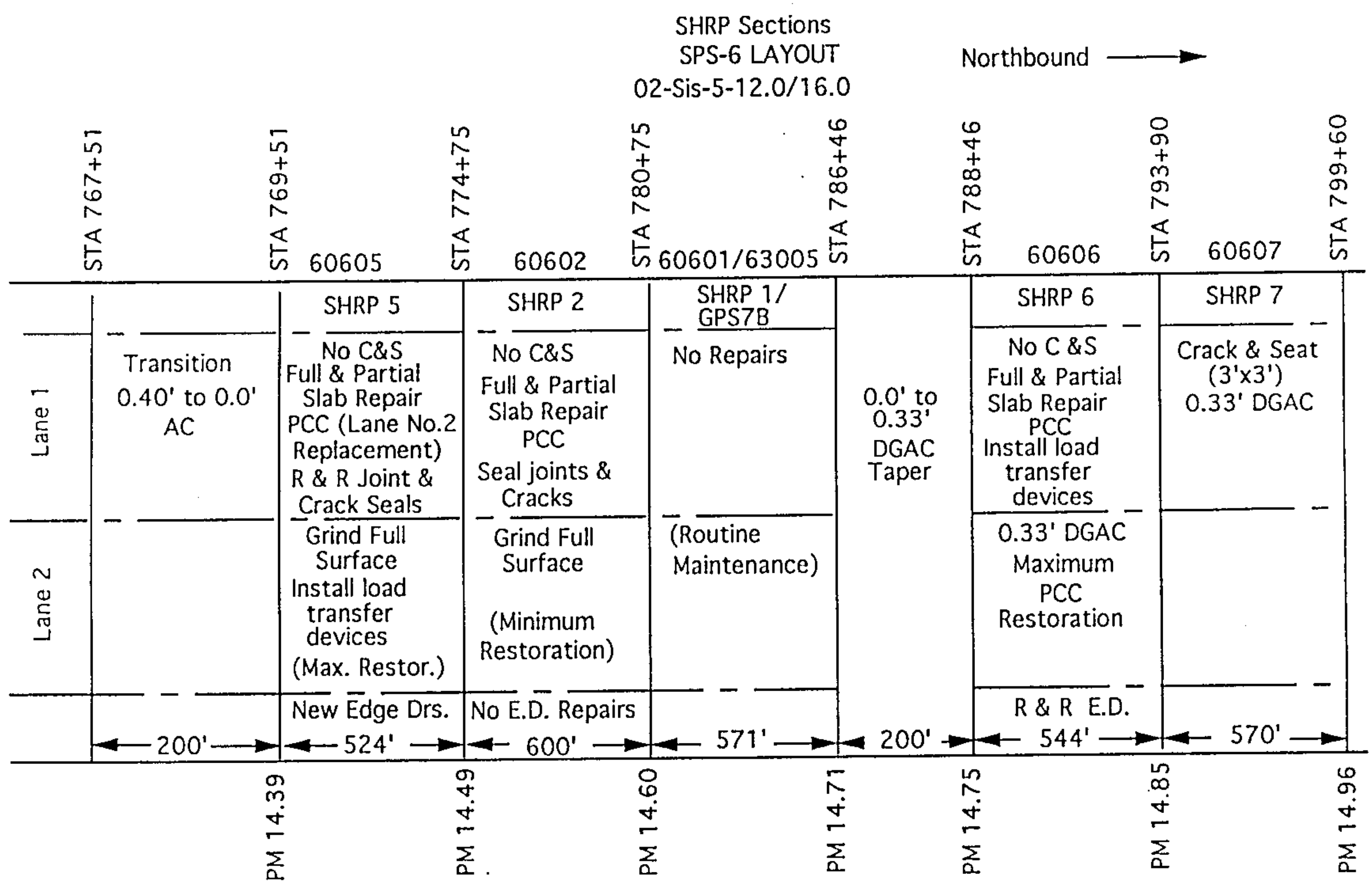

Figure 3b. California SPS-6 detailed as-built layout (cont'd).

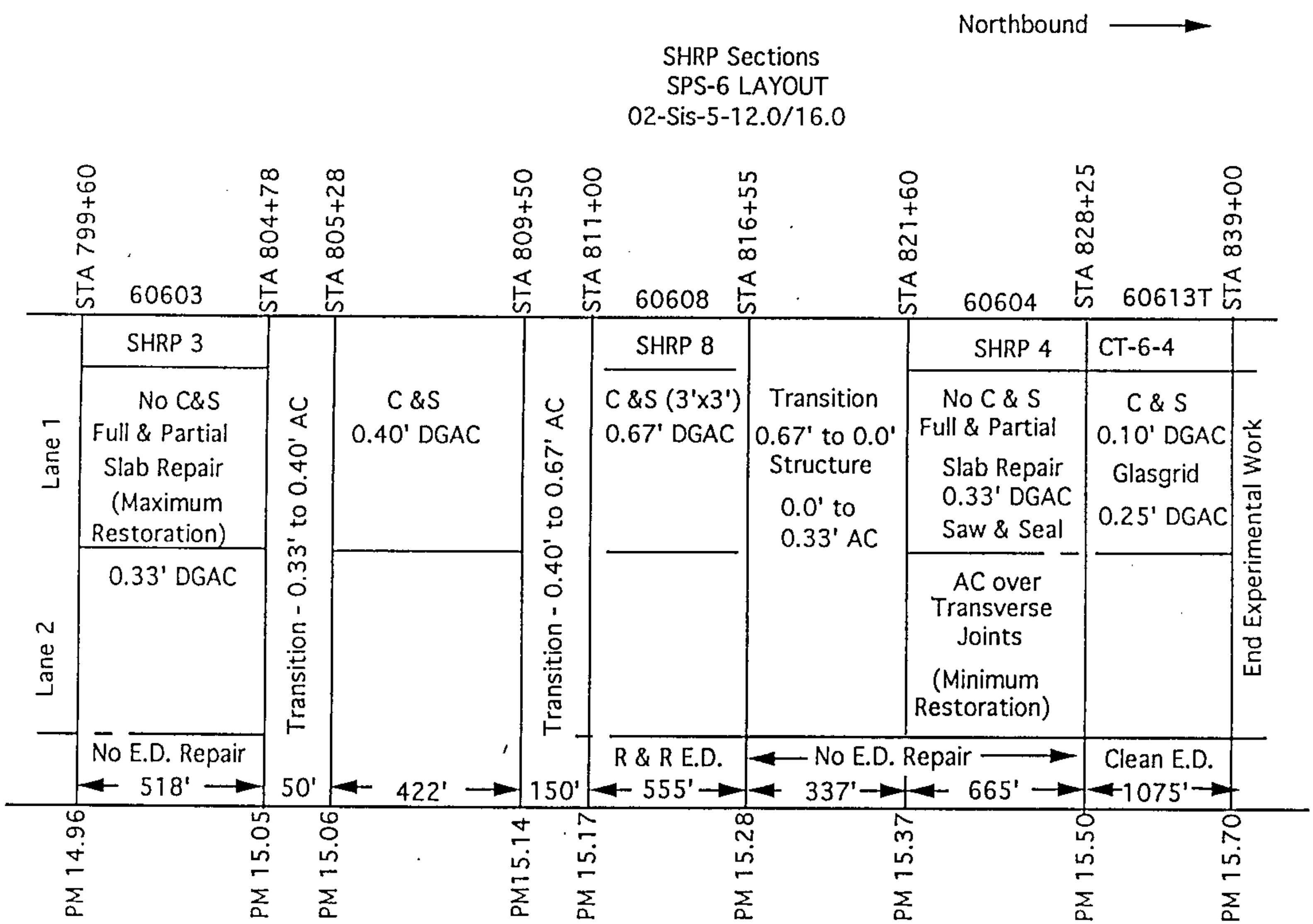

Figure 3c. California SPS-6 detailed as-built layout (cont'd).

Table 10 As-built station limits and rehabilitation strategy

SHRP 60609T (698+50 - 704+00) - Modified Caltrans Crack, Seat with AC Overlay
0 25' ACP overlay
Pavement reinforcing fabric (PRF)
0 10' ACP leveling course
Crack existing PCCP in 4' transverse by 6' longitudinal pattern, do not seat
Clean existing edge drains, do not replace

SHRP 60610T (727+75 - 743+00) - Standard Caltrans Crack, Seat with AC Overlay
0 25' ACP overlay
PRF
0 10' ACP leveling course
Crack and seat existing PCCP in 4' transverse by 6' longitudinal pattern
Clean existing edge drains, do not replace

SHRP 60611T (744+00 - 748+00) - Urethane Polymer Resin (UPR) Overlay
0.08' Urethane Polymer Resin overlay
Crack and seat existing PCCP in 4' transverse by 6' longitudinal pattern in lanes R1 and R2 only. Existing cracking in the R3 lane was to severe too crack and seat
PCCP surfacae preparation
Seal random cracks
No work on existing edge drains

SHRP 60612T (748+00 - 751+25) - Modified Latex Emulsion PCC Overlay
0 08' modified latex emulsion (MLE) PCCP overlay
Crack and seat existing PCCP in 4' transverse by 6' longitudinal pattern in lanes R1 and R2 only. Existing cracking in the R3 lane was too severe to crack and seat
Concrete pavement surface preparation
No work on existing edge drain

SHRP 60605 (769+51 - 774+75) - Intensive Restoration, no AC overlay
Lane #2, 0 67' PCCP lane replacement
Install tiebars (load transfer devices) at ends of total lane replacement
Lane #1, remove and replace joint and crack seals, repair spalls
Lanes #1 and #2, seal joints and cracks, full surface grinding and remove and replace edge drains

SHRP 60602 (774+75 - 780+75) - Minimum Restoration, No AC Overlay
0 67' PCCP slab repairs as directed by the Engineer, seal joints and cracks, repair spalls, full surface grinding and no work on existing edge drains

SHRP 60601 (780+75 - 786+46) - Routine Maintenance Only
Perform no work (control section)

Table 10 As-built station limits and rehabilitation strategy (cont'd)

SHRP 60606 (788+46 - 793+90) - Intensive Restoration with 4 Inch AC Overlay
0 33' ACP overlay
0 67' PCCP repairs as directed by the Engineer
Install tiebars (load transfer devices)
Repair spalls
Remove and Replace edge drains

SHRP 60607 (793+90 - 799+60) - Crack, Seat with 4 Inch AC Overlay
0 33' ACP overlay
Crack and seat existing PCCP in 3' by 3' pattern
Remove and replace edge drains

SHRP 60603 (799+60 - 804+78) - Minimum Restoration with 4 Inch AC Overlay
0 33' ACP overlay
0 67' PCP slab repair as directed by the Engineer
Repair spalls
No work on edge drains

SHRP 60608 (811+00 - 816+55) - Crack, Seat with 8 Inch AC Overlay
0 67' ACP overlay
Crack and seat existing PCCP in 3' by 3' pattern
Remove and replace edge drains

SHRP 60604 (821+60 - 828+25) - Minimum Restoration, Saw and Seal Joints in 4 Inch AC Overlay
0 33' ACP overlay
0 67' PCCP slab repair as directed by the Engineer
Reference existing PCCP joints and saw and seal joints in ACP overlay
Repair spalls
No work on edge drains

SHRP 60613T (828+25 - 839+00) - Crack, Seat with 0.35 Foot AC Overlay and Pavement Reinforcing Mesh
0 25' ACP overlay
Pavement reinforcing mesh
0 10' ACP leveling course
Crack and seat existing PCCP 4' transverse by 6' lontigudinal
Clean existing edge drains, do not replace

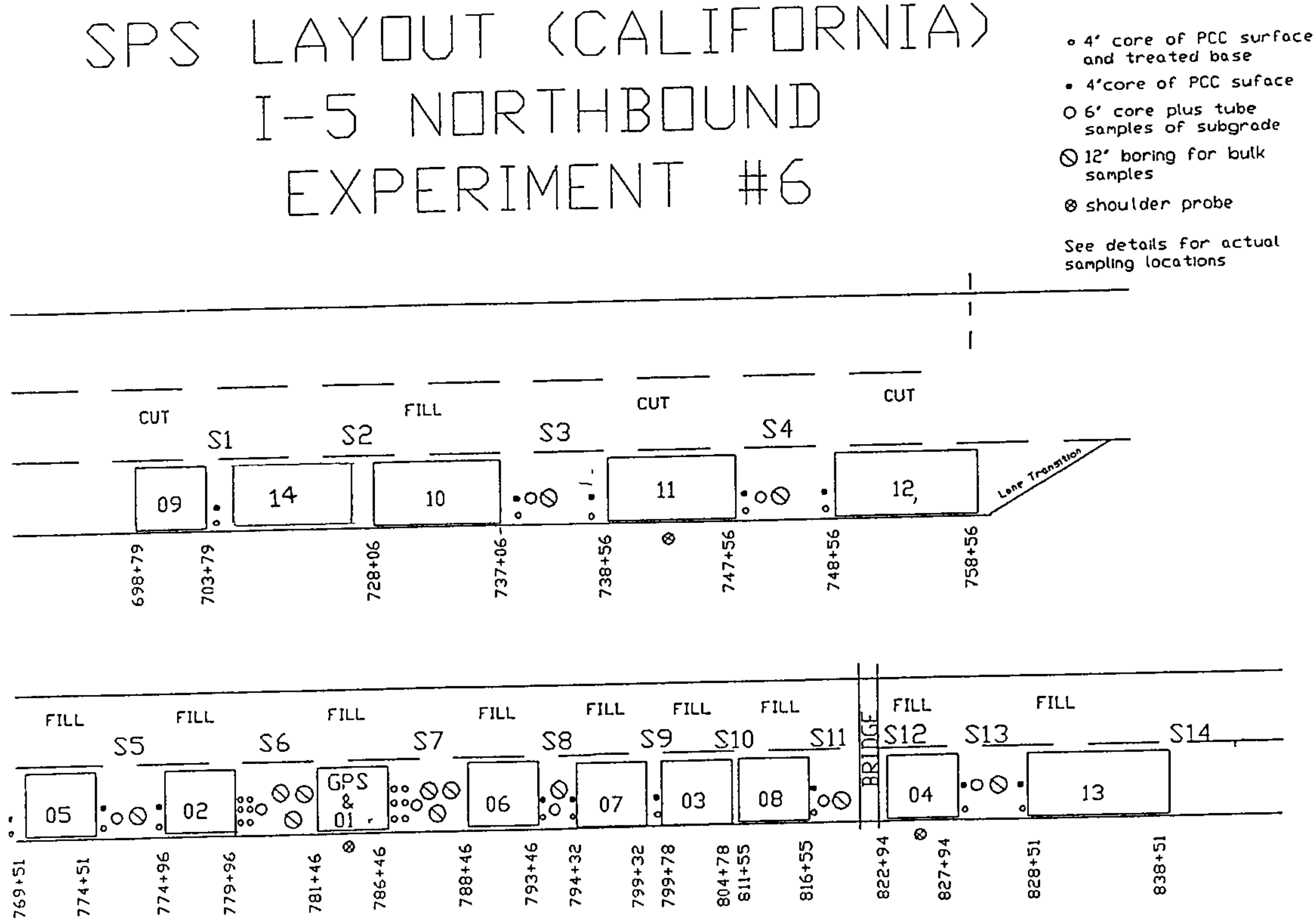

Figure 4. Before construction materials sampling locations.

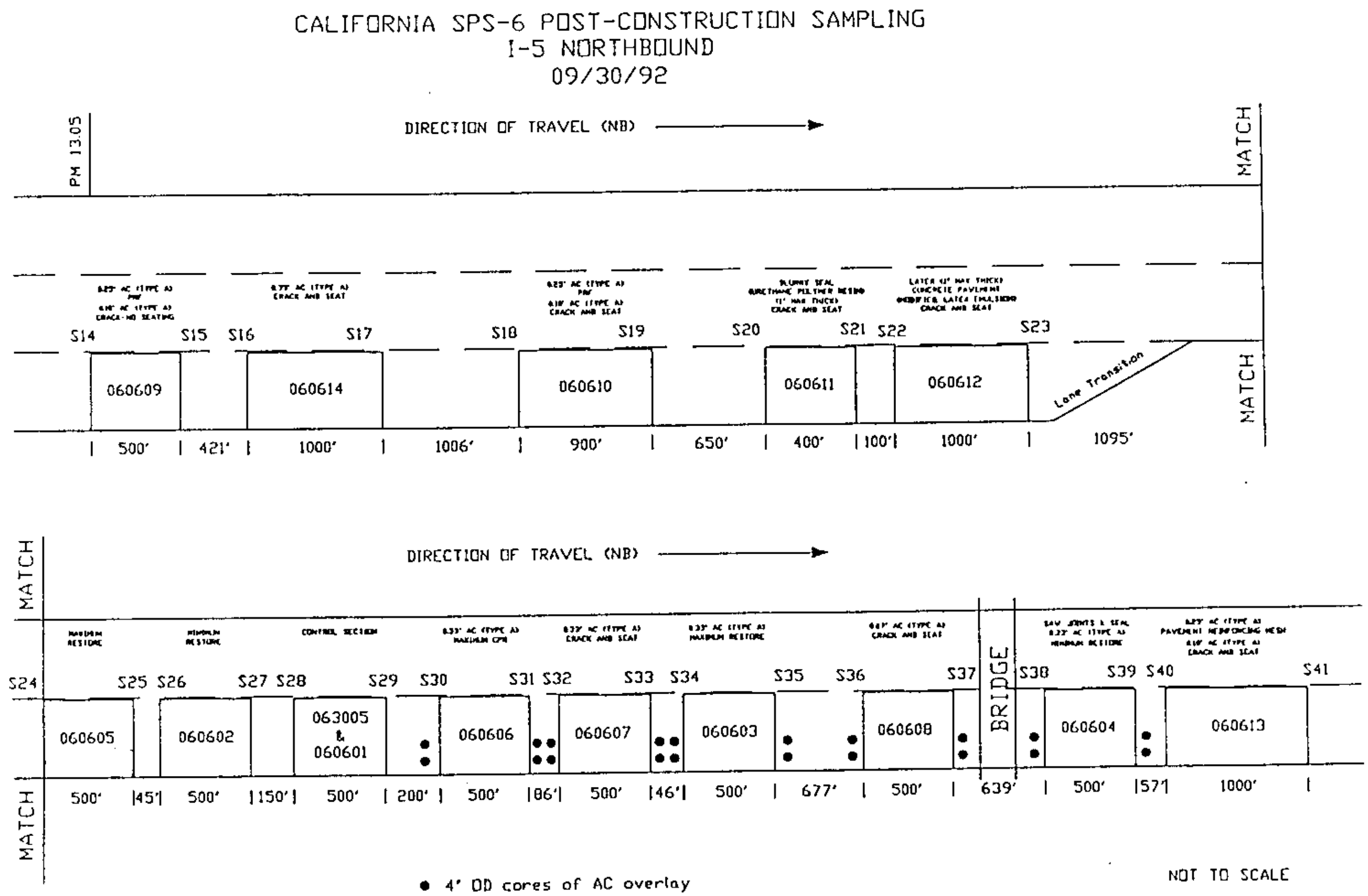

Figure 5. Post construction core locations.

REHABILITATION/CONSTRUCTION

The contract for the California SPS-6 project was awarded in July 1991, and completed in November 1992. The construction was under the direction of Harvey Yoshizuka, Resident Engineer, and the prime contractor was W Jaxon Baker, Inc There were a total of 22 subcontractors involved on the project

The project was begun on May 4, 1992, with rehabilitation as previously outlined in Table 2 Deflection testing was also begun on the 4th The rehabilitation also included completely removing slabs from some sections due to their poor condition All slabs in the travel lane of Section 060505 were removed. On May 19th and 20th, full surface diamond grinding was performed in Sections 060605 and 060602 Rehabilitation on Sections 060611 and 060612 began on May 21st with cracking and seating Crack sealing, edge drain cleaning and replacement, spall repairs, and all other rehabilitation continued through June and July Construction of the AC overlays began on August 6th and continued through September 1st

DETAILED PCC REHABILITATION NOTES

Table 3 in the SPS General Criteria Section listed the highlights of rehabilitation treatments for SPS-6 test sections These treatments, if warranted and performed, will be discussed in this section

Section 060601

This was the control section for the project and required only routine maintenance as per agency practice The section was intended to be in service for 3-5 years from the time of completion of the SHRP experimental sections The control section was used to indicate the rate of change that could be expected for the other test sections had they not been rehabilitated

SHRP Section 060602 (Minimal Surface Preparation, No Overlay)

On May 4, 1992, Falling Weight Deflectometer (FWD) testing was performed A distress survey was performed on May 5th

Also on May 5th, the contractor removed slabs 4, 8, 1/2 of 11, 12, 16, 19 and 24 due to excessive cracking The bound base underneath was disturbed very little during removal and looked good prior to PCC placement Each slab was removed by first sawing the concrete perimeter with a water-cooled diamond saw blade Next, holes were drilled in the slab pieces to insert expansion anchor pins and lifting brackets were bolted on A wire rope sling was attached to the lifting brackets and the slab pieces were lifted off the base using a backhoe This technique allowed the existing cement-treated base (CTB) to be salvaged intact with minimal repair required

Since this was a minimal preparation section, no steel load transfer dowels were placed in the existing slabs Prior to placing the new concrete, a 1/4 inch thick commercial quality polyethylene flexible foam expansion joint filler was placed across the original transverse joint face, and extended the full depth of the excavation The mix design for the replacement concrete is listed in Table 11 Concrete placement started at about 11 00 a m. on May 5th and finished at 2 20 p.m Any spalls in the PCC surface were cut out using a diamond saw and patched with PCC Skewed two feet in twelve feet counterclockwise weakened plane joints were sawed 0 17 ft deep to match the adjacent lane joints This was completed by 6 30 p m and the section was immediately opened to traffic

On May 19th, profile grinding began on the replacement slabs The PCC was diamond ground to meet a 7-in maximum per mile Profile Index After running a profilograph over the replaced section, it was decided to profile all of Section 060602 The primary purpose of the full surface grinding was to restore the transverse and longitudinal profile of the roadway, distorted due to the effects of faulting, warping, abrasive wear in the wheelpaths, and non-uniform volume changes of the subgrade The Profile Index after grinding the existing inside lane was 3 in per mile, and the Profile Index of the new PCC slabs was 6 in per mile

This section required sealing of all random cracks, as well as joints The cracks were first routed Cracks between 1/8" and 3/4" were routed, with minor or no spalling, and some faulted and rough edges Cracks greater than 3/4" wide with no spalling were also routed and sealed The contractor tried to use a saw blade device operating in a vertical plane for routing, but this produced unacceptable crack faces The device was immediately replaced with a router with the blade operating in a horizontal plane that resulted in acceptable routed crack faces for crack sealing After cleaning, all cracks were sealed with an asphalt-rubber joint sealant conforming to ASTM D3405

Transverse joints that had not previously been sealed or those exhibiting defective seals were cleaned and sealed The joints and cracks were cleaned using a diamond saw blade and sandblasting was required for the removal of fines on the sidewalls before sealing No work was done on existing edge drains

SHRP Section 060603 (Minimal Surface Preparation with 4-in Overlay)

A distress survey was performed for this section on May 4, 1992 and FWD testing also began. The contractor began to saw deteriorated panels to be removed FWD testing was completed on May 5th

On May 6th, the contractor removed slabs 7, 8, 9, 10, 11, 18, 19, 22, 23, 28, 29 and 6 ft of slab 30 Removal was consistent with the method described for Section 060602 PCC placement began at 11 30 a m and was finished by 3 30 p m The mix design was the same as for Section 060602 Saw cutting of joints was completed (same as Section 060602) by 7·00 p m and the section was opened to traffic at 7 30 p m

Table 11 Mix design for replacement PCC.

Contents	Amount
Cement (type unknown)	7 sacks
Fly ash (type unknown)	99 pounds
Calcium Chloride	157 ounces
Air Entrainment	5 5-6 5% range

Note Maximum size of aggregate used was 1"

Mixture Tests	
Type	Result
Kelly Ball Penetration	2 5 inches
Unit Weight	133 lbs/cubic ft
Modulus of Rupture(*)	
6'X6"X20" beams @ 16 hrs	330 lbs/sq in
6"X12" cylinders @ 16 hrs	750 lbs/sq in
6"X12" cylinders @ 29 days	4900 lbs/sq in

* 4 hour strengths not determined

No dowels or tiebars were retrofit into the existing pavement since this was a minimal preparation section Crack and joint sealing was not performed Any spalls present were cut out as in Section 060602 and patched No work was done on existing edge drains

SHRP Section 060604 (Minimal Surface Preparation, Saw and Seal 4-in Overlay)

A distress survey and FWD testing were completed on May 5th On May 13th, slabs 15, 16, 17, 18, 19, 20, 23, and 24 were removed as per Section 060602, and PCC placement began. PCC paving began at 9 00 a m and was completed at 12 30 p m Joint sawing and traffic opening times were not recorded Any spalls present within the section were sawed out and replaced with PCC

SHRP Section 060605 (Intensive Surface Preparation, No Overlay)

FWD testing was started on May 6th Sensor #7 malfunctioned and testing was discontinued Caltrans transverse joint deflection measurements showed that the average joint efficiency of the existing PCC slabs in this section was only 32%, as shown in Figure 6 Because of the poor condition of the slabs and poor load transfer, it was decided by the Resident Engineer to replace all slabs in the outside (SHRP) lane Therefore, FWD testing was not completed and no distress survey was performed

On May 8th, the contractor began removal of slabs at 6 45 a m (slab removal was as per Section 060602) The slab removal did very little damage to the underlying bound base Dowels were set in the approach end of the section starting at 8·15 a m An air driven rotary hammer was used to drill the dowel holes The holes appeared to be uniform in diameter and spacing Ten each, 1-5/16" diameter holes, 0 75 ft long, were drilled starting 1 ft from the slab edges and 1 ft apart at mid-slab depth Hole alignment was maintained so that the dowels were parallel to the pavement longitudinally and parallel to the pavement surface Then, 1-1/4" diameter by 18" long smooth epoxy-coated dowel bars, with epoxy retention disks (large rubber washers), were epoxied into the drilled holes Prior to placing the new concrete, a 1/4" thick commercial quality polyethylene flexible foam expansion joint filler was placed across the original transverse joint faces and extended the full depth of the excavation The dowels were then greased The dowels fit snugly in the holes without sagging and looked to be well installed The holes were completely filled with epoxy prior to insertion of the dowels, and set in about 15-20 minutes

The Caltrans stationing for the beginning of this section was in agreement with the layout sheet, but the SHRP sections as laid out originally do not match up with the stationing Therefore, there is about 25-30 ft at the beginning of 060605 that did not get replaced like the rest of the section

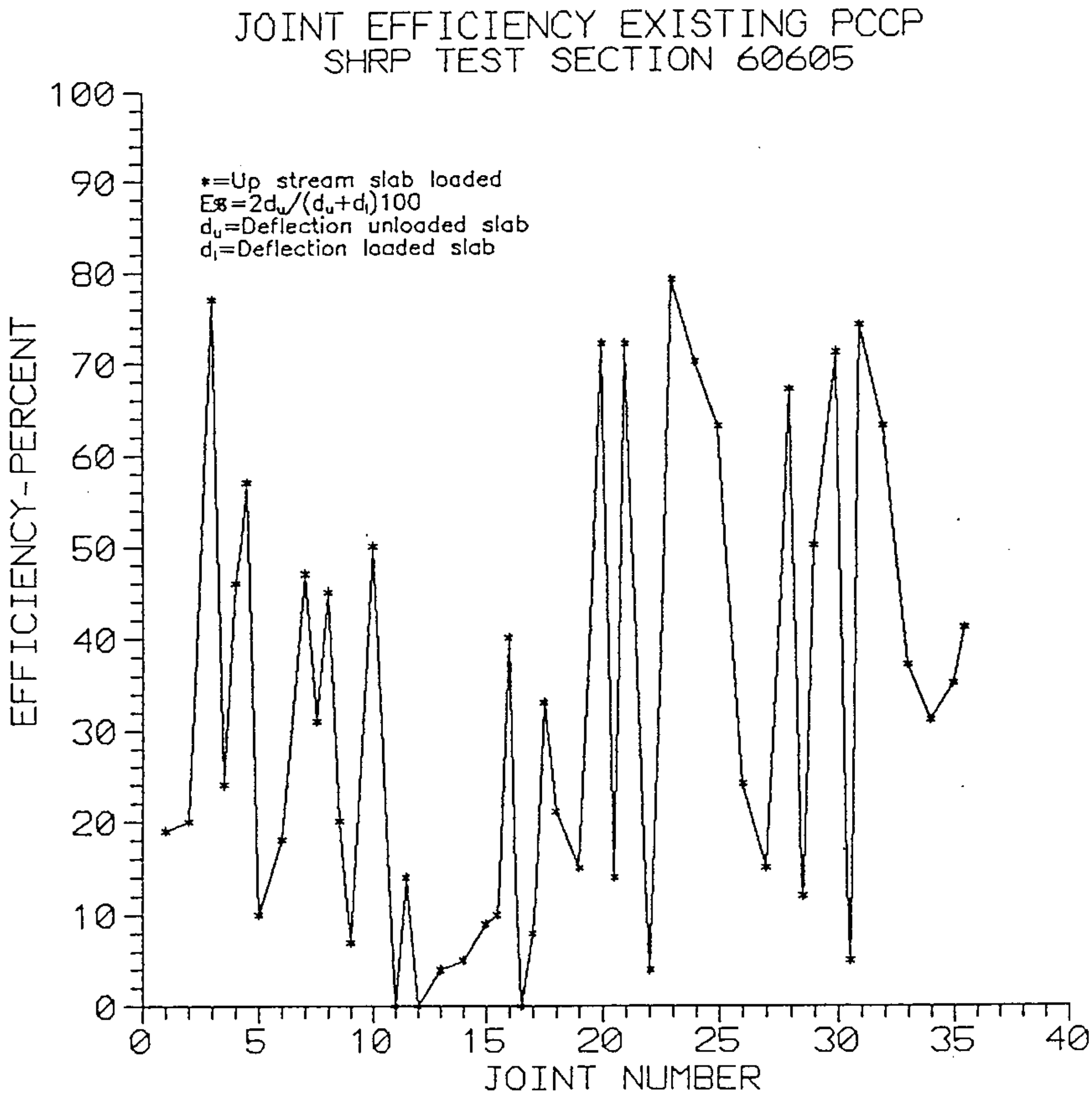

Figure 6. Joint efficiency existing PCCP SHRP test section 60605.

The PCC placement started at 11 00 a m (see Table 11 for mix design) The screed broke down at 11 30 a m , starting up again at 12 37 p m The contractor only had about 10 ft of PCC in place at breakdown When restarting, the contractor shoveled PCC back a couple of feet (flush with screeds existing position at breakdown) and placed fresh PCC over the old PCC and vibrated it in The mix was designed for rapid set, to be opened to traffic in four hours Caltrans personnel were present and allowed the contractor to continue No exact location was marked for this problem area, and it is not known whether a saw cut was placed here

The mix was consistent throughout the pour, with the trucks arriving on a timely basis The person using the vibrator was using it to move the PCC mix as well as to consolidate it The mix was placed evenly at approximately a 2-3" slump The workers shoveling the mix in front of the screed left voids with their footprints that were not always vibrated out When the footprint areas were vibrated, the PCC collapsed very visibly This could potentially have caused small voids throughout the slabs The same dowel placement procedure was used at the end of the section as at the beginning, and also at the night joint (Station 772+15) The PCC placement was finished at 3 45 p m Joint sawing was completed within 3 hours of the pour An asphalt-rubber joint sealant conforming to ASTM D3405 was used to fill all of the sawed joints The PCC was slightly green during sawing Traffic was restarted at 8 00 p m. On May 19th, the contractor profile ground all of section 060605 It took two passes to bring the profile into specifications

All edge drains within this section were removed and replaced This included longitudinal edge drains and outflow pipes The design for the drains followed local design practice, including drain geometry, filter materials, permeable drainage materials, collector pipes and outlet system

SHRP Section 060606 (Intensive Surface Preparation, with 4-in Overlay)

On May 4th, the contractor worked on sawing panels to be removed and replaced A distress survey was also performed On May 5th, FWD testing was performed on the section On May 12th, removal and replacement of panels began Panels 4, 5, 8, 15, 18, 19, 23, and 26 were removed Load transfer dowels were installed in existing slabs as was done at both ends of section 060605 A foam bond breaker was used between panels, as was done in previous sections Also, partial slab replacements were tied to the end of the remaining partial slab by ten 18 in long, #10 epoxy-coated deformed bars that were epoxy bonded in 0 75 ft long percussion drill holes Dowels were installed at the opposite end of the partial slab replacement (in the old joint) as above

On May 13th, several panels had to be removed that had been placed on May 12th They had been marked by traffic even though they were allowed to set 4 hours before opening to traffic, as was standard procedure There may have been a problem with the rapid set additive in the concrete

Any spalls within the section were cut out and patched with PCC Since this was an intensive preparation section, any existing partial or full depth patches were removed and replaced As in Section 060605, longitudinal edge drains within the section were removed and replaced following Caltrans standard procedures

SHRP Section 060607 (Crack and Seat with 4-in Overlay)

FWD testing was performed on May 4th and a distress survey performed on May 5th and May 6th On May 12th, several panels were replaced within the section due to deterioration, and replaced as in Section 060603 with no load transfer dowels installed The deterioration was due to the cracking and seating procedure, which caused considerable spalling

Longitudinal edge drains within this section were removed and replaced, following Caltrans guidelines A guillotine-type pavement breaker was used to crack the pavement sections as required The pavement was then seated with a rubber-tired roller The use of this pavement breaker caused considerable spalling in the pavement surface at the blade ends and at the blade center where a wing was welded to propagate the longitudinal crack Existing JPCP slabs were broken such that the majority of the broken pieces were 18-in in size The sequence of operations in conjunction with cracking and seating were performed in the following order

1 Determine crack configuration, load energy, and number of passes for seating in test site
2 Crack and seat existing JCP (core to check crack propagation)
3 Clean all joints, cracks and surface
4 Remove loose pieces and patch as directed by the Engineer
5 Apply tack coat
6 Place overlay

In no case were the broken JCP slabs to remain exposed more than 48 hours prior to an AC overlay For this section, a 3' x 3' cracking pattern was utilized

SHRP Section 060608 (Crack and Seat with 8 in Overlay)

On May 4th, a distress survey was performed on the section FWD testing was performed on May 11th Longitudinal edge drains within the section were removed and replaced following Caltrans guidelines Cracking and seating took place as per section 060607 no more than 48 hours prior to placing the first lift of the AC overlay A 3' x 3' cracking pattern was utilized No slabs were removed or patched within this section

State Section 060609 (Crack and no-Seat, with 4 2" AC Overlay)

FWD testing was performed on May 11th The existing PCC was cracked in a 4' transverse by 6' longitudinal pattern, but was not seated The purpose of not seating the PCC was to compare this section against Section 060610, which was seated The edge drains were cleaned, but not replaced

State Section 060610 (Crack and Seat with 4 2" AC overlay)

FWD testing was performed on May 12th The existing PCC was cracked in a 4' transverse by 6' longitudinal pattern and then seated The edge drains were cleaned but not replaced

State Section 060611 (Crack and seat with Urethane Polymer Resin (UPR) Overlay)

The proposed length of this test section was 944 feet (station 738+56 to station 748+00), but was shortened to 400 feet (station 744+00 to station 748+00) by Contract Change Order This change occurred because the trial sections placed by the subcontractor December 11, 1991 on a closed portion of the Embarcadero Freeway in San Francisco required a spread rate of 2 5 gallons of urethane polymer resin per foot of 12 foot lane width With this spread rate, only 400 feet of 36 foot wide PCCP could be overlain with the original estimated quantity To do the planned 944 feet of the test section would have cost an additional $350,000, thus it was decided to decrease the length of the test section to 400 feet

On May 11th, the Contractor removed and replaced panels 41,41,43 and 1/2 of 44 Placement started at 3 30 p m and was completed by 5 00 p m Mix designs and slab removal and placement methods were the same as the minimal preparation sections 060602 and 060603 The joints were sawed on May 12th FWD testing was also performed on May 12th No distress survey was performed on this section

On May 21st, cracking and seating was done in a 4' transverse by 6' longitudinal pattern in the two outer lanes The (SHRP) driving lane was not cracked due to the severe existing slab deterioration A contract change order provided for the removal of unsound concrete from the test section as described above The cracking and seating created a lot of damage to the pavement and the damaged pieces were chipped out with a jackhammer per directions of Caltrans They were treated as spall repairs and were repaired prior to placement of the elastic cement material No work was done on existing edge drains

Overlay

On May 22nd, the contractor continued to work on spalled areas The existing PCC surface was cleaned by dry shot blasting It was proposed to use a polymer crack sealer resin to "lock" the slab pieces together, however, only 27 gallons of crack sealer were used because of the difficulty in getting the sealer to penetrate the cracks

Nominal 1" by 2" wood strips were nailed along the lane lines as headers to hand place pre-bagged course aggregate for a 1" maximum overlay (See Mix Design in Table 12.) A wood 2 X 4 was used to hand screed the aggregate to the level of the wood header strips. After hand screeding, the "A" and "B" components of the two component urethane polymer resin were blended using a compressed air pump, feeding through a plastic hose to a PVC nozzle A pre-bagged fine aggregate was hand broadcast across the surface of the course aggregate, followed by pouring the resin across the entire surface

A problem occurred initially as the resin was not percolating through the fine sand layer to the underlying aggregate, and a "false bottom" was created The result was a thin layer of unbound sand between the aggregate/resin layer and the sand/resin layer when the intent was that they would bond together This section was removed

On May 26th, the contractor continued to work on removing the resin overlay It was decided that more aggregate would be added initially, and a thin layer of sand/resin would be applied to the top Table 13 shows the results of the urethane polymer resin pull-off tests (modified California Test 420) on 2" diameter cores performed by the Rigid Pavement and Structures Concrete Branch

On May 27th, the section was re-laid The contractor applied more aggregate and resin, then spread a thin layer of sand over the section, screeding it flat and smooth, and finally sprayed a layer of resin on top Maintaining a smooth surface was extremely difficult, and the 12' straight edge specification for this section was rarely met The weakened transverse joints were not re-established over the underlying PCC joints

State Section 060612 (Crack and Seat with Modified Latex Emulsion (MLE) PCC Overlay)

FWD testing was performed on May 12th. No distress survey was conducted On May 21st, cracking and seating was done causing spalling as in Section 060611 The crack pattern was 4' transverse by 6' longitudinal The spalls were not repaired since the Modified Latex Emulsion was expected to fill them As with Section 060611, the SHRP driving lane was not cracked due to the severe existing slab deterioration As with Section 060611, contract change order #10 provided for the removal of unsound concrete No attempt was made to "lock" the slab pieces together, as in Section 060611 No work was done on the existing edge drains

Earlier, on May 19th and 20th, a trial section of MLE was placed on the north end of Truck Village Road (an old PCC) near the job site The existing PCC surface was sand blasted, and nine trial areas approximately 3' x 3' by 1" thick were placed The MLE was made with 45% coarse aggregate and 55% sand mixed with either 3 5 or 5 0 gallons of latex per sack of cement Water was added at a rate of 1 gallon per sack of cement The results of the pull-off tests in the trial section showed the 5.0 gallons of latex per sack of cement had the highest pull-off strengths, 169 and 186 psi (on a "wet" surface) The latex/cement mixture was broomed on some sections before placing the overlay of MLE, making the surface "wet"

Table 12. Design for Section 060611

Component	Size or Rate
Course Aggregate	3/8" x #4
Pre-bagged fine aggregate	#6 x #14
Two component Urethane Polymer Resin	2.5 gallons/ft of 12' lane

Table 13. Urethane polymer resin (UPR) pull-off test analysis (PSI)

Test	1
Size	14
Mean	146
Minimum	80
Maximum	220
Median	150
Sample St. Deviation	48
Sample Variance	2272
Coefficient of Variation	0.3

The Caltrans Rigid Pavement and Structures Branch decision was to place the MLE on a dry surface as originally proposed The 5 gallon mix on a dry surface yielded 114 and 135 psi pull-off strengths The MLE mix consisted of 35 gallons of latex and 7 sacks of cement combined with fine aggregate conforming to the provisions of Section 90-3 03, fine aggregate grading (Table 14) The concrete was placed on a dry substrate and was cured by hand spraying a water-based curing compound (DFC Hydro Cure, CC-309-2WS) Placement of the outer driving lanes (1 and 2) was completed on May 27th and 28th between 1 00 a m and 7 00 a m each day Shrinkage cracking was noticed at about 6 15 a m after completion on the first day

The existing PCC surface was cleaned by dry shot blasting Rails were set up for a Bidwell paver to place a 1" maximum thickness MLE overlay Placement went fairly smoothly, but there were some problems with the curing compound Initially, it looked uniform, but later appeared to be somewhat spotty No circulation or agitation was used in the curing compound barrel, so there could have been a separation between the vehicle and pigment In the areas where the compound was thin, the treatment cracked quite a bit The transverse and longitudinal joints were resawed over the underlying existing PCC joints from pre-established reference points The newly cut joints were not sealed

On May 29th, the Resident Engineer estimated that 40% of the MLE overlay in the outer two driving lanes had shrinkage cracking

On June 4th and 5th, pull-off tests (Modified California Test 420) were taken in lanes 1 and 2 (inside driving lanes) Table 15 shows the results of the tests on 2" diameter cores The TRANS cores were taken by the Rigid Pavement and Structures Concrete Branch, and the DIST cores taken by the District 2 Materials Branch The large difference between the DIST and TRANS pull-off test results was attributed to stress fractures caused by the District core rig

The SHRP driving lane (#3) was paved on June 22nd and 23rd By August 15th debonding was occurring between Stations 751+25 and 759+06 It was decided to remove the MLE between these limits and place a 0 35 ft AC overlay with a pavement reinforcing mesh Due to these modifications, the overall length of the MLE test section was reduced to 223' Also, debonding along several transverse joints occurred in the test section The debonded MLE was removed and polyester concrete was used to repair these areas

State Section *060613* (Crack and Seat with AC overlay and Pavement Reinforcing Mesh)

A distress survey was performed on May 7th FWD testing was completed on May 13th The existing edge drains were cleaned but not replaced Cracking and seating was accomplished as in previous sections on a 4'x6' grid

Table 14. Fine aggregate grading (California Specification 90-3.03).

Sieve Size	Contract Compliance (% Passing)
3/8"	100
No. 4	93 - 100
No. 8	61 - 99
No. 16	X +/- 13
No. 30	X +/- 12
No. 50	X +/- 9
No. 100	1 - 12
No. 200	0 - 7

X = gradation which the contractor proposes to furnish

Gradation must satisfy:

1. 10 < [% pass No. 16 - % pass No. 30] < 40
2. 10 < [% pass No. 30 - % pass No. 50] < 40

Table 15. Modified latex emulsion (MLE) pull-off test analysis (PSI).

VAR NAME	SIZE	MEAN	SAMPLE STD DEV	SAMPLE VARIANCE	COEF. OF VARIATION
DIST	7	125.7	32.1	1028.6	.3
TRANS	10	248.5	92.7	8589.2	.4

VAR NAME	SIZE	MEDIAN	MINIMUM	MAXIMUM	RANGE
DIST	7	130	70	160	90
TRANS	10	265	40	365	325

State Section 060614 (Crack and Seat with AC Overlay)

This section used the standard state rehabilitation strategy (consisting of cracking and seating with a 4 2" AC overlay) This section was used to compare against all other rehabilitated sections A distress survey was performed on May 7th, and FWD testing was completed on May 11th

DETAILED OVERLAY CONSTRUCTION NOTES

The paving began on August 6th with the first lift in Sections 060609, 060614, and 060610 The paving continued through September 1st with the final lifts W Jaxon Baker from Marysville, California was the paving contractor The paving equipment used on the project included

- Belly Dump Trucks to deliver the AC mix
- Barber Greene BG260B Paver
- Dynapac CC50 (15 5 ton) double steel drum vibrating breakdown roller
- Dynapac CC-42A (12 5 ton) double steel drum non-vibrating intermediate roller
- Ingram R4064 (7 8 ton) pneumatic intermediate roller (tire pressure 75 psi)
- Hystar C350C (14 8 ton) double steel drum non-vibrating finish roller
- Ferguson 2511-B (25 ton) rubber-tired intermediate roller

The asphalt drum mixing plant (Cedar Rapids) was run by Jaxon Enterprises The plant was located 51 8 miles from the test sections, about an 80 minute commute for the belly dump trucks The mixing temperature at the plant was between 270°F and 280°F The AC surface temperature with a tack coat prior to overlaying was generally between 110°F and 120°F The rock and asphalt was supplied by Faundale Rock and Asphalt, Redding, CA Ron Mitchell was the contact for Faundale Rock

Prior to placement of the overlay on the PCC pavement, any dust, dirt, and debris in joints, cracks, or on the surface of the pavement were removed or swept away by the use of compressed air A tack coat of SS-1 emulsion was spread at a rate of 0 04 gallons per square yard, at a dilution of 80% The tack coat was also spread between successive lifts of AC A typical compaction sequence for this project was as follows

Breakdown 1-2 coverages using a 15 5 ton double drum vibratory roller (Dynapac CC50)
Intermediate 3 coverages using a 7 8 ton Ingram R4064 pneumatic roller
Finish 1 or more coverages using a 14 8 ton double drum Hystar C350C non-vibrating roller

The AC mix design for all sections is shown in Table 16

Table 16 AC mix design

Sieve Size	Actual (as used)	Specification
1"	100	100
3/4"	98	95 - 100
1/2"	85	
3/8"	76	65 - 80
1/4"	62	
No 4	55	49 - 59
No 8	38	31 - 41
No. 16	25	
No 30	16	13 - 23
No 50	10	
No 100	7	
No 200	6	3 - 8

Additive 1/2% Pavebond anti-strip
Optimum AC Content 4 0 - 4 3%
AC Type AR4000 from Huntway Refining of California
Hveem Stability 40
Optimum Air Voids 6 4

The last major construction sequence for this project was to place the AC overlay on the sections requiring it Several of the test sections were cracked and seated prior to paving as discussed under the rehabilitation notes The cracking and seating was done no more than 48 hours prior to paving

Tables 17a and 17b show the construction sequence for paving these sections and placing the paving fabrics Table 17a lists the sequence by date, and Table 17b by section Tables 18a and 18b list nominal lift thicknesses and temperatures for lifts within each section, for both SHRP and non-SHRP lanes Paving details and problems are discussed in the following sections

SHRP Section 060601 (Control Section)

This was the control section, therefore no overlay was required

SHRP Section 060602 (Minimum Restoration, No overlay)

SHRP Section 060603 (Minimum Restoration, 4" AC overlay)

Lift 1 Paving started at 9 22 a m on August 10th in the travel lane The air temperature was 70°F This lift was completed at 9 30 a m The mean loose lift thickness was 1 5" with an average laydown temperature of 226°F A low temperature of 187°F was recorded at station 802+00, and the high was 254°F at station 804+78

The SHRP lane was laid down from 1 33 p m until 1·50 p m , with a mean loose laydown thickness of 1 6" and laydown temperature average of 242°F

Lift 2 Paving took place on August 17th No data was available for the passing lane Paving in the SHRP lane finished at 10 55 a m , and no start time was recorded The mean loose laydown thickness was 2" with a mean laydown temperature of 256°F

Lift 3 On August 31st, paving began on the travel lane at approximately 9 15 a m The air temperature at 9 35 was 70°F Paving was completed by 9 45 a m , averaging 247°F for laydown temperatures and 2 9" for loose thicknesses

On September 1st, the SHRP lane was paved, starting at 9 02 a m , and finishing at 9 16 a m The air temperature was approximately 57°F Just prior to the start of the section, the surface temperature before paving but after the tack coat was 59°F Breakdown rolling consisted of one pass The shoulder was not paved at the same time as this lift, and was to be paved later in the day The mean laydown temperature was 250°F, and the mean laydown thicknesses was 2 5".

Table 17a Construction paving sequence by date

Date	Section(s)	Lane(s)	Lift	Comments
8/6/92	9 10	1 2 3	1	
8/10/92	3 4 6 7 8 13	1 2 3	1	
	8	1 2	2	
8/12/92	9 10	1	2	Fabric Placed Under Lift
	9	2	2	Fabric Placed Under Lift
8/13/92	9 10	3	2	Fabric Placed Under Lift
8/15/92	10	2	2	Fabric Placed Under Lift
8/17/92	3,4 6 7 13	1	2	Glass Mesh on Section 13
	8	1	3	
8/18/92	3 4 6 7,13	2 3	2	Glass Mesh on Section 13
	8	2	3	
8/24/92	9 10	1	3	
8/25/92	9 10	2	3	
8/26/92	9 10	3	3	
8/31/92	3 4 6 7 13	1	3	
	8	1	4	
9/1/92	3 4 6,7 13	2	3	
		3	3	
	8	2	4	
		3	4	

Note Lane 1 is always the inside lane Lane 2 or 3 is the driving lane, depending on whether two or three lanes exist in that section

Table 17b Construction paving by section

	Dates											
Section #	8/6/92	8/10/92	8/12/92	8/13/92	8/15/92	8/17/92	8/18/92	8/24/92	8/25/92	8/26/92	8/31/92	9/1/92
60603		1 2 3/1				1/2	2 3/2				1/3	2,3/3
60604		1 2 3/1				1/2	2 3/2				1/3	2 3/3
60606		1 2 3/1				1/2	2 3/2				1/3	2 3/3
60607		1 2 3/1				1/2	2 3/2				1/3	2 3/3
60608		1 2 3/1				1/3	2/3				1/4	2 3/4
		1 2/2										
60609	1 2 3/1		1 2/2	3/2				1/3	2/3	3/3		
60610	1 2 3/1		1/2	2/2	3/2			1/3	2/3	3/3		
60613		1 2 3/1				1 2	2 3/2				1/3	2 3/3

Note First set of numbers define which lane was paved/second number defines the paving lift.

Table 18a Laydown temperatures and nominal lift thicknesses

(Lane 3, SHRP lane)

	Temperatures (degrees farenheit)				Nominal Lift
Section/lift	Mean	Minimum	Maximum	Standard Deviation	Placement Thickness
1	No Overlay				
2	No Overlay				
3/1	242	220	257	11 3	1 6
3/2	256	239	267	10 1	2
3/3	250	237	274	11	2 5
4/1	246	230	268	11 4	1 6
4/2	251	233	268	9 4	1 8
4/3	244	227	256	10 1	2 5
5	No Overlay				
6/1	244	213	299	26 5	1 8
6/2	224	190	244	16 9	1 8
6/3	245	230	259	8	2 4
7/1	253	238	268	9 2	1 9
7/2	238	221	263	11 8	1 9
7/3	252	220	274	15 7	2 5
8/1	258	239	278	11 1	3 1
8/2	240	223	265	13 8	1 7
8/3	247	222	270	12 6	3
8/4	242	218	260	14 4	2 9
9/1	251	237	262	8 9	2
9/2	248	228	270	10 7	2
9/3	Unknown	Unknown	Unknown	Unknown	Unknown
10/1	260	231	273	10 9	2
10/2	257	228	265	8 8	1 7
10/3	Unknown	Unknown	Unknown	Unknown	Unknown
11	No Overlay				
12	No Overlay				
13/1	250	218	272	11 9	1 8
13/2	247	230	258	14 9	2
13/3	256	236	275	13 8	2 6
14/1	261	240	276	10 8	2
14/2	253	239	271	10 7	2 5
14/3	Unknown	Unknown	Unknown	Unknown	Unknown

Table 18b Laydown temperatures and nominal lift thicknesses

(Lane 2, Non–SHRP lane)

	Temperatures (degrees farenheit)				Nominal Lift
Section/lift	Mean	Minimum	Maximum	Standard Deviation	Placement Thickness
1	No Overlay				
2	No Overlay				
3/1	226	187	254	23 8	1 5
3/2	Unknown	Unknown	Unknown	Unknown	Unknown
3/3	247	220	268	12 4	2 9
4/1	237	212	258	16 7	1 8
4/2	Unknown	Unknown	Unknown	Unknown	Unknown
4/3	255	237	269	10 7	2 6
5	No Overlay				
6/1	217	206	227	14 8	1 8
6/2	Unknown	Unknown	Unknown	Unknown	Unknown
6/3	243	215	259	19 4	2 7
7/1	226	205	245	11 9	1 7
7/2	Unknown	Unknown	Unknown	Unknown	Unknown
7/3	243	230	254	9 7	2 9
8/1	253	239	270	9 8	2 9
8/2	241	228	256	9 5	1 7
8/3	253	238	269	10 3	3
8/4	Unknown	Unknown	Unknown	Unknown	Unknown
9/1	240	230	250	14 1	1 8
9/2	241	213	250	10 1	2
9/3	Unknown	Unknown	Unknown	Unknown	Unknown
10/1	260	250	265	8 7	2
10/2	257	228	265	8 9	2
10/3	Unknown	Unknown	Unknown	Unknown	Unknown
11	No Overlay				
12	No Overlay				
13/1	256	240	276	9 9	1 6
13/2	Unknown	Unknown	Unknown	Unknown	Unknown
13/3	250	230	272	10 2	2 6
14/1	261	240	276	10 8	2
14/2	255	236	269	9 4	2 5
14/3	Unknown	Unknown	Unknown	Unknown	Unknown

SHRP Section 060604: (Minimum Restoration, 4" AC overlay, Saw and Seal Joints)

Prior to paving, the existing transverse joints were referenced so that they could be relocated for sawing

Lift 1 Paving began in the passing lane at about 10 00 a m , finishing at 10 34 a m The mean laydown temperatures and loose laydown thicknesses were 237°F and 1 8" respectively Several low temperature measurements were recorded from station 823+50 to 825+00, with a low of 212°F

The SHRP lane was paved from 1 30 until 2 05 p m The air temperature was in the low 90's The laydown temperatures were generally higher, with a low of 230°F, and an average of 246°F The mean laydown thickness was 1 6"

Lift 2 On August 17th, both the passing and driving (SHRP) lanes were paved No data was available for the passing lane The SHRP lane was paved from 11 30 a m until 11 52 a m , with a mean laydown temperature of 251°F, and mean loose laydown thickness of 1 8"

Lift 3 The passing lane was paved on August 31st, from 11 30 until 11·45 a m The paver stopped at station 824+50 for about 15 minutes The mean laydown temperature was 255°F, and the mean loose laydown thickness was 2 6". Segregation was present at station 823+00 and 825+00 Four buckets of AC mix were taken prior to the start of the section at station 818+50, to be used for SHRP laboratory testing The rolling pattern in this section was documented as follows The breakdown roller was a Dynapac DC42A double steel drum vibrating roller. One pass was generally used A small pneumatic rubber tired roller was used as an intermediate roller A CC50 Dynapac double steel drum roller followed the pneumatic roller A Hyster double steel drum roller was used to finish rolling the section

Paving in the SHRP lane took place on September 1st from 10 34 a m until 10 50 a m The mean loose laydown thickness was 2 5" and the mean loose laydown temperature was 244°F.

At the completion of the overlay, 3/8" wide by 1-1/2" deep saw cuts were made over the referenced transverse joints The sawed joints were extended a minimum of 36" into each shoulder The saw cuts were then sealed with an asphalt-rubber joint sealant conforming to ASTM D3405

SHRP Section 060605: (Maximum Restoration, no overlay)

No overlay was required for this section

SHRP Section 060606: (Maximum Restoration, 4" AC overlay)

Lift 1 The passing lane was paved on August 10th from 9 00 until 9 15 a m The loose laydown thickness averaged 1 8" and the loose laydown temperature for the two measurements taken was 206°F and 227°F

The SHRP lane was paved from 1 15 p m until 1 35 p m. The mean loose laydown thickness was 1 8" and the mean laydown temperature was 244°F

Lift 2 On August 17th, the 2nd lift was placed No data was gathered for the passing lane The SHRP lane had a mean laydown temperature of 224°F, with a low of 190°F at station 791+00, and a high of 244°F at station 795+00

Lift 3. The passing lane was paved on August 31st, starting at 8 20 a m The paver stopped at 8 50 a m (Station 790+50) waiting for trucks, and started up again at 9 55 The mean laydown temperature was 243°F, and the mean laydown thickness was 2 7" At the start of the section the paving surface temperature after the tack coat was 57°F

A Dynapac CC42A double steel drum roller was used as a breakdown roller A 30' ski was used for grade control on the righthand side of the paver along the centerline of the roadway The air temperature in the shade at the start of paving was 60°F The mix for this section looked good, and it was noted that it was a "tender" mix since it moved substantially under the roller during compaction

The SHRP lane was paved on September 1st starting paving at 8 20 a m The air temperature at 7 30 a m was 50°F, with clouds and no sun The paving lane was 13' wide, and the shoulder was to be paved later A CC42A roller was being used for breakdown rolling, making two passes

SHRP Section 060607: (Crack and Seat with 4" AC Overlay)

Lift 1· The passing lane was paved from 9·15 a m until 9·22 a m on August 10th The mean laydown thickness was 1 7" and the mean laydown temperature was 226°F At 1.30 p m the SHRP lane was paved, and had a 253°F mean laydown temperature and 1 9" mean laydown thickness

Lift 2 Paving of the second lift took place on August 17th, with no data gathered for the inner passing lane The SHRP lane had a mean laydown temperature of 238°F and a mean laydown thickness of 1 9" Paving took place from approximately 9 30 a m until 9 50 a m

Lift 3 Paving of the passing lane third lift started at 9.05 a m. on August 31st, and finished at 9 22 a m The average laydown thickness was 2 9", and the average laydown temperature was 243°F Rolling consisted of a breakdown roller with a double steel drum, making two passes in the vibrating mode Following this, a pneumatic roller was used as an intermediate roller The finish roller type was not recorded

On September 1st, paving started in the SHRP lane at 8 40 a m , finishing at 9 10 a.m The mean laydown temperature was 252°F, and the mean loose laydown thickness was 2 5" At Station 796+00, Caltrans pulled two boxes of AC samples from the top lift The holes were then filled by shovelling the edges, and hand raking the mix No grade controls were used for this lift. The contractor matched the lefthand side of the pavement which had been paved the previous day At Station 798+50, the paver stopped for 10 minutes waiting on trucks The air temperature at 9 00 a m was 57°F

SHRP Section 060608: (Crack and Seat with 8" AC overlay)

Lift 1: On August 6th, paving took place in the inner lane from 12 55 p m until 1:20 p m The mean laydown temperature was 253°F, and the loose laydown thickness averaged 2 9"

Paving in the SHRP lane took place from 4 25 p m until 4 55 p m , with a mean laydown temperature of 258°F and mean laydown thickness of 3 1" Paving stopped for 10 minutes at station 813+00 This lift was the first of 4 to be placed

Lift 2. Paving took place on August 10th starting in the inner lane at 9 37 a m , and finishing at 9 59 a m The mean laydown temperature was 241°F and the mean loose laydown thickness was 1 7" At 1 50 p m paving started in the SHRP lane, finishing at 1 55 p m The mean loose laydown thickness was 1 7" and the mean laydown temperature was 240°F.

Lift 3: Both the passing and SHRP lanes were paved on August 17th No data was recorded for the inner lane The SHRP lane was paved starting at 10 15 a m , and finishing at 11 20 a m Paving stopped at Station 811+20 for 30 minutes, and again at station 814+00 for 15 minutes The air temperature at 11:15 a m was 86°F The mean laydown temperature was 247°F, and the mean laydown thickness was 3"

Lift 4 Paving started in the inner lane on August 31st at 10 30 The air temperature was 75°F Four buckets of AC hot mix were sampled at Station 818+50, to be used for SHRP LTPP testing Paving stopped for 10 minutes at Station 817+00, from 10 40 a m until 10 48 a m , and paving was completed at 10 55 a m The mean laydown thickness was 3", and the mean laydown temperature was 253°F

The SHRP lane was paved on September 1st from 9 50 a m until 10 05 a m Paving stopped at Station 814+50 for about 10 minutes The mean laydown temperature was 242°F, and the mean laydown thickness was 2 9"

State Section 060609: (Crack-no Seat, 3" AC overlay over pavıng fabrıc over 1 2" AC overlay)

Thıs sectıon consısted of 3 lanes The SHRP lane was the slow truck lane, or lane 3 ın Fıgure 3a

Lıft 1 Pavıng began on August 6th ın the most ınner lane, startıng at 9 00 a m , and finıshıng at 9 10 a m No data was collected for thıs lane The mıddle lane was paved from 10 15 a m untıl 10 20 a m The two laydown temperatures taken were 230 and 250°F The two laydown thıcknesses measured were 2" and 1.8".

The SHRP lane was paved from 2 25 p m untıl 2 30 p m The mean laydown temperature was 251°F and the mean laydown thıckness was 2"

Lıft 2 On August 12th, a fabrıc lıft was placed on top of the first lıft of AC ın the two ınner lanes On August 13th, fabrıc was placed on the SHRP lane. Fıgures of fabrıc placement are shown ın the dıscussıon of Sectıon 060610 The fabrıc placıng machıne sprayed a tack coat upon whıch the fabrıc was rolled The tack coat spread rate was 0 25 gallons per square yard The asphalt used was Shell AR4000, and the supplıer was

Asphalt Surface Corporatıon
Faırfield, CA
415/228-1515

Two fabrıcs were used, and the supplıers were

1 AMCO, supplyıng Amopave
2 Phıllıps, supplyıng Petromat

Prıor to placıng the fabrıc, the surface dıd not look broomed The Petromat fabrıc was used for both ınner drıvıng lanes On the SHRP lane, the Amoco fabrıc was used for the first 25', but wasn't goıng down well due to the oıl beıng too hot Several holes and tears developed ın the fabrıc At thıs poınt, ıt was decıded to use the Petromat fabrıc To repaır the holes and tears at the begınnıng of the sectıon, the Petromat was started at the begınnıng of the sectıon, and covered up the damaged Amoco fabrıc The Petromat was used for the remaınder of the sectıon, wıth no sıgnıficant problems occurrıng

Followıng fabrıc placement, the second lıft of AC was placed The AC lıft was placed as soon as possıble after placıng the fabrıc Fabrıc placement ın the ınnermost lane began at 9 00 a m , and finıshıng tımes were not recorded The AC lıft had one loose lıft thıckness measurement of 2 3", and laydown temperatures ranged from 240 to 260°F

Fabrıc placement on the mıddle lane began at 12 25 p m pavıng began at 1 35 p m and finıshed at 1 55 p m The aır temperature was ın the hıgh 90's The average laydown temperature was 241°F and the average laydown thıckness was 2"

On August 13th, fabric placement in the SHRP lane began at approximately 11:00. Paving began at 1:20 p.m. and was completed at 2:20 p.m. Air temperatures were in the upper 90's. Near the end of the section the paver stopped at Station 704+10 for 15 minutes. The average laydown temperature was 248°F and the average laydown thickness was 2".

Lift 3: The third lift of AC for all lanes was placed on August 15th. No data was recorded for either temperatures or loose thicknesses.

State Section 060610: (Crack-seat, 3" AC overlay over paving fabric over 1.2" AC overlay)

This section consisted of 3 lanes, with the SHRP lane being the slow traffic (or lane 3 in Figure 3a) lane. The section length was 900' compared with the standard 500' SHRP lengths. Rehabilitation and construction were the same as done for Section 060609, except that this section was seated after cracking.

Lift 1. Paving started at 10:12 a.m. on August 6th and was completed at 10:20 a.m. in the innermost lane. No thickness or temperature data was recorded. The middle lane was paved from 11:55 a.m. until 12:20 p.m. The air temperature at Station 732+00 was 84°F and was taken close to the pavement surface. The mean laydown thicknesses and temperatures were 2" and 260°F respectively.

Lift 2: Placement of the fabric layer began on August 12th. The fabrics were Amopave and Petromat, as noted for Section 060609. At several points in the outer lanes, the fabric had to be patched. At joints, the fabric had to be overlapped. At the lane edges, the fabric was trimmed. (See Appendix A)

No data was collected for the innermost lane for either fabric placement or paving. Fabric on the middle lane was placed at approximately 1:30 p.m. on August 12th. At 3:00, paving started on the middle layer, and the air temperature was 100°F. The fabric began to curl at the start of paving, and a patch was made at station 728+00, close to midlane. At station 730+00, the paver was pulling the fabric over, and the fabric was picking up. The paver stopped at station 731+00 to correct the problems. Paving was completed by 3:45 p.m. The mean laydown thickness was 2" and the mean laydown temperature was 257°F. The fabric used for both inner lanes was Petromat.

The fabric for the SHRP lane was placed on August 12th. Petromat was used until Station 734+85. At this point no more rolls of Petromat were available, so the Amopave fabric was used for the remainder of the section. Paving began on August 13th at 9:00 a.m., with clouds present and the air temperature 75°F. The mean laydown temperature was 257°F and the mean laydown thickness was 1.7".

Lift 3. The third lift of AC for all lanes was placed on August 15th. No data was recorded for either temperatures or loose thicknesses.

State Section 060611: (No AC overlay required)

State Section 060612: (No AC overlay required)

State Section 060613: (Crack and Seat, 3" AC over Pavement Reinforcing Mesh over 1 2" AC)

This section was constructed the same as section 060610, with the exception of using a glass fiber mesh in place of a paving fabric The length of the Section was 1000'

Lift 1 Paving began on August 10th in the inner lane The mean laydown temperature was 256°F and the mean laydown thickness was 1 6" The paver stopped for approximately 10 minutes at Station 830+00 Paving started at 10 30 a m and was finished at 11 00 a m

The SHRP lane was paved starting at 2 05 p m and finishing at 2 20 p m The mean laydown thickness was 1 8", and the mean laydown temperature was 250°F

Lift 2· On August 17th, placement of the glass fiber mesh began in the inner lane The tractor placing the mesh broke down, requiring the mesh to be placed by hand The mesh had glue on the bottom side and was rolled after placement to stay in place The rolls were 5 feet wide, so it took 3 rolls for total lane coverage When paving started, the hot mix AC melted the glue The glue then acted as a lubricant and the mesh slipped causing numerous gaps.

Several other problems occurred during placement of the mesh and AC When the bottom dump trucks hauling the AC mix pulled onto the mesh to windrow the mix, the tires caused shoving of the mesh The AC mix tended to roll around past the tamping bar and build up in front of the extensions folding up the edges of the mesh As these folds occurred, the mesh was manually cut so that it would lie flat No temperature or lift thickness data was obtained for the inner lane

On August 18th the manufacturer of the glass mesh, Bay Mills Limited, was present The style of glass grid was, Ontario Style 8501, Canada Initially on the 18th, the section was being broomed with a power sweeper The manufacturer suggested to use compressed air, which was done. Placing of the mesh started at the centerline with a 5 foot roll. Three 5 foot widths of mesh were laid side by side and overlapped 6 inches each The mesh was rolled with a 25 ton rubber tired roller A pressure test was done on the fabric with a fish scale The reading was 10 pounds, and the manufacturer said that any reading over 4 pounds would be satisfactory to pave over

Nails with washers were used to hold down the mesh on all longitudinal and transverse seams Rolling and shoving occurred in the SHRP lane as it did in the inner passing lane Rough spots in the AC mix were covered by hand, and then rolled

The mean laydown temperature for the AC overlay was 247°F, and the mean laydown thickness was 2 inches

Lift 3 The inner lane was paved on August 31st starting at 11 47 a m The paver stopped at Station 836+00 at 12 06 p m , where Caltrans was taking samples Paving started again at 12 32 p m , and was completed at 12 37 p m The mean laydown thickness was 2 6" and the mean laydown temperature was 250°F

Paving of the SHRP lane took place on September 1st from 10 30 until 11 30 a m The paver stopped for 10 minutes at Stations 834+00 and 837+00 The mean laydown thickness was 2 6" and the mean laydown temperature was 256°F The air temperature at Station 837+00 at 11 20 was 75°F

State Section 060614: (Crack and Seat, 4 2" AC overlay)

This section utilized the standard Caltrans concrete rehabilitation strategy The section was 1000' long and included 3 lanes

Lift 1 Paving began August 6th at 9 10 a m in the innermost lane with the temperature at 70°F Paving was finished at 9 30 a m No temperature or thickness data was obtained The middle layer was paved starting at 11 25 a m The finish time and thickness and temperature data were not obtained

Paving of the SHRP lane began at 2 15 p m and was completed by 2 55 p m The mean laydown temperature was 261°F, and the mean laydown thickness was 2 inches

Lift 2 Paving took place on August 12th No data was obtained for the innermost lane. The middle lane was paved beginning at 2 00 p m , and finishing at 2 35 p m The mean laydown temperature was 255°F, and the mean laydown thickness was 2 5"

Paving of the SHRP lane began at 2 40 p m and was completed by 3 20 p m The mean laydown temperature was 253°F, and the mean laydown thickness was 2 5 inches Paving stopped at Station 715+00 for about 10 minutes

Lift 3 The third lift of AC for all lanes was placed on August 15th No data was recorded for either temperatures or loose lift thicknesses

SUMMARY

For the most part, the rehabilitation and reconstruction of the California SPS-6 test sections went as planned Falling weight deflectometer testing was initially done on all of the sections This was followed by the rehabilitation of test sections as required This was typically done as per the project specifications, with several exceptions Section 060605 had PCC panels in the SHRP lane which were in very poor condition, thus all of the panels were removed and replaced

Several of the state supplemental sections had complications during construction. Section 060611 was shortened in length from 944 feet to 400 feet due to the low spread rate of the urethane polymer resin Problems with the resin also occurred, and the initial layer had to be removed and replaced

Debonding occurred in the modified latex emulsion section 060612 Close to 800' of the emulsion was removed and repaved with an AC mix, leaving the emulsion section only 223' long

The paving operations on section 060613 caused the glass grid to shove and roll, and numerous uneven spots occurred These spots were eventually leveled and patched with an AC mix

The AC paving operations went as planned, with no problems encountered.

APPENDIX A

Photo 1. Collection of aggregate samples.

Photo 2. Feed bins.

Photo 3. Cedar Rapids hot plant.

Photo 4. Asphalt paver.

Photo 5. Intermediate roller.

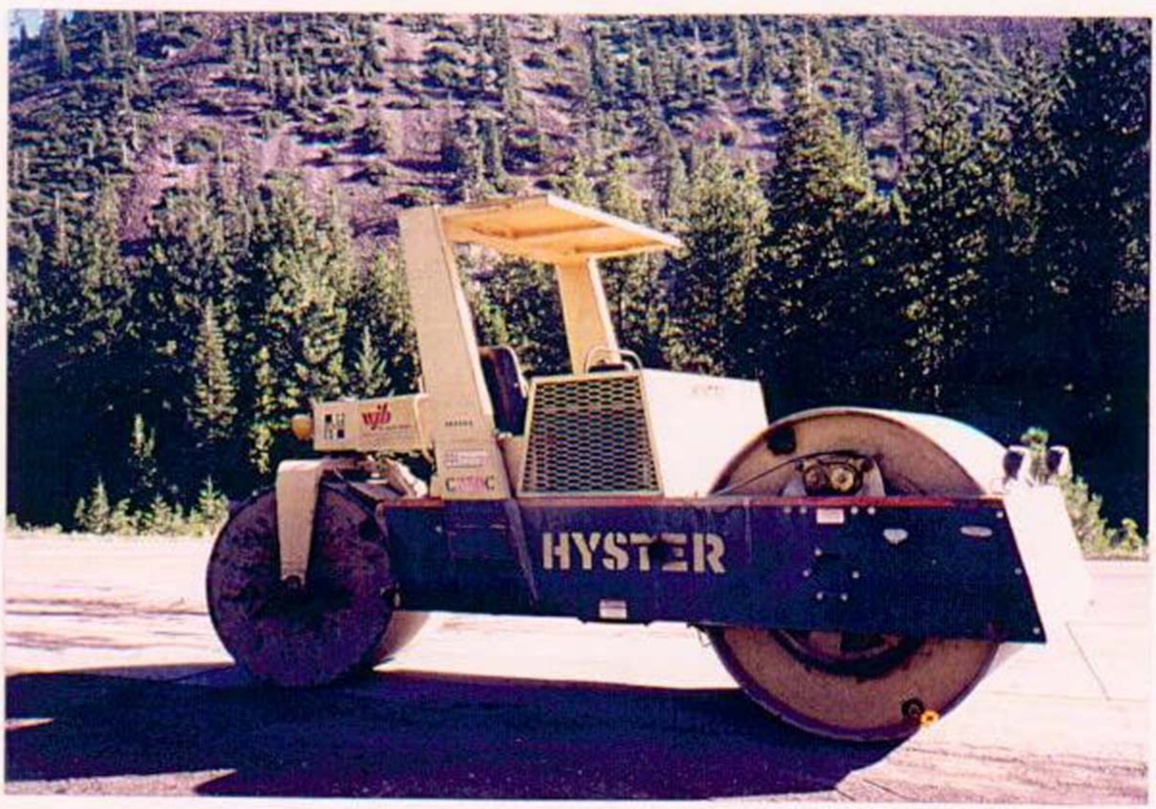

Photo 6. Finish roller.

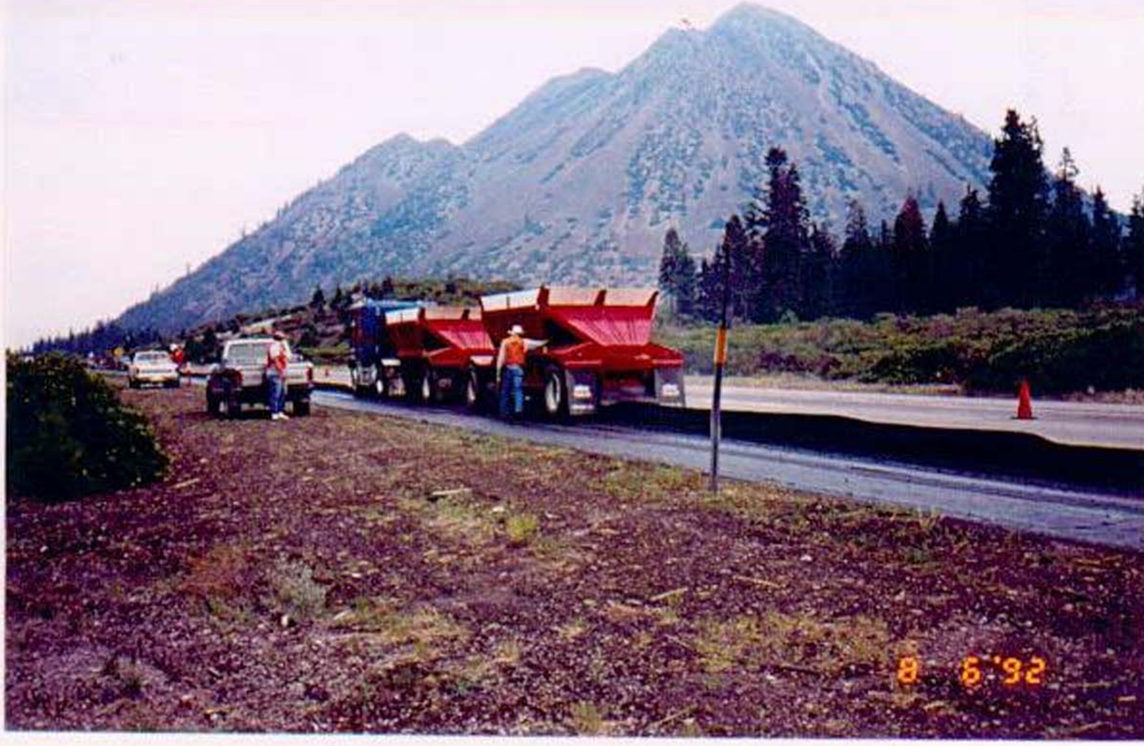

Photo 7. Asphalt haul truck.

Photo 8. Paving operation on Section 060610.

Photo 9. Rear of paving operation, Section 060610.

Photo 10. Section 060610, fabric placement.

Photo 11. Section 060610, fabric patch - emulsion too hot.

Photo 12. Section 060610, patch in fabric.

Photo 13. Section 060610, fabric in place.

Photo 14. Section 060611, urethane polymer resin overlay.

Photo 15. Section 060611, urethane polymer resin overlay - cracking after months of traffic.

Photo 16. Section 060612, checking for delamination of latex emulsion.

Photo 17. Section 060612, cracked and delaminated latex.

Photo 18. Section 060612, modified latex emulsion - cracking at joints. of pumping (outside Community Center).

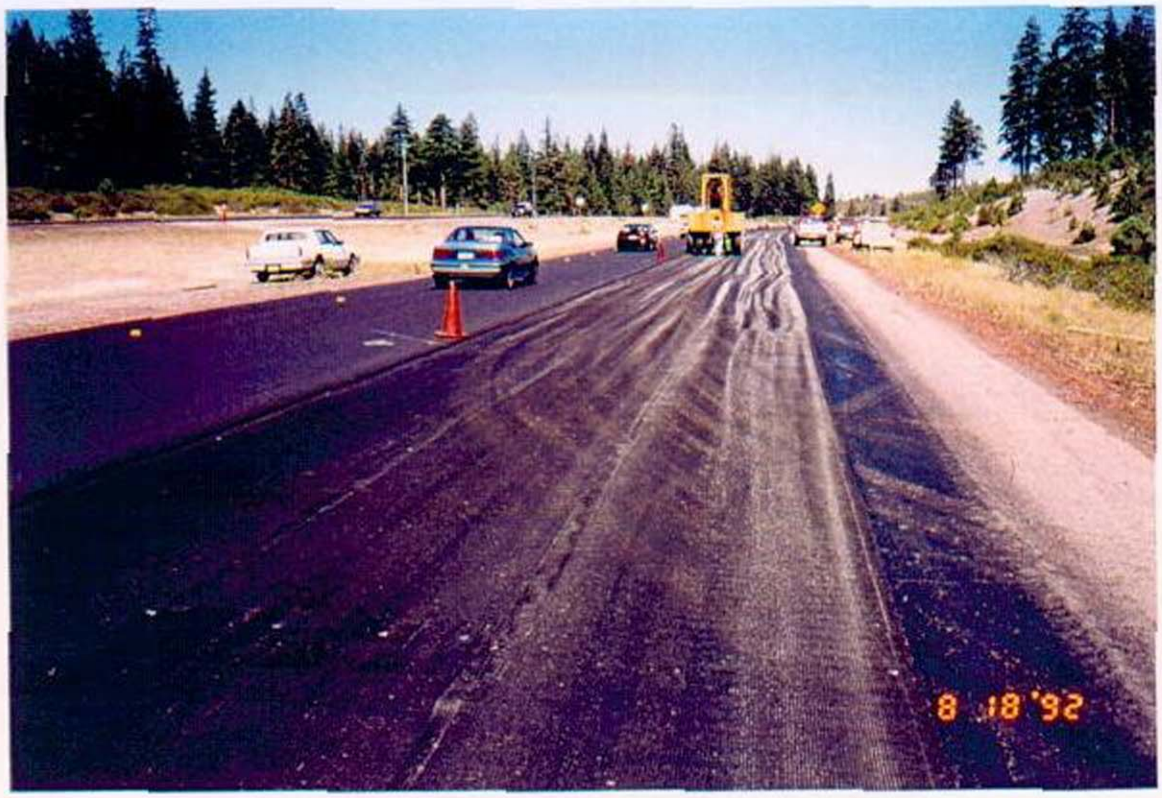

Photo 19. Section 060613, rolling grass grid.

Photo 20. Section 060613, pull test on glass grid.

Photo 21. Section 050513, pulling of glass grid.

Photo 22. Section 060613, shaving of glass grid from paver.

Photo 23. Section 060613, paving over glass grid - note bad spots due to "rolling" of glass grid below AC.

Photo 24. Section 060613, hand patches over rolled glass grid.

Photo 25. Replacing concrete slabs - maximum restoration.

Photo 26. Dowels set prior to pairing replacement slabs.

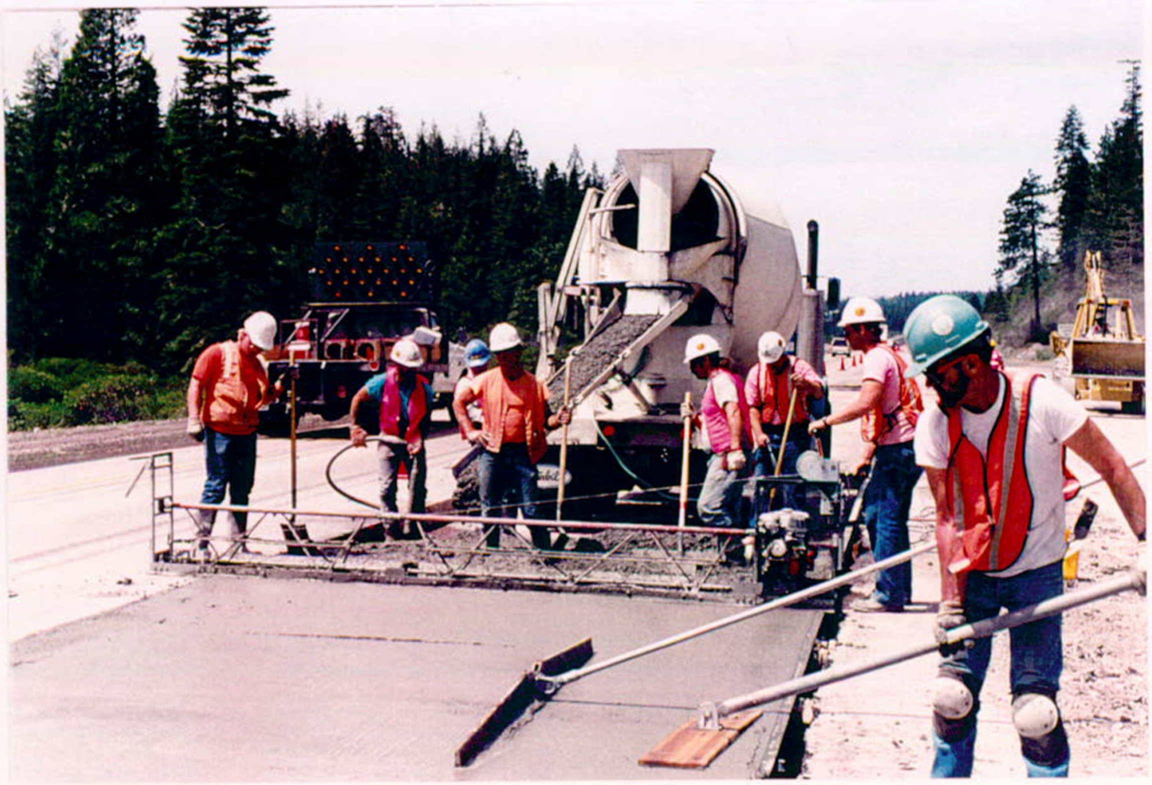

Photo 27. Finish troweling - concrete slab replacement.