SPS-2 Construction Report
US-65 Northbound
Polk County
Northeast of Des Moines, Iowa
Sections 190213 to 190224

Federal Highway Administration
LTPP Division
North Central Region

Report Prepared By:

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June 17, 1996

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Engineers and Scientists Serving the Built and Natural Environments®

June 21, 1996

Mr. Richard C. Ingberg
Regional Engineer
Braun Intertec Corporation
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 55439-0108

Dear Mr. Ingberg:

Enclosed is the Construction Report for the Iowa SPS-2 project.

If you have any questions about this report please call Ronald Urbach or Benjamin Worel.

Sincerely,

Ronald R Urbach

Ronald R. Urbach, CET

Benjamin J. Worel, PE

Attachment:
Report

c: Mr. Monte Symons, FHWA
Mr. John Miller, PCS/Law
Mr. Cameron Kruse, Braun Intertec

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Attachments

1.0 Introduction

The SPS-2 experiment has been developed to study the structural factors for rigid pavements -- more precisely, to determine the influence of the factors that effect their performance. The objectives are to determine the effects of the following specific pavement design features:

- Pavement design systems;
- Base type;
- Concrete flexible strength;
- Pavement thickness; and
- Lane width.

Some of the experiment products will help accomplish the objectives of the Long Term Pavement Performance (LTPP) projectt. The key products for the SPS-2 experiment will include:

- Development of a comprehensive database for use by agency personnel;
- Evaluation of existing design methods;
- Development and improvement of design equations for new and reconstructed pavements; and
- Determining the effects of specific design features on pavement performance.

1.1 Experiment Cell

This SPS-2 experiment in Iowa is located in the wet-freeze environmental zone placed on fine-grained subgrade soils. This is a "K" environmental cell. The Iowa SPS-2 project is a doweled jointed plain concrete pavement.

1.2 Summary of Supplemental Sections

The project includes 12 core test sections plus the Iowa control test section.

1.3 Project Location

The Iowa SPS-2 project is a relocation of US highway 65 from Rising Sun Road north to the intersection with Interstate I-80, northeast of Des Moines, Iowa. Attachment A is a project location map.

1.4 Type of Roadway

Attachment B is the test section layout. This layout summarizes the PCC design thickness and location of test sections in reference to project stationing.

1.5 Traffic Characteristics

This roadway is designed for annual average daily traffic (AADT) of 17,400.
The AADT is 16 percent trucks.
Estimated 18K ESAL in the study lane is 329,000 ESALs per year.
Total design 18K ESAL in design lane of 9,870,000.
The design period is 30 years.

1.6 Known Deviations from Guidelines

The summary of the deviations is in Attachment D.

1.7 Geometry

SPS-2 Iowa
Test Section Geometry and Underground Structures

Section Number SHRP DOT	Cut or Fill	Vertical Curve	Horizontal Curve	Underground Structures
190217 K-5	Fill 10 to 40 ft	-0.7%	None	8 x 10 foot RCP 40 feet below top of pavement.
190218 K-6	Fill 8 to 12 ft	-0.7%	None	None
190219 K-7	Fill 8 to 38 ft	+0.7%	None	8 x 8 foot RCP 38 feet below top of pavement.
190220 K-8	Fill 2 to 8 ft	+0.7%	None	None
190215 K-3	Fill 8 to 25 ft	+0.7%	2.5% high side of super elevation	4 x 4 foot RCP 25 feet below top of pavement.
190216 K-4	Fill 17 to 30 ft	-2.6%	2.5% high side of super elevation	None
190213 K-1	Fill 7 to 23 ft	-2.6%	None	2.5 foot RCP 20 feet below top of pavement.
190214 K-2	Fill 0 to 4 ft	+0.7%	None	2 foot RCP 8 feet below top of pavement.
190221 K-45	Fill 0 to 9 ft	+0.7%	None	5 foot RCP 11 feet below top of pavement.
190221 K-9	Cut 3 to 10 ft	+0.7%	None	None
190222 K-10	Cut 20 to 23 ft	+0.7%	None	None
190223 K-11	Cut 8 ft	+0.7%	None	None
190224 K-12	Cut 10 to 17 ft	+2.2%	None	None

1.8 Underground Structures Within Test Sections

The underground structures are summarized in Section 1.7.

1.9 Installation of the Weather Station

The automated weather station (AWS) will be installed in 1996. It will be placed approximately two miles east of the project site in the maintenance yard at Altoona, Iowa. The foundations and chainlink fence were installed by the agency during Fall, 1995.

1.10 Installation of the WIM

The GK-6000 Piezo weigh-in-motion device was manufactured by Peek Traffic, Inc. The equipment was installed by the Iowa DOT in June, 1995, on US-65 about one mile north at the junction of Iowa 163. It is completely automatic and reports the collected data on demand by a telephone modem, or directly at the project site. A record is produced for each vehicle traveling over the WIM site.

1.11 Schedule for Opening to Traffic

The project was scheduled to be open for traffic fall of 1994.

1.12 General Problems

There was some delay to the start of the project due to a very wet spring. There were several delays due to rain during construction.

Incorrect dowel baskets were placed in the area of test section 190222. The test section location was shifted to avoid the area. This is also summarized in the deviation report.

1.13 Resident Engineer Information

Below is a listing of the personnel actively involved with this project.

Iowa Department of Transportation

Mr. Bernard Brown
800 Lincoln Way
Ames, IA 50010
Phone: (515) 239-1452

Mr. Charles Potter, PE
Assistant Special Investigations Engineer
800 Lincoln Way
Ames, IA 50010
Phone: (515) 239-1309
Fax: (515) 239-10952

Mr. Potter did the coordination of the sampling and material testing.

1.14 Materials Sampling and Testing

Mr. Jon Allan
Box 4043
Highland Park Station
Des Moines, IA 50330
Phone: (515) 262-5692
Fax: (515) 262-9684

Under the direction of Mr. Allen, most of the materials sampling and testing was performed by agency personnel. The exception was thinwall sampling and nuclear density testing performed by Huntingdon Engineering, Des Moines, Iowa.

Mr. Mitchell J. Dillavou
Box 4043
Highland Park Station
Des Moines, IA 50330
Phone: (515) 262-5692

Mr. Dillavou was the resident construction engineer.

North Central Regional Coordination Office

Dr. Eugene Skok, Jr.
Ann Johnson, PE
Ben Worel
Ronald Urbach
Braun Intertec Corporation
6875 Washington Avenue South
P.O. Box 39108
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FHWA
Richard C. Ingberg
Regional Engineer
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, MN 54139-0108
Phone: (612) 942-3066
Fax: (612) 942-3059

1.15 Contractor Information

Mr. Charlie Davies
Project Superintendent
Irvine F. Jensen Company
Box 1618
Sioux City, IA 51105-1618
Phone: (712) 252-1891

1.16 Summary of Key Construction Equipment

Subgrade Preparation
- Motor Grader
- Farm Style Disk
- 10-ton Sheepsfoot Compactor
- CMI Model SP30AST Full Width Soil Profiler

Dense Graded Aggregate Base (DGAB)
- Motor Grader
- 10-ton Single Drum Compactor
- Pneumatic Tired Roller
- Water Truck

Permeable Asphalt Treated Base (PATB)
- Drum Style Asphalt Mix Plant
- Cedar Rapids Model CR561 Paver
- 10-ton Tandem Steel Roller

Lean Concrete Base (LCB)
- CMI Model SF 450 Slipform Paver
- Portable Portland Cement Concrete Batch Plant
- Rex Town and Country Model TBM-236, Belt Placer With Auger Spreader

Portland Cement Concrete Pavement (PCC)
- Portable Portland Cement Concrete Batch Plant
- Rex Town and Country Model, TBM-236 Belt Placer With Auger Spreader
- CME Model SF450 Slipform Paver
- Burlap Drag

Joint Sealing
- Pavement Saw
- Air Compressor

2.0 Project Details

There was a discrepancy in the LTPP design and research guideline plans dated April, 1990, that were used to complete the section layout and numbering. The construction guidelines were revised in December, 1993. The Cell "K" were renumbered 13 through 24. All future references to this section should refer to the revised numbering identification. Some of the data collection and sampling was renumbered to reflect this change. Attachment B references the original and revised section numbers.

2.1 Material Sampling and Testing

The materials sampling and testing plan dated March 25, 1994, was prepared by the RCOC office. A copy of the plan is included as Attachment C.

The Iowa DOT conducted some of their own material sampling and testing. The thinwall sampling and nuclear density tests were performed by Huntingdon Engineering from Des Moines, Iowa.

The test sections were laid out for constructability based on base type. The four test sections requiring lean concrete base (Iowa Classification Class A subbase) started at the south end of the project. The next four test sections used dense-graded aggregate base. The next section was test section 59, which is the Iowa DOT control section. This section has granular subbase. The last four

test sections were constructed with permeable asphalt treated base (PATB). The PATB was placed over 4 inches of dense-graded aggregate base. The lane width, surface thickness and flexible strength were not considered in the layout.

2.2 Construction

The mass grading for this project was started in 1992 and completed in 1994. As indicated on the test section geometry and underground structures tabulation, in some areas, over 40 feet of fill was placed. This project was an ordinary compaction project. No compaction density tests for QC were taken during construction. Density tests were performed as part of the SPS-2 sampling and testing plan. This testing was performed in 1994.

Construction was delayed due to the extremely wet spring. There were also construction delays several times after construction had started due to rain.

2.3 Subgrade Preparation

When the project was graded in 1992 and 1994, the project was supposed to be approximately 2 inches above grade.

After Irvine F. Jensen Company started to grade the project, they found that there was some areas that were below proposed subgrade. In these areas, they added additional soil so that all areas were approximately 2 inches above grade. After the grading string line was in place, they used a CMI profiler Model SP-30AST manufactured by Construction Machinery, Incorporated, of Oklahoma City. The grade was trimmed approximately 1 to 2 inches above proposed grade. The contractor was required to rework and recompact the upper 2 feet of subgrade soils.

The contractor used motor graders to remove some of the soils. After portions of the subgrade soils were removed and disked for more uniform compaction, the soils were replaced and recompacted. The soils were placed slightly above grade. The CMI profile trimmer was then used to trim the subgrades and shape it to the proposed grade.

As part of the SPS-2 material sampling testing plan, nuclear density tests were taken at the top of the subgrade layer in each of the test sections and at test pits and bulk sample locations. These tests were taken to document the density of the inplace soils.

After the subgrade soil preparation had been performed, level shots were taken at 50-foot intervals at five locations transversely in the monitoring lane. These level shots have been used as a baseline to determine the thickness of each additional structural layer placed in each of the test sections. Attachment G is a table that summarizes the design thickness and actual measurements of the pavement layers based on rod and level and laboratory thickness measurements performed on the cores. The thicknesses based on the rod and level measurement and the laboratory core measurements do vary.

As part of the material sampling and testing, plate bearing tests were performed at several locations throughout the project by agency personnel.

2.4 Placement of Base Layers

The Lean Concrete Base (LCB) was placed with a slipform paver, CMI SF 450, on four of the test sections. These test sections were at the south end of the project. The agency specification as defined as a Class A subbase was a lean concrete mix design (Ash Grove Cement Company of Overland Park, Kansas). The mix was designed for 500 to 700 pounds per square inch (psi) compressive strength at seven days. Attachment D is a copy of the mix design.

A Rex Town and Country Model TBM 236 with a belt placer and auger spreader was used to place the fresh LCB. It was placed in one pass 26 feet wide. The paving width was not adjusted for 12-foot wide lanes. The fresh LCB mix was consolidated with internal vibrators and a tamper bar on the front of the spreader.

The finish was done by screeding. The LCB was finished with a float; a membrane curing compound was then placed on the LCB. A second application of the curing membrane was placed whithin two hours of the placement of the PCC pavement.

2.5 Dense-Graded Aggregate Base (DGAB)

The remainder of the test sections had dense-graded aggregate base thicknesses of 4 inches or 6 inches. As the dense-graded aggregate base was placed and levelled off, water was added and the base was compacted with vibratory and pneumatic-tired rollers. The profiler was then used to trim the dense-graded aggregate base to the required elevations and/or thicknesses.

2.6 Permeable Asphalt-Treated Base (PATB)

The permeable asphalt-treated base was placed on top of 4 inches of dense-graded aggregate base.

The permeable asphalt-treated base material was furnished and placed by Des Moines Asphalt Paving Company. It was placed with a Cedar Rapids Model CRS61 Paver in a 13-foot wide pass. The lay down temperatures were approximately 280 degrees. The PATB was compacted with a 10-ton steel wheel tandem roller making two passes.

2.7 Mix Designs and Concrete Paving

There are two types of mixes being used for this project: mix 550 psi flexible strength at 14 days based on third-point loading; mix, 900-psi flexible strength at 14 days based on third-point loading. (Attachment F, 550-psi mix design, Attachment G, 900-psi mix design.) Prior to placing either of the mixes, the contractor performed trial batches on each. Fourteen day tests were performed on each of the trial batches. The tests indicated that the 900-psi flexible strength concrete did not meet the required flexural strength; the average flexural strength was 750 psi. SHRP guidelines indicated that the third-point loading strength should be 900-psi$\pm$100 psi. So as not to delay progress on the project, the agency and the contractor increased the cement content of the mix by 50 pounds. There were no trial batches performed on the modified mix. A 900-psi $\pm$100 psi flexural strength was attained with this modified mix.

The mix designs for the 550- and 900-psi flexural strength concrete were done by Ash Grove Cement Company. The same batch plant and equipment were used for the LCB.

Tining was used to develop surface texture just prior to placement of the curing compound.

Section 190222 was to be placed with a design thickness of 8 inches with 900-psi concrete. Incorrect dowel baskets were placed in a portion of this test section. It was decided that the contractor should correct the situation. The contractor removed (at his own expense) the concrete and replaced it from Station 574+43.5 to Station 575+78.5 in the northbound lane. Because of this, the initial location of the test section was shifted to avoid the replacement area. Because of the location change of the test section, one core location ended up in the test section. The concrete core was taken at Station 569+75 which will now be inside of the test section. Also, the location of the nuclear density test and other samples taken within test section 190222 will change from what the design materials sampling and testing plan had indicated.

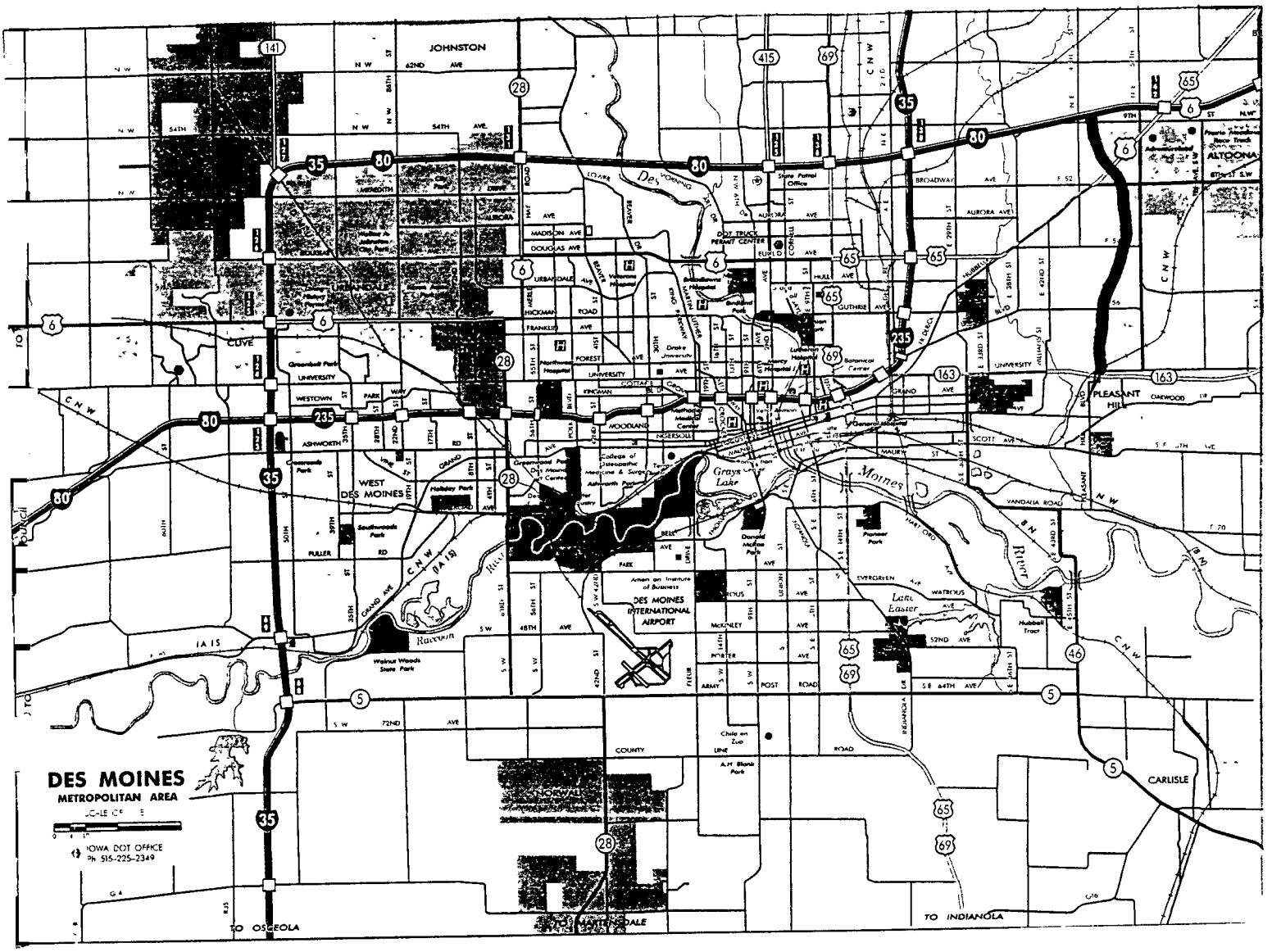
The required samples were taken for the materials reference library (MRL). The sampling requirements were outlined in the material sampling and testing guidelines. These samples were shipped to the MRL storage facility in Reno, Nevada.

As part of the design requirements, filter fabric was to be used to encapsulate the permeable asphalt treated base (PATB) under the PCC pavement. Due to the relatively low permeability (less than 4gpm/sf) of the fabric, it was mutually agreed between the technical assistance contractor (PCS/Law), the SHRP Regional Office (Braun Intertec) and the agency to remove at least 1 foot of this filter fabric. Based on a letter dated August 16, 1994, the contractor removed at least 1 foot of fabric over the longitudinal edge drains. This work was done in test sections 190221, 190222, 190223 and 190224.

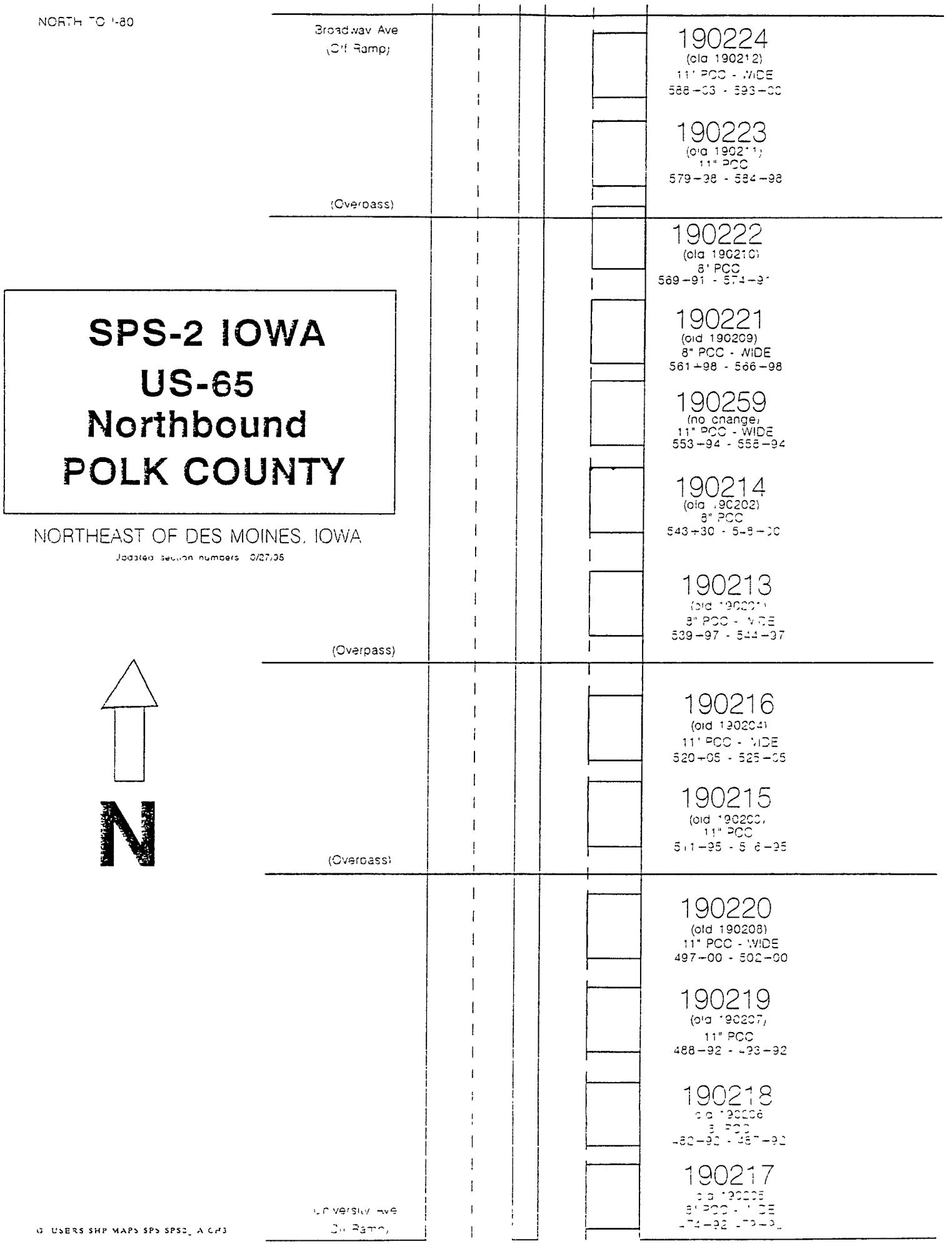
Attachment A
Project Location

SPS-2
Iowa US-65, Northbound

Attachment A. Project Location

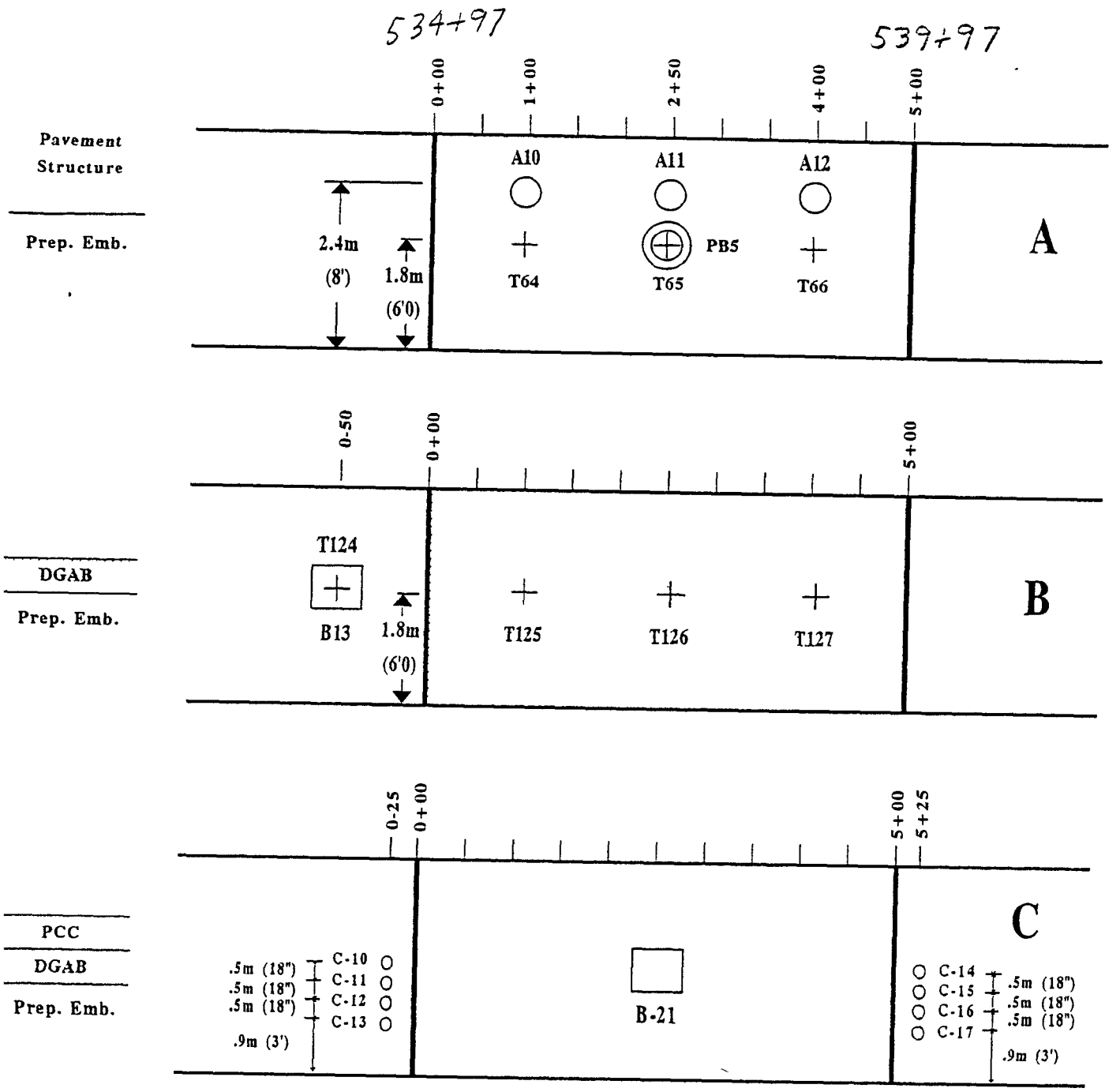


Attachment B
Section Layout



Attachment B

Attachment C
Material Sampling and Testing Plan

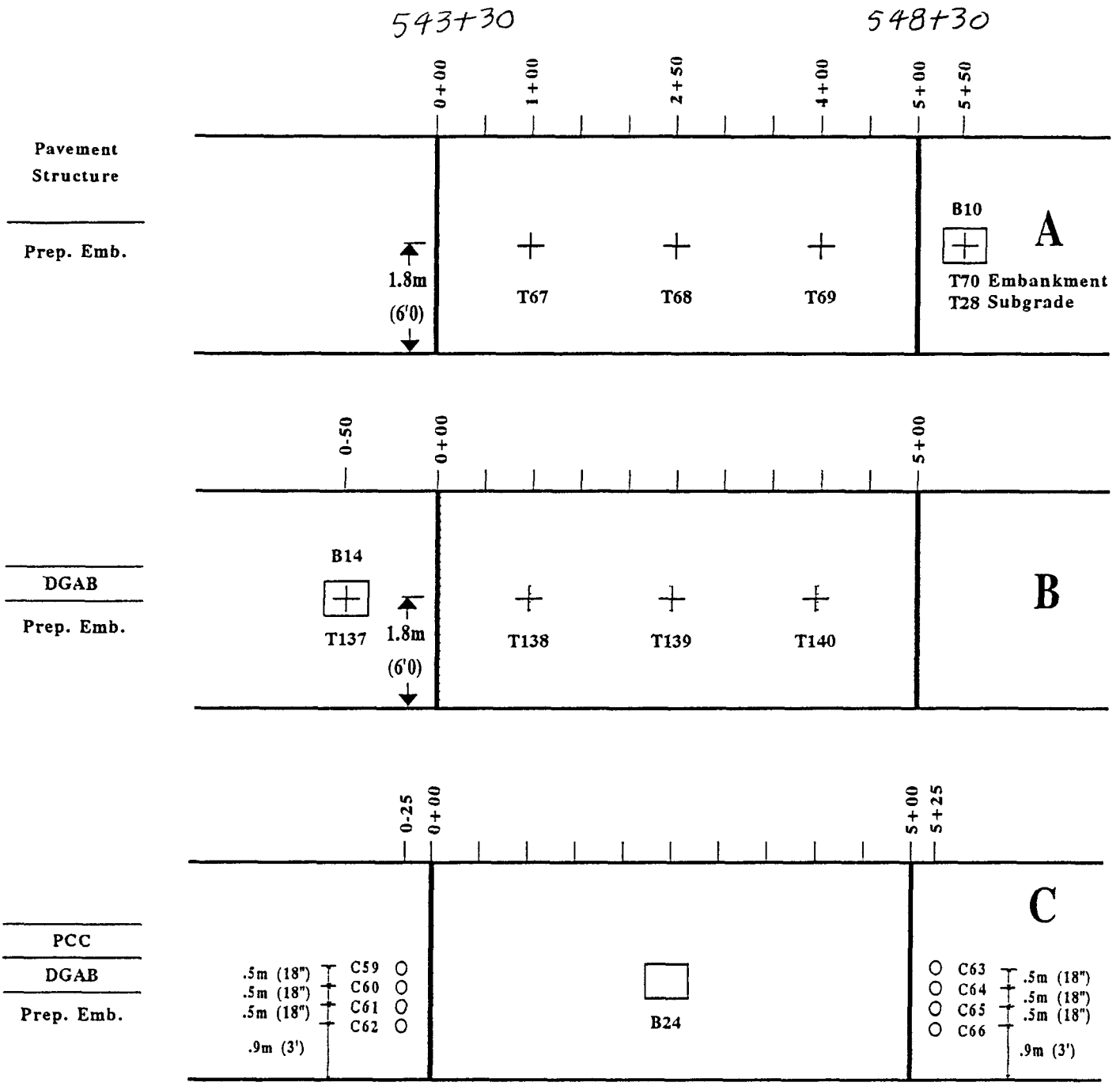


A. Testing on Prepared Embankment (T64-T66, PB5)
   Sampling of Prepared Embankment (A10-A12)
B. Testing on compacted DGAB (T124-T127)
   Sampling of uncompacted DGAB (B13)
C. Coring of finished PCC Surface (C10-C17)
   Sampling of fresh PCC (B21)

190213 (K-1)

Sampling and Testing Plan for Test Section 1

Attachment C



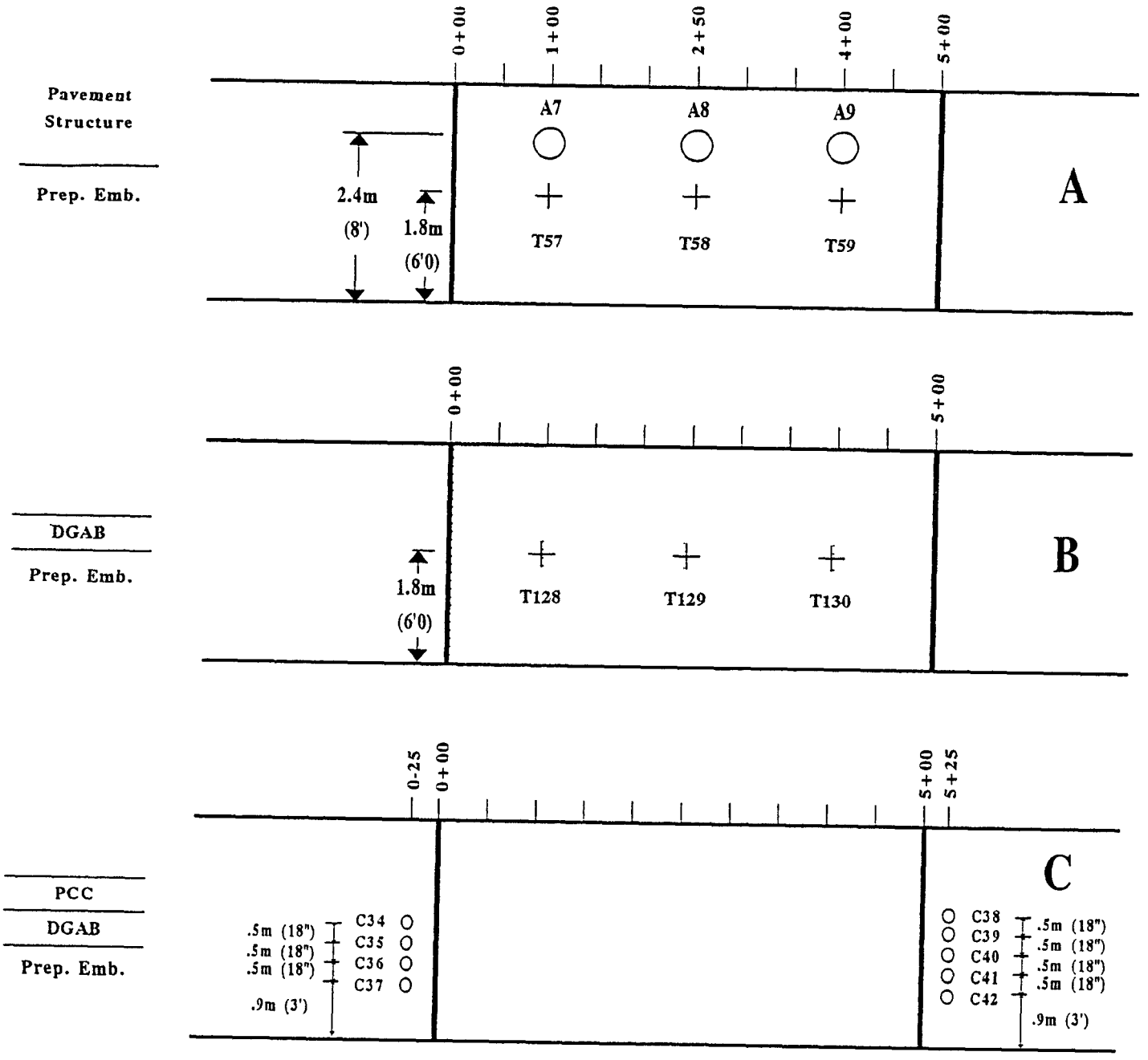
A. Testing on Prepared Embankment (T67-T70), on Subgrade (T28)
   Sampling of Prepared Embankment (B10)
B. Testing on compacted DGAB (T137-T140)
   Sampling of uncompacted DGAB (B14)
C. Coring of finished PCC Surface (C59-C66)
   Sampling of fresh PCC (B24)

190214 (K2)

Sampling and Testing Plan for Test Section 2

511+95

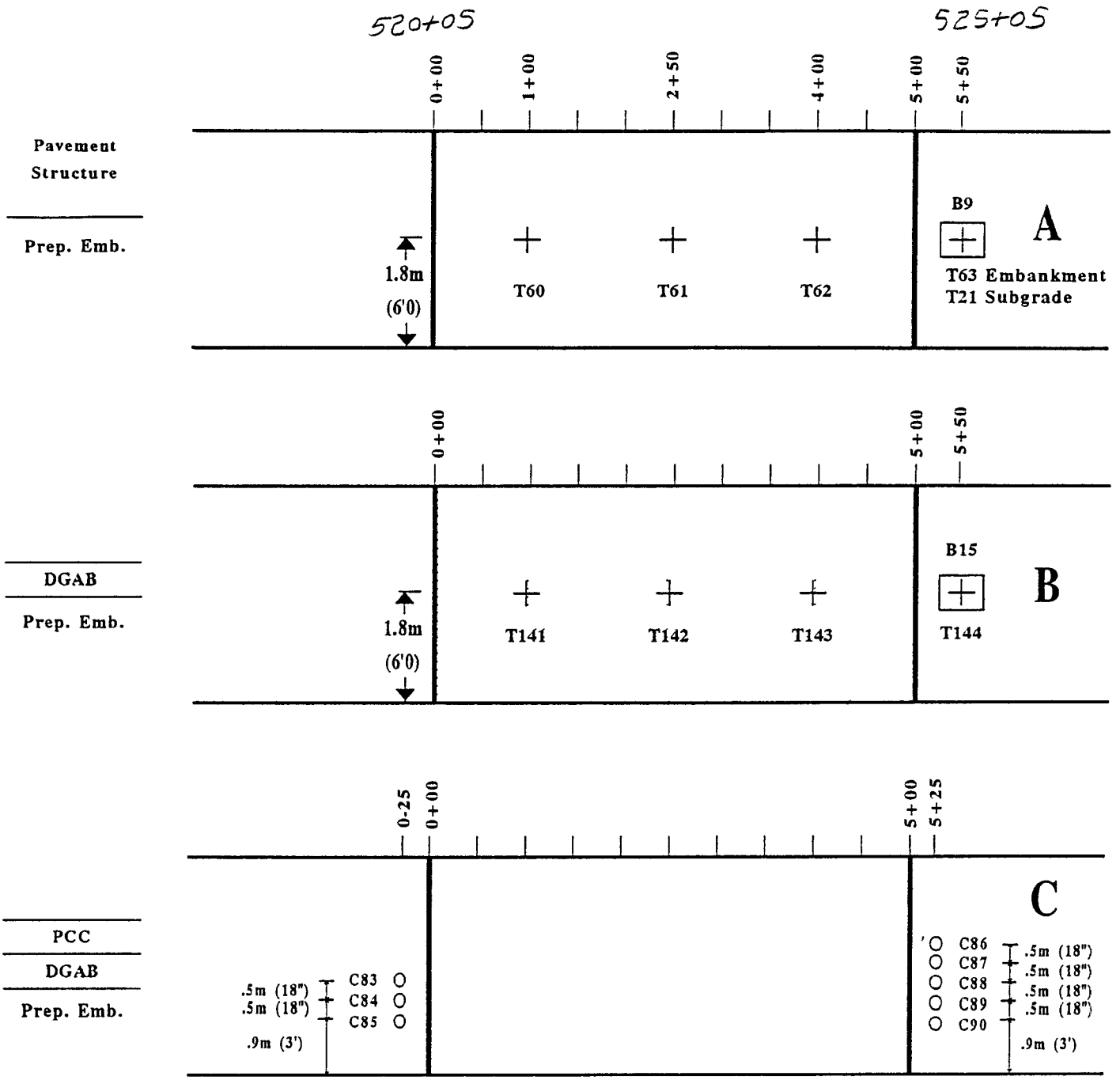
516+95



A. Testing on Prepared Embankment (T57-T59)
   Sampling of Prepared Embankment (A7-A9)
B. Testing on compacted DGAB (T128-T130)
C. Coring of finished PCC Surface (C34-C42)

190215 (K3)

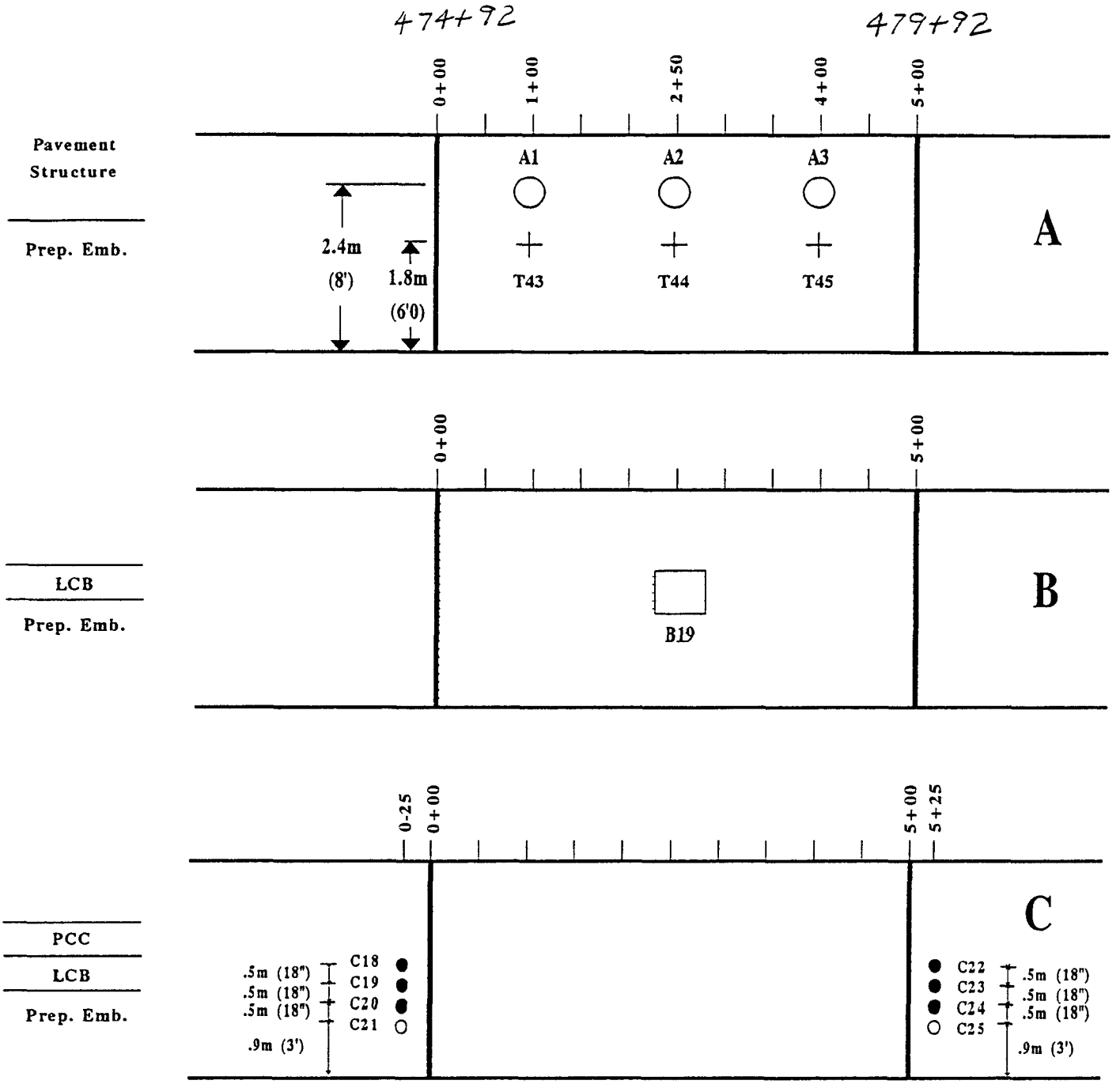
Sampling and Testing Plan for Test Section 3



A. Testing on Prepared Embankment (T60-T63), on Subgrade (T21)
   Sampling of Prepared Embankment (B9)
B. Testing on compacted DGAB (T141-T144)
   Sampling of uncompacted DGAB (B15)
C. Coring of finished PCC Surface (C83-C90)

190216 (K4)

Sampling and Testing Plan for Test Section 4



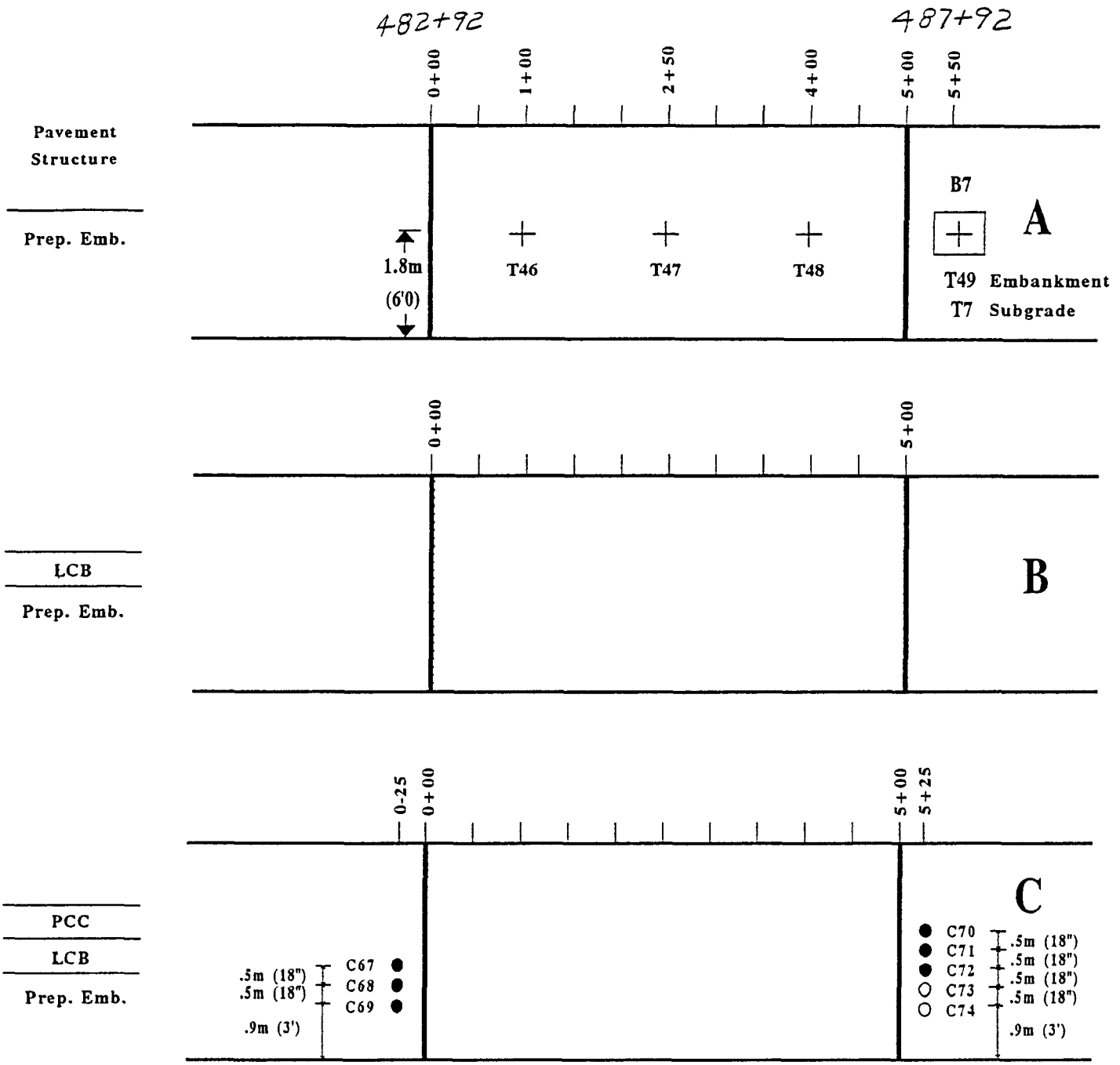
A. Testing on Prepared Embankment (T43-T45)
   Sampling of Prepared Embankment (A1-A3)

B. No testing on LCB
   Sampling of fresh LCB (B19)

C. Coring of finished PCC Surface (C21 and C25)
   Coring of finished PCC Surface and LCB (C18-C20, C22-C24)

190217 (K-5)

Sampling and Testing Plan for Test Section 5



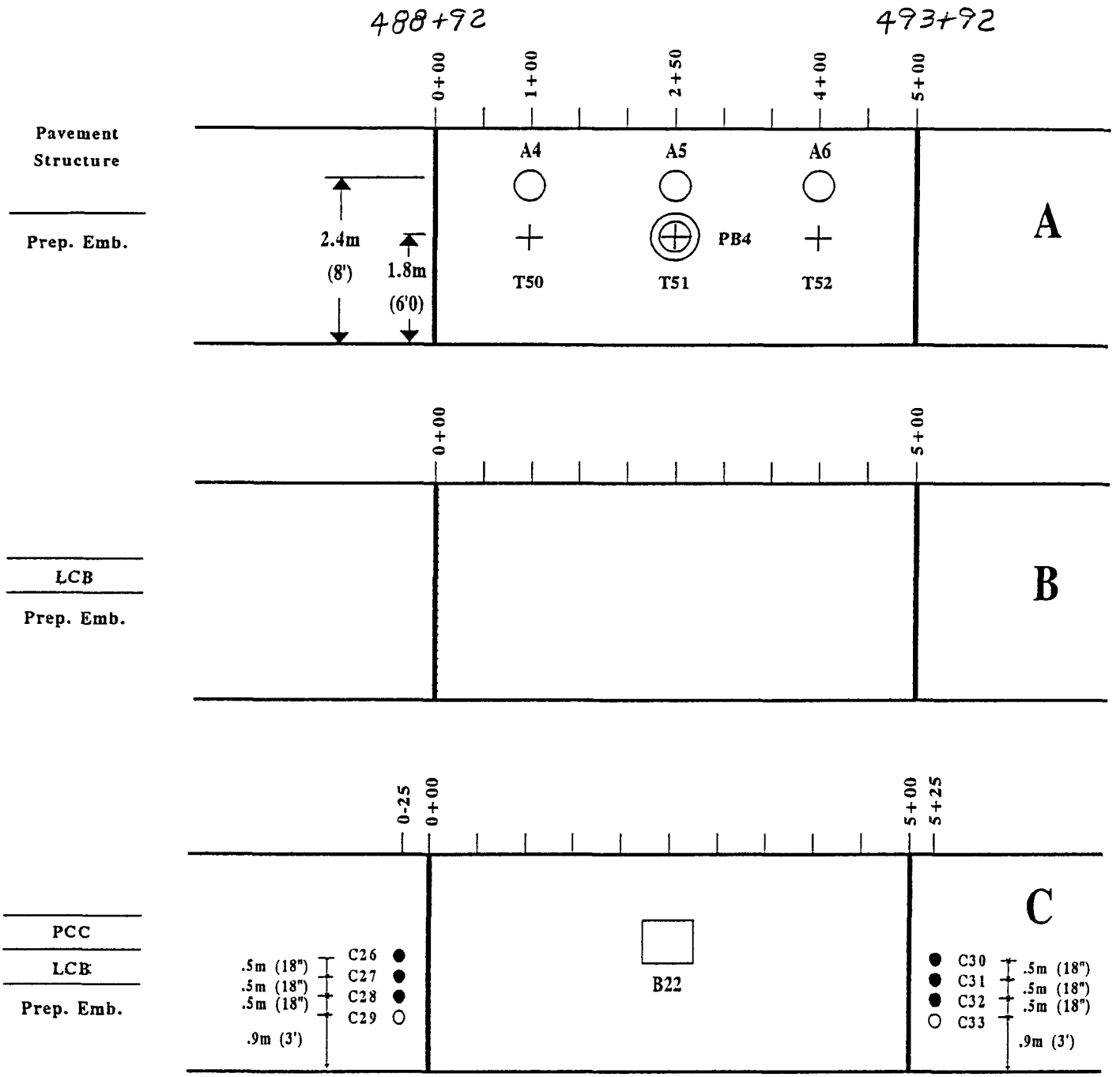
A. Testing on Prepared Embankment (T46-T49), on Subgrade (T7)
   Sampling of Prepared Embankment (B7)

B. No testing on LCB

C. Coring of finished PCC Surface (C73-C74)
   Coring of finished PCC Surface and LCB (C67-C72)

190218 (K6)

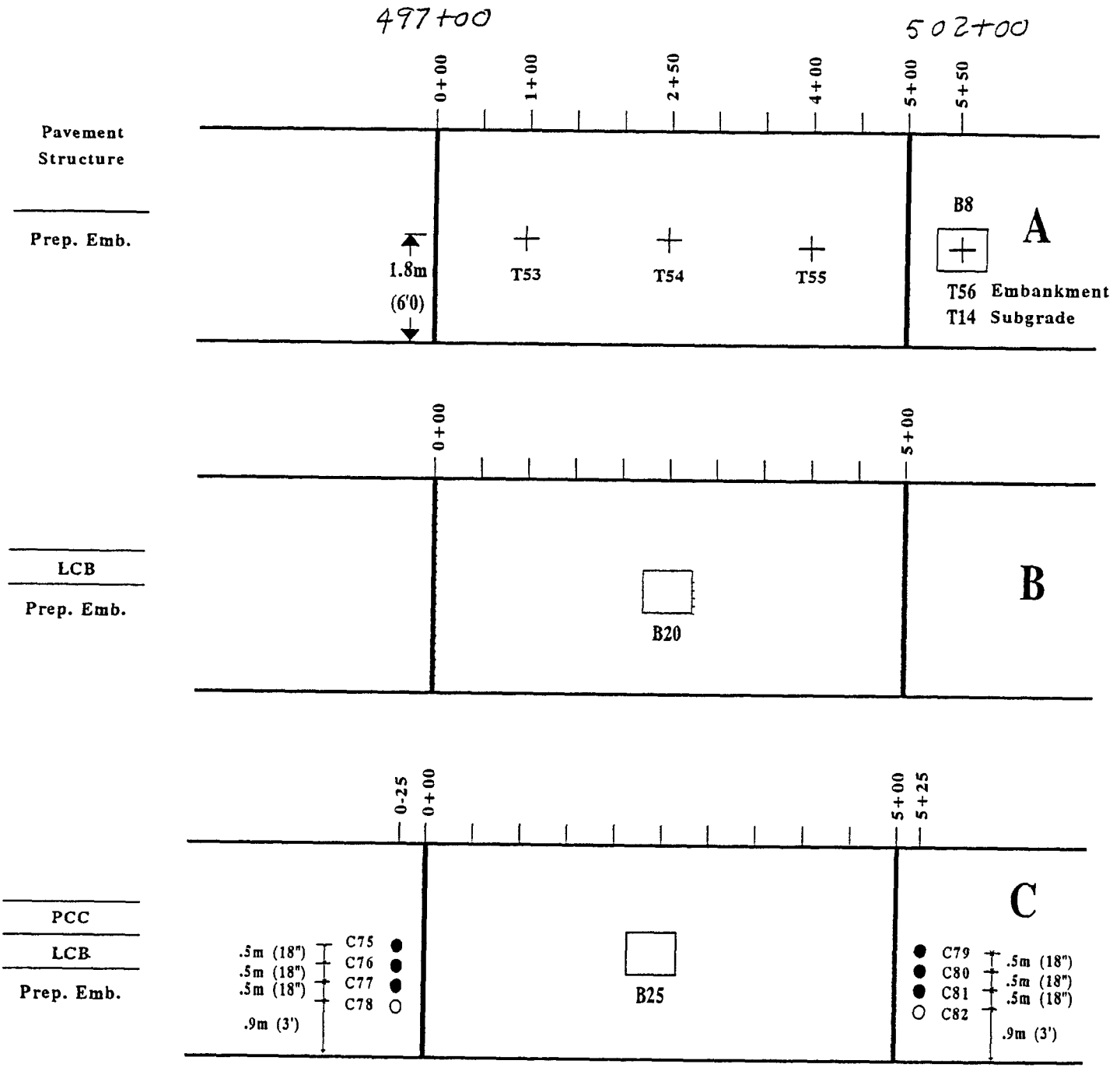
Sampling and Testing Plan for Test Section 6



A. Testing on Prepared Embankment (T50-T52, PB4)
   Sampling of Prepared Embankment (A4-A6)
B. No testing on LCB
C. Coring of finished PCC Surface (C29 and C33)
   Coring of finished PCC Surface and LCB (C26-C28, C30-C32)
   Sampling of fresh PCC (B22)

190219 (K-7)

Sampling and Testing Plan for Test Section 7



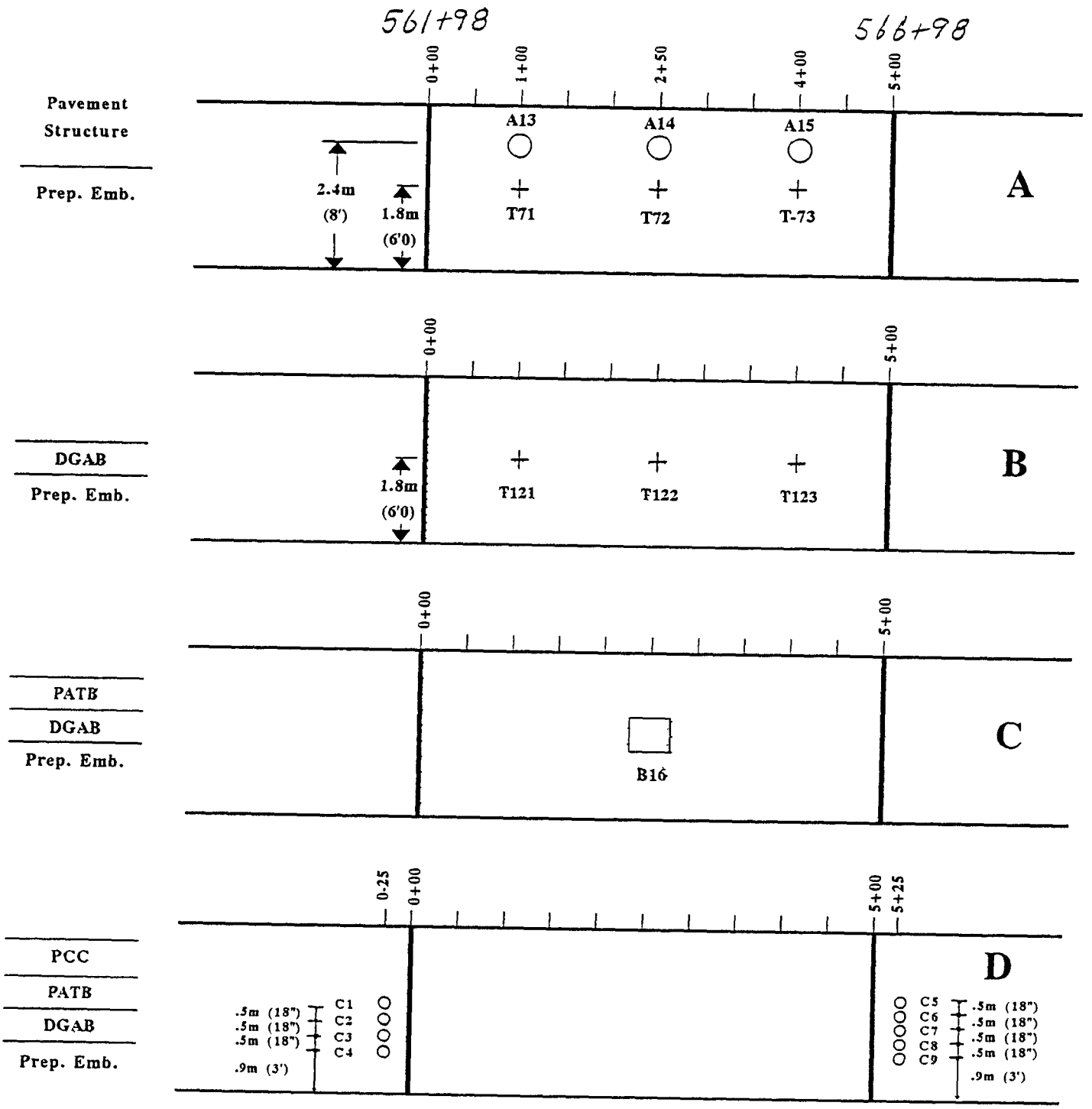
A. Testing on Prepared Embankment (T53-T56), on Subgrade (T14)
   Sampling of Prepared Embankment (B8)

B. No testing on LCB
   Sampling of fresh LCB (B20)

C. Coring of finished PCC Surface (C78, C82)
   Coring of finished PCC Surface and LCB (C75-C77, C79-C81)
   Sampling of fresh PCC (B25)

190220 (K-8)

Sampling and Testing Plan for Test Section 8



A. Testing on Prepared Embankment (T71-T73)
   Sampling of Prepared Embankment (A13-A15)

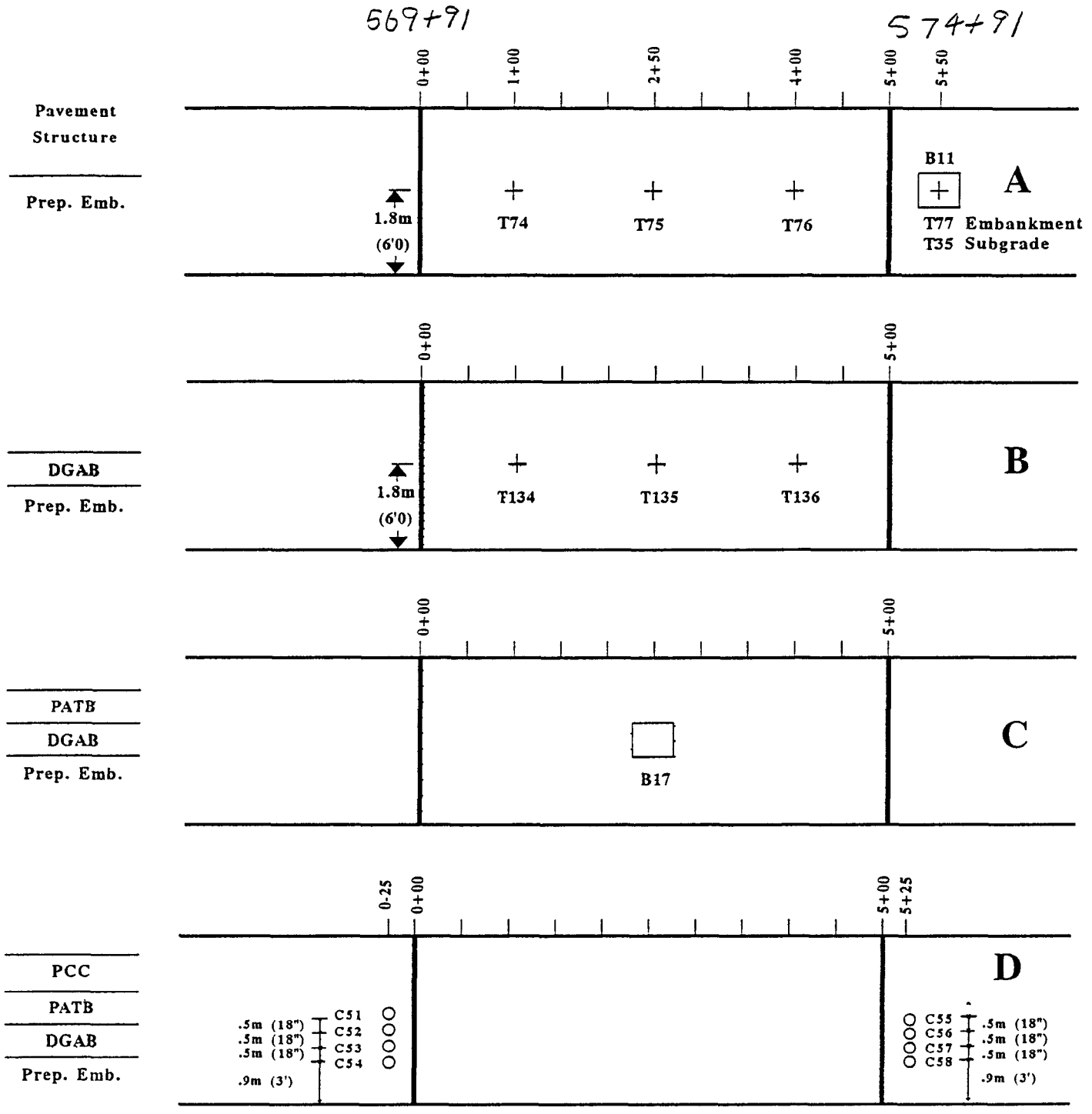
B. Testing on compacted DGAB (T121-T123)

C. No testing on compacted PATB
   Sampling from paver (B16)

D. Coring of finished PCC Surface (C1-C9)

190321 (K-9)

Sampling and Testing Plan for Test Section 9



A. Testing on Prepared Embankment (T74-T77)
   Sampling of Prepared Embankment (B11)

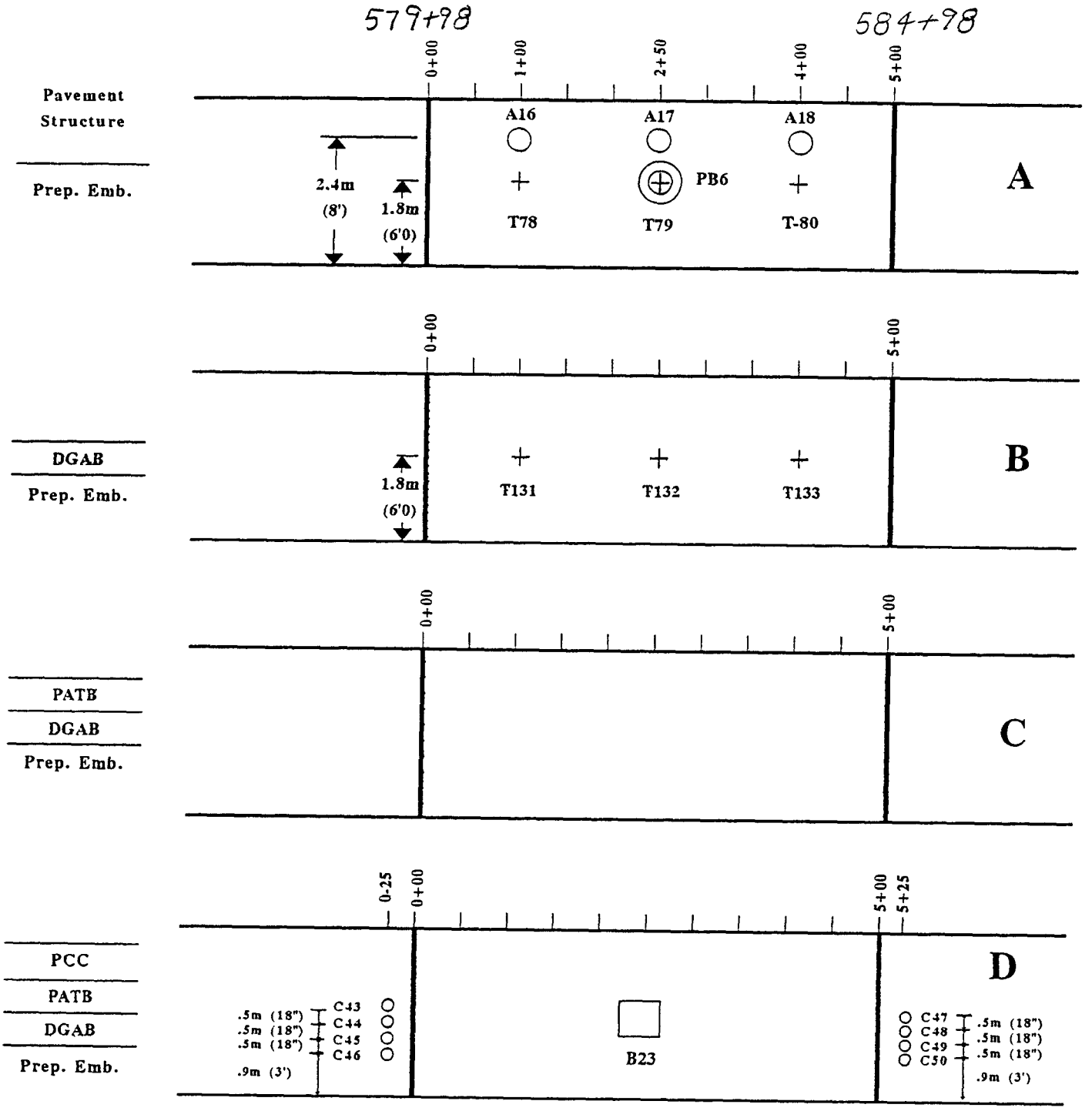
B. Testing on compacted DGAB (T134-T136)

C. No testing on compacted PATB
   Sampling from paver (B17)

D. Coring of finished PCC Surface (C51-C58)

190222 (K10)

Sampling and Testing Plan for Test Sections 10



A. Testing on Prepared Embankment (T78-T80, PB6)
   Sampling of Prepared Embankment (A16-A18)

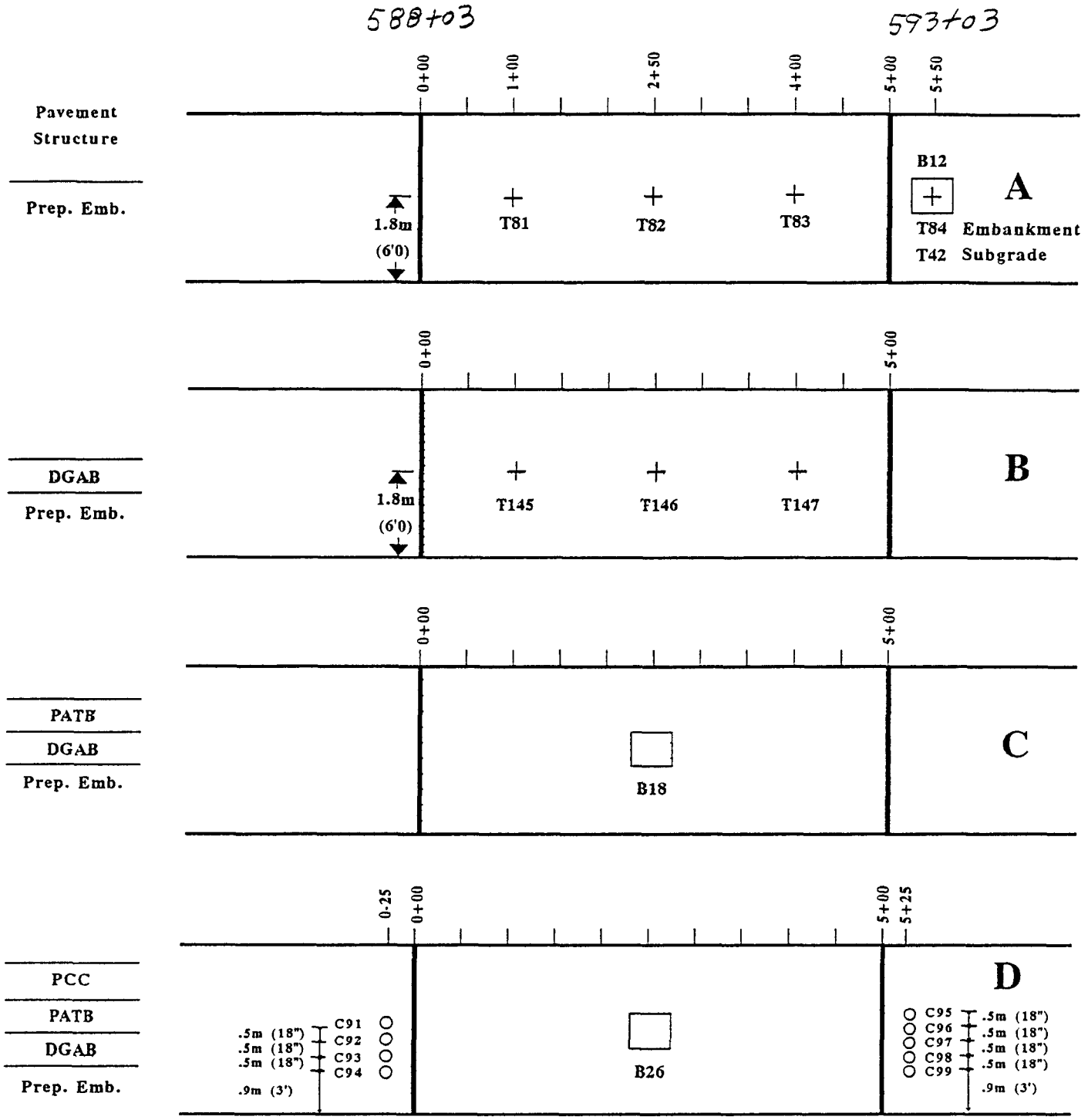
B. Testing on compacted DGAB (T131-T133)

C. No testing on compacted PATB

D. Coring of finished PCC Surface (C43-C50)
   Sampling of fresh PCC (B23)

190223 (K11)

Sampling and Testing Plan for Test Section 11



A. Testing on Prepared Embankment (T81-T84), on Subgrade (T42)
   Sampling of Prepared Embankment (B12)

B. Testing on compacted DGAB (T145-T147)

C. No testing on compacted PATB
   Sampling from paver (B18)

D. Coring of finished PCC Surface (C91-C99)
   Sampling of fresh PCC (B26)

190224 (K12)

Sampling and Testing Plan for Test Section 12

Attachment D
LTPP SPS Project Deviation Report

LTPP SPS-8 Project Deviation Report Project Summary Sheet	State Code Project Code	0	2	1 0	9 0

Project Classification Information

SPS Experiment Number: 02	State or Province: Iowa
LTPP Region:	☐ North Atlantic ■ North Central ☐ Southern ☐ Western
Climate Zone:	☐ Dry-Freeze ☐ Dry-No Freeze ■ Wet-Freeze ☐ Wet-No Freeze
Subgrade Classification:	■ Fine Grain ☐ Coarse Grain ?☐ Active (SPS-8 Only)
Project Experiment Classification Designation (SPS 1, 2 and 8): SPS-2	
Construction Start Date: June 17, 1994	Construction End Date: August 22, 1994
FHWA Incentive Funds Provided to Agency for this Project:	■ Yes ☐ No

Deviation Summary

Site Location Deviations:	☐ No Deviations ■ Minor Deviations ☐ Significant Deviations
Construction Deviations:	☐ No Deviations ■ Minor Deviations ☐ Significant Deviations

Data Collection and Processing Status Summary

nventory Data (SPS 5,6,7,9): NA	☐ Complete Submission ☐ Incomplete ☐ Data Not Available
Materials Data:	■ All Scheduled Samples Obtained and Tested ☐ Incomplete
Construction Data:	☐ All Required Data Obtained ☐ Incomplete/Missing Data Elements
Historical Traffic Data: NA	☐ All Required Historical Estimates Submitted (SPS 5,6,7,9) ☐ Required Estimates Not Submitted
Traffic Monitoring Equipment: Site Related	■ WIM Installed On-Site ☐ AVC Installed On-Site ☐ ATR Installed On-Site ☐ No Equipment Installed
Traffic Monitoring:	☐ Preferred ■ Continuous ☐ Minimum ☐ Below Minimum ☐ Site Related
Traffic Monitoring Data:	■ Monitoring Data Submitted ☐ No Monitoring Data Submitted
FWD Measurements:	☐ Preconstruction Tests Performed ☐ Construction Tests Performed ■ Post-construction Tests Performed
Profile Measurements:	☐ Preconstruction Tests Performed ■ Post-Construction Tests Performed
Distress Measurements:	☐ Preconstruction Tests Performed ■ Post-Construction Tests Performed
Maint. & Rehab. Data: NA	☐ Complete Submission ☐ Incomplete ☐ Data Not Available
Friction Data:	☐ Complete Submission ☐ Incomplete ☐ Data Not Available

Report Status

Materials Sampling and Test Plan:	☐ Document Prepared ■ Final Submitted to FHWA
Construction Report:	■ Document Prepared ☐ Final Submitted to FHWA
AWS: (SPS 1, 2, & 8) None	☐ AWS Installed ☐ AWS Installation Report Submitted to FHWA

Preparer Ron Urbach Date June 20, 1996

LTPP SPS-8 Project Deviation Report Data Collection and Materials Sampling and Testing Deviations	State Code			1	9
	Project Code	0	2	0	0

☐ Comments Pertain to All Test Sections on Project

☐ Comments Pertain Only to Section(s): (Specify) _____

Data Collection and Materials Sampling and Testing Deviation Comments

Preparer Ron Urbach

Date June 20, 1996

LTPP SPS-8 Project Deviation Report Site Location Guidelines Deviations	State Code			1	9
	Project Code	0	2	0	0

☐ Comments Pertain to All Test Sections on Project

☒ Comments Pertain Only to Section(s): (Specify)

Site Location Guideline Deviaiton Comments

Test Section 190222 during the placement of the PCC pavement incorrect dowel baskets were placed. This area was removed. The test section location was shifted to avoid the replaced pavement area. This will shift the location of bulk sampling, nuclear density testing and coring locations. Some tests will now be located outside and within the test section.

Because of misinterpretation of guidelines, the test section numbers were revised. The correct numbers should be from 13 through 24. this revision was done after most of the sampling and testing and data collection had been completed.

Preparer Ron Urbach Date June 20, 1996

LTPP SPS-8 Project Deviation Report Construction Guidelines Deviations	State Code			1	9
	Project Code	0	2	0	0

☐ Comments Pertain to All Test Sections on Project

☐ Comments Pertain Only to Section(s): (Specify) _____

Construction Guidelines Deviation Comments

Construction guidelines thicknesses deviation more than .04 feet or .48 inches

Test Section	Base Thickness	PCC Pavement
190219	+ .12 inches	
190220	+ .82 inches	
190215		+ .42 inches
190216		+ .32 inches
190213		+ .22 inches
190214		+ .22 inches
190211		+ .92 inches
190223		+ .42 inches

This information is summarized in the table in Attachment G.

Preparer Ron Urbach Date June 20, 1996

LTPP SPS-8 Project Deviation Report Other Deviations	State Code Project Code	0	2	1 0	9 0

☐ Comments Pertain to All Test Sections on Project

☐ Comments Pertain Only to Section(s): (Specify) _____

Other Deviaiton Comments

Test Section 190222 Test Section was moved after all sampling and testing and data collection was completed.

Preparer Ronald Urbach Date June 20, 1996

Attachment E
Lean Concrete Base Mix Design (Class A Subbase)

ASH GROVE CEMENT COMPANY

8900 INDIAN CREEK PARKWAY, SUITE 600, P O BOX 25900
OVERLAND PARK, KANSAS 66225
PHONE 913 / 451-8900
FAX 913 / 451-5697

JIM THOMPSON
TECHNICAL SERVICES MANAGER

Iowa SP-1139 Project :: SHRP Section

LEAN CONCRETE BASE

Trial Mix:

Class 'A' Subbase (SHRP) Mix Design 500 to 750 psi 7 Days Compressive Strength

Description: 2.2 Sack, FA not to exceed 30% of PC, 45% Ferguson Rock

Laboratory I.D.	D-051994-6	
Ash Grove Type II Cement	160	lb.
Fly ash, Class 'C', Council Bluffs	48	lb.
Sand, Hallet Materials, University	1824	lb.
Rock, D-57 Limestone, M-M, Ferguson	1486	lb.
Daravair, AEA (0.5 oz/cwt)	1.1	oz.
WRDA-82, WR (3 oz/cwt)	6.4	oz.
Water	266	lb.
Slump	1.50	in.
Air Content	6.3	%
Water/Cement	1.28	

Compressive Strength--ASTM C39

8 Days	612 psi	626 psi	624 psi	Avg. 620 psi

Attachment F
550 PSI Flexural Concrete Mix Design

ASH GROVE CEMENT COMPANY

8900 INDIAN CREEK PARKWAY, SUITE 600, P O. BOX 25900
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FAX 913 / 451-5697

JIM THOMPSON
TECHNICAL SERVICES MANAGER

Iowa SP-1139 Project :: SHRP Section

Trial Mix:

PCC mix having a target 550 psi 14 Day Third-Point Loading Flexural Strength (plus or minus 60 psi)

Description: 4.25 Sack, 15% FA Replacement, 45% Ferguson Rock

Laboratory I.D.	D-051994-1	
Ash Grove Type II Cement	347	lb.
Fly ash, Class 'C', Council Bluffs	61	lb.
Sand, Hallet Materials, University	1752	lb.
Rock, D-57 Limestone, M-M, Ferguson	1481	lb.
Daravair, AEA (1.0 oz/cwt)	4.0	oz.
WRDA-82, WR (3 oz/cwt)	12.2	oz.
Water	218	lb.
Slump	1.75	in.
Air Content	7.1	%
Water/Cement	.53	

Flexural Strength--ASTM C78

7 Days	570 psi		Avg. 570 psi
14 Days	660 psi	580 psi	Avg. 620 psi

Attachment G
900 PSI Flexural Concrete Mix Design

ASH GROVE CEMENT COMPANY

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OVERLAND PARK, KANSAS 66225
PHONE 913 / 451-8900
FAX 913 / 451-5697

JIM THOMPSON
TECHNICAL SERVICES MANAGER

Iowa SP-1139 Project :: SHRP Section

Trial Mix:

PCC mix having a target 900 psi 14 Day Third-Point Loading Flexural Strength (plus or minus 100 psi)

Description: 8 Sack, 15% FA Replacement, 60% Ferguson Rock

ENHANCED MIX

Laboratory I.D.	D-051994-3		
Ash Grove Type II Cement	639	lb.	723
Fly ash, Class 'C', Council Bluffs	112	lb.	127
Sand, Hallet Materials, University	1132	lb.	1278
Rock, D-57 Limestone, M-M, Ferguson	1717	lb.	1532
Daravair, AEA (10 oz/cwt)	75	oz.	
WRDA-82, WR (5 oz/cwt)	38	oz.	
Water	263	lb.	306
Slump	1.50	in.	
Air Content	6.1	%	
Water/Cement	.35		.423

Flexural Strength--ASTM C78

7 Days	860 psi		Avg. 860 psi
14 Days	900 psi	835 psi	Avg. 870 psi

Attachment H
Pavement/Base Thickness Summary

Section Number		Base							PC veme face								Cost P ıe Mile
		Type	Thickness						Width	Thickness							
			Design	Rod and Level			Core Results			Design	Rod and Level			Core Results			
SHRP	DOT			High	Low	Average	High	Low	Average			High	Low	Average	High	Low	Average	
190217	K-5	LCB	6"	7.6	5.8	6.4	7.0	5.8	6.4	14'	8"	8.6	7.3	8.1	8.5	7.3	7.9	708,437
190218	K-6	LCB	6"	7.3	5.9	6.2	7.0	6.3	6.4	12'	8"	9.5	8.0	8.4	8.3	8.0	8.2	740,117
190219	K-7	LCB	6"	8.8	5.9	6.6	7.0	4.8	6.3	12'	11"	12.1	10.8	11.5	12.2	8.5	11.2	771,797
190220	K-8	LCB	6"	7.1	6.0	6.5	7.3	7.3	7.3	14'	11"	12.1	11.3	11.5	11.3	11.3	11.3	787,637
190215	K-3	DGAB	6"	6.7	5.0	5.8				12'	11"	11.9	10.7	11.4	13.2	11.0	11.9	613,397
190216	K-4	DGAB	6"	6.6	5.2	5.9				14'	11"	11.9	11.0	11.4	12.0	11.3	11.8	629,237
190213	K-1	DGAB	6"	8.0	4.7	6.1				14'	8"	10.6	8.2	8.9	9.5	8.3	8.7	550,037
190214	K-2	DGAB	6"	7.3	5.5	6.3				12'	8"	8.9	8.0	8.4	9.5	8.2	8.7	581,717
190259	DOT Control									14'	11"							
190221	K-9	PATB	4"	5.2	2.6	3.9				14'	8"	9.8	7.6	8.2	11.3	8.2	9.4	824,597
		DGAB	4"	5.0	2.8	3.3												
190222	K-10	PATB	4"	4.1	2.8	4.0				12'	8"	9.1	7.8	8.3	8.9	8.3	8.5	856,277
		DGAB	4"	4.9	3.4	3.9												
190223	K-11	PATB	4"	4.4	2.9	3.5				12'	11"	13.0	12.0	12.5	12.2	11.5	11.9	887,957
		DGAB	4"	4.6	2.3	3.6												
190224	K-12	PATB	4"	6.1	4.1	4.9				14	11"	10.0	9.5	10.0	12.2	11.0	11.5	903,797
		DGAB	4"	4.8	2.0	3.8												

** Highlighted areas represent thickness more or less than .04 feet from design.